





SANTIAGO documentation and technology data library

Functionalities, definitions and data for appropriateness profiles and transfer coefficients

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Summary

SANTIAGO is a software (SANitation sysTem Alternative GeneratOr) that allows to evaluate the appropriateness of potential technologies, to build all valid system configurations from the appropriate technologies (typically more than 100'000 from a set of 90 technologies), to preselect a set of systems that is locally appropriate and diverse in terms of technical approach, and optionally to quantify nutrient, water, and total solid flows, recovery, and loss potentials as an indicator for sustainability. It comes together with a technology library, and a methodology to integrate these tools into a strategic planning process. The main advantage of using the software is the possibility to deal with a diverse and very large set of technologies and corresponding system configurations. Moreover, the software and its library provide international literature data and expert knowledge on technology appropriateness and substance flows and match it to the local context for more empirical decision-making. The library can easily be expanded to include future technology innovations and additional sanitation products. Using a software approach also allows to systematically consider uncertainties related to the technologies or the local context making it applicable at an early planning phase.

The documentation provides definitions and explanations required to understand the full functioning of SANTIAGO as well as all data and data sources to define the technology appropriateness profiles and transfer coefficients. It does not provide details on how to apply the software and how to integrate it with the planning process.

Disclaimer

This documentation is a complement to the SANTIAGO software: the SANitation sysTem Alternative GeneratOr. It provides definitions and explanations required to understand the full functioning of to the SANTIAGO software and SANTIAGO technology library including data references regarding technology appropriateness and transfer coefficients. SANTIAGO software and SANTIAGO technology library are open source and freely accessible on github:

Spuhler, D., and Scheidegger, A., (2021): SANTIAGO software, available here: https://github.com/SANTIAGO-sanitation-systems

The SANTIAGO technology library repository also contains a number of example input files implemented based on this documentation. An additional repository provides a number of scripts to analyse SANTIAGO result in the R environment.

This document does not provide details on how to apply the software and how to integrate it with the planning process. For guidance on how to apply it a Wiki is available online:

Spuhler, D., Fritzsche, J. and Scheidegger, A., (2021): SANTIAGO software Wiki, available here: https://github.com/SANTIAGO-sanitation-systems/SANTIAGO.jl/wiki

For guidance on how to use the software and how to integrate it with planning (e.g. Community-Led Urban Environmental Sanitation, CLUES (Lüthi et al., 2011), Sanitation 21 (Parkinson et al., 2014) please refer to the SaniChoice Practitioners Guide.

www.sanichoice.net/planning-with-sanichoice

This version is based on a previous version from 2020 which was developed between 2019 and 2021 as part of the GRASP project ("Generation and Assessment of appropriate Sanitation systems for Planning") at the Eawag:

Spuhler, D. and Roller, L. (2021) Sanitation technology library: details and data sources for appropriateness profiles and transfer coefficients. ERIC: https://doi.org/10.25678/0000ss. Supplementary material for: Spuhler, D., Scheidegger, A., and Maurer, M. (2020) Ex-ante

quantification of nutrient, total solids, and water flows in sanitation systems. https://doi.org/10.1016/j.jenvman.2020.111785

The here presented version has been fully revised and amended with research documented in additional articles:

Spuhler, D., Scheidegger, A. and Maurer, M. 2021. Ex-ante quantification of nutrient, total solids, and water flows in sanitation systems. Journal of Environmental Management, 111785. DOI: https://doi.org/10.1016/j.jenvman.2020.111785.

Spuhler, D., Scheidegger, A. and Maurer, M. 2020. Comparative analysis of sanitation systems for resource recovery: influence of configurations and single technology components. Water Research 186, 116281. https://doi.org/10.1016/j.watres.2020.116281.

Spuhler, D., Germann, V., Kassa, K., Ketema, A.A., Sherpa, A.M., Sherpa, M.G., Maurer, M., Lüthi, C. and Langergraber, G. 2020. Developing sanitation planning options: a tool for systematic consideration of novel technologies and systems. Journal of Environmental Management 271. https://doi.org/10.1016/j.jenvman.2020.111004.

Spuhler, D., Scheidegger, A. and Maurer, M. 2018. Generation of sanitation system options for urban planning considering novel technologies. Water Research 145, 259-278. https://doi.org/10.1016/j.watres.2018.08.021.

Revision mainly concerns the definition of screening criteria and attributes as well as the data to quantify those.

Recommended citation:

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Overview

This document is structured into two parts.

PART A: SANTIAGO documentation

This Part A documents the functionalities and the definitions underlying SANTIAGO. It contains seven chapters:

Chapter 1: What is SANTIAGO describes the motivation behind SANTIAGO, its scope, the requirements for its application as well as the outputs to be expected.

Chapter 2: Terms and definition provides an overview on different terms and concepts used by SANTIAGO:

Chapter 3: How does SANTIAGO work defines the different modules of the SANTIAGO algorithm. It does not provide user guidance on how to work with SANTIAGO. The latter is contained in the online Wiki on github.

Chapter 4: Defining technologies provides the explanation how SANTIAGO defines the technologies and the technology data contained in the SANTIAGO technology library. It is required to understand the data provided in PART B as well as to define additional technologies to be included in the library.

Chapter 5: Defining the application case explains briefly how to establish input data to run SANTIAGO software using the SANTIAGO technology for a specific case.

Chapter 6: Preparing data for SANTIAGO explains which input data is required to run the SANTIAGO software and provides example files.

Chapter 7: Currently implemented provides an overview of all the technologies, products, screening and other evaluation criteria as well as transfer coefficients that have been implemented in the current technology library. In addition, it contains an example for possible inflows into a sanitation system.

PART B: Technology library

This Part B provides data sheets for all currently implemented technologies. In the datasheet, all original data used to describe the technology for SANTIAGO as well as literature references and assumptions are presented.

- Lüthi, C., Morel, A., Tilley, E. and Ulrich, L. (2011) Community-Led Urban Environmental Sanitation Planning (CLUES), Swiss Federal Institute of Aquatic Science and Technology (Eawag), Dübendorf, Switzerland. http://www.eawag.ch/forschung/sandec/gruppen/sesp/clues/index_EN.
- Parkinson, J., Lüthi, C. and Walther, D. (2014) Sanitation 21. A Planning Framework for Improving City-wide Sanitation Service, International Water Association (IWA), London.
- Lüthi, C., Morel, A., Tilley, E. and Ulrich, L. (2011) Community-Led Urban Environmental Sanitation Planning (CLUES), Swiss Federal Institute of Aquatic Science and Technology (Eawag), Dübendorf, Switzerland. http://www.eawag.ch/forschung/sandec/gruppen/sesp/clues/index_EN.
- Parkinson, J., Lüthi, C. and Walther, D. (2014) Sanitation 21. A Planning Framework for Improving City-wide Sanitation Service, International Water Association (IWA), London.

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Abbreviations

ABR	Anaerobic Baffled Reactor
FG	Functional Group
FG C	Functional Group Conveyance
FG D	Functional Group Reuse or Disposal
FG S	Functional Group Onsite Collection and Storage/Treatment
FG T	Functional Group Decentralized or Centralized treatment
FG U	Functional Group User Interface
GRASP	Generation and Assessment of appropriate Sanitation systems for Planning
H2O	Water, resource quantified by the substance flow model
MCDA	Multi-Criteria Decision Analysis
O&M	Operation & Maintenance
SANTIAGO	SANitaTlon system Alternative GeneratOr
SAS	System Appropriateness Score
SDM	Structured decision making
SFM	Substance Flow Model
TAF	Technology Appropriateness Filter
TAS	Technology Appropriateness Score
TC	Transfer Coefficient
TN	Total Nitrogen
TP	Total Phosphorus
TS	Total Solids

01 Part A: Documentation

- 1.1 WHAT IS SANTIAGO

1.1.1 Motivation and background

1.1.1.1 Sanitation, a global need and challenge

Sanitation describes the technologies and services needed to manage human waste (mainly urine and faeces) from its point of generation to the final reuse or disposal in a safe way (WHO, 2018). Lack of sanitation is linked to reduced health and environmental degradation, and undermines social and economic development (Hutton and Varughese, 2016; WHO and UNICEF, 2000; 2013). The importance of sanitation has been recognized in the Millennium Development Goals, MDGs (UN, 2000a; b) and as a human right (UN, 2010).

The Sustainable Development Goals (SDGs) confirm the critical importance of water and sanitation for sustainable development, with explicit reference to management downstream, resource efficiency and participation of local communities (UN, 2014). In most of high-income countries, we benefit from great sanitation services and make great efforts to treat wastewaters and to prevent environmental pollution. However, at a global level considering rapidly growing urban centres in low-income areas, the situation has not been improving much recently.

55% of the global population did not use safely managed sanitation services in 2017 (UN, 2019), half of which was in cities (WHO and UNICEF, 2019) and 80% of wastewaters globally are discharged without any treatment at all.

Existing sanitation services, especially in low-income areas are often limited to latrines or septic tanks without appropriate effluent treatment or emptying (Strande, 2014; WSP, 2014). Only 18% of the products from domestic onsite sanitation facilities are treated worldwide (UN-WATER, 2018). Systematic collection and safe disposal of wastewater and sludge are often missing (Strande, 2014; WSP, 2014), leading to 90% of urban wastewater globally being discharged without appropriate treatment (UNW-DPC, 2013).

One of the reasons for the high share of the population not having access to safely managed sanitation is that the unprecedented growth in urban areas of developing countries (informal settlements, slums, and small towns) often exceeds the capacities of administrations (Lüthi et al., 2012; Lüthi et al., 2010; UN-HABITAT, 2003). Pressure will most likely increase in the future, as 70% of the world population is projected to live in urban areas by 2050 and over 90% of urban growth will take place in developing countries (Birch et al., 2012; Dodman et al., 2013; UNFPA, 2007). In rapidly growing areas of developing countries, challenges of sanitation provisions are exasperated by high density, informality, and a lack of administrative and financial capacities for planning, implementing, and operating safe sanitation (Dodman et al., 2013; Dodman et al., 2017; Isunju et al., 2011; Ramoa et al., 2014; Tremolet et al., 2010; UN-HABITAT, 2012).

1.1.1.2 Failure of conventional approaches to sanitation system design

Conventional sanitation systems are based on a flush toilet, a sewered system, and hopefully a more or less sophisticated treatment (and recovery) plant at the end. The development of such system has helped the world to increase human health by reducing disease and making cities more liveable. On the other hand, this system is also a tragic failure (Wald, 2021) because it is not viable in many areas of the world leaving more than half of the global population without a toilet and sanitation system that safely manages body waste. The situation is particularly challenging in the developing urban areas where most of the population growth is currently taking place.

In these areas, conventional sanitation solutions are not appropriate and thus not viable because they require large amounts of water, energy, and space, expensive infrastructure, skilled staff for operation and maintenance, and long planning horizons (Davis et al., 2019; Dodman et al., 2017; Isunju et al., 2011; Tremolet et al., 2010; UNDESA, 2014)

The abandonment or breakdown of sanitation infrastructures in developing urban areas is a common phenomenon (Barnes and Ashbolt, 2006), which indicates the failure of conventional approaches to sanitation planning and service provision (McConville, 2010). Planning approaches have a tendency to be top-down, technology-driven, and focussed on implementations of technology or regional master plans. This has led to inappropriate technology choices for local physical and social environments and the often-limited available human and financial resources for maintenance and operation (Kalbermatten et al., 1980; Kvarnström et al., 2011; Menck, 1973; Starkl et al., 2013; Tilley et al., 2014a). Additionally, conventional systems are also highly resource inefficient, as they lead to the pollution of large amounts of clean water, waste a lot of nutrients and energy, and promote the spread of medical residues in the environment.

1.1.1.3 Sustainable sanitation

Safe sanitation requires to address the entire system, from the toilet to containment and storage/treatment onsite, or conveyance, treatment and eventual safe end use or disposal off-site.

Sustainable sanitation systems should be locally appropriate in terms of technology, institutions and social acceptance, and economically viable in order to protect the human health and the environment (SuSanA, 2008). But to be in line with SDG 6, they should also be designed to closing water and nutrient loops at the lowest possible level.

1.1.1.4 Sanitation Technology and System Innovations

The recognition of drawback of conventional sanitation system has triggered massive investments in the development of novel technologies (e.g. urine diversion dry toilets, composting toilets, briquetting) and system configurations (e.g. container-based sanitation) providing solutions for non-sewer sanitation and faecal sludge management.

Being independent from energy, water and sewer networks, these innovations are potentially more appropriate for developing urban areas. They also have the potential to enhance sustainability and resilience by reducing water requirements, being more adaptable for socio-demographic and environmental changes, and allowing recovery of nutrients, energy, and water resources (Drechsel et al., 2011; Larsen et al., 2016; Tilmans et al., 2015; Tobias et al., 2017).

They also expand opportunities for private sector involvement in the collection and safe reuse of resources (Diener et al., 2014; Evans et al., 2013; Langergraber, 2014; Lüthi et al., 2009; Murray and Ray, 2010; Parkinson and Tayler, 2003; Schertenleib, 2005). The development of novel sanitation options has massively influenced the sanitation sector and the potential of alternative systems has also been recognized in high-income countries, where the focus is on optimising aging infrastructure. Although there are little to no full-scale implementation examples of those innovations, there exists today a global consensus that sanitation technology and system innovations need to find their way into practice (Larsen et al., 2016).

A sanitation system is a set of technologies which in combination treat and manage human waste and wastewater from the source of generation to the final point of reuse or disposal. This includes five functional groups (FGs): the user interface, collection and storage, conveyance, semicentralized treatment, and reuse or disposal (Tilley et al., 2014b).

Each technology should be appropriate to the context-specific health, environmental, economic and financial, sociodemographic, and institutional conditions. Moreover, given a certain choice of appropriate options, the preferred option should be the one that is most sustainable in terms of SDG6: the one that has the lowest water requirements, least emissions, and highest resource recovery potentials at the least costs. This strongly highlights the multi-criteria aspect of sanitation systems planning (Zurbrügg et al., 2009) and the importance of trade-offs and stakeholder preferences (e.g. (Lennartsson et al., 2009; Motevallian and Tabesh, 2011; Willetts et al., 2013).

1.1.1.5 Increase Planning Complexity

While novel technologies and innovative system configuration potentially enhance appropriateness, inclusiveness, and sustainability, they also increase planning complexity. How compatible are different technologies to be assembled into entire systems? And what is their performance in a given setting?

From a decision-making viewpoint, selecting a locally appropriate and sustainable sanitation system and its corresponding technologies is a complex multi-criteria decision-making problem (Bracken et al., 2005; Kvarnström and Petersens, 2004; Zurbrügg et al., 2009). Structured decision-making (SDM) helps tackle such problems by systematically comparing several decision options regarding the defined decision objectives in order to reveal tradeoffs and balance for opposing interests using Multi-Criteria Decision Analysis (MCDA).

SDM helps to structure the decision-making process and to deliver insights about what matters to diverse stakeholders and how well various objectives may be satisfied by different decision options (Gregory et al., 2012; Marttunen et al., 2017).

This leads to more strategic but also more informed and thus more accepted decisions. The facilitated participatory framework covers at least six steps generic to any decision-making process (Gregory et al., 2012): (1) understanding the decision context; (2) defining decision objectives and criteria; (3) identifying decision options/alternatives; (4) evaluating consequences of the options for decision objectives; (5) discussing the trade-offs and selecting for the preferred options; and (6) implementing and monitoring.

1.1.1.6 Strategic sanitation planning and structured decision making

Several sanitation planning frameworks that adopt SDM approaches for strategic sanitation planning have been developed (Schertenleib et al., 2021). Some of widely recognized examples include Community-Led Urban Environmental Sanitation (CLUES), (Lüthi et al., 2011a), Sanitation 21 (Parkinson et al., 2014), or City Sanitation Planning (CSP), (Gol, 2008; MOUD, 2008). Despite the continuous development of these theoretical foundations, there is a lack of putting them into practice (Kennedy-Walker et al., 2014; Ramôa et al., 2018; Starkl et al., 2013). Missing leadership and lack of knowledge of new approaches leads to the propagation of outdated solutions which are locally inappropriate (Kennedy-Walker et al., 2014; Lüthi and Kraemer, 2012; McConville, 2010).

1.1.1.1 Gap

To facilitate the adoption of SDM frameworks, recent research has focused on the development of tools to operationalize the different planning steps (Spuhler and Lüthi, 2020). Yet, most of the research focuses on the understanding of the problem (step 1 and 2 of SDM), (Peal et al., 2014; Robb et al., 2017; Strande et al., 2018) or the selection of a preferred option (step 5 of SDM), (Schütze et al., 2019), assuming that a set of options is already available. Yet, every decision support approach is only as good as the alternatives presented.

Typically, the creation of sanitation decision options (step 3 of SDM) is left over to engineers who lack data and systematic reproducible evaluation methods for considering the entire spectrum of currently available technologies and sustainability criteria (Spuhler and Lüthi, 2020). This introduces a whole range of shortcomings, such as insufficient knowledge and data leading to bias, opaque pre-selection processes based on experts' personal preferences and little local ownership.

The lack of suitable methods for the systematic generation of locally appropriate sanitation systems is one of the biggest weaknesses in strategic urban sanitation planning (Gregory et al., 2012; Hajkowicz and Collins, 2007). In particular, considering simultaneously a broad and large range of conventional and novel options remains a challenge. Additionally, there is insufficient data to evaluate the sanitation options, particularly the novel options, according to the various sustainability criteria.

To make strategic decisions one needs to be aware of a large and diverse set of sanitation options at an early planning phase, and one needs to be able to compare their performance. This requires data about the performance of both individual technologies and entire system configurations regarding various sustainability criteria at an early stage when measurements are usually not available.

1.1.2 Why SANTIAGO

Error! Not a valid link. has been developed to fill in the gap and provide a systematic method that enables the consideration of novel technologies despite lack of knowledge and data. SANTIAGO can predict transparently the appropriateness of potential technologies based on locally defined selection criteria. It can generate all possible system configurations. It can select from all the possible configurations a manageable number of sanitation system options, which are locally appropriate and diverse enough to highlight trade-offs. Finally, it is able to quantify resource recovery and emission potential for nutrients, water and total solids of sanitation technologies and systems.

1.1.2.1 Field Validation and Results

SANTIAGO was developed iteratively in collaboration with case studies in Nepal (2016/2017), Ethiopia (2016 and 2019), Peru (2019), and South Africa (2020) (Nisaa et al., 2021; Spuhler et al., 2020a; Spuhler et al., 2018). The case studies provided immediate feedback from users and evaluated the methodology from their perspective. They also were able to prove that SANTIAGO is capable of generating reasonable results. They also showed that there are some key characteristics that influence resource recovery in general. These key characteristics were used to develop a number of recommendations for the development and selection of sanitation technologies and systems for resource recovery (Spuhler et al., 2020b):

- Prioritize short systems that close the loop at the lowest possible level (fewer treatment steps results in fewer losses);
- Separate waste streams as much as possible. This does not necessarily lead to fewer treatment steps, still it allows for higher recovery potentials (e.g. through urine separation);
- Use storage and treatment technologies that can contain products with as few losses as possible and at the same time avoid technologies that leach (e.g. single pits) and technologies with high risk of volatilization into air (e.g. drying beds);
- Design sinks that optimise recovery and avoid sinks that simply dispose of substances;
- Combine various reuse options for different side streams such as the reuse of urine and the production of biofuel from faeces.

The results also led to three key conclusions which will guide future research. First, both the local appropriateness and resource recovery depend on technology interactions and system configurations and therefore both have to be evaluated for entire systems. Second, there exists no unequivocal set of factors determining appropriateness or resource recovery potential. And thirdly, local appropriateness, resource recovery and other important sustainability indicators can be contradictory. This highlights the need for an automated software that is able to generate all valid sanitation systems and predict the quantification of their appropriateness and resource recovery.

The case studies also showed that SANTIAGO can provide a number of additional benefits for planning practice (Spuhler et al., 2020a). For instance, inappropriate options are eliminated at the beginning, streamlining the process. SANTIAGO also enforces the consideration of entire systems and it suggests a technical option for each and every step in the sanitation value chain and each and every product. Moreover, the options space is expanded with systems that experts would not have thought of or did not even know about. The diversity of the set of options is guaranteed to help in revealing and discussing trade-offs during the further evaluation (e.g. costs versus hygiene).

1.1.2.2 The Aim of this Document

This documentation is a complement to the SANTIAGO software: the SANItation sysTem Alternative GeneratOr. It provides definitions and explanations required to understand the full functioning of the SANTIAGO software and SANTIAGO technology library including data references regarding technology appropriateness and transfer coefficients.

1.1.3 Scope of Application

1.1.3.1 What is SANTIAGO

SANTIAGO is a software proposed to provide a manageable and diverse set of locally appropriate sanitation system options for any decision-making or planning process. It provides the tools to operationalize step 3 (identification of decision options) and step 4 (evaluation of options) of a structured decision making (SDM) process. The aim is to enable a systematic and transparent consideration of large and diverse range of conventional and novel sanitation technologies and systems as well as locally relevant sustainability criteria at an early stage of planning.

SANTIAGO has been designed for the application to household generated wastewater products derived from faeces, urine, greywater in combination with stormwater and organic solid waste. However, SANTIAGO can be adapted to deal with any other similar problem such as drinking water supply (https://www.eawag.ch/en/research/humanwelfare/drinkingwater/compendium/) or municipal waste treatment (Selecting Organic Waste Treatment Technologies. SOWATT (Zabaleta et al., 2020)) as long as the respective technology libraries are defined in compatible format.

SANTIAGO helps to implement four steps:

- It evaluates the appropriateness of all potential technologies for a given case (e.g. a city or a neighbourhood) by comparing technology profiles to local conditions concerning user defined screening criteria.
- 2. It generates all possible system configurations from the appropriate technologies from the user interface to final reuse or disposal based on the compatibility of input and output products.
- 3. It proposes a set of sanitation system options that is diverse and of manageable number and appropriate for the case.
- 4. It quantifies resource recovery and loss potentials to compare the proposed systems in more detail.

SANTIAGO requires the user to customize the existing technology library, provide data about the local conditions against which the technology appropriateness is evaluated, the inflows for the substance flows to be quantified, and the number of inhabitants. These are the elements that allow the user to customize SANTIAGO:

- The technology library consists of a set of technologies for five functional groups: the user interface (U), the onsite storage and treatment (S), conveyance (C), (semi-)centralized treatment (T), and reuse or disposal (D). Each technology is defined by the input products it can accept and the output products that it generates. This technology library will define the scope of SANTIAGO.
- The conditions of the application case are quantified in the form of a number of case attributes that represent relevant appropriateness screening criteria such as temperature, or water, energy, space and skills availability.
- The inflows are needed to define for each user interface, how much substance such as nutrients, water, or solids are entering the system to then quantify which fraction of this can be recovered or is lost by each system configuration.
- The number of inhabitants is used to scale the substance flows and recovery and loss ratios.

When SANTIAGO is customized to other applications than household wastewater, the systems templates need to also be customized. System configurations can be characterized by different system templates and each system can be assigned to one template. The system templates cover the diversity of all the options and sorting systems into the templates makes their number more manageable as typically for only a few dozens of technologies the number of system configurations can be more than 100'000. The SANTIAGO templates are based on a number of technical

conditions (e.g. if effluent is transported offsite or if it is a wet or dry system) and the degree of decentralisation (onsite, decentralized, hybrid, offsite). By adapting these conditions, different templates can be defined.

1.1.3.1 What is SANTIAGO not?

SANTIAGO is not intended to replace any existing planning frameworks that address the entire Structured Decision Making (SDM) process (e.g. CLUES¹) but to provide input in the form of the infrastructure decision options including data on their performance in regard to local appropriateness and resource recovery and loss potentials.

To facilitate the integration of SANTIAGO into any SDM procedure and to support engineers in obtaining suitable input data, we developed a procedure based on a number of interactive workshops. The screening criteria used to determine appropriateness include technical, physical, demographic, socio-cultural, legal and financial criteria as well as criteria concerning capacity and management. Thus, they consider different non-technical aspects. However, the finally presented sanitation options consider the technologies and their configurations solely from an infrastructure point of view. In most cases it might be relevant to also discuss other aspects such as different service delivery and financing arrangements. This then will also allow to look at other relevant evaluation options such as costs along with resource recovery and losses.

Moreover, SANTIAGO uses a number of simplifications to make the automation possible (see also <u>chapter 1.1.9</u> <u>Assumptions and limitations</u>). Therefore, systems, that one wishes to consider as serious options, must be checked by an expert for plausibility. This plausibility check is the first step also for a detailed feasibility analysis where spatial aspects are going to be considered as they are not explicitly considered in SANTIAGO (only through the inclusion of physical criteria such as space availability or slope).

In summary, the main additional aspects not covered by SANTIAGO but important to consider in practice:

- The corresponding decision-making process and its steps and stakeholders;
- Additional aspects concerning the options such as different service delivery and financing arrangements;
- Other evaluation criteria than resource recovery such as costs;
- A plausibility check and a detailed feasibility analysis also considering spatial aspects.

1.1.4 SANTIAGO Steps

SANTIAGO integrates four algorithms (also depicted in Figure 1 on the left side):

- For the identification of all appropriate sanitation technologies in a technology library based on a list
 of criteria. These criteria should be independent from stakeholder preferences and thus nonnegotiable and they can therefore be used to screen for appropriate technologies.
- 2. For the generation of all possible and valid sanitation system configurations (typically more than 100'000) using the appropriate technologies. A valid sanitation system is defined as a set of

¹ Community-Led Urban Environmental Sanitation Planning. Available at: www.sandec.ch/clues

- compatible technologies which, in combination, ensure that all sanitation products (e.g. excreta, sludge, blackwater) are either transferred, transformed, or end up in a sink.
- 3. For the selection of the desired number of appropriate system configurations from all generated options. The selection covers the full diversity of the sanitation system options space defined by 19 system templates grouped into simple onsite, urine diversion, biofuel, or blackwater systems.
- 4. For the modelling of substance mass flows along entire system chains in order to quantify resource recovery potentials and environmental emissions for nutrients, organics, energy, and water.

The diverse set of locally appropriate sanitation system options is the main output of SANTIAGO, which is passed over to the SDM process for further evaluation, discussion of trade-offs, and selection of the preferred options using any kind of facilitated MCDA method (steps 5 and 6 of SDM). Resource recovery and loss potentials provide some of the relevant performance indicators for this further evaluation. The options cover the technological aspect of the system only; aspects related to management and service delivery are to some extent considered in the appropriateness assessment.

1.1.5 SANTIAGO technology library

SANTIAGO also comes with a technology library that currently covers more than 90 conventional and novel technologies that can be combined in several 100'000 valid system configurations. The technologies are based on (Gensch et al., 2018; Mcconville et al., 2020; Spuhler et al., 2018; Tilley et al., 2014b) and (Spuhler, 2020). The library also provides the data for more than 30 screening criteria and the transfer coefficients for four substances (phosphorus, nitrogen, water, total solids) for each and every technology based on international literature and expert knowledge. Part B of this document contains a descriptive document that also contains all literature references (— 2.4 References Part B). An editable table format (JSON3) is provided online at github (see also chapter 1.1.7 Where Is SANTIAGO Available). Any new technology can be added to the table following the instructions provided in this document (chapter 2.2.1Customization of Technology Library).

1.1.6 Integration with Planning

To utilise the full strength of SANTIAGO, it should be integrated into a facilitated and participatory SDM process such as Community-Led Urban Environmental Sanitation (Lüthi et al., 2011a). The SaniChoice Practicioners' Guide for this integration is presented in:

www.sanichoice.net/planning-with-sanichoice

The integration is illustrated in Figure 1. The main output is a diverse set of locally appropriate sanitation system options that is of manageable size. This set needs to be further evaluated in regard to the main decision objectives (e.g. costs, operation and managements scheme, etc.). Only afterwards it can be handed over to the SDM process for the discussion of trade-offs and the selection of the preferred option, using any kind of multi-criteria decision analysis (MCDA) method. The required inputs are:

- 1. The set of potential technologies and data on their appropriateness and transfer coefficients (provided in this document)
- 2. The list of relevant and non-negotiable screening criteria (e.g. energy requirements) including their quantification for the application case and the desired number of options given by the SDM process.

3. Input mass flows for substance flow modelling and discussion of trade-offs and recovery potentials (provided by the SANTIAGO documentation).

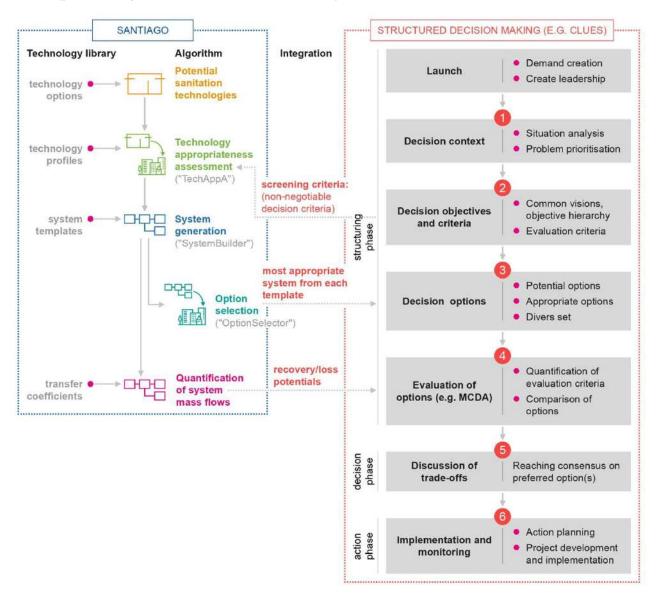


Figure 1: Integration of the SANitation sysTem Alternative GeneratOr (SANTIAGO) and the Structured Decision Making (SDM) approach which happens at two stages. First, the decision objectives are used to derive screening criteria which allows assessment of the appropriateness of potential sanitation technologies for the given application case. The potential technologies are characterized in the technology library. Correspondingly the user characterizes the screening criteria for the given application case. Then, SANTIAGO generates all possible system configurations, calculates their appropriateness scores, and identifies the most appropriate system from each template to be handed over to the decision-making process. Optionally, it can also quantify resource recovery potentials and environmental emissions as inputs into further evaluations.

1.1.7 Where Is SANTIAGO Available

SANTIAGO is open source and freely accessible on github:

Spuhler, D., and Scheidegger, A., (2021): SANTIAGO software, available here: https://github.com/SANTIAGO-sanitation-systems

The link not only contains SANTIAGO software repository (SANTIAGO.jl) but also the SANTIAGO technology library repository. It also contains an additional repository that provides a number of scripts to analyse SANTIAGO result in the R environment.

This document does not provide details on how to apply the software and how to integrate it with the planning process. For guidance on how to apply it a Wiki is available online:

Spuhler, D., Fritzsche, J. and Scheidegger, A., (2021): SANTIAGO software Wiki, available here: https://github.com/SANTIAGO-sanitation-systems/SANTIAGO.jl/wiki

For guidance on how to integrate the software with planning (e.g. Community-Led Urban Environmental Sanitation, CLUES (Lüthi et al., 2011a), Sanitation 21 (Parkinson et al., 2014) please refer to the SaniChoice Practicioners' Guide.

www.sanichoice.net/planning-with-sanichoice

1.1.8 SANTIAGO Advantages

The main advantage of using a software is the possibility to deal with large numbers and very diverse technologies and systems. Moreover, the software and its library allow to provide international literature data and expert knowledge. This can provide evidence about possible solutions and their potential performance at an early stage in the planning process for any application case in the world. The consequence is hopefully more informed decision-making. By providing a diverse set of options together with quantified information this can reveal trade-offs and thereby support a constructive dialogue among stakeholders to balance out conflicts of interest.

Another important advantage of SANTIAGO is that it uses generic definitions of technologies and products and therefore is also flexible to be adapted with new or better data or expanded with any future technology innovations.

The three main potential added values that we expect from the adoption of SANTIAGO in practice are:

- (1) To open up the options space and provide decision makers with sanitation system options that they might not have thought of based on experience alone and which are potentially not only more appropriate but also more sustainable
- (2) To increase the local acceptance for decisions by making them more evidence based and transparent. This hopefully contributes to better ownership and long-term operation and maintenance.
- (3) To enable the prioritisation of more appropriate and sustainable sanitation systems at an early planning phase. This hopefully helps to make new sanitation innovations more accessible for practitioners and to contribute to circular economy and the SDGs.

1.1.9 Assumptions and limitations

It is important to note that the models used to produce the presented data are based on a number of simplifications that include very generic definitions of technologies and products. Consequently, the substance transfer coefficients (TC) which are defined for each technology and product are also impacted by these simplifications. Therefore, systems must be checked by an expert for plausibility when they are being seriously considered as planning options. An example is the treatment of faeces alone in a biogas reactor; it would not make much sense from an engineering perspective, while it would make sense if sludge and e.g. organics are also digested in the same reactor. Another example concerns transfer coefficients: soil loss in a single pit could be defined much more accurately if one would know whether the input product is moist (excreta with pour flush water) or dry (pure faeces). Consequently, the approach is suitable for strategic planning but not for detailed design and implementation of a specific sanitation system.

Modelling substance flows based only on TCs is clearly a simplification, as it excludes possible substance generation, (e.g. through biological fixation, see also (Spuhler et al., 2020c). For most technologies, this limitation is not relevant. A more detailed approach would substantially increase computational demand and the collection of comparable parameters from literature would also be difficult. Another simplification is the assumption of fault-free implementation, operation, and maintenance of the technologies.

Importantly, these simplifications allow the automation and generalization of the model application. Consequences of the simplifications are captured in the uncertainty calculations. The user is free to be more specific in the technology and product definition (e.g. make different types of single pits for different products), or to use more complicated TC models if more accuracy is needed (see also <u>chapter 2.2.1Customization</u> of Technology Library).

— 1.2 TERMS AND DEFINITIONS

1.2.1 Sanitation technologies

A sanitation technology is defined as any process, infrastructure, method or service that is designed to contain, transform or transport sanitation products. Here, it is characterized by its name, the input and output products and how they relate to each other as well as attributes describing its appropriateness. All implemented sanitation technologies can be found in *chapter 1.7.1 Currently implemented technologies*.

1.2.2 Sanitation Products

Some sanitation products are generated directly by humans (urine or faeces), others are required in the functioning of technologies (flush water to move excreta through sewers, etc.) and some are generated as a function of storage or treatment (sludge, effluent, etc.). All implemented sanitation products can be found in *chapter 1.7.2 Currently implemented products*.

1.2.3 Sanitation systems

A sanitation system is defined as a set of sanitation technologies which, in the given configuration, manage sanitation products from its point of generation to the final reuse or disposal. A sanitation system is valid if it contains only compatible technologies and every sanitation product either finds its way into a subsequent technology or a sink. Two sanitation technologies are compatible if the output product of one can be the input product of the other.

1.2.4 Functional groups

A sanitation system can also be defined as the sanitation value chain comprising of five functional groups (FG) that include technologies with similar functions: The user interface (U), the onsite collection and storage/treatment (S), the conveyance (C), the decentralized or centralized treatment (T), and the reuse or disposal (D).

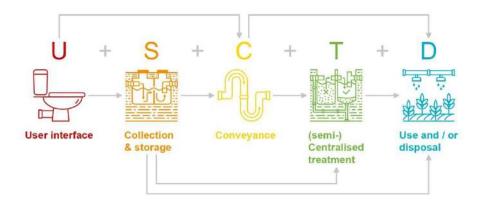


Figure 2: A valid sanitation system is a set of technologies which in combination manage sanitation products from the point of generation to a final point of reuse or disposal. Technologies contained in a system can be organized in five functional groups (FGs): source/ toilet user interface (U), on-site storage and treatment (S), conveyance (C), (semi-)centralized treatment (T), and reuse or disposal (D). Technologies belonging to U are sources, technologies belonging to D are sinks.

1.2.5 Sustainable sanitation

A sustainable sanitation system is one that not only provides appropriate technologies that protect human health and the environment but are also economically viable, socially acceptable, and institutionally applicable (SuSanA, 2008). This definition can be translated into five main objectives for sustainable sanitation: protection of health, protection of the environment and natural resources, economic viability, technological and institutional appropriateness, sociocultural acceptance. The sustainability of sanitation systems depends on how technology interacts within a system as well as on how the technical system (hardware) interacts with other aspects such as the service delivery model and the enabling environment (favourable legal, political, and socio-economic conditions).

1.2.6 Appropriate technologies

An appropriate sanitation technology or system is one that provides a socially and environmentally acceptable level of service at affordable cost (Iwugo, 1979). This can be translated into technical, physical, demographic, socio-cultural, legal and financial criteria as well as in criteria concerning capacity and management.

1.2.7 Criteria

Criteria are used to assess and compare different sanitation systems in a consistent and transparent framework. SaniChoice differentiates between three different types of criteria: SaniChoice uses some criteria for pre-filtering certain technologies and sanitation systems, which are called **pre-conditions**. Criteria to assess the local appropriateness of technologies and sanitation systems and pre-select the most appropriate are named **screening criteria** and cover criteria that are non-negotiable, meaning they are independent from stakeholder preferences and can be quantified at an early planning phase. Screening criteria comprise most areas of appropriate technology: technical, physical and socio-cultural criteria as well as criteria concerning management and capacity. Criteria that are negotiable (not unanimously agreed and involving conflict of interests) are used in a later stage for the detailed evaluation of options and negotiation of trade-offs. These negotiable criteria are called **evaluation criteria**. SANTIAGO mainly uses screening criteria, which are described by corresponding technology and case attributes.

1.2.8 Attributes

A screening criterion always has a corresponding case attribute and a corresponding technology attribute per technology. These corresponding attributes are the variables that are identified for the criterion to measure and to report, either qualitatively or quantitatively, how well an option performs with respect to the criteria (Eisenführ et al., 2010). One example would be the socio-cultural screening criterion "Cleansing Method": For the technology, it describes the performance of that technology given a specific type of anal cleansing method. For instance, a cistern flush toilet would perform 100% for water or soft tissue paper as anal cleansing material but would not function (0%) with hard and bulky cleansing materials, such as maize cobs. For the case, the attribute describes the use of different anal-cleansing methods in that location (case). It could be characterized by stating that 80% of the population use anal-cleaning water, 20% soft tissue paper and no hard cleansing material. All the attributes corresponding to a certain technology or an application case are called technology profile, respectively, application case profile.

1.2.9 Application case

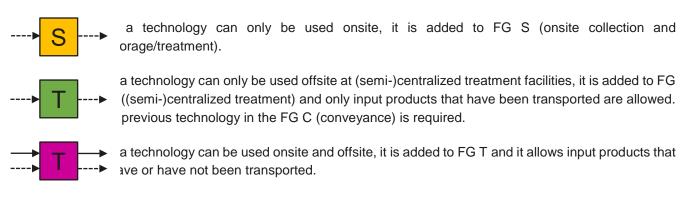
Application case refers to the spatial zone (e.g. village, different zones within a city) to which the SaniChoice procedure is applied to. They can be defined by physical, socio-demographic or political boundaries. These boundaries describe the local context based on which the local appropriateness of a sanitation system is determined.

1.2.10 System templates

A sanitation system template defines a class of sanitation systems with similar conceptual characteristics. It can be defined by using different binary conditions based on characteristics such as if it is dry, wet, produces biofuel, uses urine diversion or based on its level of decentralisation (onsite, decentralized, offsite or hybrid). Each sanitation system can be assigned to one unique template. Detailed information on the use of system templates can be found in *chapter 1.3.6.1 System templates*.

1.2.11 Onsite, Decentralized and Offsite Technologies and Systems

Treatment technologies can be assigned to functional groups based on their suitability for locations close to the toilet infrastructures (onsite) or at distant centralized treatment facilities (offsite):



Based on these technology definitions the following four different types of sanitation are defined:

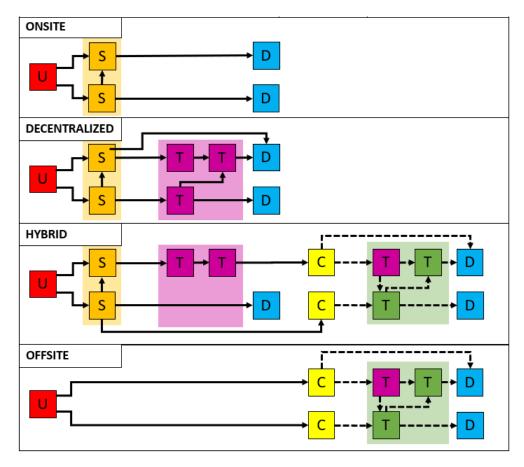


Figure 3. Schematic representation of four types of sanitation systems characterized by their spatial location. *Onsite* and *decentralized* systems are characterized by a lack of transport to an offsite location by a technology in FG C (conveyance). *Decentralized* systems are further defined as ones that do include decentralized technologies (FG T, purple). *Offsite* systems are defined to not include any onsite technologies of type FG S, while *hybrid* systems allow some processes to be onsite and others offsite. Technologies of FG T can accept input products from other FG T technologies and therefore create loops. The same is true for FG S technologies and these possible loops are denoted by transparent boxes. All products after an FG C technology are "transported" and denoted by dashed arrows.

1.2.12 Technology Appropriateness Scores

The Technology Appropriateness Score (TAS) is the result of evaluating the screening criteria for a specific technology within SaniChoice and expresses the confidence in how appropriate a technology is for a given application case. It is obtained by comparing a technology profile with the application case profile previously defined by the user. Each attribute is compared individually resulting in an attribute score. The aggregation of all attribute appropriateness scores via a geometric mean results in the TAS for the given case. The TAS can take values from 0 % to 100 % with 0 % being totally inappropriate and 100 % being totally appropriate.

1.2.13 System Appropriateness Scores

The System Appropriateness Score (SAS) is the result of evaluating the screening criteria for a specific sanitation system within SaniChoice and expresses the confidence in how appropriate a specific sanitation system (a set of compatible technologies) is for a given application case. It is obtained by aggregating the Technology Appropriateness Scores of the technologies used in the system (using a compromise between the geometric mean and the product of all scores). The SAS can take values from 0 % to 100 % with 0 % being totally inappropriate and 100 % being perfectly appropriate.

1.2.14 Substance flows

The substance flow refers to the mass inflow or outflow of a substance into a technology within a sanitation system. The substance flow is part of an input or output product, such as the mass flow of nitrogen (N) in the product of "blackwater". Possible substances can be nitrogen (N), phosphorus (P), water (H2O) and total solids (TS). The substance flow of an output product is calculated by multiplying the TCs with the sum of all substance inflows to the technology. The newly calculated substance flow in the output product can then be transferred into inflows into the subsequent technology.

1.2.15 Transfer coefficients

The transfer coefficient (TC) gives the fraction of the total substance that enters a technology with all input products, which is transferred into a specific output product. The TC for the substance s and the i-th output of a Tech (%) is the fraction of the sum of the input flows that leave the Tech through output i:

$$TC_{i,s} = \frac{out_{i,s}}{\sum_{j=1}^{n} in_{j,s}}$$

Where $out_{i,s}$ and $in_{j,s}$ refer to the mass of substance s in output product i and in input product j.

For instance, a septic tank is fed with the product "blackwater", which contains a certain amount of the substance nitrogen (N). The output products of the septic tank are defined as "sludge" and "effluent". The TC defines how much of the nitrogen is transferred to the sludge and how much is transferred to the effluent (e.g. 20% and 78%, respectively). Additionally, there are also losses of substances into air, soil and groundwater, or surface water, which

have to be accounted for (e.g. 2% for nitrogen loss into air and 0% for soil and water loss). For every substance that is transferred into several output products, the sum of all TCs is equal to 1.

1.2.16 Loss potentials

The loss potentials are defined per substance and refer to the amount of substance transferred to air, soil and groundwater, and surface water over the whole sanitation system. It can be described either as a mass flow [kg/year] or as a ratio of the inflow into the system (%). The Loss Potential mass flow can be quantified as the sum of losses to air, soil and water for all technologies within a system. The Loss Potential ratio is determined as the fraction of the sum of losses compared to the initial substance flow entering the system via the source technology (functional group U). The Loss Potential ratio ranges from 0 (none lost) to 1 (all lost).

1.2.17 Recovery potentials

The recovery potential is defined for a whole sanitation system and refers to the amount of substance that can be recovered in the sink technology of a sanitation system (FG D). It can be described either as a mass flow [kg/year] or as a ratio of the inflow into the system (%). The Recovery Potential mass flow can be quantified as the difference between the mass inflow of the substance into the source technology (FG U) and the losses to air, soil and water for all technologies within a system. The Recovery Potential ratio is determined as the fraction of this recovered mass compared to the initial substance flow entering the system via the source technology (functional group U). The Recovery Potential ratio ranges from 0 (none recovered) to 1 (all recovered) and the sum of the recovery and loss potential ratio should equal 1.

— 1.3 HOW DOES SANTIAGO WORK

1.3.1 Disclaimer

This chapter is based on definitions and methods published in: (Spuhler et al., 2018; 2021)

1.3.2 SANTIAGO algorithms

SANTIAGO contains four algorithms to perform the above steps:

- the Technology Appropriateness Filter TAF that quantifies the appropriateness of potential technologies for a given application case;
- the **System Builder** that generates all valid system configurations from a set of potential and appropriate technologies;
- the **Option Selector** that selects a desired number of system configurations that is diverse and has a high appropriateness;

 and the Substance Flow Model SFM quantifies for a given amount of substance that enters the system how much is recovered or lost to soil, surface water, and air.

1.3.3 Required data

To run SANTIAGO, the set of potential technologies, the relevant screening criteria defining local appropriateness, the data for these criteria for the local application case, the number of inhabitants, and the desired number of system options are required.

1.3.3.1 Potential technologies

A sanitation technology is defined as any process, infrastructure, method or service that is designed to contain, transform or transport sanitation products (see also <u>chapter 1.2.1 Sanitation technologies</u> for a definition). SANTIAGO comes with a technology library that compiles data for over 90 conventional and novel technology options along the five functional groups User Interface (U), Onsite Collection and Storage/Treatment (S), Conveyance (C), Semi-centralized Treatment (T), and Reuse or Disposal (D).

Each technology is defined by its input and output products, its functional group, and the data for all screening criteria (the technology attributes) that apply for a given functional group. This data can be found in the technology library *chapter* — *2.3 Currently implemented technologies* for all currently implemented technologies. If additional technologies are to be added to the library or existing ones modified *chapter 1.4.1 How to define technologies: functional groups, products* provides a helpful overview. Additionally, the relationship of the input and output products has to be defined. For instance, a technology could be defined as follows: a, b (OR) -> X -> d, e (AND). SANTIAGO then automatically generates all possible X variations: a -> X1 -> d, e; b -> X2 -> d, e; and a, b -> X3 -> d, e. The variations are further explained in *chapter 1.3.5.2 Technology Variations*.

The set of all input and output products contained in the technologies will define the scope of the sanitation system. E.g. if stormwater is considered then, not only toilet source needs to be looked at. It is important to consider, that when a technology is added with a new product, it has to be defined where its products are supposed to come from or go to and this has to be integrated in the existing set of technologies in order to be able to find the system configurations later with the System Builder.

The technology library (current format is JSON3) can be customized according to the above definitions. Customization includes adding, modifying, removing technologies, products, or criteria (see <u>2.2.1</u> Customization of Technology Library).

1.3.3.2 Screening criteria

The appropriateness of technologies is evaluated on the basis of screening criteria derived from the overall decision objectives for sustainable sanitation as defined by (SuSanA, 2008). Based on this definition, a sustainable sanitation system not only has to protect and promote human health by providing a clean environment and breaking the cycle of disease, but also has to be economically viable, socially and institutionally acceptable, technically appropriate, and protective of the environment and natural resources. The process to identify the list of screening criteria to be used for a given case is described in the SaniChoice Practicioners' Guide.

For each screening criterion, a pair of appropriateness attributes is required: a "technology attribute" and a "case attribute" (e.g. performance of a technology needing a certain energy supply, and energy availability in the given application case). The technology library currently contains the data and definitions for more than 30 criteria from five categories: technical, environmental and physical, socio-cultural, humanitarian, and criteria concerning capacity and management. The data for the corresponding case attribute has to be provided by the SANTIAGO user. The definitions for these criteria are available below in *chapter 1.7.3 Currently implemented screening criteria*.

1.3.3.3 Case data

The case data has to be provided by the user for each screening criteria ("case attribute") and compiled in a "case profile" that needs to correspond to the "technology profiles". Below we also provide guiding questions to establish the application case profiles (see the subchapter "Case question" for each criterion in *chapter 1.7.3 Currently implemented screening criteria*). Data required can generally be extracted from material collected through the planning process: baseline assessments, reports from previous projects, statistics, field visits, and key informant interviews. More sophisticated data collection methods, such as household surveys, should not be required for the application of SANTIAGO.

1.3.3.4 Inflows, number of users

To quantify resource recovery and loss potentials, the masses of inflowing substances need to be defined. The SANTIAGO technology library currently includes four substances and a number of sources. For each source and each substance, the mass of substance entering the system needs to be known per person. For instance, we can assume that a person produces 0.548 kg total phosphorus per year. Of course the masses vary depending on the diet of people, but if no local data is available, one can use an internationally valid estimate as provided in *chapter* 1.7.6 Currently implemented inflows. The substance flows and resulting resource recoveries and losses can then be scaled using the number of inhabitants within an area or adapted if local data is available.

1.3.3.5 Number of options

From a dozen of potential sanitation technologies, typically more than 100'000 valid systems can be generated. Many of them might be appropriate. On the other hand, the number of systems that can be managed by a typical SDM process strongly depends on the evaluation methods. In the case of a more sophisticated MCDA (e.g. using multiple-attribute value theory, MAVT), this number might be as high as 50. But the most often, especially in a simple context, as described in CLUES (Lüthi et al., 2011b), three to eight options are the most that can be dealt with (Gregory et al., 2012). SANTIAGO is designed to select a desired number of options using the system templates as an indicator for diversity. A good compromise in terms of size and diversity can be obtained by setting the number of options equal to the number of templates.

1.3.4 Appropriateness assessment

The first step to find an appropriate sanitation system is to identify those technologies among all potential ones that are appropriate for a specific case. For example, if no water can be supplied in the case, all technologies that require water supply can be excluded immediately.

The screening attributes cannot be described by a single value, as temporal and regional variabilities exist, and because of other uncertainties (e.g. data availability, future evolution, etc.). To account for these uncertainties, we use probability functions to parametrize the attributes. Each pair of technology and case attributes consists of one probability density function, e.g. the water availability for a given case, p(water availability); and one conditional probability function, e.g. the performance of a technology given a certain water availability P(performance/water availability); see also (Spuhler et al., 2018). One attribute function describes the requirements, and the other the conditions that have to be matched. Whether the density or the conditional probability function is used for the technology or the case is not important as long as both types of functions are a pair for each criterion.

The match of the two attribute functions defines the screening criteria appropriateness score between 0 and 100% either as:

$$AS_{t,c} = P(p) = \int P(p|c) p(c) dc$$
,

if p(c) is a probability density function, or:

$$AS_{t,c} = P(p) = \sum_{c \in \Omega} P(p|c) p(c')$$

if P(c') is a probability distribution function.

By aggregating all criteria scores for a given technology and application case, the technology appropriateness score (TAS) is obtained (Spuhler et al., 2018). Again, it is a number between 0 and 100% that expresses the confidence in the appropriateness of the technologies and sanitation systems for a given application case:

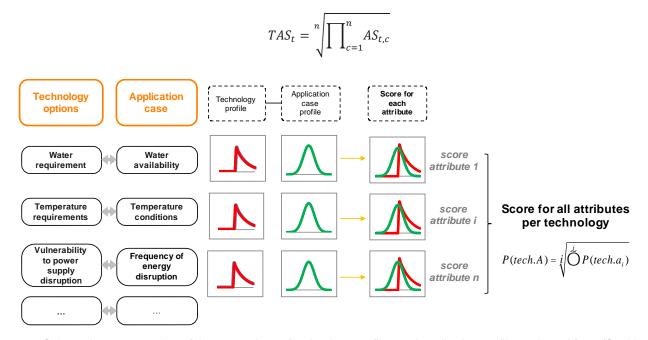


Figure 4 : Schematic representation of the comparison of technology profiles and application profiles, adapted from (Spuhler et al., 2018).

It is important to note that screening criteria are different from performance criteria in SDM and MCDA, as they are used to quantify the suitability of an option in a given context and not to identify the best option (Eisenführ et al., 2010). Consequently, screening criteria do not necessarily apply to all options under assessment, whereas performance criteria must do so. For instance, water availability should not influence the TASt of a Tech t that operates completely independently of the water availability. However, the TASt of this Tech t can still be compared to the TASx of another Tech x which is water reliant. Therefore, the aggregation function should allow for different numbers of criteria. We also require it to be equal to zero if at least one ASt,c is zero. The geometric mean fulfils these requirements (Langhans et al., 2014; Pollesch and Dale, 2015; Rowley et al., 2012).

Technologies with a TAS = 0 are totally inappropriate for the given case and are therefore excluded.

1.3.5 System builder

A sanitation system is defined as a set of technologies which, in combination, manage sanitation products from the point of generation to a final point of reuse or disposal (see definition in *chapter 1.2.3 Sanitation systems*). The technologies contained in a system can be organized in functional groups (FGs). We use the following FGs: toilet user interface (U), onsite collection and storage/treatment (S), conveyance (C), treatment (T), and reuse or disposal (D). A technology belonging to U is always a source, while a Tech belonging to D is always a sink. Additional sources, such as tabs, drainage, or organic solid waste collection bins can also be added and are assigned to a sub-group of U called Uadd. Each sanitation system comprises at least one source and one sink and a number of compatible technologies in such a way that all products end up in another technology or in a sink.

A sanitation system is valid if (1) it contains only compatible technologies and (2) every sanitation product either finds its way into a subsequent technology or a sink (Spuhler et al., 2018). Two sanitation technologies are compatible if the output product of one can be the input product of the other (Mauer et al. 2012).

The System Builder (Spuhler et al., 2018; 2020d) is an algorithm that allows automatic generation of all valid sanitation system configurations from a set of potential technologies.

The set of all valid sanitation systems is constructed on the basis of the appropriate technologies, as illustrated in Figure 5**Error! Reference source not found.**. A Sanitation system is valid if it fulfils the following criteria:

- every output product of each Tech must be connected to another Tech that can take this product as its input,
- no Tech has inputs that are not connected to the output of another Tech.

These rules allow loops in a sanitation system. However, loops between Technologies are practically only possible if the infrastructures are situated close to each other. This leads to the additional constraint that loops are only allowed for the FG S or T either at the level of the premises (onsite) or at semi-centralized treatment facilities (offsite).

1.3.5.1 Transported products

The same product may occur onsite or offsite. In this case, it is treated as two different products for the generation of sanitation systems. For example, blackwater that is produced onsite (e.g. by a 'septic tank'), cannot feed into a centralized Tech (e.g. 'activated sludge'); it must first be transported by a transport Tech in FG C (e.g. 'conventional sewer'). For the generation of sanitation systems we distinguish between products and transported products in building the systems (i.e. 'blackwater' and 'transported blackwater'). Transported products are either output products of Techs in FG C or of Techs that accepted a transported input product.

1.3.5.2 Technology Variations

The generation of sanitation systems requires some assumptions and simplifications to be automated and generic enough to deal with all potential sanitation technologies. The main simplifications concern the way of how the input and output streams are related to each other. Some Technologies of the FG C take a varying number of input products that are then mixed together. To take this fact into consideration, the model defines a hierarchy of products according to their degree of pollution. When different products enter into such a Tech, the resulting output corresponds to the product which is defined to be the most polluted. For example, a conventional sewer fed with greywater and blackwater will produce blackwater. The same Tech fed with blackwater will also produce blackwater.

Another simplification concerns the generation of different Tech variations. The relations of different in- and out-products to each other is defined as either (i) any possible combination ('OR'), (ii) their mutual exclusion ('XOR'); or their compulsory co-existence ('AND'). For example, a septic tank can have the following in-products: 'blackwater' OR 'greywater'; and has the following out-products: 'sludge' AND 'effluent'. This results in three possible combinations of in- and out-products: (i) blackwater, greywater -> effluent, sludge; (ii) blackwater -> effluent, sludge; (iii) greywater -> effluent, sludge. For the generation of sanitation systems we treat each of these possible combinations as a distinct technology variation.

Creating all possible combinations of Technologies is not feasible as a very large number of combinations exist. Moreover, only a very small fraction of these possible combinations are valid sanitation systems. The here proposed sanitation system builder provides an efficient heuristic design to create all valid sanitation systems (see details in the SI-B). The functioning of the algorithm is illustrated in Figure 5.

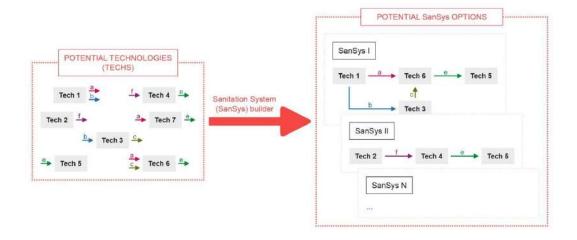


Figure 5: Concept underlying the System Builder, adapted from (Spuhler et al., 2018; 2020d).

1.3.5.3 Quantifying system appropriateness

The sanitation System Appropriateness Score (SAS) is calculated by aggregating the TAS of every Tech of the system. Any aggregation function could be used. We propose a function that can either mimic the product of all TAS, the geometric mean, or a compromise between both:

$$SAS_{S} = \prod_{i=1}^{n.tech} TAS_{t}^{\frac{1}{\alpha (n.tech-1)+1}}$$

where *n. tech* is the total number of technologies in a given system, and $\alpha \in [0,1]$.

A purely multiplicative aggregation ($\alpha=0$) systematically penalizes sanitation systems with a large number of technologies (long systems). This contradicts the principle of allowing a broad range of sanitation systems in the decision option set. Using the geometric mean ($\alpha=1$) is often not desirable either, because a simple system should be preferred over a complex (long) one with the same performance. The smaller the factor α that is chosen, the more are longer sanitation systems (i.e. sanitation system with a large number of technologies) penalized. The weight α is to be chosen in such a way that longer systems are not penalized over shorter, but a benefit is still provided for simpler systems over longer ones.

1.3.6 Option Selector

The set of all possible sanitation systems created with the System Builder may contain more than a hundred thousand systems. From these, we must select a sub-set of potentially applicable decision options that will serve as an input for decision-making. For this, we define three rules:

- The set contains the desired number of decision options. The absolute number of decision options depends on the user and its ability to handle small or larger numbers of decision options.
- The set entails a diverse range of options. The integration of a high variability of different options is important to
 open up the decision space for the stakeholders and to be able to reveal and discuss trade-offs and therefore
 increases the probability of finding a sustainable solution.
- The set contains locally appropriate options. The appropriateness is defined by the system appropriateness scores SAS.

To characterize the diversity, we use system templates. A system template defines a class of sanitation systems with similar conceptual characteristics (for a definition refer to *chapter 1.2.10 System templates*).

The optimal set of options in terms of size, appropriateness, and diversity is obtained by selecting the system with the highest SAS from each system template (Spuhler et al., 2018). In case more options can be managed, SANTIAGO uses a clustering algorithm (Spuhler et al., 2018) to pre-select more than one option from each template using system complexity and length as additional diversity indicators. In case fewer options need to be selected, the algorithm uses the 90% quantile of the SAS for each template to define which templates should be considered (Spuhler et al., 2018).

1.3.6.1 System templates

The Option Selector uses binary conditions (e.g. "produces biofuel", "includes transport") to define a set of system templates. Each sanitation system can be assigned to one unique template. To define system templates is rather complex as it has to be done based on a good understanding of technologies and generated systems. Therefore, the SANTIAGO package comes with a predefined template function based on a number of binary conditions and system templates (see Table 1). These classifications are partly inspired on the *Compendium of Sanitation Systems and Technologies* (Tilley et al., 2014b). The system templates differentiate between onsite, offsite (decentralised, or centralised) and hybrid sanitation systems. Onsite refers to systems that have treatment solely onsite at the location of the toilets (no conveyance technology (FG C) required). For offsite systems the output products of FG S are transported, and all treatment takes place at another location, while hybrid systems have treatment steps onsite and offsite. For further details refer to *chapter 1.2.11 Onsite*, *Decentralized and Offsite Technologies and Systems*.

<u>Onsite, Decentralized and Offsite Technologies</u> and Systems. It is possible to have sanitation systems that do not automatically fit into any template and that need to be considered separately by a user.

Table 1. System templates (ST) used to characterize the sanitation system options. The STs are adapted from (Spuhler et al., 2018). Each of the STs has a unique profile defined by a value for nine properties. And each of the sanitation systems can be assigned to one ST by testing the binary conditions for the system. '1' means that the property is true (e.g. 'the system does not have dry material production"); 0 means that the property is false (e.g. "in this system there is no dry material"); and 'not defined' (n.d.) means that the property is not evaluated for this ST.

Group				Dry material (faeces or excreta)	Sludge	Sludge onsite or decentralised	Blackwater	Transported blackwater	Urine	Onsite storage and treatment (functional	Decentralized and offsite storage and	Transport of products	Biofuel	Biofuel onsite or decentralised	Biofuel production offsite	Biomass production	Urinal	Controlled open defecation
Dry	ST	1.	Onsite dry system with sludge production without biomass production	1	nd	1	0	0	0	1	0	0	0	nd	nd	0	0	0
		2.	Onsite dry system with sludge production and with biomass production	1	nd	1	0	0	0	1	0	0	0	nd	nd	1	0	0
		3.	Onsite dry system without sludge production without biomass production	1	nd	0	0	0	0	nd	0	0	0	nd	nd	0	0	0
		4.	Onsite dry system without sludge production and with biomass production	1	nd	0	0	0	0	1	0	0	0	nd	nd	1	0	0
		5.	Decentralized dry system without biomass production	1	nd	nd	0	0	0	nd	1	0	0	nd	nd	0	0	0
		6.	Decentralized dry system with biomass production	1	nd	nd	0	0	0	nd	1	0	0	nd	nd	1	0	0
		7.	Hybrid dry system without biomass production	1	nd	nd	0	0	0	1	nd	1	0	nd	nd	0	0	0
		8.	Hybrid dry system with biomass production	1	nd	nd	0	0	0	1	nd	1	0	nd	nd	1	0	0
		9	Centralized dry system without biomass production	1	nd	nd	0	0	0	0	nd	1	0	nd	nd	0	0	0
		10.	Centralized dry system with biomass production	1	nd	nd	0	0	0	0	nd	1	0	nd	nd	1	0	0
Blackwater	ST	11.	Onsite blackwater system without sludge with or without effluent transport	nd	nd	0	1	0	0	1	0	0	0	nd	nd	nd	0	0
		12.	Onsite blackwater system with sludge production without effuent transport	nd	nd	1	1	0	0	1	0	0	0	nd	nd	nd	0	0
	ST	13.	Decentralized blackwater system with sludge	nd	1	nd	1	0	0	nd	1	0	0	nd	nd	nd	0	0
	ST	14.	Decentralized blackwater system without sludge	nd	0	nd	1	0	0	nd	1	0	0	nd	nd	nd	0	0
	ST	15.	Hybrid blackwater system with sludge	nd	1	nd	1	nd	0	1	nd	1	0	nd	nd	nd	0	0
	ST	16.	Centralized blackwater system with sludge	nd	1	nd	1	nd	0	0	nd	1	0	nd	nd	nd	0	0
	ST	17.	Hybrid blackwater system without sludge	nd	0	nd	1	nd	0	1	nd	1	0	nd	nd	nd	0	0
	ST	18.	Centralized blackwater system without sludge	nd	0	nd	1	nd	0	0	nd	1	0	nd	nd	nd	0	0
Biofuel	ST	19.	Onsite dry system with biofuel production without effluent transport	1	nd	nd	0	0	0	1	0	0	nd	1	nd	nd	0	0
	ST	20.	Onsite blackwater system with biofuel production without effluent transport	0	nd	nd	1	nd	0	1	0	0	nd	1	nd	nd	0	0
	ST	21.	Decentralized dry system with biofuel production	1	nd	nd	0	0	0	nd	1	0	nd	1	0	nd	0	0
	ST	22.	Decentralized blackwater system with biofuel production	0	nd	nd	1	nd	0	nd	1	0	nd	1	0	nd	0	0

	ST	23.	Hybrid dry system with biofuel production	1	nd	nd	0	0	0	1	nd	1	1	nd	nd	nd	0	0
	ST	24.	Centralized dry system with biofuel production	1	nd	nd	0	0	0	0	nd	1	1	nd	nd	nd	0	0
	ST	25.	Hybrid blackwater system with biofuel production	0	nd	nd	1	nd	0	1	nd	1	1	nd	nd	nd	0	0
	ST	26.	Centralized blackwater system with biofuel production	0	nd	nd	1	nd	0	0	nd	1	1	nd	nd	nd	0	0
Urine	ST	27.	Onsite dry system with urine diversion without effluent transport	1	nd	nd	0	0	1	1	0	0	nd	nd	nd	nd	0	0
	ST	28.	Onsite blackwater system with urine diversion without effluent transport	0	nd	nd	1	0	1	1	0	0	nd	nd	nd	nd	0	0
	ST	29.	Decentralized dry system with urine diversion with or without effluent transport	1	nd	nd	0	0	1	nd	1	0	nd	nd	nd	nd	0	0
	ST	30.	Decentralized blackwater system with urine diversion with or without effluent transport	0	nd	nd	1	nd	1	nd	1	0	nd	nd	nd	nd	0	0
	ST	31.	Hybrid dry system with urine diversion	1	nd	nd	0	0	1	1	nd	1	nd	nd	nd	nd	0	0
	ST	32.	Centralized dry system with urine diversion	1	nd	nd	0	0	1	0	nd	1	nd	nd	nd	nd	0	0
	ST	33.	Hybrid blackwater system with urine diversion	0	nd	nd	1	nd	1	1	nd	1	nd	nd	nd	nd	0	0
	ST	34.	Centralized blackwater system with urine diversion	0	nd	nd	1	nd	1	0	nd	1	nd	nd	nd	nd	0	0
Others	ST.	35.	Urinal	0	nd	nd	0	0	1	nd	1	0						
	ST	36.	Controlled open defecation in humanitarian context	nd	1													
	ST	37.	Not defined	nd														

Table 2: System templates using summarized binary conditions for the online tool <u>www.sanichoice.net</u>

Group				Dry (no Flush water)	Wet (Blac kwate r)	Sludg e produ ction	Biom ass Prod uctio n	Biofu el Prod uctio n	Urine Diver sion	Onsit e	Dece ntrlis ed	Hybri d	Centr alized
Dry	ST	1.	Onsite dry system with sludge production without biomass production	1	0	1	0	0	0	1	0	0	0
		2.	Onsite dry system with sludge production and with biomass production	1	0	1	1	0	0	1	0	0	0
		3.	Onsite dry system without sludge production without biomass production	1	0	0	0	0	0	1	0	0	0
		4.	Onsite dry system without sludge production and with biomass production	1	0	0	1	0	0	1	0	0	0
		5.	Decentralized dry system without biomass production	1	0	ND	0	0	0	0	1	0	0
		6.	Decentralized dry system with biomass production	1	0	ND	1	0	0	0	1	0	0
		7.	Hybrid dry system without biomass production	1	0	ND	0	0	0	0	0	1	0
		8.	Hybrid dry system with biomass production	1	0	ND	1	0	0	0	0	1	0
		9	Centralized dry system without biomass production	1	0	ND	0	0	0	0	0	0	1

		1 0.	Centralized dry system with biomass production	1	0	ND	1	0	0	0	0	0	1
Blackwat	ST	1	Onsite blackwater system without sludge with or without effluent transport	0	1	0	ND	0	0	1	0	0	0
		1 2.	Onsite blackwater system with sludge production without effuent transport	0	1	1	ND	0	0	1	0	0	0
	ST	1 3.	Decentralized blackwater system with sludge	0	1	1	ND	0	0	0	1	0	0
	ST	1 4.	Decentralized blackwater system without sludge	0	1	0	ND	0	0	0	1	0	0
	ST	1 5.	Hybrid blackwater system with sludge	0	1	1	ND	0	0	0	0	1	0
	ST	1 6.	Centralized blackwater system with sludge	0	1	1	ND	0	0	0	0	0	1
	ST	1 7.	Hybrid blackwater system without sludge	0	1	0	ND	0	0	0	0	1	0
	ST	1 8.	Centralized blackwater system without sludge	0	1	1	ND	0	0	0	0	0	1
Biofuel	ST	1 9.	Onsite dry system with biofuel production without effluent transport	1	0	ND	ND	1	0	1	0	0	0
	ST	2 0.	Onsite blackwater system with biofuel production without effluent transport	0	1	ND	ND	1	0	1	0	0	0
	ST	2 1.	Decentralized dry system with biofuel production	1	0	ND	ND	1	0	0	1	0	0
	ST	2 2.	Decentralized blackwater system with biofuel production	0	1	ND	ND	1	0	0	1	0	0
	ST	3	Hybrid dry system with biofuel production	1	0	ND	ND	1	0	0	0	1	0
	ST	2 4	Centralized dry system with biofuel production	0	1	ND	ND	1	0	0	0	0	1
	ST	5	Hybrid blackwater system with biofuel production	1	0	ND	ND	1	0	0	0	1	0
	ST	6	Centralized blackwater system with biofuel production	0	1	ND	ND	1	0	0	0	0	1
Urine	ST	7	Onsite dry system with urine diversion without effluent transport	1	0	ND	ND	ND	1	1	0	0	0
	ST	8	Onsite blackwater system with urine diversion without effluent transport	0	1	ND	ND	ND	1	1	0	0	0
	ST	9	Decentralized dry system with urine diversion with or without effluent transport	1	0	ND	ND	ND	1	0	1	0	0
	ST	3 0	Decentralized blackwater system with urine diversion with or without effluent transport	0	1	ND	ND	ND	1	0	1	0	0

	ST	3	Hybrid dry system with urine diversion	1	0	ND	ND	ND	1	0	0	1	0
	ST	3 2	Centralized dry system with urine diversion	0	1	ND	ND	ND	1	0	0	0	1
	ST	3	Hybrid blackwater system with urine diversion	1	0	ND	ND	ND	1	0	0	1	0
	ST	3 4	Centralized blackwater system with urine diversion	0	1	ND	ND	ND	1	0	0	0	1
Others	ST.	3 5	Urinal	ND	ND	ND	ND	ND	1	ND	ND	ND	ND
	ST	3 6	Controlled open defecation in humanitarian context	ND	ND	1	ND						
	ST		Not defined	ND	ND			ND	ND	ND	ND	ND	ND

Table 3: Summarized characterisation of the currently implemented system templates (STS).

			Onsite	Decentralized	Hybrid	Centralized				
Simple	Dry	Without biomass production	ST1 (with sludge) ST3 (without sludge)	ST5	ST7	ST9				
		With biomass production	ST2 (with sludge) ST4 (without sludge)	ST6	ST8	ST10				
Blackwater	Wet		ST11 (without sludge) ST12 (with sludge)	ST13 (without sludge) ST14 (with sludge)	ST15 (without sludge) ST17 (with sludge)	ST16 (without sludge) ST17 (with sludge)				
Biofuel	Dry		ST19	ST21	ST23	ST24				
	Wet		ST20	ST22	ST25	ST26				
Urine diversion	Dry		ST27	ST29	ST31	ST32				
	Wet		ST28	ST30	DZ33	ST34				
Controlled open setting)	defectio	n (humanitarian	ST35							
Urinal only	Urinal only			ST36						
Not defined			ST37							

1.3.7 Substance Flow Model (SFM)

1.3.7.1 Approach

For the evaluation of trade-offs and the selection of the preferred sanitation system option, detailed information regarding the performance of various options can be useful. Nutrient emission or recovery potentials, water reuse or loss, and energy recovery potential are performance indicators that can matter in a multi-criteria selection of the preferred option. To analyse and quantify the flows of matter and energy into, within and out of the defined borders of a system, material flow analysis (MFA) or substance flow modelling (SFM) has proven to be a good option (Villeneuve et al., 2004).

We apply a simplified substance flow model to quantify substance flows of the sanitation systems. The flow paths are defined by the sanitation products that connect technologies within a system.

Using the transfer coefficients, the SFM algorithm propagates the entering mass of substance through the entire system, providing the percentage of substance mass transferred or lost, either to the soil, air, or water for each technology. In the sink technologies, substances are not transferred further but either lost or recovered for reuse. By summing up all losses and recoveries in the entire system, balances for resource recovery potentials and losses can be quantified. The uncertainty of the transfer coefficients is propagated using Monte Carlo providing the recovery and loss potentials, mean values and standard deviations. First tests showed (Spuhler et al., 2020d) that the standard deviations of the results remain in the order of magnitude of conventional material flow analysis studies for sanitation systems (Montangero and Belevi, 2008).

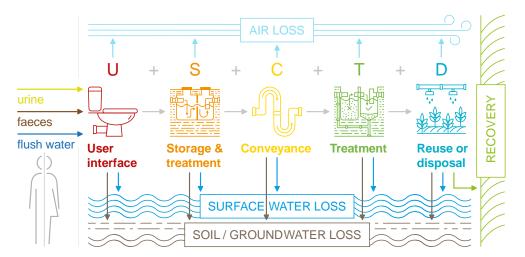


Figure 6: Concept underlying the Substance Model. The substances (phosphorus, nitrogen, total solids, water) enter the systems through the user interface (source, U) and are either transferred, lost to air, soil or surface water, or recovered at the sink level (reuse or disposal, D).

1.3.7.2 Transfer coefficients

Each technology needs to be characterised with a TC for each output flow and substance of interest. For a given substance, the TC for the i-th output flow of a technology (TC_i) is the fraction of the sum of the input flows that leave the technology through outflow i:

$$TC_i = \frac{\text{out}_i}{\sum_{j=1}^n in_j}$$

where n is the total number of inputs to this technology. The output flows are the output products as well as the losses to the environment - to air, soil/groundwater, and surface water. Input flows are defined only by the input products as we assume a system with no biological fixation. Thus, the sum of all TCs of a technology must always be 1 and all TCs positive.

Three types of TCs can be distinguished:

- Input-output TCs. For every output a TC needs to be defined; the number of outputs depends on the Tech.
- Input-loss TCs. Quantifying the fraction of substances transferred to air, soil or groundwater, and surface water. We only consider the losses (e.g. leaching of phosphorus from a single pit into the soil) and not the subsequent interactions (e.g. transfer of the same phosphorus from the soil to the surface water).
- Recovery TCs. Besides losses, sink technologies also have a TC to quantify the fraction of a substance that can be recovered (e.g. over 90% of phosphorus is recovered through the sink 'application of stored urine').

Figure 7 provides an example of the flows and the TCs for the technology single pit and the substance total phosphorus (TP). The example also shows the high variability of the data found in literature. Therefore, we need a systematic method to consider and model this uncertainty.

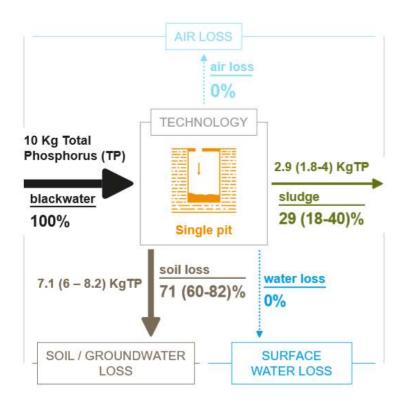


Figure 7: Illustration of the approach used to quantify transfer coefficients (TCs) using the example of total phosphorus (TP) pathways in a single pit. The TCs are estimated based on literature values in mass and in percentage as mean values. In parenthesis we provide the variability range resulting from the literature data points. From the 100% of phosphorus entering the single pit via blackwater, 29% are transferred to sludge and 71 % are lost to the soil. But these values can vary as much as between 18 to 40 and 60 to 82 % respectively.

1.3.7.3 Transfer Coefficient Uncertainty Propagation

Monte Carlo simulations are used to propagate the uncertainty of the TCs through the substance flow model and to quantify their effect on the resource recovery and loss ratios. The TCs for each Tech are sampled from their Dirichlet distribution and used to compute the mass flow of the entire sanitation system in repeated runs. We used a total of 300 runs which proved to be sufficient for stable results.

1.3.7.4 Mass flow calculations

The product connections between the technologies in each sanitation system define the flow paths of the substances (see also Figure 2). Transfer coefficients (TCs) define how much of substance entering a technology is transferred to one of the outputs products or lost to the environment. These TCs and the connections can be expressed in a matrix P, where Pi, is the fraction of the substance leaving Tech i that is transferred to Tech j. Additionally, we define

a row vector $F^e(t)$, where the i-th element represents the external inflow to Tech i at time t (e.g. the dry toilet Tech receives 0.550 kg/year of phosphorus per one person). Based on this information, we can calculate the total inflow into Tech i at time t. We define a row vector (t) where the i-th element represents the sum of all inflows to Tech i at time t (e.g. the amount of phosphorus entering a single pit through excreta).

The mass flows at time t + 1 are obtained by

$$F_{t+1} = F_t * P + F_{t+1}^{ext}$$

If we assume a constant inflow $F_e(t) = F_{ext}$, we have a steady state flow F that is calculated by

$$F = F \cdot P + F_{ext}$$

$$F = F_{ext} \cdot (I - P)^{-1}$$

The flow at steady state from node *i* to node *j* is consequently defined as

$$flow_{i,j} = F_i \cdot P_{i,j}$$

When considering the whole sanitation chain the model substance inflows into the source technologies (FG U) are transferred into the respective output products (e.g. urine, faeces, excreta or blackwater) using the transfer coefficients (TCs). From then on, the flow of the substances *s* through the system is calculated by multiplying the sum of all inflows to the technology by TCs in order to get the amount of substance in the output products. These are then transferred into inflows in the subsequent technology until the sink technologies (FG D) are reached.

The recovery potential of a sanitation system is defined by the mass flow that can be recovered from the sink technologies. The losses to air, soil and water for all technologies within a sanitation system are summed up and represent the mass flow of the total loss potential per environmental compartment $loss_{air/water/soil,s}$ [kg/cap/year]. It can also be quantified as the $Loss\ Potential\ ratio_{air/water/soil,s}$ [%] compared to the mass inflow $in_{FG\ U,s}$ entering the source technology by the following equation

$$Loss\ Potential\ ratio_{air/water/soil,s} = \frac{loss_{air/water/soil,s}}{in_{FG\ U,s}} = \frac{\sum_{all\ techs} loss_{air/water/soil,s}}{in_{FG\ U,s}}$$

In analogue, the total recovery potentials can be determined as both recovered mass flows $out_{FG\ D,s}$ [kg/cap/year] in the sink technology and as $Recovery\ Potential\ ratios_s$ [%] of mass inflow $in_{FG\ U,s}$ entering the system by the flowing equation

$$Recovery\ Potential\ ratio_{s} = \frac{out_{FG\ D,s}}{in_{FG\ U,s}} = \frac{in_{FG\ U,s} - \sum_{all\ techs} loss_{air,s} - \sum_{all\ techs} loss_{water,s}}{in_{FG\ U,s}}$$

The recovery ratio depends solely on the transfer coefficients of the technologies. In comparison, the recovery mass flow is affected by the substance inflow into the sanitation system, which differs for different source technologies. For instance, a cistern flush toilet has a larger inflow of water (H2O) compared to a dry toilet. Therefore, a system with a cistern flush toilet might have a larger absolute water mass recovered, but a smaller recovery ratio of water than a sanitation system with a dry toilet.

Because we have different external inflows and transfer coefficients for each substance, the calculations are repeated separately for each substance that is to be modelled.

1.3.8 Results and Outputs

SANTIAGO provides the following results and outputs:

- Appropriateness Scores: for each technology and each screening criterion an appropriateness score between 0 and 100% is provided and describes how well the technology matches the local conditions for this screening criterion (e.g. space availability).
- Technology Appropriateness Scores: aggregating the individual appropriateness scores for all screening criteria
 determines the Technology Appropriateness Score, also a number between 0 and 100%. The TAS expresses
 the confidence in how appropriate this technology is for the local conditions.
- System options: SANTIAGO provides a list of all possible system configurations and their properties.
- System properties: The system properties for each system include a unique identifier, the included technologies
 and their product connections, the system template it belongs to and the system appropriateness score SAS
 based on the aggregation of the TASs. In addition, the system properties include the mass flow statistics
 including the substance mass flows per output product and the overall resource recovery and loss potential
 masses and ratios.
- A selection of diverse and appropriate sanitation system options and their properties according to the desired number of system options that one wishes to further evaluate.

— 1.4 DEFINING TECHNOLOGIES

To define a technology, following elements are required:

- A name
- The functional group it belongs to
- The input and output products and their relations
- The attribute functions and parameters for all relevant screening criteria (not all the screening criteria apply for all functional groups, but if it applies to a functional group, then all technologies within this functional group need an attribute for this criteria).
- The transfer coefficients into each output product and into the environmental compartments air, soil and water.
- Optionally a short description can be provided

1.4.1 How to define technologies: functional groups, products

The following list comprises the general input data needed to add a new technology to the technology library:

Name Unique and intuitive

Definition: Short description of the technology.

FG: User interface (U), onsite collection and storage/treatment (S), conveyance (C), (semi-) centralized treatment (T), use and/or disposal (D)

Treatment technologies can be sorted into different FG based on their suitability for locations close to the toilet infrastructures (onsite) or at distant centralized treatment facilities (offsite): If a technology can only be used onsite, it is added to FG S. If a technology can only be used offsite at (semi-)centralized treatment facilities, it is added to FG T and additionally it is defined that solely transported input products are allowed. If a technology can be used onsite and offsite, it is added to FG T and transported as well as not-transported input products are allowed.

Products: In- and output products of the technologies; for an overview of all currently implemented products and more information see <u>chapter 1.2.2 Sanitation Products</u>.

Relations: Required to generate the technology variations (see chapter 1.3.5.2 Technology <u>Variations</u>). Relation between the input products as well as between the output products:

'OR': any possible combination of products entering/leaving the technology

'XOR': a mutual exclusion with only one of the products entering/leaving the technology

'AND': a compulsory co-existence of all products entering/leaving the technology

For technologies in the FG C (conveyance): the order of output products separated by ">" indicates which output product is most/more dominant in case different products get mixed during conveyance. For example if blackwater AND greywater enter a conventional sewer, the output product will be considered to be transported blackwater (as blackwater > greywater).

1.4.2 Appropriateness Profiles

Additionally, to the data given above we also need to specify the appropriateness attributes for a technology in order to be able to calculate appropriateness scores. The functions to parametrize attributes given below are recommendations, but you can also use other probability density functions and/or conditional probability functions. In principle only two functions are required:

- The trapezoidal function: based on four values a, b, c, and d. If a=b and c=d then the functions correspond to the range functions. If b=c then it corresponds to the triangular functions.
- The categorical function: based on a pre-defined set of category names

It is important to remember that the technology and case functions for a given criteria must always be a pair of a conditional probably (performance function) and a probability distribution (condition function). For instance the technology has a performance given a certain temperature (performance function) and the temperature has a certain distribution over the year in a certain case (condition function).

1.4.2.1 Possible attribute functions

In the following, we propose two functions (one continuous and one categorical) that should be sufficient for most of the data. However, if more accuracy is needed, any other probability function could be used.

1.4.2.1.1 Trapezium Function: Continuous

The trapezium function can describe values where a linear interpolation between four data points (a = min, b = 1st optimum, c = 2nd optimum and d = max) is assumed. However, the trapezium function can be used in various ways depending on how the parameters are set.

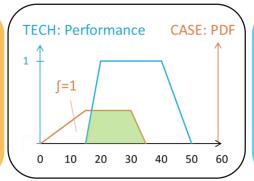
Trapezium function in general → Trapez(a,b,c,d), a<b<c<d

Example (Normal trapezium function as a performance and PDF function for "Temperature"):

The case area has a temperature range of 0 to 35°C. For most of the year the temperatures lie between 15 and 30°C.

PDF, Trapez:

(a=0, b=15, c=30, d=35)



The technology starts working at 15°C, reaches its optimum at 20 to 40°C and does not work over 50°C.

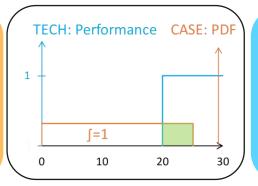
Performance, Trapez:
(a=15, b=20, c=40, d=50)

Trapezium function as a range → Trapez(a,b,c,d), a=b<c=d

If the parameters are set a=b and c=d we can define a certain range as a function. This can be used for an interpolation between two data points (min and max value, e.g. "the available surface area ranges between 0 and 25 m^2 ") \rightarrow Trapez(a=b=0, c=d=25)

Example (Trapezium used as PDF and performance range function for "Surface Area"):

A maximum surface area of 25m² is available. PDF, Range: (a=b=0, c=d=25)



A minimal surface area of 20m² is required Performance, Range: (a=b=20, c=d=999)

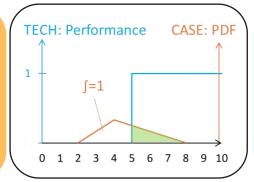
Trapezium function as a triangle → Trapez(a,b,c,d), a<b=c<d

The triangle function can describe values where a linear interpolation between three points is assumed (min, medium and max value, e.g. "the groundwater ranges between 2 m and 8 m with an average of 4 m") > Trapez(a=2, b=c=4, d=8)

Example (Trapezium used as PDF triangle function for "Groundwater Depth"):

The groundwater level varies between 2m and 8m with an average of 4m. PDF, Triangle:

(a=2, b=c=4, d=8)



The technology only works groundwater depths deeper than 5m. Performance, Range: (a=b=5, c=d=999)

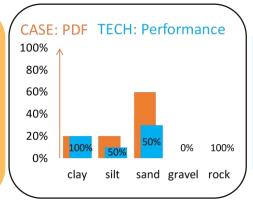
1.4.2.1.2 Discrete Function: Category

The category function allows us to give values to specific categories.

→ cat(category 1, category 2, category 3, ...)

Example (Categorical function as PDF and performance function for "Soil Type"):

The soil in the area is 20% clay, 20% silt and 60% sand. PDF, Categorical $\rightarrow \Sigma = 1$ (clay = 20%, silt = 20%,sand = 60%, gravel = 0%, rock = 0%)



The technology works 100% for clay and rock, but only 50% for silt and sand and does not work for gravel. Performance, Categorical (clay = 100%, silt = 50%,sand = 50%, gravel = 0%, rock = 100%)

1.4.3 Quantifying Transfer Coefficients

The Substance Flow Model (SFM) algorithm requires transfer coefficients for each technology and substance. The classical approach for quantifying transfer coefficients in material flow analysis is to make in-situ measurements to parametrize the transfer coefficients as a function of different parameters such as volume, temperature, etc. The problem is that in-situ measurements are often not possible and that the measurement results can be very different for different implementations of a technology. Therefore, we have chosen a more generic approach.

We use two different ways to determine transfer coefficients for the case where literature data is available and for the case of literature data being absent.

If literature data was available, we defined the expected value μ_i for TC_i as the median of the data points collected from the literature. In absence of literature data, we used expert judgement. For expert judgement, we collected information on the chemical and physical processes to make a best guess or contacted colleagues directly involved in the development of the technology to do that for us.

An exact definition is not possible, because TCs depend on many factors such as the environmental conditions, the design and implementation of a technology, the qualities and quantities of inputs, and because ignorance is common (especially for novel technologies). It is therefore important to consider uncertainties attached to the TCs. A suitable model is the Dirichlet distribution as it encodes the sum constraint that requires the sum of all TCs to be equal to 1. Thus, the probability density of the transfer coefficients $TC = [TC_1 ... TC_n]$ of a given Tech is:

$$TC \sim f(x) = \frac{1}{B(\alpha)} \prod_{i=1}^{n} x_i^{\alpha_i - 1},$$

where B is the Beta function and n is the number of TCs for a given Tech (Johnson et al., 1995). We define $\alpha_i = \mu_i \cdot k$, where μ_i is the expected value of TC_i and k is the concentration describing the variability range r_i of the TCs. The smaller the k, the larger the standard deviation of the observations. For a very small k, the marginal distributions become bimodal. The effect of k is visualized in Figure 8.

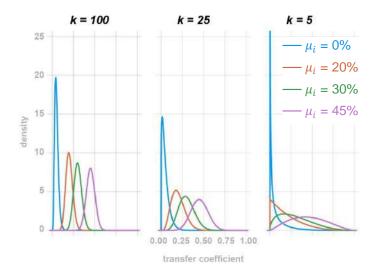


Figure 8: Three examples of concentration factors k for a set of four transfer coefficients μ_i (0%, 20%, 30% and 45%). For k = 100, the distributions are relatively narrow (small variability range of up to 10% expressed as standard deviation). For k = 5, the variability ranges are up to 40%.

To simplify the application of the approach, we define six generic values for k and use two different approaches to define k for a given TC: one for the case when literature data is present and based on the literature data variability; and one for the case of expert judgement based on the confidence in the judgement.

1.4.3.1 Concentration factors k based on literature observation

The range between the lowest and the highest values of all data points, the variability range r_i , is determined and used to define the concentration factor k with the help of Table 4. In the example presented in Figure 7, total phosphorus transferred to sludge in a single pit, we found TC values in the literature between 18 % and 40 %, resulting in $r_i = 0.40$ -0.18 = 0.22 and thus k = 5. As the r_i for different TC_i s of one Tech are not identical, we use the largest r_i to define k. Table 4 shows the k associated with each variability range r_i . The values are based on an approximation using 45 possible scenarios of TCs sets and their variability ranges.

1.4.3.2 Concentration factors k for TCs defined by expert judgement

We define the concentration factor k as a statement of the experts' confidence in two dimensions: (i) confidence in knowledge about the technology, and (ii) confidence in knowledge about the specific substance, as shown in Table 5. The knowledge about the technology is defined by the readiness level and its complexity. The knowledge in the substance is defined by a judgement how well the substance behaviour can be predicted.

Table 4: If literature data is present: Six standardized intervals are used to translate the variability of ranges observed in literature into the concentration factor k. The variability range of a transfer coefficient i (TCi) is defined by the range between the lowest and the highest value data points reported in literature.

Table 5: Based on the confidence in the expert judgement: Experts' knowledge about the technology and confidence in the substance are used to define the concentration factor k for transfer coefficients based on expert judgement. Confidence in the technology depends on different factors such as its development stage and the process used. Nitrogen and total solids have lower confidence, while phosphorus and water have medium and high confidence.

Observed variability ranges in literature data	Concentration factor for the Dirichlet distribution (k)
[0, 0.1] (0-10%)	100
]0.1, 0.2] (10-20%)	25
]0.2, 0.4] (20-40%)	5
]0.4, 0.6] (40-60%)	2
]0.6, 0.8] (60-80%)	1
]0.8, 1] (80-100%)	0.5

Concentration used in the Di distribution (k	richlet	Confidence in knowledge about technology (technology readiness level)								
		Low	Medium	High						
Confidence in	Low	1	2	5						
substance	Medium	2	5	25						
	High	5	25	100						

— 1.5 DEFINING THE APPLICATION CASE

As mentioned earlier the integration of SANTIAGO with the planning process is defined in detail in The SaniChoice Practicioners' Guide:

www.sanichoice.net/planning-with-sanichoice

Here we only refer to the minimal requirement information to use SANTIAGO. The two main steps are:

- Define which screening criteria are relevant from the list currently implemented in the technology library.
- Use existing data and literature to define the case profiles including all the attribute functions for the relevant criteria. How the appropriateness works is explained in <u>chapter 1.3.4 Appropriateness assessment</u>. <u>Chapter 1.4.2 Appropriateness Profiles</u> and the criteria definitions in <u>chapter 1.7.3 Currently implemented screening criteria</u> will tell you how to translate the data into functions. In the WIKI of SANTIAGO there are implemented case studies that can be used as templates for the case profiles.

https://github.com/santiago-sanitation-systems/Santiago.jl/wiki/5.-Input-Files

1.5.1 Inflows and Number of Options

In <u>chapter 1.3.3 Required data</u> we explained how to define the Inflows and the Number of Options. In <u>chapter 1.7.6</u> <u>Currently implemented inflows</u> we provide some generic inflow masses that can be used by default. The Number of Options is best set to be equal to the number of templates applicable to the set of potential technologies. This provides a manageable number of sanitation systems that are based on diverse system templates.

— 1.6 PREPARING DATA FOR SANTIAGO

SANTIAGO requires the input data to be in the JSON3 format. Three files are required:

- A Technology with all the technology profiles
- An Application Case file with the case profile
- An Inflow File

Additional parameters such as the number of inhabitants are defined in the runfile when calling the functions.

In the Technology Library you will find example files to start with:

In the WIKI of SANTIAGO you can find a best practice example and the instructions how to prepare own JSON files:

https://github.com/SANTIAGO-sanitation-systems/SANTIAGO.jl/wiki

- 1.7 CURRENTLY IMPLEMENTED

1.7.1 Currently implemented technologies

The following Table 6 provides an overview of the more than 90 technologies that have been implemented at this point in time. Additional sources, such as tabs, drainage, or organic solid waste collection bins can also be added and are assigned to a sub-group of U called Uadd.

A technology is defined by its functional group (FG), its unique identifier (ID), its input and output products as well as the relation between the input as well as the output products, its appropriateness profile and the TCs, which can be found for each technology in the technology factsheets in <u>Part B — 2.3 Currently implemented technologies</u>. A detailed description of each technology can be found online on SaniChoice based on (Gensch et al., 2018; Mcconville et al., 2020; Tilley et al., 2014b).

Table 6. List of currently implemented technologies sorted by their functional groups.

Uadd	U	S	С	Т	D
Handwashing Facility	Cistern-Flush Toilet	Urine Storage Tank	Motorized Emptying and Transport of Urine	Urine Bank	Application of Urine and Nutrient Solutions
Kitchen Sink	Pour-Flush Toilet	Double Dehydration Vaults	Human-Powered Emptying and Transport of Urine	Struvite Precipitation	Application of Aurin
Organic Waste Bin	Dry Toilet	Single Faeces Storage Chamber	Motorized Emptying and Transport of Solids	Nitrification and Distillation of Urine	Application of Struvite or Dried Urine
Stormwater Collection	Urine Diversion Dry Toilet (UDDT)	Container- Based Toilet	Human-Powered Emptying and Transport of Solids	Alkaline Dehydration of Urine	Application of Dried Faeces
	Urine Diversion Flush Toilet (UDFT)	Single Pit	Conventional Gravity Sewer	Unplanted Drying Bed Sludge	Application of Compost and Biochar
	Urinal	Single Ventilated Improved Pit	Simplified Sewer	Planted Drying Bed	Application of Stabilized Sludge
	User Interface for Controlled Open Defecation	Double Ventilated Improved Pit	Solids-Free Sewer	Unplanted Drying Bed Dry	Fill and Cover

Twin Pits for Pour-Flush Toilets	Stormwater Drainage	Sedimentation / Thickening Ponds	Biogas Combustion
Composting chamber		Co-Composting	Briquettes as Fuel
Fossa Alterna		Offsite Vermi-Composting	Co- Combustion
Onsite Vermi- Composting		Black Soldier Fly Composting	Soak Pit
Septic tank		Ladepa-Pelletizing	Leach Field
Raised Latrine		Briquetting (Sanivation)	Irrigation
Shallow Trench Latrine		Settler	Fish Pond
Deep Trench Latrine		Imhoff Tank	Floating Plant Pond
Chemical Toilet		Anaerobic Baffled Reactor (ABR)	Surface Water Disposal
Storage Trench for Controlled Open Defecation		Upflow Anaerobic Sludge Blanket Reactor (UASB)	Surface Disposal and Storage
Transfer Station		Biogas Reactor	Borehole Latrine
		Anaerobic Filter	
		Sequencing Batch Reactor (SBR)	
		Waste Stabilization Ponds (WSP)	
		Free-Water Surface Constructed Wetland	
		Horizontal Subsurface Flow	
		Constructed Wetland	
		Vertical Flow Constructed Wetland	
		Aerated Pond	
		Trickling Filter	
		Activated Sludge Lactic Acid Fermentation	
		Treatment	
		Caustic Soda Treatment	
		Urea Treatment	
		Hydrated Lime Treatment	
		Microbial Fuel Cell (MFC)	
		Algae Cultivation	
		Membranes	
		Carbonisation	
		Mono-Incineration	

1.7.2 Currently implemented products

The definitions of the different sanitation products given in Table 7 are mostly based on those given in the Compendium of Sanitation systems and Technologies (Tilley et al., 2014b) and the supplementary Guide to Sanitation Resource-Recovery Products & Technologies (Mcconville et al., 2020). Further sources for the sanitation products are referenced in Table 7.

Table 7. List of currently implemented products defined by a unique identifier. Some products have an additional identifier where the prefix "transported" has been added. These identifiers refer to the same product, however assuming that prior conveyance of products has taken place and these products are only used in offsite treatment facilities. The differentiation between transported and not transported products is made to ensure a correct assembly of technologies by the sanitation system builder.

Product(s)	Identifier	Description	Reference
Anal cleansing water	anal_cleansing_water	Anal cleansing water is the water used to cleanse oneself after defecating and/or urinating. It is generated by those who use water, rather than dry material, for anal cleansing. The volume of water used per cleaning typically ranges from 0.5 L to 3 L.	(Mcconville et al., 2020)
Ash	ash	Incineration ash can be divided into two main categories: incinerator bottom ash (IBA) and air pollution control residue, commonly referred to as fly ash. IBA forms at the bottom of an incinerator from heavy components that are neither combustible nor volatile. These residues contain large proportions of	(Mcconville et al., 2020)
Ash	transportedash	phosphorous and potassium, which can fertilise the soil for agricultural purposes if the sludge is not chemically contaminated. It can also be used in construction materials such as roads.	
Aurin	aurin	Aurin is the product of a series of urine treatment processes. It is a highly concentrated nutrient solution that compares well to	(Etter et al., 2015)
Aurin	transported_aurin	commercial liquid fertilisers in terms of nutrient concentrations.	_0,0,
Biogas	biogas	Biogas is the common name for the mixture of gases released from anaerobic digestion. Biogas is comprised of methane (50 to 75%), carbon dioxide (25 to 50%) and varying quantities of	(Tilley et al., 2014b)
Biogas	transportedbiogas	nitrogen, hydrogen sulphide, water vapour and other components. Biogas can be collected and burned for fuel (like propane).	
Biochar	biochar	Biochar is a solid material obtained from pyrolysis, the thermochemical conversion of biomass in an oxygen-limited environment. Biochar derived from pyrolysis of sludge, faeces and/or organic waste may be applied to soils to improve soil properties and crop yields. Additionally, it acts as a carbon sink	(Mcconville et al., 2020)
Biochar	transportedbiochar	to reduce climate change impacts. Other applications include use as an adsorption material for filters, especially for water purification purposes, or as a feedstock for energy recovery. It is typically called "biochar" when it is used as a soil conditioner and "char" when it is used as a fuel.	
Blackwater	blackwater	Blackwater is the mixture of urine, faeces and flushwater along with anal cleansing water (if water is used for cleansing) and/or	(Tilley et al., 2014b)
Blackwater	transportedblackwater	dry cleansing materials. Blackwater contains the pathogens of faeces and the nutrients of urine that are diluted in the flushwater.	
Briquettes	briquettes	Briquettes are the product of a process developed by Sanivation in Naivasha, Kenia. Consisting of a mixture of dried, ground	(Spuhler and Roller, 2020)
Briquettes	transportedbriquettes	faecal matter and coal-dust, the briquettes are round and black. They burn longer than normal charcoal and produce less smoke.	(Jones, 2017)
Brownwater	brownwater	Brownwater is the mixture of faeces and flushwater, and does not contain Urine. It is generated by Urine-Diverting Flush Toilets and, therefore, the volume depends on the volume of the flushwater used. The pathogen and nutrient load of faeces is not	(Tilley et al., 2014b)
Brownwater	transported_brownwater	reduced, only diluted by the flushwater. Brownwater may also include anal cleansing water (if water is used for cleansing) and/or dry cleansing materials.	
Brownwater	transported_brownwater	reduced, only diluted by the flushwater. Brownwater may also include anal cleansing water (if water is used for cleansing)	

Compost	compost	Compost is decomposed organic matter that results from a controlled aerobic degradation process. In this biological process, microorganisms (mainly bacteria and fungi) decompose the biodegradable waste components and produce this earthlike, odourless, brown/black material. Compost has excellent soil-conditioning properties and variable nutrient content. Because of leaching and volatilization, some of the nutrients may	(Tilley et al., 2014b)
Compost	transportedcompost	be lost, but the material is still rich in nutrients and organic matter. Generally, excreta or sludge should be composted long enough (2 to 4 months) under thermophilic conditions (55 to 60 °C) in order to be sanitized sufficiently for safe agricultural use. This temperature is not guaranteed in most composting chambers, but considerable pathogen reduction can normally be achieved.	
Dried faeces	dried_faeces	Dried Faeces is faeces that has been dehydrated until it has become a dry, crumbly material. Dehydration takes place by storing faeces in a dry environment with good ventilation, high temperatures and/or the presence of absorbent material. Very little degradation occurs during dehydration and this means that	(Tilley et al., 2014b)
Dried faeces	transporteddried_faeces	the dried faeces are still rich in organic matter. However, faeces reduce by around 75% in volume during dehydration and most pathogens die off. There is a small risk that some pathogenic organisms can be reactivated under the right conditions, particularly, in humid environments.	
Dried urine	dried_urine	Dried urine is a nutrient-rich solid fertiliser produced by dehydrating and concentrating human urine in an alkaline substrate (pH > 10). Alkaline urine dehydration, the technology used to obtain dried urine, can be implemented using different	(Mcconville et al., 2020)
Dried urine	transporteddried_urine	alkaline substrates, which determines the composition and physicochemical properties of the dried product. The dried urine captures nearly all of the fertilising nutrients in urine.	
Effluent	effluent	Effluent is the general term for a liquid that leaves a technology, typically after blackwater or sludge has undergone solids separation or some other type of treatment. Effluent originates at either a collection and storage/treatment or a (semi-) centralized	(Tilley et al., 2014b)
Effluent	transportedeffluent	treatment technology. Depending on the type of treatment, the effluent may be completely sanitized or may require further treatment before it can be used or disposed of.	
Excreta	excreta	Excreta consists of urine and faeces that is not mixed with any flushwater. Excreta is small in volume but concentrated in both nutrients and pathogens. Depending on the quality of the faeces, it has a soft or runny consistency.	(Tilley et al., 2014b)
Open Defecation Excreta	od_excreta	Excreta consists of urine and faeces that is not mixed with any flushwater. Excreta is small in volume but concentrated in both nutrients and pathogens. Depending on the quality of the faeces, it has a soft or runny consistency. The product was added to allow "Open Controlled Defecation" and "Shallow Trench Latrines" to be considered as technologies in FG S, since the screening criteria of the FG S are more suitable for these technologies than FG U.	Based on own judgement
Faeces	faeces	Faeces refers to (semi-solid) human excrement that is not mixed with urine or water. Depending on the diet, each person produces approximately 50 L per year of faecal matter. Fresh faeces contain about 80% water. Of the total nutrients excreted, Faeces contain about 12% N, 39% P, 26% K and have 10 ⁷ to 10 ⁹ faecal coliforms in 100 mL.	(Tilley et al., 2014b)

Flushwater		Flushwater is the water discharged into the User Interface to transport human excreta and anal cleansing material and/or clean the user interface. Freshwater, stormwater, recycled greywater or any combination of the three can be used as a flushwater source. The volume of flushwater used depends on the toilet but generally ranges from 2 to 15 L per flush.	(Tilley et al., 2014b)	
Freshwater	freshwater	Freshwater is the water derived from a water source and is assumed to be uncontaminated.	Based on own judgement	
Greywater	greywater	Greywater is the water generated from washing food, clothes and dishware, as well as from bathing, but not from toilets. It may contain traces of excreta (e.g. from washing diapers) and,	(Tilley et al., 2014b)	
Greywater	transportedgreywater	therefore, also pathogens. Greywater accounts for approximately 65% of the wastewater produced in households with flush toilets.		
Nutrient Solution	nutrient_solution	Liquid nutrient solutions refer to the concentrated liquid products obtained in either the feed stream or permeate streams from membrane filtration processes. Membrane distillation (MD) and forward osmosis (FO) are the most widely documented technologies to produce these nutrient solutions from urine and	(Mcconville et al., 2020)	
Nutrient Solution	transported_nutrient _solution	wastewater. The nutrient recovery products from membranes are primarily ammonia (NH ₃), potassium (K) and phosphate (PO ₄) solutions that can be used as liquid fertiliser or further processed in industry.		
Organics	organics	Organics refers to biodegradable plant material (organic waste) that must be added to some technologies for them to function properly (e.g. composting chambers). Organic degradable material can include but is not limited to, leaves, grass and	(Tilley et al., 2014b)	
Organics	transportedorganics	market waste. Although other products in SaniChoice contain organic matter, the term organics refers to undigested plant material only.		
Pellets	Pellets	Pellets are the product of the LaDePa (Latrine Dehydration and Pasteurization) machine and are brown and brittle. They are produced from faecal sludge and have a similar nutrient content	(Spuhler and Roller, 2020) Septien,	
Pellets	transportedpellets	to manure and compost, and similar calorific value to wood. As such they have suitable characteristics for reuse in agriculture and as a biofuel.	2018 #76}	
Pit Humus	pithumus	Pit humus is the term used to describe the nutrient-rich, hygienically improved, humic material that is generated in double pit technologies (double ventilated improved pit (VIP), fossa alterna, twin pits for pour flush) through dewatering and degradation. This earth-like product is also referred to as EcoHumus, a term conceived by Peter Morgan in Zimbabwe. The various natural decomposition processes taking place in alternating pits can be both aerobic and anaerobic in nature,	(Tilley et al., 2014b)	
Pit Humus	transportedpithumus	depending on the technology and operating conditions. The main difference between pit humus and compost is that the degradation processes are passive and are not subjected to a controlled oxygen supply, C:N ratio, humidity and temperature. Therefore, the rate of pathogen reduction is generally slower and the quality of the product, including its nutrient and organic matter content, can vary considerably. Pit humus can look very similar to compost and have good soil conditioning properties, although pathogens may still be present.		
Processed Sludge	processed_sludge	Sludge that has undergone some sort of treatment such as sedimentation, anaerobic, or aerobic digestion (see also sludge).	(Spuhler and Roller, 2020)	
Processed Sludge	transported_processed		. ,	

	_sludge		
			.,
Secondary Effluent	secondary_effluent	Effluent that has undergone treatment for stabilisation and is expected to have better quality, than for example, septic tank	(Spuhler and Roller, 2020)
Secondary Effluent	transported_secondary _effluent	effluent. Examples are aurin production, waste stabilization ponds (WSP) and horizontal subsurface flow constructed wetland (HSSFCW).	
Sludge	sludge	Sludge is a mixture of solids and liquids, containing mostly excreta and water, in combination with sand, grit, metals, trash and/or various chemical compounds. A distinction can be made between faecal sludge and wastewater sludge. Faecal sludge comes from onsite sanitation technologies, i.e. it has not been transported through a sewer. It can be raw or partially digested,	(Tilley et al., 2014b) (Strande, 2014)
Sludge	transportedsludge	a slurry or semisolid, and results from the collection and storage/treatment of excreta or blackwater, with or without greywater. For a more detailed characterization of faecal sludge refer to (Strande, 2014). Wastewater sludge (also referred to as sewage sludge) is sludge that originates from sewer-based wastewater collection and (semi-) centralized treatment processes. The Sludge composition will determine the type of treatment that is required and the end-use possibilities.	
Transferred Sludge	transferred_sludge	Transferred sludge is sludge that has been transported to a transfer station for intermittent storage before being further transported for treatment. For instance, in densely populated sites, emptying has to be done with a smaller volume vehicle due	Based on own judgement
Transferred Sludge	transportedtransferred_sl udge	to limited vehicular access. Storing the sludge in a transfer station allows usage of a larger vehicle for transporting it to a treatment site that lies out of the town.	
Stabilized Sludge	stabilized_sludge	Stabilized sludge is the sludge that has undergone some sort of treatment similar to processed sludge but is expected to be of	Based on own
Stabilized Sludge	transported_stabilized _sludge	better hygienic quality. Stabilized sludge is obtained e.g. in drying beds or from lactic acid fermentation.	judgement
Stabilized Urine	stabilized_urine	Stabilized urine is the urine that was kept in a urine bank and has been hydrolysed naturally over time, i.e. the urea has been converted by enzymes into ammonia and bicarbonate. It has a pH of approximately 9. Most pathogens cannot survive at this	(Spuhler and Roller, 2020)
Stabilized Urine	transported_stabilized _urine	pH. After 6 months of storage, the risk of pathogen transmission is considerably reduced. Stored urine, if stored according to the guidelines from the World Health Organisation is a type of stabilized urine.	
Stored Faeces	stored_faeces	Faeces that were collected in a faeces storage chamber to be collected and transported to a treatment facility.	(Spuhler and Roller, 2020)
Stored Faeces	transported_stored _faeces		, _020)
Stored Urine	stored_urine	Urine that was collected in a urine storage tank to be collected and transported to a treatment facility.	(Spuhler and Roller, 2020)
Stored Urine	transportedstored_urine	,	,)
Stormwater	stormwater	Stormwater is the general term for the rainfall-runoff collected from roofs, roads and other surfaces before flowing towards low-	(Tilley et al., 2014b)
Stormwater	transportedstormwater	lying land. It is the portion of rainfall that does not infiltrate into the soil.	

Struvite	Struvite	phosphate hexahydrate (MAP), is a phosphate mineral that occurs naturally in sanitation systems. It is a common precipitate in, e.g. pipes and heat exchangers, and it can also be purposefully extracted from waste streams, for example, through	(Mcconville et al., 2020)	
Struvite	transportedstruvite	purposefully extracted from waste streams, for example, through the addition of magnesium to urine. Struvite precipitation can be applied to reduce phosphorus concentrations in effluents while at the same time generating a product that can be applied as a fertiliser or industrial raw material.		
Urine	Urine	Urine is the liquid produced by the body to rid itself of urea and other waste products. In this context, the urine product refers to pure urine that is not mixed with faeces or water. Depending on	(Tilley et al., 2014b)	
Urine	transportedurine	diet, human urine collected from one person during one year (approx. 300 to 550 L) contains 2 to 4 kg of nitrogen. With the exception of some rare cases, urine is sterile when it leaves the body.		

1.7.3 Currently implemented screening criteria

Table 8: Overview of currently implemented screening criteria. The criteria marked by a star (*) are considered in a preevaluation as well as post-evaluation of selected systems and are not included in the appropriateness calculation. The first column provides links to chapters that contain more detailed information on the criterion including definitions and advice on how to quantify the case and technology attributes.

Screening Criteria	Case Attribute	Case Function	Technology Attribute	Technology Function	Applies to these FG	Units/Categories
Application Level*	NA	NA	Performance of technology given a certain application level	Performance Categorical	S,C,T,D	Household Neighbourhood City
Management Level*	NA	NA	Performance of technology given a certain management level	Performance Categorical	U,S,C,T,D	Household Shared Public
<u>Development</u> <u>Phase*</u>	NA	NA	Performance of technology given a certain development phase	Performance Categorical	U,S,C,T,D	Acute Stabilisation Development/recovery
Water Supply	Existing water supply types	PDF Categorical	Performance of technology given a certain water supply type	Performance Categorical	U	House Yard Public None
Water Volume	Available water volume for sanitary use	PDF Trapez	Required water volume for technology	Performance Trapez	S,C	[L/cap/day]
Electricity Supply	Availability and reliability of electricity supply	PDF Categorical	Performance of technology given different levels of electricity availability	Performance Categorical	S,T,D	Electricity Intermittent No electricity
Fuel Supply	Availability of fuel	PDF Categorical	Performance of technology for given fuel availability	Performance Categorical	С	Fuel No fuel
Frequency of Operation and	Capacity for O&M	Performance Categorical	Required frequency of labour to operate	PDF Categorical	U,S,C,T,D	Irregular Regular Continuous

Maintenance (O&M)			and maintain technology			
Pipe Supply	Availability of pipes	PDF Categorical	Performance of technology for certain pipe availability	Performance Categorical	S,C,T,D	No pipes Difficultly available Pipes
Pump Supply	Availability of pumps	PDF Categorical	Performance of technology for certain pump availability	Performance Categorical	S,C,T,D	No pumps Difficultly available Pumps
<u>Concrete</u> <u>Supply</u>	Availability of concrete	PDF Categorical	Performance of technology for certain concrete availability	Performance Categorical	U,S,C,T,D	Concrete Difficultly available No concrete
Spare Parts Supply	Availability of different types of spare parts	Performance Categorical	Proportion of spare part types that need to be replaced	PDF Categorical	U,S,C,T,D	Simple Technical Special
<u>Temperature</u>	Temperature range	PDF Categorical	Performance of technology given a certain temperature range	Performance Categorical	S,T,D	Very cold (< -10°C) Cold (-10 - 10°C) Temperate (10 - 20°C) Warm: (20 - 30°C) Hot: (>30°C)
Flooding	Flooding occurrence	PDF Categorical	Performance of the technology given a certain flooding risk	Performance Categorical	S,C,T,D	Flooding No flooding
Vehicular Access	Accessibility of households	PDF Categorical	Performance of the technology given access to certain types of vehicles	Performance Categorical	S	No access Difficult access Full access
_Slope	Slope distribution	PDF Categorical	Performance of technology for given slope	Performance Categorical	С	Flat (<1%) Not flat (>1%)
Soil Type	Soil type occurrence	PDF Categorical	Performance of technology for given soil type/permeability	Performance Categorical	S,D	Clay Silt Sand Gravel Rock
Groundwater Depth	Groundwater depth	PDF Trapez	Required groundwater depth to avoid groundwater pollution	Performance Trapez	S,D	Distance from the surface to the groundwater table [m]
Excavation	Ease of excavation	PDF Categorical	Performance of technology if excavation is difficult	Performance Categorical	S,C,T,D	Easy Hard
Surface Area (Onsite)	Availability of area onsite	PDF Trapez	Required area for onsite toilet infrastructure	Performance Trapez	S	[m2/plot]
Surface Area (Offsite)	Availability of area offsite	PDF Trapez	Required area for treatment technologies	Performance Trapez	Т	[m2/cap]
<u>Drinking Water</u> <u>Exposure</u>	Distance to drinking water sources	PDF Categorical	Risk of technology polluting a nearby water source	Performance Categorical	S,D	Close Not close
Construction Skills**	Level of construction skills in local workforce	PDF Categorical	Performance of technology for different levels of construction skills	Performance Categorical	U,S,C,T,D	Unskilled Skilled Professional

Design Skills**	Level of design skills in local workforce	PDF Categorical	Performance of technology for different levels of design skills	Performance Categorical	U,S,C,T,D	Unskilled Skilled Professional
Operation and Maintenance (O&M) Skills**	Level of O&M skills in local workforce	PDF Categorical	Performance of technology for different levels of O&M skills	Performance Categorical	U,S,C,T,D	Unskilled Skilled Professional
Cleansing Method	Population distribution of anal cleansing methods	PDF Categorical	Performance of technology for different anal cleansing materials	Performance Categorical	U	Washers Soft wipers Hard wipers
<u>Lifetime</u>	Expected lifetime	PDF Categorical	Possible lifetime of technology	Performance Categorical	S,T,D	Short (< 1 year) Medium (1-5 years) Long (>5 years)
Speed of Implementation For Toilet Structure	Expected speed of implementation	Performance Categorical	Probability of toilet being implemented in a certain time span	PDF Categorical	S	Rapid (< 3 days) Moderate (3 days to 2 weeks) Slow (> 2 weeks)
Speed of Implementation For Treatment	Expected speed of implementation	Performance Categorical	Probability of technology being implemented in a certain time span	PDF Categorical	Т	Rapid (<= 1 week) Moderate (1 week - 3 months) Slow (> 3 months)
<u>Scalability</u>	Importance of scalability	PDF Categorical	Degree of difficulty to up-scale technology capacity	Performance Categorical	S,C,T	Easy Difficult
Construction Parts Supply	Availability of different types of construction parts	Performance Categorical	Proportion of parts required for construction	PDF Categorical	U,S,C,T,D	Simple Technical Special

^{**}Alternative: One might also consider specific categories as 'none', 'unskilled labour', 'mason', 'specially trained mason', 'construction engineer', 'supervisor' or others. However, these professions do not ensure that all skills that might be needed are included and the skill level per category might differ from one region to the other. In SANTIAGO, a less detailed approach has been implemented.

1.7.3.1 Application Level

1.7.3.1.1 Why is it relevant?

Different sanitation technologies demand different levels of application: While some are appropriate for households or neighbourhoods, other technologies such as large, centralized wastewater treatment facilities can only be implemented on the city level. The application level is therefore an important proxy for technology appropriateness.

1.7.3.1.2 **Definition**

The application level is meant to provide additional information when comparing different locally appropriate sanitation system options in order to select the preferred one in the given case. Three spatial levels are defined under this heading:

- **Household:** implies that the technology is appropriate for one or several households.
- **Neighbourhood:** means that the technology is appropriate for anywhere between several and several hundred households.

City: implies that the technology is appropriate at the city-wide level (either one unit for the whole city, or many units for different parts of the city).

This criterion does not apply to the technologies belonging to the user interface functional group (FG U) since their application level depends largely on the subsequent technologies.

1.7.3.1.3 Case questions

This is a case-independent criterion and there are therefore no case-specific questions.

1.7.3.1.4 Tech question

How suitable is the technology to a certain application level?

Fill in 1 to indicate a technology is suitable for a specific application level. Fill in 0.5 if the technology is less suitable and 0 if the technology is not suitable for a specific application level.

1.7.3.1.5 Additional notes

To define how suitable a technology is to a certain application level, we used the definitions of the *Compendium of Sanitation systems and Technologies* (Tilley et al., 2014b) and the *Compendium of Sanitation Technologies in Emergencies* (Gensch et al., 2018): Stars are used to indicate the appropriateness of any technology for the application level defined in the case. **: two stars means suitable (i.e. 100% performance), *: one star means less suitable (i.e. assumed 50% performance), no star: means not suitable (i.e. 0% performance).

1.7.3.2 Management Level

1.7.3.2.1 Why is it relevant?

Different sanitation technologies demand different levels of management: While some can be managed by the users themselves, other technologies require a more complex organization such as institutional or government run facilities to manage its operation. The management level is therefore an important proxy for technology appropriateness.

1.7.3.2.2 **Definition**

Management Level describes the organizational style best used for the operation and maintenance (O&M) of the given technology:

- Household: implies that the household, i.e. the family, is responsible for all O&M.
- Shared: means that a group of users (e.g. at a school, a community-based organization, or market vendors) handles the O&M by ensuring that a person or a committee is responsible for it on behalf of all users. Shared facilities are defined by the fact that the community of users decides who is allowed to use the facility and what their responsibilities are; it is a self-defined group of users.
- **Public**: implies institutional or government run facilities, and all O&M is assumed by the agency operating the facility. Usually, only users who can pay for the service are permitted to use public facilities.

The management level is meant to provide additional information when comparing different locally appropriate sanitation system options in order to select the preferred one in the given case. The technologies in the functional

group User Interface (FG U) do not include a management level since maintenance is dependent on the subsequent technologies, and not simply on the user interface.

1.7.3.2.3 Case questions

This is a case-independent criterion and there are therefore no case-specific questions.

1.7.3.2.4 Tech question

How suitable is the technology to a certain management level?

Fill in 1 to indicate a technology is suitable for a specific management level. Fill in 0.5 if the technology is less suitable and 0 if the technology is not suitable for a specific management level.

1.7.3.2.5 Additional notes

To define how suitable a technology is to a certain management level, we used the definitions of the *Compendium* of *Sanitation systems and Technologies* (Tilley et al., 2014b) and the *Compendium of Sanitation Technologies in Emergencies* (Gensch et al., 2018): Stars are used to indicate the appropriateness of any technology for the management level defined in the case. **: two stars means suitable (i.e. 100% performance), *: one star means less suitable (i.e. assumed 50% performance), no star: means not suitable (i.e. 0% performance).

1.7.3.1 Development Phase

1.7.3.1.1 Why is it relevant?

Different sanitation technologies are suitable in different development phases: Some sanitation technologies are only suitable in the acute phase immediately following the cause of the emergency, while other technologies are not suitable for the acute and stabilisation phases of emergencies. "[Approximately identifying these phases can be helpful when evaluating technology appropriateness], however the division should be viewed as theoretical and simplified, modelled after singular disaster events. Real life is seldom so clearly defined." (Gensch et al., 2018)

1.7.3.1.2 **Definition**

Qualitative estimates of the applicability of each technology given the phase of emergency in a specific case. It is based on three categories:

- Acute: refers to the humanitarian phase immediately following an emergency. It usually covers the first days up to the first few weeks, where effective short-term measures are applied to alleviate the emergency situation quickly until more permanent solutions can be found.
- Stabilisation (or transition phase): refers to the phase starting after the first weeks of a crisis and can last several months or longer.
- **Development/Recovery**: refers to either a longer-term approach aiming to develop sanitation infrastructure in general (Development) or in a humanitarian context (Recovery), it refers to the phase where the aim is to rehabilitate infrastructure or implement long-lasting sanitation infrastructure and services.

The allocation of technologies to different humanitarian/development phases is mainly based on speed of implementation, budget and material requirements. It allows giving a first general orientation but may differ in a specific local situation.

1.7.3.1.3 Case questions

This is a case-independent criterion and there are therefore no case-specific questions.

1.7.3.1.4 Tech question

What is the applicability of a technology for a certain humanitarian/development phase?

Fill in 1 to indicate a technology is suitable for a specific development phase. Fill in 0.5 if the technology is less suitable and 0 if the technology is not suitable for the specific development phase

1.7.3.1.5 Additional notes

To define how suitable a technology is to a certain development phase, we used the definitions of the *Compendium of Sanitation Technologies in Emergencies* (Gensch et al., 2018): Stars are used to indicate the appropriateness of any technology for the applicability level defined in the case. **: two stars means suitable (i.e. 100% performance), *: one star means less suitable (i.e. assumed 50% performance), no star: means not suitable (i.e. 0% performance).

The recovery phase in emergencies and general development projects were combined into one category to avoid an artificial division between sanitation technologies suitable in humanitarian contexts and suitable for development contexts.

1.7.3.2 Water Supply

1.7.3.2.1 Why is it relevant?

Different sanitation technologies require water at a different spatial level: While some require a constant source of water at the location of the technology, other technologies can work with an intermittent water supply or even fully independent of water. The spatial level of the water supply is therefore an important proxy for technology appropriateness.

1.7.3.2.2 **Definition**

Qualitative estimate of the performance of each technology given a certain type of water supply available in a specific case. It is defined based on a scale of four categories taking into account different spatial levels:

- House: refers to an in-house water connection.
- Yard: refers to yard taps.
- Public: refers to public or community-managed standpipes.
- None: refers to no water supply.

The technology appropriateness is quantified based on the performance given a certain type of water supply. Type of water supply is only applied for technologies from the user interface (FG U) since this will consequently affect water availability further down the sanitation system. For example, cistern flush toilets require an in-house water supply while pour flush toilets can work with yard supply. Water supply does not account for the amount of water available. There is another criterion "water volume".

1.7.3.2.1 Case questions

How is the water supply distributed in your case area?

Allot the proportion (%) of households in the case area that have a certain type of water supply. The sum of all values must be 100%.

1.7.3.2.2 Tech question

What is the performance of the technology given a certain water supply type?

Allot the performance (between 0 and 100%) for each category based on how well the technology performs for the category.

1.7.3.2.3 Additional notes

Public or community-managed standpipes in this case mean that individual household sanitation facilities which rely on water are not appropriate. However, it should still be taken into account that community-managed sanitation blocks could rely on water if built next to extraction points (this would require a very skilled and careful operation in order not to pollute groundwater). On the other hand, regions that rely on public or community-managed standpipes mostly have a very low water consumption and are unlikely to use sanitation technologies that work with water.

An additional criterion describing the performance of technologies in case of water supply disruption could be added. However, it was not considered, because we assume that sanitation systems that rely on water are as inappropriate for an unreliable water supply as for no water supply (Loetscher and Keller, 2002).

1.7.3.3 Water Volume

1.7.3.3.1 Why is it relevant?

Different sanitation technologies demand different amounts of water to function: While some technologies do not require any, others are dependent on large volumes of water. Some technologies, such as pit latrines, might also be disturbed by larger water inputs. The water volume that can be handled by a technology is therefore an important proxy for technology appropriateness.

1.7.3.3.2 Definition

The water volume is defined in litres per person per day used for flushing and anal cleansing using following default values and 6 uses per day per person:

Anal cleaning water: 0.3 to 3 litres per use

Pour flush toilet and urine diversion flush toilet: 1 to 3 litres per use

Cistern flush toilet: 6 to 10 litres per use

The technology appropriatenes accounts for the minimum water volumes required (e.g. for sewer, septic tank) and the maximum that a technology can handle (e.g. for pits). Water volume is defined for the collection and storage (FG S) and conveyance (FG C) technologies. Technologies of FG S and FG C that do not handle flushwater or blackwater will always be appropriate whatever the water volume considered.

1.7.3.3.3 Case questions

How much water volume is used for sanitary use (flushing and anal cleansing) in litres per person per day?

Option 1: Provide the minimal (A) and maximal value (D). If there is no clear minimum, allot the value 0. If there is no clear maximum, allot the value 999. Option 2: Up to four values can be allotted: the absolute minimum (A), the likely/typical minimum (B), the likely/typical maximum (C), and the absolute maximum (D).

Note: A must be smaller or equal than B must be smaller or equal than C must be smaller or equal than D.

1.7.3.3.4 Tech question

What is the performance of the technology given a certain water volume entering in litres per person and day (l/person/day)?

If the technology does not handle blackwater, provide 0 and 999 l/person/day for the minimal and maximal volume to avoid these technologies from being discarded. If the technology is able to handle blackwater, provide the minimum water volume required as an input for the technology to function. Alternatively, you can provide both the absolute minimum water volume required and the optimal minimum water volume (from which the technology performs 100%). If the technology has restrictions on the maximum amount of water volume it can handle, provide the absolute optimum (until which the technology performs 100%) and absolute maximum water volume it can deal with.

For filling in the tech library it might be helpful to think in terms of the four values (a,b,c,d) of the trapez function:

- a = min. value with performance >= 0%
- b = min. value with a performance of 100%
- c = d = 999 L/cap/day = max. value (unless technology has blackwater as an input and has restrictions on the maximum amount of water volume it can handle. Then allot explicit values for "c" and "d".).

1.7.3.3.5 Additional notes

The upper limit on the amount of water a given technology can handle is generally kept at a default value of 999 L/cap/day (few exceptions exist) because of two reasons. Firstly, since the SANTIAGO algorithm is based on the assumption that input and output products match, this inherently ensures that the FG S technologies for which high water volumes are problematic are not connected to FG U technologies that produce a lot of wastewater. Secondly, high water volumes and other associated problems are additionally accounted for with other criteria such as "Flooding" and "Groundwater Depth".

Many technologies have a minimum water requirement. These are considered by the "a" and "b" values. If the technologies do not require any water "a" and "b" can be characterized by 0 L/cap/d.

Some technologies further perform badly, if too much water enters them. These can be separated into two types of technologies:

The first type only accepts input products with low water volume (faeces, urine, etc.) and no blackwater. For the
first type it is assumed that no blackwater input equals a sufficiently low water volume input and no explicit
maximum water input needs to be defined.

• The second type accepts blackwater as input and therefore the SANTIAGO algorithm can pair these technologies with FG U techs that introduce high volumes of water into the system (e.g. pour-flush, cistern-flush). Thus, the criterion "Water Volume" should reduce the performance of these technologies and hence their appropriateness when a user defines a case attribute with high water inputs. Therefore, an explicit limit of water volume the technology can handle needs to be defined. For the three affected technologies (single pit, single VIP, deep trench latrine) the following values "c=8 L/cap/d" and "d=33 L/cap/d" are allotted. This is based on the assumption that for these technologies the amount of blackwater generated by a pour-flush toilet would be acceptable, whereas a cistern flush toilet should be avoided. Consequently the maximum water volume is determined by considering that pour-flush systems only require 1-3 litres of flush water and multiplying this value with the average of 6 toilet visits per person per day. (Tilley et al., 2014b)

Alternative: A categorical function could be implemented, instead of a continuous one. However, a continuous function was chosen, because sufficient data could be found to estimate the lower and upper limits of water volumes for a technology. The benefit of a continuous function is that no category limits need to be pre-defined, and the minimum and maximum water limits can instead be defined individually for each case and technology.

1.7.3.4 Electricity Supply

1.7.3.4.1 Why is it relevant?

Different sanitation technologies require different levels of electricity supply: While some technologies don't work without continuous electricity, other technologies are not dependent on electricity to function. The electricity supply is therefore an important proxy for technology appropriateness.

1.7.3.4.2 **Definition**

Qualitative estimate of the performance of each technology during normal operation and maintenance (e.g. for pumping, ventilation, aeration), given a certain energy supply in a specific case. It is based on a scale of three categories:

- Continuous electricity: power cuts are highly unlikely.
- Intermittent electricity: frequent power cuts are occurring.
- No electricity.

Electricity supply is defined for the onsite collection and storage/treatment (FG S), treatment (FG T), and reuse or disposal (FG D) technologies. Technologies for conveyance (FG C) such as sewers might need electricity depending on the slope and the pumps required, however, this is covered separately by other criteria ("Slope" and "Pump Supply").

1.7.3.4.3 Case questions

How is the electricity supply in the case for aeration, ventilation, pumping, or other power-consuming activities?

Allot the proportions (%) of the case area that have a certain electricity availability or the proportion (%) of months in the year where there is a certain electricity availability. The sum of all values must be 100%.

1.7.3.4.4 Tech question

What is the performance of the technology given a certain electricity supply?

Allot the performance (between 0 and 100%) for each category based on how well the technology performs for the category. To ensure consistency among the different technologies, their performance have been set on the following qualitative assumptions:

(electricity - intermittent - no electricity):

→ 100% - 100% - 100%: No electricity required.

→ 100% - 90% - 70%: Generally, technology can work without electricity, but it can improve the

technology performance slightly (e.g. added ventilation system). Uninterrupted

electricity supply performs slightly better.

→ 100% - 50% - 50%: Technology can work without electricity, however, under some conditions

electricity is required (e.g. larger scale irrigation, pumps in sewers with too low

slope).

→ 100% - 30% - 10%: Technology can work without electricity, but performance is far better with

electricity (mainly related to mixing and recirculation pumps).

→ 100% - 0% - 0%: Constant source of electricity required.

1.7.3.4.5 Additional notes

Note that most technologies can be built in multiple configurations, e.g. an imhoff tank can be either built with pipes and pumps that require electricity or use pumping trucks that require fuel and vehicular access (Tilley et al., 2014b). Since SANTIAGO cannot account for if/else statements, the performance for 'no electricity' is set to 0.5. This way, we can partially account for the loss of configuration variability. The category 'intermittent' might be set to 0.5 as in the example (100%-50%-50%) above or to 0.75 depending on whether the operation of the technology is flexible enough to use electricity when it is available. For example, for the Imhoff Tank emptying can be implemented during times with electricity.

For FG S technologies the electricity requirements of emptying pumps are not considered here.

The reliability of electricity, i.e. the performance of a technology for power supply disruption is considered in the category 'intermittent electricity'. Several alternative technology configurations could be considered:

- Alternative 1: If more data were available one could describe it as a continuous function based on the available hours of electricity and the performance of technologies for these hours.
- Alternative 2: if data on the energy consumption were available could also be a categorical function describing
 the amount of electricity available and required (a fan probably needs less voltage than aeration in a big pond).

1.7.3.5 Fuel Supply

1.7.3.5.1 Why is it relevant?

Different sanitation transport technologies require different inputs of fuel during operation and maintenance: While some require fuel to be operated, other technologies can be used even in absence of any source of fuel. The fuel supply is therefore an important proxy for technology appropriateness.

1.7.3.5.2 **Definition**

The fuel supply is defined by two categories:

- Fuel: refers to if fuel is always available.
- No fuel.

The technology appropriateness is quantified based on the performance of a technology during normal operation (motorized transport in vehicles or with pumps) given a certain fuel supply. Fuel supply is defined for conveyance (FG C) technologies only.

1.7.3.5.3 Case questions

How is the fuel supply in the case?

Allot proportions (%) of the case area that have a certain fuel availability or the proportion (%) of months in the year when there is certain fuel availability. The sum of all values must be 100%.

1.7.3.5.4 Tech question

What is the performance of the technology given a certain fuel supply?

Allot the performance (between 0 and 100%) for the category 'no fuel' based on how well the technology performs in the absence of fuel. To avoid technologies from being discarded (as the possibility of electric vehicles exists or during lack of fuel motorized vehicles can be replaced temporarily by manual labour), one should refrain from entering the value 0% for 'no fuel'. For the category 'fuel' the performance is always 100%.

1.7.3.6 Frequency of Operation and Maintenance

1.7.3.6.1 Why is it relevant?

Different sanitation technologies require operation and maintenance at different frequency: While some can be operated with occasional cleaning and repair, others demand time-consuming operations that require permanent staff. The frequency of operation and maintenance is therefore an important proxy for technology appropriateness.

1.7.3.6.2 **Definition**

The frequency of operation and maintenance (O&M) is defined based on the extent of labour (type of task and time) required to maintain a certain technology. Maintenance considered is cleaning, repairing and/or replacing mechanical parts but NOT emptying/desludging. It is evaluated in three categories:

- Irregular: is used for technologies that require low maintenance, for operations such as occasional cleaning or eventual repair. No maintenance of odour seals, washing with detergents or monitoring is required.
- **Regular**: refers to more time-consuming operations such as regular cleaning, washing with detergents (e.g. the bowl with acid) or checking and replacing odour seals.
- Continuous: is used for technologies that require permanent staff (full-time job) for maintenance, repair, removing scum, etc.

1.7.3.6.3 Case questions

What is the availability of operation and maintenance (O&M) capacity in the case?

Allot for each category the feasibility (between 0 and 100%) to provide a certain frequency of O&M service.

Note: This is a ladder function, so if the application case can provide 'continuous' operation and maintenance levels, it can also provide 'regular' and 'irregular' levels (i.e. 100%). The values allotted to 'irregular' will always be equal to or higher than 'regular' and those allotted to 'regular' will be equal or higher than 'continuous'.

1.7.3.6.4 Tech question

What type of operation and maintenance (O&M) is required to ensure the performance of the technology?

Allot the proportions (%) based on the technology requirements for each category of O&M frequency.

1.7.3.6.5 Additional notes

The desludging rate is not included in this criterion since it is measured in a different scale. Another idea to consider it would be to have a second criterion only for "emptying". A technology can require a lot of maintenance but very rarely desludging, e.g. Aerated Pond: "Permanent, skilled staff is required to maintain and repair aeration machinery and the pond must be desludged every 2 to 5 years." (Tilley et al., 2014b)

Alternative: One might also consider a criterion describing the hours of operation and maintenance per technology and year. However, this is very difficult to quantify and if the workload is per technology, all the technologies summed up within a system might exceed the workload specified for the case (if the case allows for up to 100 hours of O&M per year and all the technologies require 50 hours per year, the score for every technology would be good and the aggregated score for the system as well, even if all the technologies summed up would require more than 100 hours of operation and maintenance).

1.7.3.7 Pipe Supply

1.7.3.7.1 Why is it relevant?

Different sanitation technologies make varying use of pipes: While some do not require any, the design of other technologies can be adapted to work without pipes. Some technologies must be built with pipes to properly function. The availability of pipes for construction is therefore an important proxy for technology appropriateness.

1.7.3.7.2 **Definition**

Qualitative estimate of the performance of each technology given a certain pipe availability in a specific case. Pipes are mainly required for ventilation or transport/drainage associated with technologies. They can be made out of plastics or concrete. Alternative pipes such as bamboo are not considered here. It is based on a scale of three categories:

- No pipes.
- Difficultly available: pipes are difficult to source locally (high prices or fluctuating availability).
- Pipes: refers to if pipes are easily available.

Different technologies offer varying degrees of flexibility towards the usage of pipes. Certain technologies cannot be built without pipes. Certain ones usually use pipes, however, can also be designed without them. And others can be built entirely without pipes.

Pipe supply is defined for the onsite collection and storage/treatment (FG S), conveyance (FG C), treatment (FG T), and reuse and disposal (FG D) technologies and includes all pipes (e.g. drainage, ventilation, inlet, outlet).

1.7.3.7.3 Case questions

What is the local availability of pipes for the case?

Allot the proportions (%) of the case area that have a certain pipe availability. The sum of all values must be 100%.

1.7.3.7.4 Tech question

What is the performance of the technology given a certain pipe availability?

Allot the performance (between 0 and 100%) for each category. To ensure consistency among the different technologies, their performance have been set on the following qualitative assumptions: (pipes - difficultly available - no pipes):

→ 100% - 100% - 100%: No pipes required OR pipe can be produced with local material (latter option

usually refers to aboveground ventilation pipes).

→ 100% - 75% - 75%: Alternative configuration of technology without pipes is possible but usually

performs slightly worse.

→ 100% - 75% - 50%: Inlet/outlet/T-shaped pipes required for the technology. It would be possible to

find a workaround solution without pipes.

→ 100% - 50% - 0%: For drains and sewers where pipes are a necessity.

1.7.3.7.5 Additional notes

Alternative: This criterion could also be characterized based on the necessary pipe diameters. However, this is very hard to quantify both for the case and the technologies.

1.7.3.8 Pump Supply

1.7.3.8.1 Why is it relevant?

Different sanitation technologies make varying use of pumps: While some do not require any, the design of other technologies can be adapted to work without pumps. Some technologies must be built with pumps to properly function. The availability of pumps is therefore an important proxy for technology appropriateness.

1.7.3.8.2 **Definition**

Qualitative estimate of the performance of each technology given a certain pump availability in a specific case. The definition of pumps used here includes those required for emptying, discharge, mixing, overcoming elevations in sewer systems, and generating pressurized systems. It is based on a scale of three categories:

- No pumps.
- Difficultly available: pumps are difficult to source locally (high prices or fluctuating availability)
- Pumps: refers to if pipes are easily available.

Different technologies offer varying degrees of flexibility towards the usage of pumps. Certain technologies cannot be built without pumps. Some usually use pumps but can also be designed without them in certain circumstances (e.g. waste stabilisation ponds). Also, certain technologies require pumps in some circumstances (e.g. gravity sewers to overcome elevations).

Pump Supply is defined for the onsite collection and storage/treatment (FG S), conveyance (FG C), treatment (FG T), and reuse and disposal (FG D) technologies.

1.7.3.8.3 Case questions

What is the local availability of pumps for the case?

Allot the proportions (%) of the case area that have a certain pump availability.

1.7.3.8.4 Tech question

What is the performance of the technology given a certain pump availability?

Allot the performance (between 0 and 100%) for each category based on the following examples (pumps - difficultly available - no pumps):

→ 100% - 100% - 100%: No pumps required.

→ 100% - 75% - 75%: Alternative configuration of technology without pumps is possible, but usually

performs a bit worse (refers to mixing, emptying purposes).

→ 100% - 75% - 50%: For certain cases pumps are required for this technology, while for other cases

they are not needed. (e.g. Pumps might be needed to overcome elevation. This depends on the slopes of the case or the designed depth of the technology.)

→ 100% - 50% - 0%: Pumps are required (e.g. for pressurized systems or discharge purposes).

1.7.3.8.5 Additional notes

In regard to emptying the pump supply only affects the performance of technologies in FG T and not in FG S. Technologies in FG S, which could be emptied with pumps, do not affect the technology performance for pump supply, as the actual emptying occurs in FG C via motorized or manual emptying. For technologies in FG T, which can be emptied by pumps, the pump supply does affect the technology performance. The reason is that after FG T no further emptying technologies can be added to the system and pumps are necessary at the treatment site.

Alternative: The criterion could be characterized by the pumping capacity of the pumps to specify what kind of pumps are available/necessary, but the available data is mostly not sufficient.

1.7.3.9 Concrete Supply

1.7.3.9.1 Why is it relevant?

Different sanitation technologies make varying use of concrete: While some do not require any, the design of other technologies can be adapted to work without concrete. Some technologies must be built with concrete to properly function. The availability of concrete is therefore an important proxy for technology appropriateness.

1.7.3.9.2 **Definition**

The concrete supply refers to concrete required to build the technology. The concrete supply is defined by three categories:

- No concrete.
- Difficultly available: concrete is difficult to source locally (high prices or fluctuating availability).
- Concrete: refers to if it is easily available.

Concrete supply is defined for all technologies regardless from their functional group and is important for technologies that need to be lined or sealed (e.g. biogas settler, sedimentation ponds). Some technologies could be built with locally available alternative materials (e.g. plastic liner) or a pre-fabricated version could be purchased, in which case the performance is assumed to be reduced for the categories "No concrete" and "Difficultly available".

1.7.3.9.3 Case questions

What is the local availability of concrete for the case?

Allot the proportions (%) of the case area that have a certain concrete availability. The sum of all values must be 100%.

1.7.3.9.4 Tech question

What is the performance of the technology given a certain concrete availability?

Allot the performance (between 0 and 100%) for each category based on the following examples (concrete - difficultly available - no concrete):

→ 100% - 100% - 100%: No concrete is required.

→ 100% - 75% - 75%: Concrete slightly improves the performance of the technology.

→ 100% - 75% - 50%: The technology could be made from a locally available alternative material (e.g.

plastic liner) or a pre-fabricated version could be purchased from the

international market. However, concrete would be preferable e.g. due to a longer

lifetime or available experience with concrete.

→ 100% - 50% - 0%: Concrete is required for the technology.

1.7.3.9.5 Additional notes

It is assumed that pre-fabricated materials that are not made from concrete often need to be imported and are therefore more expensive. Consequently, concrete is preferred compared to pre-fabricated units made from alternative materials.

Alternative: If data is available this attribute could also be used with a continuous function describing the amount of cement available/needed per technology.

1.7.3.10 Spare Parts Supply

1.7.3.10.1 Why is it relevant?

Different sanitation technologies require different kinds of spare parts: While some can be fixed with conventional parts, other technologies require more technical spare parts or even spare parts that need to be specifically constructed. The spare parts requirements are therefore an important proxy for technology appropriateness.

1.7.3.10.2 Definition

Qualitative estimate of the performance of each technology during operation given a certain spare parts availability in a specific case. Spare parts are defined as the parts to be replaced during maintenance and repair, including covers, siphons, membranes, etc. It is based on a scale of three categories:

- **Simple**: conventional parts generally locally available (e.g. simple metal or wood parts, covers, slabs).
- **Technical**: technical parts generally available (e.g. a siphon).
- **Special**: parts that need to be specifically manufactured (e.g. a membrane).

Spare parts supply is defined for all technologies regardless from their functional group.

1.7.3.10.3 Case questions

What level of accessibility do different types of spare parts have for the case?

Allot the performance (between 0 and 100%) for each category based on how easily such parts can be accessed in the case area.

Note: This is a ladder function, so if the application case can provide 'special parts', it can also provide 'technical' and 'simple' parts. The values allotted to 'simple' will always be equal to or higher than 'technical' and those allotted to 'technical' will be equal or higher than 'special'.

1.7.3.10.4 Tech question

What are the different kinds of spare parts that are expected to fail during operation and need to be replaced in order for that technology to continue to function?

Allot the proportions (%) of the different types of parts of the technology.

1.7.3.10.5 Additional notes

This criterion does not refer to parts used during construction. These are considered in the criterion "Construction Parts Supply" in humanitarian contexts.

It has to be assessed individually what "locally accessible" means (regional/national level?) but it should be possible to bring spare parts easily and quickly to the facility.

Note that spare parts do not include chemicals here. The chemical supply could be considered in an additional criterion.

1.7.3.11 Temperature

1.7.3.11.1 Why is it relevant?

Different sanitation technologies function in different ranges of temperatures: While some function at any temperatures, the process of other technologies is hampered at particularly low or high temperatures. The effect of temperature on a technology is therefore an important proxy for technology appropriateness.

1.7.3.11.2 Definition

Semi/quantitative estimate of the performance of each technology for different temperature ranges. The criterion accounts for the effect of temperature on biological processes and soil infiltration. It is based on a scale of five categories (referring to daily mean temperatures):

- Very cold: refers to temperatures less than -10°C.
- Cold: refers to temperatures between -10 to 10°C.
- Temperate: refers to temperatures between 10 to 20°C.
- Warm: refers to temperatures between 20 to 30°C.
- Hot: refers to temperatures above 30°C.

Temperature is defined for the onsite collection and storage/treatment (FG S), treatment (FG T), and reuse or disposal (FG D) technologies.

1.7.3.11.3 Case questions

How is the temperature distributed over the year in your case area?

Allot the proportions (%) based on the number of days per year whose mean daily temperature lies in the respective ranges of each category.

1.7.3.11.4 Tech question

What is the performance of the technology given a certain temperature range?

Allot the performance (between 0 and 100%) for each category based on how well the technology performs for the given temperature range.

Note that technologies that primarily or partially rely on soil absorption (percolation) may have a decreased performance if the ground is frozen. Moreover, the application of many products (e.g. compost) is not viable if the ground is frozen and therefore, cannot take up nutrients. Technologies that follow this suit are allotted the following performance values: (very cold = 0.5, cold = 0.7, temperate = 1, warm = 1, hot = 1).

1.7.3.11.5 Additional notes

This criterion looks at the performance of technologies for different temperature ranges. It is especially relevant for treatment technologies that rely on bacterial activity. Some of these technologies perform therefore better at higher than lower temperatures. Bacterial activity can sometimes occur even at 60°C. The effect of such high temperatures is not considered here as it is assumed that rarely daily average temperatures reach these levels.

Some technologies are unsuitable if the ground freezes and are therefore unsuitable during periods with less than - 10°C. It should be considered that several factors play a role in order for the ground to freeze, such as humidity, salt content and exposure time. The influence of these other factors is not considered here.

Alternative: The criterion could also be described as a continuous function with the case attribute referring to the minimum, mean and maximum daily average temperatures, while the technology would perform well in a specific temperature range. However, insufficient data was available to find the specific lower or upper temperature boundaries for a continuous function. Furthermore, a categorical function allows to distinguish the performance between different temperature zones. This represents reality better as technologies do perform differently in different temperature zones. For example, an unplanted drying bed can be installed in 'cold', 'temperate' and 'hot' climates, but it performs better in 'temperate' and 'hot' climates. (Tilley et al., 2014b) In addition, for the case profile the categorical option can represent the actual distribution of temperature over a year's time, whereas the continuous function could only provide minimum, mean and maximum temperatures.

1.7.3.12 Flooding

1.7.3.12.1Why is it relevant?

Different sanitation technologies react differently to flooding: While some are not affected by flooding events, other technologies should not be used in flood-prone areas. The vulnerability of technologies to flooding is therefore an important proxy for technology appropriateness.

1.7.3.12.2Definition

Qualitative estimate of the performance of each technology given a certain risk of flooding in a specific case. It is based on two categories:

- No flooding: describes conditions where surface flooding is a rare phenomenon.
- Flooding: describes conditions where intense rainfall and/or rise in levels of a neighbouring water body leads to flooding of surfaces.

There are three different types of floods.

- 1. Fluvial floods: occur when the water level in a river, lake or stream rises and overflows onto the surroundings. The water level rise could be due to excessive rain or snowmelt.
- 2. Pluvial floods: occur when heavy rainfall creates a flood independent of an overflowing water body, either due to an overwhelmed urban drainage system and/or due to a high proportion of sealed surfaces.
- 3. Flash floods can severely disrupt sanitation technologies; however, they are "sharp and sudden" i.e. difficult to predict/anticipate for a given region.

Fluvial and pluvial floods can be anticipated. Therefore the user can allot proportions to the categories 'flooding' and 'no flooding' based on the number of months pluvial or fluvial flooding is to be expected or not expected (e.g. monsoon season). In comparison, flash floods are difficult to predict and thus, are not considered for this criterion (sanitation systems, like other civil engineering projects, are not planned for rare extreme events).

Flooding is defined for the onsite collection and storage/treatment (FG S), conveyance (FG C), treatment (FG T), and reuse or disposal (FG D) technologies.

1.7.3.12.3 Case questions

What is the risk of flooding in this case?

Allot the proportions (%) based on the number of months per year when flooding can be expected for the case. The sum of all values must be 100%.

1.7.3.12.4 Tech question

What is the performance of the technology given a certain flooding risk?

Allot the performance (between 0 and 100%) for the category 'flooding' based on how well the technology performs when inundated, i.e. under flooding conditions. To avoid technologies from being discarded (as even in locations prone to flooding, technologies can be built on elevated surfaces unlikely to get flooded), one should refrain from entering the value 0% for 'flooding'. For the category 'no flooding' the performance is always 100%.

You can use the following examples (no flooding - flooding):

\rightarrow	100% - 100%:	Technology performance is not affected by flooding.
_	100% - 80%/90%	Technology is in theory not affected by flooding, e.g. water-tight tank-ha

\rightarrow	100% - 80%/90%:	l echnology is in theory not affected by flooding, e.g. water-tight tank-based
		technologies or sufficiently large sewers that can handle stormwater and/or
		groundwater infiltration. However, in practice the performance of the technology
		can be hampered during flooding events. It also includes technologies in FG D
		that apply a certain product, since flooding could possibly lead to a low risk of

pathogen transmission for the applied products.

→ 100% - 50%: The technology performance can be severely disrupted by flooding events.

However flood-preventive configurations of the technology are possible, such as raised structures or implementing embankments and other flood protective

structures around the technology.

→ 100% - 10%: Technologies that are impossible to operate during flooding or in the case of FG

S and D technologies that lead to an unacceptable hygiene risk in case of flooding. A low performance of 10% is allotted to the category 'flooding' given that there exists the possibility that the technology could be built at elevated/ non-flooded plot areas of the flood-prone region, or one could operate the

technology only during non-flooded times.

1.7.3.12.5 Additional notes

"If the project area is subject to regular flooding, alternatives based on soil absorption, or which are relying on stormwater drains for sewage collection, are unsuitable" (Loetscher and Keller, 2002). However, treatment technologies, which DO NOT rely on soil absorption, are generally designed to be watertight, i.e. are sealed against the ground. Therefore, it can be assumed that their functioning is not hampered significantly by flooding events (flooding = 90%).

Technologies can be built to have configurations that can withstand flooding (e.g. septic tanks could be built as raised septic tanks in flood-prone regions). If such a configuration is possible for a given technology, it is awarded a higher performance to account for this possibility (flooding = 50%).

1.7.3.13 Vehicular Access

1.7.3.13.1Why is it relevant?

Different sanitation technologies require different levels of vehicular access during operation and maintenance: While some do not require any kind of vehicles, others depend on vehicles being able to access the location of the technologies for emptying and transport. The vehicular access is therefore an important proxy for technology appropriateness.

1.7.3.13.2Definition

Semi-quantitative estimates of the performance of each technology during operation and/or maintenance given certain vehicular access in a specific case. This criterion refers to the need to empty onsite facilities by truck in dense areas. It is based on a scale of three categories:

- **No access**: vehicles cannot reach the site, because the road widths are less than 2 meters or the terrain is impossible to traverse.
- Difficult access: road widths are between 2-5 meters or terrain is difficult (no proper roads, hilly, etc.)
- Full access: road widths are over 5 meters which larger vehicles, such as a pumping truck, can use without any problem.

Note: Vehicular access can also be limited due to seasonal conditions (e.g. flooding during monsoon), however, this is not considered here and instead in the criterion "Flooding".

Vehicular access is only used for onsite and decentralized onsite collection and storage/treatment technologies (FG S).

1.7.3.13.3 Case questions

How accessible by motorized vehicles (e.g. pumping trucks) are the onsite locations for the planned toilets and treatment technologies?

Allot the proportions (%) of the case area that have certain vehicular accessibility.

1.7.3.13.4Tech question

What is the performance of the technology given a certain type of vehicular access?

Allot the performance (between 0 and 100%) for each category based on how well the technology performs for the different categories of vehicular accessibility. You can use the following examples (full access - difficult access - no access):

100% - 100% - 100%: No vehicular access necessary. Includes cases where material requires no further

treatment and could be used for example onsite as soil amendment.

→ 100% - 80% - 80%: Vehicular access is not necessary, as manual transport is possible. However,

motorized vehicles can slightly improve the operation efficiency (e.g. by handling

slightly larger loads of products such as dried faeces that do not require frequent emptying. In case of urine this often is treated onsite or transported manually and does not require vehicular transport.

→ 100% - 60% - 30%: Vehicular access is not necessary, as manual transport is possible. However,

motorized vehicles can strongly improve the operation efficiency (e.g. as they can handle very large loads of material that are voluminous such as sludge and

require frequent emptying).

→ 100% - 50% - 0%: Access for some type of motorized vehicles is necessary. Smaller non-motorized

vehicles (e.g. Gulper) can navigate difficult terrain but they are less efficient in

transporting the dug-out material.

→ 100% - 0% - 0%: Access for larger vacuum pumping trucks is necessary.

1.7.3.13.5 Additional notes

The criterion is only used to assess technologies in FG S, which are assumed to be onsite technologies. The assumption behind this choice is that vehicular access to the onsite facilities (plots) and not the offsite treatment facilities is the limiting factor. The reasoning is that these onsite technologies need to be emptied by desludging vehicles and the collected material can be treated close by or transported to an accessible offsite treatment facility. It has to be kept in mind that technologies of FG T can also be used as onsite technologies but are not limited by the criterion. To consider possible errors caused by this assumption, the four different sanitation system types (see <u>1.2.11</u> <u>Onsite, Decentralized and Offsite Technologies and Systems</u>)

Onsite, Decentralized and Offsite Technologies and Systems Onsite are evaluated for the criterion "Vehicular Access":

- Onsite + Decentralized systems: The criterion "Vehicular Access" penalizes FG S technology even though all processes happen onsite and consequently no transport and no vehicular access are required. If a user plans to implement the whole sanitation chain onsite or at a decentral location that only requires manual transport over short distances, they can set the case values to (no access = 1, difficult access = 0, full access = 0) and avoid this penalization.
- Hybrid system: The criterion "Vehicular Access" might penalize FG S technologies even though in some cases their output products enter onsite FG T or D technologies and no vehicular access is required. At the same the criterion does not penalize onsite technologies of type FG T or D, even though vehicular access might be required for these. For example, an onsite anaerobic baffled reactor would not have a reduced appropriateness even though vehicles would need to access it for sludge emptying.
- Offsite system: It is assumed that vehicular access to the offsite treatment facilities is not a limiting factor.

The assumption is made that for technologies that can be either emptied or displaced (e.g. pit latrine) the content is actually emptied.

Alternative: The criterion could be additionally applied for FG C technologies to reduce the appropriateness of sanitation systems that include motorized transport. However, then the appropriateness of such a system would be reduced twice: Once for the limited accessibility of the FG S technology and a second time for the technology motorized transport. Therefore, to avoid double-counting only FG S technologies are considered and the user must ensure that such systems are not implemented in case of 'no access'. "Vehicular Access" is not implemented for FG T and D, because it is assumed that offsite facilities and disposal sites are in general accessible by vehicle. This

assumption needs to be verified for the specific application case. The assumption also ignores the fact that technologies in FG T and D can be onsite or decentralized, where vehicular access might be relevant.

1.7.3.14 Slope

1.7.3.14.1 Why is it relevant?

Different sanitation technologies can be operated at different slopes: While some can function in particularly flat areas, other technologies require a certain gradient for proper functioning. The slope is therefore an important proxy for technology appropriateness.

1.7.3.14.2 Definition

Semi-quantitative estimates of the performance of each technology during operation and/or maintenance given a certain slope in a specific case. Slope can be an important aspect for all technologies but here it is considered relevant for conveyance technologies (FG C) only. In FG C, the slope is particularly important for piped technologies such as sewers whose function is greatly affected by flat slopes. Thus, this criterion is based on two categories:

- Flat: 0-1% gradient.
- Not flat: this includes everything from rolling to steep slopes (>1% gradient).

1.7.3.14.3 Case questions

How much of the area is flat in the case?

Allot the proportions (%) of the case area that have a slope that is greater or lower than 1%. The sum of all values must be 100%.

1.7.3.14.4 Tech question

What is the performance of the technology given a certain ground slope?

Allot the performance (between 0 and 100%) for the category 'flat' based on how well the technology performs if the slope is 'flat', i.e. <1%. To avoid technologies from being discarded (as even in flat slope, piped technologies could function with pumps), one should refrain from entering the value 0% for 'flat'. For the category 'not flat' the performance is always 100%.

1.7.3.14.5 Additional notes

The direction of the slope is not considered in this criterion. A more detailed feasibility study evaluating if the local slopes support a sewer system need to be conducted.

Following the approach of (Monvois et al., 2012), this criterion should allow to distinguish between if the natural hydraulic gradient is sufficient to let the wastewater flow through the sewerage system (>1°) or if it is too flat (<1°) because that would require additional digging. Doing so, one can specify the case constraints as means of fractions (20% of the area is 'flat', 80% is steep).

Several alternative characterizations were considered:

- Alternative 1: For this criterion, you might also consider categories such as verbal descriptions with defined boundary values, e.g. 'plain (0-5.7°, 0-10%)', 'rolling (5.7-14°, 10-25%)', 'mountainous (14-31°, 25-60%)' and 'steep (>31°, >60%)' as used by (Bustos, 2016). Since the main purpose is to evaluate suitability for a sewerage system, such a detailed analysis is considered unnecessary.
- Alternative 2: One could also quantify this attribute by exact numbers [% of gradient] and with a trapezium function, but the constraints for the case cannot be entered in fractions as before. A probability density function describing the prevailing slope distribution in the settlement has to be created for the case. Since one is interested in the proportion of the case area that is suitable for a sewerage system, the continuous function is less preferable than the categorical one.

1.7.3.15 Soil Type

1.7.3.15.1Why is it relevant?

Different sanitation technologies can be operated at locations with different soil types: While some require the soil to be permeable for soil absorption, other technologies can function even in very rocky areas. Some technologies in turn are dependent on the cleansing capacity of the soil. The soil type is therefore an important proxy for technology appropriateness.

1.7.3.15.2Definition

Qualitative estimates of the performance of each technology for operation given a certain soil type in a specific case. Soil type is mainly important for technologies depending on soil absorption during operation. Different soil types possess different permeability, thereby, some bear more risk for stagnation than others. Additionally, certain soils have better filtration characteristics or in other words a greater cleansing capacity for polluted effluents.

It is based on a scale of five categories:

- Rock: extremely low/ negligible permeability, would certainly lead to stagnation of polluted effluent towards surfaces. Also, the filtration or cleansing capacity is very limited. Here, we refer to a continuous rocky stratum.
- Clay: very low permeability, has a high risk of stagnation of polluted effluent towards surfaces. Since percolation is low, the filtration or cleansing capacity is also limited. It is assumed here that the clay has no fissures.
- **Silt**: low permeability, has a moderate risk of stagnation of polluted effluent towards surfaces. Silty soil offers adequate filtration or cleansing capacity.
- Sand: moderate permeability, offers good percolation of polluted effluent, along with good soil filtration or cleansing capacity.
- **Gravel**: high permeability, is considered best for percolation of polluted effluent. But the cleansing capacity of the soil or filtration power is very limited and likely to be insufficient.

Although the risk of percolation of polluted effluent and the abilities of different soils to filter it is somewhat considered as part of this criterion, the specific focus of percolation leading to pollution of drinking water sources is additionally looked at in a separate criterion "Drinking Water Exposure". Moreover, some technologies also need a certain soil type for construction, especially when concerning the stability of the technology underground, however, this is not a consideration here.

Soil type is used for onsite collection and storage/treatment (FG S), and reuse and disposal (FG D) technologies.

1.7.3.15.3 Case questions

What is the soil type in the case area?

Allot the proportions (%) of the case area that consist of one of the given soil type categories. The sum of all values must be 100%.

1.7.3.15.4Tech question

What is the performance of the technology given a certain soil type/permeability?

Allot the performance (between 0 and 100%) for each category based on the following examples (clay – silt – sand – gravel – rock):

\rightarrow	100% -	100% -	100% -	100% -	100%:
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→ 70% - 90% - 100% - 90% - 70%:

→ 25% - 50% - 100% - 50% - 25%:

→ 0% - 25% - 100% - 25% - 0%:

Technology is sealed and/or does not rely on soil absorption.

The technology can be designed to make use of soil percolation and filtration, in order to lower the desludging rates, but does not necessarily have to (e.g. raised latrines). Soil percolation and filtration are desirable for this technology as it results in lower desludging rates. (e.g. pit latrines).

The functionality of the technology primarily depends on soil percolation and filtration. (e.g. soak pits, leach fields).

1.7.3.15.5 Additional notes

According to (Loetscher and Keller, 2002) coarse or medium sand does not provide a sufficient level of filtration and can lead to high risks of groundwater contamination. However, to simplify for this criterion it is assumed that 'sand' has a sufficiently good cleansing capacity.

1.7.3.16 Groundwater Depth

1.7.3.16.1 Why is it relevant?

Different sanitation technologies demand different groundwater depths to function: While some might pollute the groundwater and should not be built in case of high groundwater levels, other technologies are fully sealed and independent from the groundwater depth. The groundwater depth is therefore an important proxy for technology appropriateness.

1.7.3.16.2 Definition

Quantitative estimates of the performance of each technology for construction and operation given a certain groundwater depth in a specific case. The groundwater depth is estimated in meters distance from the surface. For the case the focus lies on the lowest distance from the surface or the highest groundwater table over a year's time. This criterion is mainly important if the technology can pollute the groundwater by infiltration.

If any given technology is built to be sealed against the ground, it is assumed that it functions successfully (100% performance) given any level of groundwater depth. In reality, not all such sealed technologies may be recommended

for areas with high groundwater tables, however, this is not considered here. The actual soil absorption capacity of a technology is not considered here but instead in the criterion "Soil Type".

Groundwater depth is defined for the onsite collection and storage/treatment (FG S), and reuse and disposal (FG D) technologies. Conveyance (FG C) and treatment technologies (FG T) are assumed to be sealed against the ground.

1.7.3.16.3 Case questions

What is the local groundwater depth (=distance from the surface to the groundwater table)?

Option 1: Provide the minimal (A) and maximal value (D). If there is no clear minimum, allot the value 0. If there is no clear maximum, allot the value 999.

Option 2: Up to four values can be alloted: the absolute minimum (A), the likely/typical minimum (B), the likely/typical maximum (C), and the absolute maximum (D). Note: A must be smaller or equal than B must be smaller or equal than C must be smaller or equal than D.

1.7.3.16.4Tech question

What is the performance of the technology given a certain groundwater depth?

Provide the minimum groundwater depth at which the technology can function. Alternatively, you can provide both the absolute minimum groundwater depth at which the technology can function and the optimal minimum groundwater depth at which the technology performs at 100%. It might be helpful to think in terms of the four values (a,b,c,d) of the trapez function:

- a = min. value with performance >= 0%
- b = min. value with performance of 100%
- c = d = 999m = max, value

Note: A minimum vertical safety distance of three meters is assumed between the point of infiltration (e.g. the bottom of a pit) and the groundwater table as suggested by (Monvois et al., 2012).

1.7.3.16.5 Additional notes

"Wastewater that infiltrates the soil or comes from leakages can constitute a pollution risk for the groundwater table. A groundwater table is not compatible with technologies that use infiltration of water into the soil or where there is a risk of leakage if this table is situated less than 3 meters away from the point of infiltration (e.g. the bottom of a pit). The intervention of a (hydro-) geologist may be required to establish if there is a risk of groundwater table contamination" (Monvois et al., 2012). (Loetscher and Keller, 2002) set the threshold at 5 m below surface, if water is abstracted locally from the groundwater, and at 2 m below surface, if the water supply is transported in pipes to the location. For SANTIAGO, we set the minimum vertical distance for technologies that rely on soil absorption to 3 meters.

This criterion considers the possible pollution of the groundwater by infiltrating technologies as well as the structural stability of underground structures in regard to the groundwater table. It is an addition to the criterion "Drinking Water Exposure" that covers the sensitivity of the regional water supply to polluted groundwater. "Groundwater Depth" does

not consider the effect of groundwater on the soil absorption capacity of a technology, as this is part of the criterion "Soil Type".

1.7.3.17 Excavation

1.7.3.17.1Why is it relevant?

Different sanitation technologies demand different amounts of excavation: While some can be built above ground in the case of challenging soil conditions, other technologies are imperatively dependent on the process of excavation during construction. The ease of excavation is therefore an important proxy for technology appropriateness.

1.7.3.17.2Definition

Qualitative estimate of the performance of a technology given how easy it is to excavate soil in a specific case. The ease of excavation is important for technologies that have to be constructed below ground. It is based on two categories:

- Easy: can be excavated without special machinery.
- Hard: needs special machinery and equipment for instance in rocky ground conditions.

Excavation is defined for the onsite collection and storage/treatment (FG S), conveyance (FG C), treatment (FG T), and reuse and disposal (FG D) technologies. Technologies belonging to the user interface (FG U) are linked to the FG S technologies and excavation is therefore not a relevant criterion.

1.7.3.17.3 Case questions

What is the ease of excavation in the case?

Allot the proportions (%) of the case area that can be excavated easily or with more difficulty. The sum of all values must be 100%.

1.7.3.17.4 Tech question

What is the performance of the technology given a certain level of difficulty in excavation?

Allot the performance (between 0 and 100%) for the category 'hard' based on how well the technology performs if excavation is difficult. To avoid technologies from being discarded (as excavation though difficult, is always possible), one should refrain from entering the value 0% for 'hard'. For the category 'easy' the performance is always 100%. You can use the following examples

(easy - hard):

\rightarrow	100% - 100%:	No excavation required.
\rightarrow	100% - 75%:	Shallow excavation required (<3m deep) or one of multiple configurations is
		underground and therefore requires excavation.
\rightarrow	100% - 50%:	Deeper excavation required (>=3m deep) or shallow and wide excavation (e.g.
		as for simplified sewers).
\rightarrow	100% - 25%:	Deep (>=3m deep) and wide excavation necessary (e.g. as for a conventional
		sewer)

1.7.3.18 Surface Area (Onsite)

1.7.3.18.1 Why is it relevant?

Different onsite sanitation technologies require different amounts of surface area: While some can be built on a very small footprint relative to the number of users, other technologies demand a large plot of land that might not be available in a certain case. The surface area onsite is therefore an important proxy for technology appropriateness.

1.7.3.18.2 Definition

The surface area (onsite) refers to the space available for onsite technology construction. Is is evaluated in m2 per unit. The unit could be at the household level or the community level.

It must be noted that when multiple technologies from FG S are part of a system, the SANTIAGO algorithm does NOT apply the surface area restrictions to the cumulative sum of all the areas of individual technologies. E.g. if for the case a 5 m² plot is available, SANTIAGO individually compares the area required by a certain technology against this number. However, if two or more technologies are recommended as part of the system (e.g. urine storage tanks in addition to dehydration vaults), it does NOT compare the sum of their areas against the 5 m² restriction.

Surface area (onsite) is defined for the onsite collection and storage/treatment technologies (FG S) only.

1.7.3.18.3 Case questions

How much surface area (m²) is available in the case onsite per unit of planned technology (e.g. one double pit)?

Option 1: Provide the minimal (A) and maximal value (D). If there is no clear minimum, allot the value 0. If there is no clear maximum, allot the value 999.

Option 2: Up to four values can be allotted: the absolute minimum (A), the likely/typical minimum (B), the likely/typical maximum (C), and the absolute maximum (D).

Note: A must be smaller or equal than B must be smaller or equal than C must be smaller or equal than D.

1.7.3.18.4Tech question

What is the degree of feasibility of the technology given a certain surface area available in the case in m² per unit?

Provide the minimum surface area required for the technology to perform 100%. Alternatively, you can provide both the absolute minimum surface area required for technology to function and the optimal minimum at which the technology performs best.

Note: A maximum surface area requirement does not apply to technologies and therefore, a default value of 999 m² is assumed. It might be helpful to think in terms of the four values (a,b,c,d) of the trapez function:

- a = min. value with performance >= 0%
- b = min. value with performance of 100%
- c = d = 999 m² = max, value

1.7.3.18.5 Additional notes

Note that in SANTIAGO, if space is required underground, it still has the same space requirements as if it were aboveground.

Defining the surface area requirements for different technologies is challenging. The following very simplified strategy was implemented to classify groups of collection and storage/treatment FG S technologies with similar surface area requirements:

 \rightarrow Movable technologies with very low surface area requirements (container-based): (a = 0 m², b = 0.5 m²)

These technologies can basically be put anywhere and possibly do not require any permanent space at all. A space requirement starting at a = 0 m² is therefore proposed. There are many different variations of container-based toilets and urine storage tanks, so common sense can be applied here to define a small value of 0.5 m² as a requirement for 100% performance.

 \rightarrow Technologies with low surface area requirements: (a = b = 1 m^2)

These technologies are all based on storing excreta below the user interface and therefore have similar surface area requirements as the user interface above. The value of 1 m² is based on a recommendation for single pits (Tilley et al., 2014b). The same value is assumed to be valid for the single VIP, the borehole latrine and the single faeces storage chamber.

The chemical toilet and deep trench latrine can also be constructed with a small footprint (Gensch et al., 2018) and are therefore added to this class.

 \rightarrow Techs with medium surface area requirements: $(a = b = 2 \text{ m}^2)$

The technologies (fossa alterna, double VIP, double dehydration vault) are based on storing excreta below the user interface, but making use of alternating chambers. Therefore, their surface area requirements are similar and assumed to be (at least) twice the area of the single chamber technologies of 1 m².

The same value of 2 m² is assumed for worm-based toilet, because they require additional 0.7 to 1 m² for the vermifilter (Gensch et al., 2018). The composting chamber is assumed to be of similar size as a vermicompost, but could also be significantly larger. Finally raised latrines also require more space since there needs to be some kind of elevated structure with stairs.

 \rightarrow Techs with high surface area requirements: $(a = b = 5 \text{ m}^2)$

The values for septic tanks and twin pits for pour flush are based on the following references (Monvois et al., 2012) and (Gensch et al., 2018).

 \rightarrow Techs with surface areas that highly depend on the number of users: (a = 35 m², b = 35 m²)

For shallow trench latrines, 0.25 m²/cap/day are required (Gensch et al., 2018). Assuming they are used at minimum for 2 weeks by 10 people, we get at a surface area requirement of 35 m². The same value is used for the open defecation field, though space requirements could be even larger there. These assumptions are very generic and further feasibility studies by a user are required.

There are several other criteria that are related to the surface area and could be considered either additionally or as a replacement for the surface area:

- Alternative: One might also consider a criterion describing the population density. This is especially important
 for technologies that rely on on-site soil absorption (Loetscher and Keller, 2002). However, it is very hard to
 quantify at what threshold a technology relying on soil absorption is inappropriate for a certain population density.
- Alternative 2: Another criterion one might consider is one describing the total population size, because e.g. activated sludge is not very feasible for a small population size (<2000 inhabitants) due to economies of scale (Loetscher and Keller, 2002). However, the reason is most probably because these kinds of technologies are

too expensive. In SANTIAGO, costs are covered with a separate criterion and a criterion describing the population size is therefore not needed.

1.7.3.19 Surface Area (Offsite)

1.7.3.19.1Why is it relevant?

Different offsite sanitation technologies require different amounts of surface area: While some can be built on a small footprint, other technologies demand a large plot of land that might not be available in a certain case. The surface area offsite is therefore an important proxy for technology appropriateness.

1.7.3.19.2Definition

The surface area (offsite) refers to the space available for technology construction offsite at a centralized location and is evaluated in m² per person. Surface area (offsite) is defined for the treatment technologies (FG T) only.

It must be noted that when multiple technologies from FG T are part of a system, the SANTIAGO algorithm does NOT apply the surface area restrictions to the cumulative sum of all the areas of individual technologies. E.g. if for the case a 5 m² plot is available, SANTIAGO individually compares the area required by a certain technology against this number. However, if two or more technologies are recommended as part of the system (e.g. waste stabilisation ponds in addition to a drying bed), it does NOT compare the sum of their areas against the 5 m² restriction.

1.7.3.19.3 Case questions

How much total surface area per capita (m²/cap) is available offsite for decentralized and centralized treatment technologies for the case?

Option 1: Provide the minimal (A) and maximal value (D). If there is no clear minimum, allot the value 0. If there is no clear maximum, allot the value 999.

Option 2: Up to four values can be allotted: the absolute minimum (A), the likely/typical minimum (B), the likely/typical maximum (C), and the absolute maximum (D).

Note: A must be smaller or equal than B must be smaller or equal than C must be smaller or equal than D.

1.7.3.19.4Tech question

What is the degree of feasibility of the technology given a certain surface area available offsite (decentralized and centralized sites) in m² per capita?

Provide the minimum surface area required for the technology to perform 100%. Alternatively, you can provide both the absolute minimum surface area required for technology to function and the optimal minimum at which the technology performs best.

Note: A maximum surface area requirement does not apply to technologies and therefore, a default value of 999 m² is assumed.) It might be helpful to think in terms of the four values (a,b,c,d) of the trapez function:

- a = min. value with performance >= 0%
- b = min. value with performance of 100%

c = d = 999 m² = max. value

1.7.3.19.5 Additional notes

Defining the surface area requirements for technologies is challenging and depends on many factors, such as the actual technology configuration, its scale, etc. Therefore, SANTIAGO cannot calculate the actual area requirements of a sanitation technology and only provides the minimally required surface area. In real life, the same technology might be far larger. The range is chosen as broad as possible to ensure that no technology is discarded unnecessarily. A detailed feasibility study by the user is necessary to determine the actual surface area per technology.

In addition, as previously mentioned in the criterion definition, the SANTIAGO algorithm can only check whether any technology individually exceeds the available surface area. It is therefore recommended that a user adds the surface areas of all technologies for a plausibility check.

While "Surface Area (Offsite)" includes the word "offsite", it actually refers to the area required by the treatment technologies in FG T according to the SANTIAGO algorithm. The treatment technologies can be either implemented close to the toilets themselves (decentralized system) or further away at (semi-)centralized facilities (offsite system) (see also <u>chapter 1.2.11 Onsite</u>, <u>Decentralized and Offsite Technologies and Systems</u>). Therefore, for this criterion the user needs to quantify the area where they expect to implement the treatment facilities. This can be close to the toilets themselves or further away. It is further possible that the treatment technologies are spread over several locations. These can all be onsite, all offsite or a hybrid system with a mix of both. For all of these cases the user can add all the areas together and then divide them by the proposed number of users. However, after the appropriateness assessment, any selected sanitation system requires another plausibility check examining how the technologies are distributed between the different locations and if that matches the available surface at these locations.

It is further assumed that the surface area required by technologies in FG U, C and D are negligible compared to technologies in FG S and C. This requires another plausibility check as some, e.g. fish ponds, also need significant space.

Note that in SANTIAGO, if space is required underground, it still has the same space requirements as if it were aboveground.

1.7.3.20 Drinking Water Exposure

1.7.3.20.1Why is it relevant?

Different sanitation technologies can be used in varying proximity to drinking water sources: While some rely on soil absorption or might possibly leak into the groundwater and could potentially pollute drinking water, other technologies can be used in close proximity to water sources. The drinking water exposure is therefore an important proxy for technology appropriateness.

1.7.3.20.2 Definition

Quantitative estimation of the performance of the technology given a certain water source proximity. This is important for technologies that rely on soil absorption and might pose a risk to nearby drinking water sources. It is based on two categories:

- Close: refers to a distance less than 30 meters to the closest drinking water source (e.g. a groundwater well).
- Not close: refers to a distance of more than 30 meters from the closest drinking water source.

Drinking water exposure is defined for the onsite collection and storage/treatment (FG S), and reuse and disposal technologies (FG D). The sites where such technologies are to be implemented are referred to here as 'implementation sites'.

1.7.3.20.3 Case questions

How many of the implementation sites can pollute nearby drinking water sources (e.g. groundwater wells)?

Allot proportions (%) based on the number of implementation sites that are 30m closer or not closer from drinking water sources (e.g. groundwater well). Implementation sites could be either at the household or the community level. The sum of all values must be 100%.

1.7.3.20.4Tech question

What is the performance of the technology with respect to preventing the risk of pollution given a drinking water source is closer than 30 meters?

Allot performance (between 0 and 100%) for the category 'close' based on how likely it is for the technology to infiltrate polluted effluent into the soil. To avoid technologies from being discarded (as infiltration of polluted effluent into drinking water sources can indeed be prevented), one should refrain from entering the value 0% for 'close'. For the category 'not close' the performance is always 100%.

1.7.3.20.5 Additional notes

The category 'not close' does not consider the water requirements of a technology as this is covered in the criteria "Water Supply" and "Water Volume".

The limit of 30 m distance between containment facilities and water sources is based on the Sphere Standards (Association, 2018).

Alternative: This criterion could also be used as a continuous function on the distance to the next water source in meters instead of categories. It mostly depends on the data available for both the case and the technologies.

1.7.3.21 Construction Skills

1.7.3.21.1Why is it relevant?

Different sanitation technologies require different skills for their initial construction: While some can be entirely built with very limited skill, other technologies require highly trained professionals for the construction of certain parts of the technology. The availability of construction skills is therefore an important proxy for technology appropriateness.

1.7.3.21.2Definition

Qualitative estimation of the performance of each technology given a certain construction skills availability in a specific case. This differs from the criterion 'Design Skills' as correct implementation of the technology needs both effective design and effective construction. Construction skills refer to the skills required for the construction of sanitation technologies and is defined by three categories:

- Unskilled labour: casual/daily labourer such as mason, artisan, or craftsman.
- **Skilled labour**: plumber, technician (maintenance, lab, IT), mechanic, electrician, trained mason/artisan/craftsman.
- **Professional**: highly qualified engineer, architect, planner, or supervisor.

Construction skills is defined for all technologies regardless from their functional group. It is not representative of the entire local workforce but only the one that will be involved in the implementation of sanitation technologies.

1.7.3.21.3 Case questions

What is the availability of different levels of construction skills in the case?

Allot proportions (%) based on the construction skill set of the workforce in the case area. The sum of all values must be 100%.

1.7.3.21.4Tech question

What is the performance of the technology given a certain availability of construction skills?

Allot for each category the performance of a technology (between 0 and 100%) for a given skill level of the available workforce.

Note: This is a ladder function, so if a technology performs 100% with 'unskilled labour', it will also perform well (i.e. 100%) with 'skilled' and 'professional' labour. The values allotted to 'professional' will always be equal to or higher than 'skilled' and those allotted to 'skilled' will be equal or higher than 'unskilled'.

1.7.3.21.5Additional notes

Alternative: One might also consider specific categories as 'none', 'unskilled labour', 'mason', 'specially trained mason', 'construction engineer' and 'supervisor'. However, these professions do not ensure that all skills that might be needed are included and the skill level per category might differ from one region to the other. In SANTIAGO, a less detailed approach has been implemented.

1.7.3.22 Design Skills

1.7.3.22.1Why is it relevant?

Different sanitation technologies require different skills for their design: While some can be designed with very limited knowledge, other technologies require the design skills of highly trained professionals to ensure proper functioning. The availability of design skills is therefore an important proxy for technology appropriateness.

1.7.3.22.2 Definition

Qualitative estimation of the performance of each technology given a certain design skills availability in a specific case. This differs from the criterion 'Construction Skills' as implementation needs both effective design and effective construction. It is based on a scale of three categories:

- Unskilled labour: casual/daily labourer such as mason, artisan, or craftsman.
- Skilled labour: plumber, technician (maintenance, lab, IT), mechanic, electrician, trained mason/artisan/craftsman.
- Professional: highly qualified engineer, architect, planner, or supervisor.

Design skills is defined for all technologies regardless from their functional group. It is not representative of the entire local workforce but only the one that will be involved in the design of sanitation technologies.

1.7.3.22.3 Case questions

What is the availability of different levels of design skills in the case?

Allot proportions (%) based on the design skill set of the workforce in the case area.

1.7.3.22.4Tech question

What is the performance of the technology given a certain availability of design skills?

Allot for each category the performance of a technology (between 0 and 100%) for a given skill level of the available workforce.

Note: This is a ladder function, so if a technology performs 100% with 'unskilled labour', it will also perform well (i.e. 100%) with 'skilled' and 'professional' labour. The values allotted to 'professional' will always be equal to or higher than 'skilled' and those allotted to 'skilled' will be equal or higher than 'unskilled'.

1.7.3.22.5 Additional notes

Alternative: One might also consider specific categories as 'none', 'unskilled labour', 'mason', 'specially trained mason', 'planning engineer' and 'supervisor'. However, these professions do not ensure that all skills that might be needed are included and the skill level per category might differ from one region to the other. In SANTIAGO, a less detailed approach has been implemented.

1.7.3.23 Operation and Maintenance (O&M) Skills

1.7.3.23.1Why is it relevant?

Different sanitation technologies require different skills for operation and maintenance: While some can be operated with a very limited set of skills, other technologies require highly specialized training to ensure endured functioning. The availability of operation and maintenance skills is therefore an important proxy for technology appropriateness.

1.7.3.23.2Definition

Qualitative estimation of the performance of each technology given a certain operation and maintenance (O&M) skills availability in a specific case. It is based on a scale of three categories:

- **Unskilled**: casual/daily labourer such as pit digger, sanitary worker, pit emptier.
- **Skilled**: plumber, technician (maintenance, lab, IT), mechanic, electrician, trained mason/artisan/craftsman. Also includes basic administrative and finance skills.
- **Professional**: highly qualified collection supervisor, treatment supervisor, chemist, and administrator (including finance).

O&M skills is defined for all technologies regardless from their functional group. It is not representative of the entire local workforce but only the one that will be involved in the operation and maintenance of sanitation technologies.

1.7.3.23.3 Case questions

What is the availability of different levels of operation and maintenance skills (O&M) in the case?

Allot proportions (%) based on the O&M skill set of the workforce in the case area.

1.7.3.23.4Tech question

What is the performance of the technology given a certain operation and maintenance (O&M) skills availability?

Allot for each category the performance of a technology (between 0 and 100%) for a given skill level of the available workforce. The sum of all values must be 100%.

Note: This is a ladder function, so if a technology performs 100% with 'unskilled labour', it will also perform well (i.e. 100%) with 'skilled' and 'professional' labour. The values allotted to 'professional' will always be equal to or higher than 'skilled' and those allotted to 'skilled' will be equal or higher than 'unskilled'.

1.7.3.23.5Additional notes

Alternative: One could also define specific categories, such as 'none', 'unskilled labour', 'specially trained labour', 'technician', 'supervisor', 'administrator', 'engineer' and 'scientist'. However, these professions do not ensure that all skills that might be needed are included and the skill level per category might differ from one region to the other. In SANTIAGO, a less detailed approach has been implemented.

1.7.3.24 Cleansing Method

1.7.3.24.1Why is it relevant?

Different sanitation technologies can be used by people preferring different cleansing methods: While some technologies can be used with anal cleansing water as well as dry cleansing material, some technologies only function perfectly with one type of cleansing method. The cleansing method is therefore an important proxy for technology appropriateness.

1.7.3.24.2 Definition

Qualitative estimation of the performance of each technology given a certain cleansing method in the specific case. It is based on a scale of three categories:

- Washer: refers to the use of anal cleansing water.
- **Soft wipers**: refers to the use of toilet paper or other soft materials.

• Hard wipers: refers to the use of any other, mostly hard and bulky material such as maize cobs.

Cleansing method is defined for the user interface (FG U) technologies only.

1.7.3.24.3 Case questions

Which anal cleansing methods are used by the population?

Allot proportions (%) based on the share of the population using each of the proposed cleansing methods. The sum of all values must be 100%.

1.7.3.24.4Tech question

What is the performance of the technology given a certain anal cleansing material?

Allot the performance (between 0 and 100%) for each category based on how well the technology performs for the different anal cleansing materials.

1.7.3.24.5 Additional notes

The criterion "Cleansing Method" is only defined for the user interface (FG U). This is based on the assumption that some kind of pre-screening is implemented before any technology in FG S, C, T and D, which screens out dry cleansing material.

1.7.3.25 Lifetime

1.7.3.25.1Why is it relevant?

The criterion was chosen as relevant for humanitarian contexts by experts in a study by (Jain and Ilmanen, 2021). Some technologies have short design lifetimes and are therefore appropriate in the short-term or in a transition period. This is especially relevant for technologies in the initial phases of a humanitarian crisis, where interim solutions and short lifetimes of technologies are acceptable whereas in the long-term other technologies might be more appropriate. The lifetime is therefore an important proxy for technology appropriateness in humanitarian contexts.

1.7.3.25.2 Definition

The criterion lifetime has been developed specifically and is only applicable for humanitarian contexts.

It is defined by the semi-quantitative estimates of how appropriate each technology is given an expected lifespan in a specific case. It is based on the following three categories (based on expert judgement):

- Short: refers to a lifetime of less than one year.
- Medium: refers to a lifetime ranging from over one year to up to five years.
- Long: refers to a lifetime of over five years.

The criterion is defined for technology for storage and treatment (FG S), (Semi-)centralized treatment (FG T) and reuse or disposal (FG D).

If a technology has a long service life, it can be also used for shorter periods of time. This assumption is not correct for all technologies due to their long start-up time or required minimum storage time. The minimum lifetime of a technology (e.g. due to the minimum storage time for composting chambers) is not taken into consideration in this criterion. However, start-up times are considered separately in "Speed of Implementation".

If this criterion is used for screening technologies by implementing an appropriateness calculation, stakeholders need to agree on a preferred scalability. If this is not the case the criterion should not be considered as a screening criterion and instead looked at in more detail in the evaluation phase when evaluating appropriate options and when negotiating a preferred option with all stakeholders.

1.7.3.25.3 Case questions

What lifetime is a technology required to last in the case?

Allot proportions (%) based on how acceptable the given service lifetimes are for the case. E.g. if a short lifetime is acceptable, 100% should be allotted to the category 'short'. The sum of all values must be 100%.

Note: If the lifetime does not matter for the case, this criterion must be excluded from consideration.

1.7.3.25.4Tech question

What is the performance of technology given a certain expected design lifetime?

Allot for each category the performance (between 0 and 100%) based on how appropriate the technology is for the different proposed lifetimes.

Note: This is a ladder function, so if a technology performs 100% if a 'long' service lifetime is expected', it will also perform well (i.e. 100%) for 'medium' or 'shorter' lifetimes. The values allotted to 'short' will always be equal to or higher than 'medium' and those allotted to 'medium' will be equal or higher than 'long'.

1.7.3.25.5 Additional notes

Some technologies are only meant for the short-term but end up being used for far longer timespans. This is considered in the form of performance values between 0 and 100%.

For FG D 'technologies'/concepts that include the application of stored and treated material, the storage and treatment time are accounted for in FG S and FG T.

Several alternative technology configurations were considered:

- Alternative 1: A PDF function could be used to describe the possible lifetime of a technology. This alternative was discarded, because several technologies could be used equally in the short- or long-term and should have therefore achieved appropriateness scores of 100%. However, with a PDF function such a technology could only be described by (short = 0.3, medium = 0.4, long = 0.3) and consequently the appropriateness score of such a technology might have been reduced.
- Alternative 2: A performance function without a ladder function could be used to describe the performance of technology. This alternative was discarded, because for most technologies no data was available, on its

performance for short (<1a) or medium lifetimes (1-5a). The assumption that a technology with a long service life can also be used for a shorter lifetime by abandoning it was deemed realistic.

1.7.3.26 Speed of Implementation For Toilet Structure

1.7.3.26.1Why is it relevant?

The criterion was chosen as relevant for humanitarian contexts by experts in a study by (Jain and Ilmanen, 2021). The initial response to a humanitarian crisis requires a quick implementation of adequate sanitary facilities. To account for this the speed of implementation of toilet structures is considered an important proxy for technology appropriateness in humanitarian contexts.

1.7.3.26.2 Definition

The criterion has been developed specifically and is only applicable for humanitarian contexts.

Semi-quantitative estimates of the performance of each technology given the preference for the time within which functional toilets are required in a specific case. It is based on the following three categories:

- Rapid: refers to when implementation is possible under three days.
- Moderate: refers to an implementation time between three days to two weeks.
- Slow: refers to an implementation time longer than two weeks.

Toilet coverage with safe onsite containment is a priority and often comes prior to the implementation of the entire treatment chain. It is relevant to use this criteria in an acute response phase. The quality of implementation of the technology is assumed to be the same for all of the aforementioned speeds, i.e. for example, 'rapid' in no way equates to fast sub-standard construction.

The speed of implementation can be judged based on many factors such as the complexity of construction and skills required, local availability of materials, concrete curing time, etc.

This criterion refers to the speed of implementation of onsite collection and storage/treatment technologies (FG S) only (it is assumed that construction of the superstructure, i.e. technologies belonging to the user interface are not the time-limiting agent here).

1.7.3.26.3 Case questions

How acceptable are the following speeds of implementation for finishing the toilet structure?

Allot for each category values between 0 and 100% based on the desire for a given speed of implementation.

Note: This is as a ladder function, i.e. values allotted to category 'rapid' will always be equal to or higher than 'moderate' and those allotted to 'moderate' will be equal or higher than 'slow'. This reflects reality as for example, if a 'moderate' speed is acceptable to the user, it automatically implies that 'rapid' speed is acceptable with equal or higher preference.

The following case can realistically never be a possibility: (rapid=0, moderate=0.5, slow=1), as it would imply that a rapid speed of implementation is not desirable whereas a slow one is. This is principally undesirable for infrastructure projects.

1.7.3.26.4Tech question

How quickly can this technology be implemented?

Allot proportions (%) based on how quickly the treatment technology can be implemented. E.g. if a rapid implementation in less than a week is possible, 100% should be allotted to the category 'rapid'.

1.7.3.26.5 Additional notes

Here, the speed with which a technology can be implemented is judged based on multiple considerations, such as whether a technology requires more complex materials that might not be locally accessible in a humanitarian context. Technologies can be rapidly implemented (rapid = 1, moderate = 0, slow = 0) if prefabricated units are available and can be easily transported to the location. The speed of implementation is reduced if concrete is used as generally a minimum time of 7 days is required for the curing of concrete. The speed of implementation is further reduced if the construction or design are complex and require time (e.g. digging is required or ventilation system needs to be designed) as this can cause a delay when setting up the technology. Finally, technologies that require a start-up time (e.g. for the biological activity to reach its full potential) are considered as 'slowly' implemented.

1.7.3.27 Speed of Implementation For Treatment

1.7.3.27.1 Why is it relevant?

The criterion was chosen as relevant for humanitarian contexts by experts in a study by (Jain and Ilmanen, 2021). In a humanitarian crisis sanitary facilities are implemented that require treatment of the collected material (e.g. emptying and treatment of excreta in a latrine). To avoid contaminating the camp and surrounding area with these output products they need adequate treatment. Therefore, a faecal sludge treatment system needs to be developed before the storage technologies are completely filled. Certain technologies might require too much time to design and construct to be adequate in a humanitarian context. To account for this the speed of implementation of treatment is considered an important proxy for technology appropriateness in humanitarian contexts.

1.7.3.27.2 Definition

The criterion has been developed specifically and is only applicable for humanitarian contexts.

Semi-quantitative estimates of the performance of each technology given the preference for time within which a functional treatment system is required in a specific case. It is based on the following three categories created to facilitate comparison between different technologies:

- Rapid: refers to implementation within a few days to up to one week.
- Moderate: refers to an implementation time between a few weeks up to three months.
- Slow: refers to an implementation time longer than three months.

A treatment system is considered to be functional after its expected construction time and start-up time if any is required (e.g. for biological processes). In the implementation phase, functional treatment system comes often after

having reached toilet coverage and safe onsite containment. Therefore, it is relevant to consider this criteria more in the stabilization phase of humanitarian context. This criterion is applicable to (semi-) centralized treatment technologies (FG T) only. A treatment system is considered to be functional after its expected construction time and start-up time if any is required (e.g. for biological processes).

The speed of implementation can be judged based on many factors such as the local availability of materials as well as prefabricated units, concrete curing time, required start up time, etc.

1.7.3.27.3 Case questions

How acceptable are the following speeds of implementation for realising a functional faecal sludge treatment technology?

Allot for each category values between 0 and 100% based on the desire for a given speed of implementation.

Note: This is as a ladder function, i.e. values allotted to category 'rapid' will always be equal to or higher than 'moderate' and those allotted to 'moderate' will be equal or higher than 'slow'. This reflects reality as for example, if a 'moderate' speed is acceptable to the user, it automatically implies that 'rapid' speed is acceptable with equal or higher preference.

The following case can realistically never be a possibility: (rapid=0, moderate=0.5, slow=1), as it would imply that a rapid speed of implementation is not desirable whereas a slow one is. This is principally undesirable for infrastructure projects.

1.7.3.27.4 Tech question

How quickly can this technology be implemented?

Allot proportions (%) based on how quickly the treatment technology can be implemented. E.g. if a rapid implementation in less than a week is possible, 100% should be allotted to the category 'rapid'.

1.7.3.27.5 Additional notes

A user enters preferences at what point of time the storage (FG S) volumes need to be emptied the first time and/or a functioning treatment system of the faecal sludge/blackwater is necessary.

Here, the speed with which a technology can be implemented is judged based on multiple considerations, such as whether a technology requires more complex materials that might not be locally accessible in a humanitarian context. Technologies can be rapidly implemented (rapid = 1, moderate = 0, slow = 0) if prefabricated units are available and can be easily transported to the location. The speed of implementation is reduced if concrete is used as generally a minimum time of 7 days is required for the curing of concrete. The speed of implementation is further reduced if the construction or design are complex and require time as this can cause a delay when setting up the technology. Finally, technologies that require a start-up time (e.g. for the biological activity to reach its full potential) are considered as 'slowly' implemented.

1.7.3.28 Scalability

1.7.3.28.1 Why is it relevant?

The criterion was chosen as relevant for humanitarian contexts by experts in a study by (Jain and Ilmanen, 2021). Planning sanitation facilities during a humanitarian crisis is difficult since the future is often unpredictable and changes happen fast. To at least account for a changing number of users, for example due to a rising number of refugees, the criterion "Scalability" was developed. It is supposed to judge whether a technology can adapt to such a change in population size and considered therefore an important proxy for technology appropriateness in humanitarian contexts.

1.7.3.28.2 Definition

The criterion has been developed specifically and is only applicable for humanitarian contexts.

Qualitative estimates of the performance of each technology with reference to its scalability given the expected increases in population size for a specific case. It is based on two categories:

- Easy: refers to if the technology can be easily up-scaled to accommodate changing number of users.
- **Difficult**: refers to difficulty in achieving the above.

Scalability is either possible due to a flexible design that allows for larger inputs or a modular design where units can be added to extend capacity. The focus is on the technological feasibility to scale up and limitations such as space or economics are not considered. The criterion only considers if a technology can be up-scaled and not whether it can be downscaled.

If this criterion is used for screening, stakeholders need to agree on the importance of scalability. If this is not the case the criterion should not be used for screening but considered in more detail when evaluating and discussing trade-offs of options appropriate options with all stakeholders.

The criterion is implemented for storage and treatment (FG S), conveyance (FG C) and (Semi-) centralized treatment (FG T) technologies.

1.7.3.28.3 Case questions

How important is it for the case that the treatment capacity can be easily extended (to accommodate an increase in population)?

Allot the proportions (%) based on the importance of scalability for the case. The sum of both values must be 100%.

1.7.3.28.4Tech question

What is the performance of the technology if its capacity needs to be scaled up?

Allot the performance (between 0 and 100%) for the category 'difficult' based on how well the capacity of the technology can be extended. To avoid technologies from being discarded (as it is always possible to scale-up by building a new unit of the technology), one should refrain from entering the value 0% for 'difficult'. For the category 'easy' the performance is always 100%.

You can use the following examples (easy – difficult):

→ 100% - 100%: Treatment capacity of a technology can be easily extended. Alternatively, a

technology in FG S can be replicated quickly and allows therefore easy

upscaling.

→ 100% - 80%: Technology can be extended or replicated, but there are some drawbacks.

→ 100% - 50%: Technology is complete and difficult to extend. However, it might be able to

accept changing (flow/load) inputs and therefore to some degree an increasing number of users. The technology can be scaled up by building an additional unit

though this is not always easy.

→ 100% - 30%: Technology is complete and very difficult to extend. Building an additional unit is

sometimes possible, but very difficult due to long start-up times, complex

designs, difficult construction, etc..

1.7.3.29 Construction Parts Supply

1.7.3.29.1Why is it relevant?

The criterion has been developed and implemented specifically for humanitarian contexts, where accessibility of construction materials might be limited or special prefabricated parts might cause delays and higher costs due to the required transportation. Different sanitation technologies require different kinds or parts that might make them more or less suitable in humanitarian contexts with limited accessibility to construction materials. For cases that are not in humanitarian contexts, it is assumed that the parts required to build the technology are available and only spare parts limit the technology appropriateness. The construction parts supply is considered an important proxy for technology appropriateness in humanitarian contexts.

1.7.3.29.2 Definition

Construction parts supply is applied specifically for humanitarian contexts, where accessibility of construction materials might be limited or special prefabricated parts might cause delays and higher costs due to the required transportation. It is a qualitative estimate of the feasibility of the construction of technology given a certain construction parts availability in a specific case. It is based on a scale of three categories:

- Simple: conventional parts generally locally available (e.g. simple metal or wood parts, covers, slabs).
- Technical: technical parts generally available (e.g. a siphon).
- Special: parts that need to be specifically manufactured (e.g. a membrane).

1.7.3.29.3 Case questions

What level of accessibility do different types of parts (required for construction) have for the case?

Allot the performance (between 0 and 100%) for each category based on how easily such parts can be accessed in the case area. This has to be filled in as a ladder function: 'simple' construction parts' value is always higher or equal to 'technical' which is always higher or equal to 'special', the most limiting category.

1.7.3.29.4Tech question

What are the different kinds of parts that are required to build this technology?

Allot the proportions (%) of the different types of parts of the technology.

1.7.3.29.5 Additional notes

The technology attributes for this criterion have similar proportions to the criterion "Spare Parts Supply" though in some cases "Construction Parts Supply" receive higher proportions for 'simple' parts as more of them are required to initially construct the technology.

It has to be assessed individually what "locally accessible" means (regional/national level?) but it should be possible to bring parts quickly to the construction site.

1.7.4 Currently implemented additionally evaluation criteria

The technology library also includes data for a number of additional evaluation criteria which should allow to further compare system options identified with SANTIAGO. These criteria however are not used for the technology appropriateness filter of SANTIAGO as they are only very rough estimates and not suitable for screening as not independent from preferences and trade-offs. The currently implemented additional evaluation criteria are Capital Expenditure (Capex) Requirements, Operational Expenditure (Opex) Requirements and Technical Maturity.

1.7.4.1 Capital Expenditure (Capex) Requirements

1.7.4.1.1 Why is it relevant?

Different sanitation technologies demand different capital expenditures: While some require only little upfront investment, other technologies require large quantities of material, a lot of labour and a large area of land. This leads to high costs. The capital expenditure requirements are therefore an important proxy for technology appropriateness.

1.7.4.1.2 **Definition**

The capital expenditure requirement level presents an indication of the expected level of investment costs that will arise from the implementation of a given technology. It is based on the estimation of required resources using expert judgement. Three types of required resources are considered, namely, material, labour, and land. The criterion investment requirements can indicate the investment cost levels when considered together with local market prices for different resources.

The judgement is made by comparing technologies per functional group. For technologies from the functional group U and S, the judgement is made based on one typical unit and not per user. For technologies belonging to functional groups C, T, and D, the judgement is made for applications of comparable scale and per user. For each technology, the quantities of material, labour, and land are individually judged and allotted a value 1, 2, or 3 indicating low, medium, high, respectively. The final score for any technology is then determined based on the sum of points from the above three parameters assuming that they all have the same weight.

- Low cost (3 points): means that only small amounts of material, labour and land are required.
- Medium cost (4 to 6 points): implies that medium amounts of material and/or labour and/or land are required.
- High cost (7 to 9 points): implies that large amounts of material and/or labour and/or land are required.

The capex (and opex) requirement level are not meant to provide sufficient information to select a certain technology. It merely provides additional information for comparing different sanitation system configuration options. It must be looked at together with other criteria such as resource recovery, emissions, or appropriateness. A key consideration is also that the final costs not only depend on local market prices but also on economies of scale and who of the stakeholders will pay for the costs depending on different technologies. Thus, for a detailed evaluation and selection of the most preferred option, investment and operation requirement levels are not enough but a context-specific cost estimation will be required based on local unit prices, financial arrangements, and economies of scale.

1.7.4.1.3 Case questions

This is a case-independent criterion and there are therefore no case-specific questions.

1.7.4.1.4 Tech question

What is the capital expenditure (Capex) requirement level of the technology?

Fill in by adding 1 to the category that applies.

1.7.4.2 Operation Expenditure (Opex) Requirements

1.7.4.2.1 Why is it relevant?

Different sanitation technologies cause different expenditures during operation: While some can be operated with a tight budget, the operation of other technologies causes substantial costs due to material, labour or electricity/fuel requirements. Operation Expenditure Requirements are therefore an important proxy for technology appropriateness.

1.7.4.2.2 **Definition**

The operation expenditure requirement level presents an indication of the expected level of investment costs that will arise from the implementation of a given technology. It is based on the estimation of required resources using expert judgement. Three types of required resources are considered, namely, material, labour, and electricity/fuel. The criterion operation requirements can indicate the operation cost levels when considered together with local market prices for different resources.

The judgement is made by comparing technologies per functional group over a lifetime of 10 years. For technologies from the functional group U and S, the judgement is made based on one typical unit and not per user. For technologies belonging to functional groups C, T, and D, the judgement is made for applications of comparable scale and per user. For each technology, the quantities of material, labour, and electricity/fuel are individually judged and allotted a value 1, 2, or 3 indicating low, medium, high, respectively. The final score for any technology is then determined based on the sum of points from the above three parameters assuming that they all have the same weight.

- Low cost (3 points): means that only small amounts of material, labour and electricity/fuel are required.
- Medium cost (4 to 6 points): implies that medium amounts of material and/or labour and/or electricity/fuel are required.
- **High cost (7 to 9 points)**: implies that large amounts of material and/or labour and/or electricity/fuel are required.

The opex (and capex) requirement level is not meant to provide sufficient information to select a certain technology. It merely provides additional information for comparing different sanitation system configuration options. It must be looked at together with other criteria such as resource recovery, emissions, or appropriateness. A key consideration is also that the final costs not only depend on local market prices but also on economies of scale and who of the stakeholders will pay for the costs depending on different technologies. Thus, for a detailed evaluation and selection of the most preferred option, investment and operation requirement levels are not enough but a context-specific cost estimation will be required based on local unit prices, financial arrangements, and economies of scale.

1.7.4.2.3 Case questions

This is a case-independent criterion and there are therefore no case-specific questions.

1.7.4.2.4 Tech question

What is the operation expenditure (Opex) requirement level of the technology?

Fill in by adding 1 to the category that applies.

1.7.4.3 Technical Maturity

1.7.4.3.1 Why is it relevant?

Sanitation technologies differ in how established and therefore technically mature they are: While some have only been applied in pilot projects and few contexts, other technologies have proved to be operational in many contexts. The technical maturity is therefore an important proxy for technology appropriateness.

1.7.4.3.2 **Definition**

The technical maturity presents an indication of how well-established the technology is. It indicates how certain the information on its performance is and how much practical experience there exists related to it. It is based on three different levels derived based on the technology readiness level (TRL):

- Low: implies that the technology has been applied in pilot projects, i.e. TRL 5. Technologies with a TRL lower than the pilot scale are not considered here.
- **Medium**: implies that the technology is emerging and has been demonstrated in one or more different contexts, i.e. TRL 6 to 8.
- High: implies that the technology is established and operational in one or more contexts, i.e. TRL 9.

The technical maturity level is meant to provide additional information when comparing different locally appropriate sanitation system options to select the preferred one in the given case.

1.7.4.3.3 Case questions

This is a case-independent criterion and there are therefore no case-specific questions.

1.7.4.3.4 Tech question

What is the technical maturity of the technology?

Fill in by adding 1 to the categories that apply.

1.7.5 Currently implemented substances and transfer coefficients

1.7.5.1 Currently implemented substances

So far, we have defined transfer coefficients for four substances that typify different properties: total phosphorus (TP), total nitrogen (TN), total solids (TS), and water (H2O). All four substances are relevant as indicators for resource recovery and pollution potential. Both phosphorus and nitrogen have value and crucial significance: as important macronutrients, there are resources to be recovered; and as environmental pollutants, there are emissions to be minimised. Total solids can be used as a proxy for energy that could be recovered, for example, in the form of briquettes or biochar, as well as for organic matter that could be recovered as soil amendment. If discharged into the environment, total solids also has significant pollution potential. Water is under increasing pressure in many urban areas and has become a scarce commodity which should be either saved or reused.

For TN and TS, the behaviour is also more difficult to predict than for TP and water. Water is a special case because the inflowing masses vary significantly depending on the source (e.g. dry toilet versus cistern-flush toilet) and from a sustainability perspective, both the requirement and the recovered masses are interesting.

We are aware that these are not the only performance indicators required for the evaluation of the main decision criteria. However, to align decisions with the SDGs, the optimized use of natural resources and the minimisation of losses to the environment (both services provided by many technology innovations) become more relevant than ever.

There are two main general interests in the *SanitationSystemMassFlow* model. First, knowledge on the substance flow and emissions to the environment is gained. And secondly, options and potentials of the different sanitation systems for recovery and reuse of these substances are better understood.

In the following, the interest in the used substances, their sources, fates in the treatment process, and transfer coefficients are described in more detail.

1.7.5.2 Phosphorus

1.7.5.2.1 Interest and reuse potential

Phosphorus (P) is an essential nutrient for plant growth and may cause algae bloom in water bodies, leading to excessive oxygen consumption and oxygen free zones (Tchobanoglous et al., 2009). As phosphates are not reduced like organic matter, but remain in the cycle, the discharge of effluents from sanitation systems containing P can be problematic. Because P is an important plant nutrient, the recovery of P from sanitation systems can be financially attractive and achieved through different methods (e.g. irrigation with effluent, composting of sludge, or struvite production (Etter et al., 2011; Jönsson et al., 2004).

1.7.5.2.2 Sources of P in wastewater and chemical characteristics

In raw wastewater P is found in different forms as organic phosphates, inorganic orthophosphates, and polyphosphates. While organic phosphates have physiological origin, inorganic phosphates originate mainly from

detergents and other household chemicals (von Sperling, 2007). Humans excrete 30 to 50% of P in faeces and the other 50 to 70% in urine (Montangero and Belevi, 2007; Rose et al., 2015). As detergents can account for up to 50% of P in wastewater, it is vital to know if greywater enters a treatment system or not (von Sperling, 2007).

Orthophosphates, such as PO₃-, HPO₄²-, H₂PO₄- and H₃PO₄, are directly available for biological metabolism, in which of these forms they occur depends on the pH (Montangero and Belevi, 2007). Polyphosphates are complex molecules, which slowly transform to the orthophosphate forms through hydrolysis and can then be consumed by microorganisms (Tchobanoglous et al., 2009; von Sperling, 2007).

The bigger part (~75%) of phosphorus in raw domestic sewage is soluble, comprised of the inorganic forms, as well as part of P bound to soluble organic matter. The remaining ~25% are organic P bound to particulate organic matter (Tchobanoglous et al., 2009; von Sperling, 2007).

1.7.5.2.3 Treatment process

Phosphorus is required as a growth nutrient for microorganisms that stabilise organic matter during treatment (von Sperling, 2007). Consequently, biological removal of phosphorus is based on the removal of phosphate accumulating organisms. Removal of phosphorus by physical-chemical processes after biological treatment can polish the effluent and result in very low P (Sasse, 1998; von Sperling, 2007). Transformation or storage of P (e.g. in compost) are additional ways of treatment, with the aim of recovery.

1.7.5.2.4 Determination of transfer coefficients for P

For the *SanitationSystemMassFlow* model, we use Total phosphorus (TP) to describe the flows of P through sanitation systems because most of the consulted research literature on the TCs for P in sanitation technologies uses TP as a measurement. A few literature examples also look at another type of phosphorus. In these cases, estimations were transformed to TP. The uncertainties that come with this procedure are considered in the corresponding concentration factor.

1.7.5.3 Nitrogen

1.7.5.3.1 Interest and reuse potential

Just like phosphorus, nitrogen (N) is a fundamental nutrient for plant growth and a potential pollutant of water bodies, leading to algae growth and eutrophication (Mudrack and Kunst, 2003). Adverse impacts on humans are caused by nitrite (NO_2 -) in drinking water, as it can cause illness (methemoglobinemia). In the form of free ammonia gas (NH_3), it is toxic to fish (von Sperling, 2007). During nitrogen conversions in wastewater treatment processes, nitrous oxide (N_2O) is produced (Kampschreur et al., 2009). N_2O emission are not discussed further here but accounted for by air losses of total nitrogen.

Nitrogen is also a valuable fertiliser. During composting and drying of faeces and sludge, a high percentage of nitrogen volatises (Meinzinger, 2010). The rest remains retained in the biosolid. High N recoveries can be achieved by direct recovery from urine.

1.7.5.3.2 Sources of N in wastewater and chemical characteristics

Nitrogen can take on different oxidation stages in water, the changes between which are often brought about by bacteria. Additionally, the changes in oxidation stages vary with the availability of free oxygen in the water, i.e. aerobic

or anaerobic conditions (Tchobanoglous et al., 2009). The chemistry of nitrogen in wastewater treatment is, thus, fairly complex.

In domestic wastewater, N is mainly found as organic nitrogen and ammonia. About 80 to 90% of N in domestic wastewater originates from urine as urea; the remaining 10 to 20% come from faeces and are mainly in the form of proteinaceous matter (Montangero and Belevi, 2007; Rose et al., 2015). Urea is rapidly hydrolysed to ammonia and is detectable in small quantities only in sewage. In aquatic solutions, ammonia exists in two forms: ammonium ions (NH₄⁺) and ammonia (NH₃) as shown in the equilibrium reaction in:

$$NH_4^+ \leftrightarrow NH_3 + H^+$$

The distribution of ammonia forms here is dependent on the pH. At pH = 9.25, the reaction is in equilibrium, while, at a higher pH, it is displaced to the right and more gaseous ammonia is released (Tchobanoglous et al., 2009). In typical raw domestic sewage., the pH ranges around 7 and consequently ammonia is predominantly present as NH_4^+ (von Sperling, 2007).

1.7.5.3.3 Treatment process

Nitrogen from wastewater undergoes two main processes during treatment, i.e. nitrification and denitrification. Nitrification is a two-step process in which ammonia is first oxidised to nitrite and then to nitrate (Tchobanoglous et al., 2009). The oxidation is carried out by two groups of autotrophic bacteria under aerobic conditions as they consume oxygen. Denitrification occurs under anoxic conditions. Consequently, if essential nitrogen removal is required, the treatment needs to comprise a mixture of aerobic and anaerobic conditions (Sasse, 1998).

1.7.5.3.4 Determination of transfer coefficients for N

Different forms of nitrogen can be and are measured in wastewater treatment monitoring, often according to the treatment process and prevailing form of N. A short overview of the commonly measured forms of N is given here (von Sperling, 2007):

Organic nitrogen (No): Nitrogen in the form of proteins, amino acids and urea

Ammonia: Ammonium ions (NH₄+) and ammonia gas (NH₃), produced by the

decomposition of organic nitrogen

Nitrite: NO₂-, product of first oxidation stage of ammonia, basically not found in

raw sewage

Nitrate: NO₃-, final product of ammonia oxidation, basically not found in raw

sewage

Total Nitrogen: Includes organic nitrogen, ammonia, nitrite and nitrate

Total Kjeldahl nitrogen (TKN): Organic nitrogen and ammonia together

For the *SanitationSystemMassFlow* model, Total nitrogen (TN) is used to describe the flows of N through sanitation systems. Many of the studies considered for the determination of TCs, however, did not measure TN, but did measure

other forms of N. If TN and an additional form of N were measured in one literature source, the ratio of these two was determined and applied to other literature for the same or similar treatment processes in order to convert all values found in the literature to TN. Ratio estimations were made based on the measured form of N and personal knowledge of the nitrogen pathway in the respective technology. The uncertainties that come with this procedure are represented by the corresponding concentration factor.

1.7.5.4 Total Solids

1.7.5.4.1 Interest and reuse potential

Excessive discharge of total solids (TS) into water bodies induces microbial growth and can, thus, lead to a lowering of the dissolved oxygen availability in water. Aquatic life is negatively impacted and eutrophication may occur. Because of this, determining flows of TS in sanitation systems is important. Moreover, TS can be used as indicator for energy content or for organic carbon content, which is a valuable soil amendment. For both relationships, TS-energy and TS-organics, other factors, especially the volatile and fixed matter content are important. The subchapter "Energy in wastewater" goes into detail about the relation of TS and energy.

1.7.5.4.2 Sources of Total Solids in wastewater and chemical characteristics

The term Total Solids (TS) comprises all matter in wastewater which is not water and which remains after evaporation and drying (Hauser, 1996). Besides faeces, urine and paper from toilet usage, food residues and wash waters have to be considered.

Total solids can be further divided by size and state into Total Suspended Solids (TSS) and Total Dissolved Solids (TDS) (Sasse, 1998). TSS includes settleable, as well as non-settleable suspended solids retained by filtration and is often used as an indicator for the performance of wastewater treatment plants (Tchobanoglous et al., 2009). An alternative way of describing the different fractions of TS is by distinguishing them into Volatile Solids (VS) and Fixed Solids (FS). VS burn off or volatilise when heating up to temperatures of around 550°C and are considered the organic matter fraction of wastewater (Tchobanoglous et al., 2009). FS still contains a combustible part (inorganic solids) and inert mineral (ash), see also Figure 9.

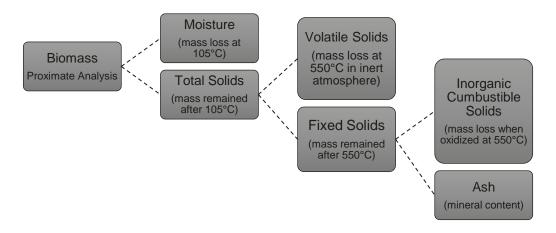


Figure 9. Procedure for determination of biomass volatile solids, fixed solids and ash (Sahito et al., 2013)

1.7.5.4.3 Treatment process

In primary treatment especially, suspended solids get removed through the physical process of sedimentation (50 to 70% of TSS) (Scholz, 2006). A major part of this is organic matter in suspension. As a result, primary sludge contains a big VS fraction, which is the fraction interesting for fertilisation or energy recovery. In secondary treatment, the solids content in wastewater is further reduced through biochemical processes carried out by different kinds of microorganisms (Hauser, 1996; von Sperling, 2007). There are different setups for secondary treatment, all aiming at establishing contact of the microorganisms with the wastewater through biofilms, mixing or guided flow paths (von Sperling, 2007).

1.7.5.4.4 Determination of transfer coefficients for TS

The literature mostly reports on measurements of the removal efficiencies of TSS. To obtain values for TS pathways, studies measuring TS, as well as TSS removal ratios, were used to establish a "removal ratio" between these. The ratios were then applied to other data to calculate transfer coefficients for TS (see, for example, the calculation 13.2.1 in the "Septic Tank" technology factsheet in <u>chapter 02 - Part B: Technology factsheets</u>). The uncertainties that result from this procedure are represented by the corresponding uncertainty factor.

Another difficulty that was encountered relates to the consumption of solids by microorganisms. As the used concept of transfer coefficients does not include a "removal" of substance but only describes their transfer into output products, compromises had to be made. In most cases the amount of solids taken up by microorganisms was considered as transferred to sludge. In composting and dehydration technologies, it was considered as air loss.

1.7.5.4.5 Energy from wastewater

There are different ways energy can be gained from wastewater. Biogas is produced in anaerobic digestion of wastewater sludge and can be used for electricity production or as heating energy. Other technologies for thermal processing of faeces or faecal sludge in mono- and co-combustion include pelletising or briquetting (Werther and Ogada, 1999).

To estimate the energy that can be gained through the combustion of biomass solid fuels, the composition of the fuel is of importance. While volatile and fixed solids contribute to the calorific value, high ash and moisture content have a negative effect (Sheng and Azevedo, 2005; Yin, 2011).

The following equation can be used to calculate the gross calorific value (GCV) of biomass, based on the amount of fixed and volatile solid content minus ash (Sahito et al., 2013).

$$GCV [MJ/kg] = 0.21575 (VS) + 0.07492 (FS) - 0.08426 (ash)$$

In the case of faecal sludge, ash originates, for example, from indigestible nutrients and sand from pit linings and increases slagging and fouling (Hafford et al., 2017; Rose et al., 2015). The moisture content of the fuel again depends on the drying technology.

The heating value of faecal sludge varies considerably, depending on initial composition, storage duration and containment types (Strande et al., 2014). It has, for example, been shown that anaerobic digestion of faecal sludge reduces the readily degradable organic fraction into ash and lowers the calorific value (Andriessen et al., 2019). Dried faeces or sewage sludge, therefore, have a higher calorific value than anaerobic digested sludge (Hafford et al., 2017).

In the same way, energy recovery in the form of biogas, which is based on methane production from anaerobic digestion, works best from primary sludge. Most organic matter is contained in settleable solids, collects here and can be digested (Shizas and Bagley, 2004; Zhang and Li, 2017).

1.7.5.5 Water

1.7.5.5.1 Interest and reuse potential

Wastewater reuse is an important part of urban water cycles. In about 80% of the towns in Africa, Asia and Latin America, use wastewater, non- or partially treated, for irrigation (Meinzinger, 2010). This due to the scarcity of fresh water, high prices, or convenience. Fertilisers are also expensive, and the nutrients and organic matter contained in the wastewater are an added value. Moreover, the availability can be linked to water consumption (Meinzinger, 2010). As treated wastewater still contains pathogens, it should be handled with care (Sasse, 1998) and treated according to the purpose (e.g. if used for irrigation, nutrient content is not a problem). Guidelines on the usage of treated wastewater are published by various organisations, such as the WHO (von Sperling, 2007). To plan the irrigation options with reclaimed water, the quantities available after losses in the sanitation systems are important to know better.

1.7.5.5.2 Sources of water and chemical characteristics

Water in sanitation systems can originate from various sources within households: toilet flushing, bathing, wash water, kitchen sinks and so on. Depending on the country, type of toilet, culture and habit, different flows are to be expected. Additionally, there is stormwater, which may infiltrate into sanitation systems and influence the flow rates. In this study, only flush water is considered as entering the system.

1.7.5.5.3 Treatment process

In most treatment technologies considered in this study, there is little change in the amount of water flow. Some is retained when solid and liquid phase are separated. The biggest losses of water are due to evapotranspiration and infiltration.

1.7.5.5.4 Determination of transfer coefficients for water

Little data was found on the pathway of water in sanitation technologies, most likely because as mentioned before, there is almost no change in quantity. If technologies are open to the atmosphere, evaporation may occur. Infiltration into soil due to leakages is another pathway but is not well documented. Consequently, a lot of TC used in this study are based on expert judgement.

1.7.6 Currently implemented inflows

For the four implemented substances, we also defined inflows for currently implemented toilet sources using values from international literature. These inflow values are average literature from all over the world and therefore are quite generic. For the application in a specific case, those values could be adjusted to account for the local diet and flush water usages.

Table 9: Overview of estimated inflow substance masses based on international literature per person and year. TP: total phosphorus, TN: total nitrogen, TS: total solids, H2O: water. The amount of TP, TN, and TS are the same for all sources; only

the water inflow masses depend on the flush volume. The assumed amount of flushing water is 2L/day/person for the pour flush toilet and 60 L/day/person for the cistern flush toilet.

Inflows in kg year ⁻¹ for 1 person equivalent	Total phosphorus	Total nitrogen	Total solids	Water
Cistern Flush Toilet	0.548	4.55	32.12	22'447.1
Pour Flush Toilet	0.549	4.56	32.13	1'277.1
Dry Toilet	0.550	4.57	32.14	547.1
Urine Diverting Dry Toilet	0.551	4.58	32.15	547.1
Urine Diverting Flush Toilet	0.552	4.59	32.16	22'447.1
Urinal	0.370	4.00	21.54	510.98
Controlled Open Defecation (humanitarian)	0.554	4.61	32.18	547.1

Table 10: Detailed overview on raw data and used literature to estimate inflow substance masses. *Retained values

		g/P/d	Kg/P/Year	Reference
TP	Urine		0.365*	(Vinnerås, 2002; Vinnerås et al., 2006)
			0.3	(Jönsson et al., 2004)
	Faeces		0.183*	(Vinnerås, 2002; Vinnerås et al., 2006)
			0.1	(Jönsson et al., 2004)
	Total	1	0.365	(von Sperling, 2007)
			0.548*	(Vinnerås, 2002; Vinnerås et al., 2006)
			0.4	(Jönsson et al., 2004)
TN	Urine		4*	(Vinnerås, 2002; Vinnerås et al., 2006)
		11	4.015	(Rose et al., 2015)
			2.3	(Vinnerås, 2002; Vinnerås et al., 2006)
	Faeces		0.55*	(Vinnerås, 2002; Vinnerås et al., 2006)
		1.8	0.657	(Rose et al., 2015)
			0.3	(Jönsson et al., 2004)
	Total	8	2.92	(von Sperling, 2007)
			<i>4.55</i> *	(Vinnerås, 2002; Vinnerås et al., 2006)

2.6 (Jönsson et al., 2004) TS Urine 59 21.535* (Rose et al., 2015) dry weight 14 5.11 (Rose et al., 2015) summary 45.4 16.571 (Meinzinger, 2010), Annex B Faeces 29 10.585* (Rose et al., 2015) dry weight 32 11.68 (Rose et al., 2015) summary 40.4 14.746 (Meinzinger, 2010), Annex B				4.672	(Rose et al., 2015)
TS Urine 59 21.535* (Rose et al., 2015) dry weight 14 5.11 (Rose et al., 2015) summary 45.4 16.571 (Meinzinger, 2010), Annex B Faeces 29 10.585* (Rose et al., 2015) dry weight 32 11.68 (Rose et al., 2015) summary 40.4 14.746 (Meinzinger, 2010), Annex B					
45.4 16.571 (Meinzinger, 2010), Annex B Faeces 29 10.585* (Rose et al., 2015) dry weight 32 11.68 (Rose et al., 2015) summary 40.4 14.746 (Meinzinger, 2010), Annex B	TS	Urine		21.535*	(Rose et al., 2015) dry weight
Faeces 29 10.585* (Rose et al., 2015) dry weight 32 11.68 (Rose et al., 2015) summary 40.4 14.746 (Meinzinger, 2010), Annex B			14	0	
32 11.68 (Rose et al., 2015) summary 40.4 14.746 (Meinzinger, 2010), Annex B			45.4	16.571	(Meinzinger, 2010), Annex B
40.4 14.746 (Meinzinger, 2010), Annex B		Faeces	29	10.585*	(Rose et al., 2015) dry weight
(32	11.68	(Rose et al., 2015) summary
T. () () () () () () () () () (40.4	14.746	(Meinzinger, 2010), Annex B
180 65.7 (von Sperling, 2007)		Total	180	65.7	(von Sperling, 2007)
32.12 * (Rose et al., 2015),from dry weight				32.12*	(Rose et al., 2015), from dry weight
16.79 (Rose et al., 2015) 2015 summary				16.79	(Rose et al., 2015) 2015 summary
31.317 (Jönsson et al., 2004)				31.317	(Jönsson et al., 2004)
H ₂ O Urine 529 (Vinnerås et al., 2006)	H ₂ O	Urine		529	(Vinnerås et al., 2006)
1399.9 510.98 * (Rose et al., 2015)			1399.9	510.98*	(Rose et al., 2015)
Faeces 40 (Vinnerås et al., 2006)		Faeces		40	(Vinnerås et al., 2006)
99 36.135 * (Rose et al., 2015)			99	36.135*	(Rose et al., 2015)
Total 569 (Vinnerås et al., 2006)		Total		569	(Vinnerås et al., 2006)
547.11 * (Rose et al., 2015)				547.11*	(Rose et al., 2015)
Flushwater Dry toilet 0	Flushwater	Dry toilet		0	
Pour flush 2555		Pour flush		2555	
547.5				547.5	
730* 2 litres, own experience of Nepal, only once per day				730*	2 litres, own experience of Nepal, only once per day
cistern flush 21900* 10 litres, own experience, 5+1 times per day		cistern flush		21900*	10 litres, own experience, 5+1 times per day
UDDT 0		UDDT		0	

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Part B: Technology factsheets

- 2.1 OVERVIEW

In this Part B, the detailed data behind the SANTIAGO technology library are available. It is a compilation of (Gensch et al., 2018; Mcconville et al., 2020; Tilley et al., 2014) and many other references to establish appropriateness attributes and transfer coefficients. The condensed JSON format is available here:

www.github.com/santiago-sanitation-systems/Sanitation-technology-library

Based on the here presented examples of data, the SANTIAGO user can develop or adjust the JSON library to modify or add Technologies or appropriateness attributes.

- 2.2 EXPLAINING THE TECHNOLOGY SHEETS

The SANTIAGO technology library is based on different technology sheets. Each technology has a sheet containing the quantified technology attributes and transfer coefficients including the data sources and assumptions behind them. The PDF sheets are to be read according to the following overview:

Table 11: Overview of the technology sheet PDFs.

FUNCTIONAL GROUP	Functional Group of the Technology (see <u>chapter 1.2.4</u> <u>Functional groups</u>): user interface (U), collection and storage/treatment (S), conveyance (C), (semi-)centralized treatment (T), use and/or disposal (D)				
NUMBER	Number identifying technology in the technology list				
UNIQUE IDENTIFIER	Code that uniquely identifies each technology				
DATA COMPILER	All persons who compiled the data in the technology sheet				
REVIEWER	All persons who reviewed the technology sheet				
INPUT PRODUCT	Input products of the technology; for an overview of all products and more information see <i>chapter 1.2.2 Sanitation Products</i> .				
OUTPUT PRODUCT	Output products of the technology; for an overview of all products and more information see <i>chapter 1.2.2 Sanitation Products</i> .				
RELATIONS	Describes the relation between the input and between the output products: 'OR': any possible combination of products entering/leaving the technology 'XOR': a mutual exclusion with only one of the products entering/leaving the technology 'AND': a compulsory co-existence of all products entering/leaving the technology For technologies in the FG C (conveyance): the order of output products separated by ">" indicates which output product is most/more dominant in case different products get mixed during conveyance. For example if blackwater AND greywater enter a				

	conventional sewer, the output product will be considered to be transported blackwater (as blackwater > greywater).
COMMENTS	Additional comments
EXTENDED PROPERTIES	Includes evaluation criteria of a technology that are not part of
	the appropriateness assessment.

Appropriateness Attributes

Overview of the quantified screening criteria for the technology including the underlying assumptions and data sources. Each Screening Criterion has a unique identifier (e.g. "water_supply" for criterion "Water Supply"). It is further defined by its Type "*Performance/PDF*" and its Function Type "*Categorical/Trapez*". For a further explanation of the attributes and functions refer to *chapter 1.4.2 Appropriateness Profiles*.

For trapez functions the unit and for categorical functions the possible categories are given in column "UNITS/CATEGORIES". The actual quantified attribute values can be found in the column "PARAMETERS", while the reasoning for these values is explained in the following column "DATA SOURCE/ASSUMPTIONS".

Some attributes are not considered appropriate for certain functional groups and are marked as "FALSE" and "NA". For example, technologies in the functional group user interface (FG U) do not need to be evaluated according to the acceptable "Water Volume" ("water_vol_cont").

Table 12: Example of screening criteria with the underlying assumptions and data sources.

ATTRIBUTE	TYPE AND FUNCTION	ATTRIBUTE USED FOR THIS TECHNOLOGY [TRUE/FALSE]	UNITS/ CATEGORIES	PARAMETERS	DATA SOURCE/ ASSUMPTIONS	REVIEW DONE
water_supply	Performance, Categorical	TRUE	house yard public none	•	"Requires a constant source of water", "Requires less water than a traditional Cistern Flush Toilet" (Tilley, E. et al. (2014)) It is assumed that UDFTs are not appropriate if there is no in-house water supply.	yes
water_volume	Performance, Trapez	FALSE	[L/cap/day]	NA		NA

Transfer coefficients

Overview of the quantified transfer coefficients as well as the concentration factor for the Dirichlet distribution (k) for the output products of the technology. The technology sheet includes the calculations to determine these transfer coefficients as well as their underlying data sources. For further information on the quantification refer to *chapter 1.4.3 Quantifying Transfer Coefficients*.

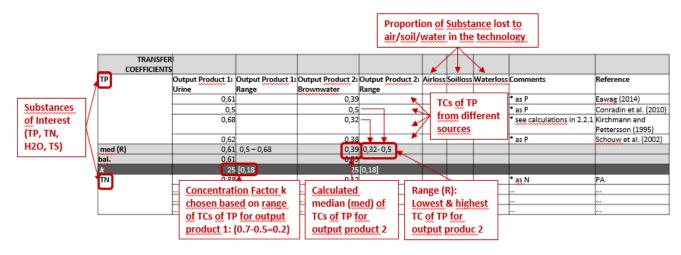


Figure 10: Example of transfer coefficients in the technology factsheets.

Table 13: Example of additional calculations to the transfer coefficients in the technology factsheets.

Additional Information: Calculation 2.2.1

	N [kg	N/P*a]	P [kg	P/P*a]	TC_TN	TC_TP
	Median	Range	Median	Range		
Urine	3,4	2.5 - 4.3	0,85	0.7 - 1.0	0,85	0,68
Faeces	0,6	0.5-0.7	0,4	0.3 - 0.5	0,15	0,32
Data from: Kirchmann and Pettersson (1995)		Calculation:				
					TC_TN Urine =	TC_TP Urine =
					Mass N in Urine [kg N/P*a]/	Mass P in Urine [kg P/P*a]/
					Total Mass N (in Urine & Faeces)	Total Mass P (in Urine & Faeces)
					[kg N/P*a]	[kg P/P*a]
					0,85 = 3,4 / (3,4 + 0,6)	0,68 = 0,85 / (0,85 + 0,4)
				TC_TN Faeces = Mass N in Faeces	TC_TP Faeces = Mass P in Faeces	
					[kg N/P*a]/	[kg P/P*a]/
					Total Mass N (in Urine & Faeces)	Total Mass P (in Urine & Faeces)
					[kg N/P*a]	[kg P/P*a]
					0,15 = 0,6 / (3,4 + 0,6)	0.32 = 0.4 / (0.85 + 0.4)

Abbreviations:

TP: Total Phosphorus
TN: Total Nitrogen

H2O: Water

TS: Total Solids med:. Median (R): Range

bal.: Balanced Results

k: ... [] Concentration factor [and range it was based on]

PA: Personal Assessment by Author

EJ: Expert Judgement

Comment: *as... Chemical form in which the substance was described in the reference

calculations X.X Further calculations based on information in the source found in the Additional

Information

Calculations

The TCs were calculated with the following equation

$$TC_{i,s} = \frac{out_{i,s}}{\sum_{j=1}^{n} in_{j,s}}$$

Where:

- → out_{i,s} = mass of substance s in output product i
- $\rightarrow in_{i.s}$ = mass of substance s in input product j
- → s = substance of interest

The TCs from different sources are aggregated by determining the median of all found TCs. In some cases the different medians for the TCs of different output products do not sum up to 1. For such cases the results are balanced with the equation below and the balanced results should have a sum of 1.

$$bal.median_{op,1} = \frac{median_{op,1}}{\sum_{i=1}^{n} median_{op,i}}$$

Where:

- \rightarrow median_{op,i} = median of output product i
- → bal. median_{op,1}= balanced median of output product i

The concentration factor for the Dirichlet distribution k can be determined in two ways: Firstly, if literature data is present, it is determined based on the range of values, which we define as the difference between the lowest and the highest TC value mentioned in all sources (see Table 4). Secondly, if the TCs are determined by expert judgement, then the concentration factor k is based on the confidence of the expert (see Table 5).

2.2.1 Customization of Technology Library

Customization includes adding, modifying, removing technologies, products, or criteria:

Technologies can be added by entering all required data for a technology sheet (products, appropriateness criteria, TCs) (see <u>chapter — 2.2 Explaining the technology sheets</u>). The same way several more detailed versions of the same technology can be set up by copying the original version and adapting it to the personal specifications (e.g. make different types of single pits for different products).

Similarly the generic technology data can be adapted to the specific technologies one wishes to use by changing the appropriateness profiles according to <u>chapter 1.4.2 Appropriateness Profiles</u> and the criteria definition in <u>chapter 1.7.3 Currently implemented screening criteria</u> or to use more complicated or better validated TC models if more accuracy is needed.

Finally, it is also possible reduce the number of technologies to ones that are applicable for the case study and reduce the computation time of the programme.

- 2.3 CURRENTLY IMPLEMENTED TECHNOLOGIES

A technology is defined by its functional group (FG), its unique identifier (ID), its input and output products as well as the relation between the input as well as the output products, its appropriateness profile and the TCs. A detailed description of each technology can be found online on SaniChoice based on (Gensch et al., 2018; Mcconville et al., 2020; Tilley et al., 2014). A technology belonging to functional group toilet user interface (U) is always a source and does not have any input products (NA), while a Tech belonging to FG reuse or disposal (D) is always a sink and does not have an output product (NA). Additional sources, such as tabs, drainage, or organic solid waste collection bins can also be added and are assigned to a sub-group of U called Uadd.

Table 14: List of currently implemented technologies defined by a unique identifier (ID). The table also contains information on the functional group (FG) of the technology, the input and output products of the technology as well as the relations between the input products as well as the output products.

FG	Name	Unique Identifier (ID)	Input products	Output products	Relations
Ua dd	Handwashing Facility	handwashing_facility	freshwater For Santiago: NA	greywater	Input: NA Output: NA
Ua dd	Kitchen Sink	kitchen_sink	freshwater For Santiago: NA	greywater	Input: NA Output: NA
Ua dd	Organic Waste Bin	organic_waste_bin	organics For Santiago: NA	organics	Input: NA Output: NA
Ua dd	Stormwater Collection	stormwater_collection	stormwater For Santiago: NA	stormwater	Input: NA Output: NA
U	Cistern-Flush Toilet	cistern_flush	urine, faeces, flushwater, anal_cleansing_water For Santiago: NA	blackwater	Input: OR, For Santiago: NA Output: NA

U	Pour-Flush Toilet	pour_flush	urine, faeces, flushwater, anal_cleansing_water For Santiago: NA	blackwater	Input: OR, For Santiago: NA Output: NA
U	Dry Toilet	dry_toilet	urine, faeces, anal_cleansing_water For Santiago: NA	excreta	Input: OR, For Santiago: NA Output: NA
U	Urine Diversion Dry Toilet (UDDT)	uddt	urine, faeces For Santiago: NA	urine, faeces	Input: OR, For Santiago: NA Output: AND
U	Urine Diversion Flush Toilet (UDFT)	udft	urine, faeces, flushwater, anal_cleansing_water For Santiago: NA	blackwater, urine	Input: OR, For Santiago: NA Output: AND
U	Urinal	urinal	urine For Santiago: NA	urine	Input: NA Output: NA
U	User Interface for Controlled Open Defecation	u_controlled_od	urine, faeces For Santiago: NA	od_excreta	Input: NA Output: NA
S	Urine Storage Tank	urine_storage_tank	urine	stored_urine	Input: NA Output: NA
S	Double Dehydration Vaults	double_dehydration_ vaults	faeces	dried_faeces	Input: NA Output: NA
S	Single Faeces Storage Chamber	single_faeces_stora ge_chamber	faeces	stored_faeces	Input: NA Output: NA
S	Container-Based Toilet	container_based_toil et	faeces	stored_faeces	Input: NA Output: NA
S	Single Pit	single_pit	faeces, excreta, blackwater	sludge	Input: OR Output: NA
S	Single Ventilated Improved Pit	single_vip	faeces, excreta, blackwater	sludge	Input: OR Output: NA
S	Double Ventilated Improved Pit	double_vip	faeces, excreta	pithumus	Input: OR Output: NA
S	Twin Pits for Pour- Flush Toilets	twin_pits_pour_flush	blackwater	pithumus	Input: NA Output: NA
S	Composting chamber	composting_chambe r	faeces, excreta, organics	compost, effluent	Input: OR Output: AND
S	Fossa Alterna	fossa_alterna	faeces, excreta, organics	pithumus	Input: OR Output: NA
S	Onsite Vermi- Composting	onsite_vermi_compo sting	faeces, excreta, organics, blackwater	effluent, compost	Input: OR Output: AND
S	Septic tank	septic_tank	blackwater, greywater	sludge, effluent	Input: OR Output: AND
S	Raised Latrine	raised_latrine	faeces, excreta	sludge	Input: OR Output: NA
S	Shallow Trench Latrine	shallow_trench_latrin e	faeces, excreta	sludge	Input: OR Output: NA
S	Deep Trench Latrine	deep_trench_latrine	faeces, excreta, blackwater	sludge	Input: OR Output: NA
S	Chemical Toilet	chemical_toilet	faeces, excreta	sludge	Input: OR Output: NA
S	Storage Trench for Controlled Open Defecation	s_controlled_od	od_excreta	sludge	Input: NA Output: NA
S	Transfer Station	transfer_station	sludge	transferred_sludge	Input: NA Output: NA
С	Motorized Emptying and Transport of Urine	motorized_emptying _urine	urine, stored_urine, stabilized_urine, concentrated_urine, dried_urine, struvite	NA [for SaniChoice, use x]	Input: OR Output: urine > stored_urine > stabilized_uri ne >

		-			
					concentrated _urine > dried_urine > struvite
	Human-Powered Emptying and Transport of Urine	human- powered_emptying_ urine	urine, stored_urine, stabilized_urine, concentrated_urine, dried_urine, struvite	NA [for SaniChoice, use x]	Input: OR Output: urine > stored_urine >
С					stabilized_uri ne > concentrated _urine > dried_urine > struvite
С	Motorized Emptying and Transport of Solids	motorized_emptying _solids	sludge, transferred_sludge, processed_sludge, pithumus, dried_faeces, stabilized_sludge, stored_faeces, organics, compost, pellets, briquettes, biochar, ash	NA [for SaniChoice, use x]	Input: OR Output: sludge > transferred_sl udge > processed_sl udge > pithumus > dried_faeces > stabilized_slu dge > stored_faece s > organics > compost > pellets > briquettes > biochar > ash
С	Human-Powered Emptying and Transport of Solids	human-powered_emptying_solids	sludge, transferred_sludge, processed_sludge, pithumus, dried_faeces, stabilized_sludge, stored_faeces, organics, compost, pellets, briquettes, biochar, ash	NA [for SaniChoice, use x]	Input: OR Output: sludge > transferred_sl udge > processed_sl udge > pithumus > dried_faeces > stabilized_slu dge > stored_faece s > organics > compost > pellets > briquettes > biochar > ash
С	Conventional Gravity Sewer		blackwater, effluent, greywater, secondary_effluent, stormwater	NA [for SaniChoice, use x]	Input: R Output: blackwater > effluent > greywater > secondary_ef fluent > stormwater
С	Simplified Sewer	simplified_sewer	blackwater, effluent, greywater, secondary_effluent	NA [for SaniChoice, use x]	Input: OR Output: blackwater > effluent > greywater >

					secondary_ef
С	Solids-Free Sewer	solids-free_sewer	effluent, greywater, secondary_effluent	NA [for SaniChoice, use x]	Input: OR Output: effluent > greywater > secondary_ef fluent
С	Stormwater Drainage	stormwater_drainage	greywater, stormwater	NA [for SaniChoice, use x]	Input: OR Output: greywater > stormwater
Т	Urine Bank	urine_bank	transportedurine, transportedstored_urine	transportedstabilized_ urine	Input: OR Output: NA
Т	Struvite Precipitation	struvite_precipitation	urine, transportedurine, greywater, transportedgreywater	struvite, transportedstruvite, effluent, transportedeffluent	Input: OR Output: AND
Т	Nitrification and Distillation of Urine	nitrification_distillatio n_urine	transportedurine, transportedstored_urine	transportedconcentrat ed_urine, transportedsecondary_ effluent	Input: OR Output: AND
Т	Alkaline Dehydration of Urine	alkaline_dehydration _of_urine	transportedurine, transportedstored_urine	transporteddried_urine	Input: OR Output: NA
Т	Unplanted Drying Bed Sludge	unplanted_drying_be d_sludge	sludge, transportedsludge, transportedtransferred_sludge	stabilized_sludge, transportedstabilized_ sludge, effluent, transportedeffluent	Input: OR Output: AND
Т	Planted Drying Bed	planted_drying_bed	sludge, transportedsludge, transportedtransferred_sludge	stabilized_sludge, transportedstabilized_ sludge, effluent, transportedeffluent	Input: OR Output: AND
Т	Unplanted Drying Bed Dry	unplanted_drying_be d_dry	stored_faeces, transportedstored_faeces pithumus, transportedpithumus	dried_faeces, transporteddried_faec es	Input: OR Output: AND
Т	Sedimentation / Thickening Ponds	sedimentation- thickening_ponds	transportedsludge, transportedtransferred_sludge	transportedprocessed_ sludge, transportedeffluent	Input: OR Output: AND
Т	Co-Composting	co-composting	stored_faeces, transportedstored_faeces, pithumus, transportedpithumus, sludge, transportedsludge, , transportedtransferred_sludge, processed_sludge, transportedprocessed_sludge, organics, transportedorganics	compost, transportedcompost	Input: OR Output: AND
Т	Offsite Vermi- Composting	offsite_vermi_compo sting	stored_faeces, transportedstored_faeces, pithumus, transportedpithumus, sludge, transportedsludge, transportedtransferred_sludge, blackwater, transportedblackwater, organics, transportedorganics	compost, transportedcompost, effluent, transportedeffluent	Input: OR Output: AND
Т	Black Soldier Fly Composting	black_soldier_fly_co mposting	transportedstored_faeces, transportedpithumus, transportedsludge, transportedtransferred_sludge, transportedorganics	transportedcompost	Input: OR Output: NA
Т	Ladepa-Pelletizing	ladepa_pelletizing	transportedstored_faeces, transportedsludge, transportedtransferred_sludge, transportedprocessed_sludge, transportedstabilized_sludge, transportedpithumus	transportedpellets	Input: OR Output: NA

Т	Briquetting (Sanivation)	briquetting	transporteddried_faeces, transportedstored_faeces, transportedprocessed_sludge, transportedstabilized_sludge, transportedpithumus	transportedbriquettes	Input: OR Output: NA
Т	Settler	settler	blackwater, transportedblackwater	effluent, transportedeffluent, sludge, transportedsludge	Input: OR Output: AND
Т	Imhoff Tank	imhoff_tank	blackwater, transportedblackwater, greywater, transportedgreywater	effluent, transportedeffluent, sludge, transportedsludge	Input: OR Output: AND
Т	Anaerobic Baffled Reactor (ABR)	abr	blackwater, transportedblackwater, greywater, transportedgreywater	effluent, transportedeffluent, sludge, transportedsludge	Input: OR Output: AND
Т	Upflow Anaerobic Sludge Blanket Reactor (UASB)	uasb	blackwater, transportedblackwater, sludge, transportedsludge, transportedtransferred_sludge, pithumus, transportedpithumus	effluent, transportedeffluent, processed_sludge, transportedprocessed_ sludge, biogas, transportedbiogas	Input: OR Output: AND
Т	Anaerobic Filter	anaerobic_filter	blackwater, transportedblackwater, greywater, transportedgreywater, effluent, transportedeffluent	effluent, transportedeffluent, sludge, transportedsludge	Input: OR Output: AND
Т	Sequencing Batch Reactor (SBR)	sbr	blackwater, transportedblackwater, greywater, transportedgreywater, sludge, transportedsludge, transportedtransferred_sludge	processed_sludge, transportedprocessed_ sludge, effluent, transportedeffluent	Input: OR Output: AND
Т	Waster Stabilization Ponds (WSP)	wsp	transportedblackwater, transportedgreywater, transportedeffluent, transportedstormwater	transportedsludge, transportedsecondary_ effluent	Input: OR Output: AND
Т	Free-Water Surface Constructed Wetland	free-water_wetland	effluent, transportedeffluent, greywater, transportedgreywater, stormwater, transportedstormwater	secondary_effluent, transportedsecondary_ effluent	Input: OR Output: AND
Т	Horizontal Subsurface Flow Constructed Wetland	horizontal_wetland	blackwater, transportedblackwater, effluent, transportedeffluent, greywater, transportedgreywater, stormwater, transportedstormwater	secondary_effluent, transportedsecondary_ effluent	Input: OR Output: AND
Т	Vertical Flow Constructed Wetland	vertical_wetland	blackwater, transportedblackwater, effluent, transportedeffluent, greywater, transportedgreywater, stormwater, transportedstormwater	secondary_effluent, transportedsecondary_ effluent	Input: OR Output: AND
Т	Aerated Pond	aerated_pond	transportedblackwater, transportedgreywater, transportedeffluent	transportedsludge, transportedsecondary_ effluent	Input: OR Output: AND
Т	Trickling Filter	trickling_filter	transportedblackwater, transportedgreywater, transportedeffluent	transportedsludge, transportedsecondary_ effluent	Input: OR Output: AND
Т	Activated Sludge	activated_sludge	transportedblackwater, transportedgreywater, transportedeffluent	transportedsludge, transportedsecondary_ effluent	Input: OR Output: AND
Т	Lactic Acid Fermentation Treatment	lactic_acid_fermenta tion_treatment	stored_faeces, transportedstored_faeces, blackwater,	stabilized_sludge , transportedstabilized_ sludge	Input: OR Output: AND

			transportedblackwater, sludge, transportedsludge, transportedtransferred_sludge		
Т	Caustic Soda Treatment	caustic_soda_treatm ent	stored_faeces, transportedstored_faeces, blackwater, transportedblackwater, sludge, transportedsludge, transportedsludge	stabilized_sludge , transportedstabilized_ sludge, effluent, transportedeffluent	Input: OR Output: AND
Т	Urea Treatment	urea_treatment	stored_faeces, transportedstored_faeces, blackwater, transportedblackwater, sludge, transportedsludge, transportedsludge	stabilized_sludge , transportedstabilized_ sludge	Input: OR Output: AND
Т	Hydrated Lime Treatment	hydrated_lime_treat ment	stored_faeces, transportedstored_faeces, blackwater, transportedblackwater, sludge, transportedsludge, transportedtransferred_sludge	stabilized_sludge , transportedstabilized_ sludge, secondary_effluent, transportedsecondary_ effluent	Input: OR Output: AND
Т	Microbial Fuel Cell	microbial_fuel_cell	transportedurine, transportedeffluent, transportedgreywater	transportedsecondary_ effluent	Input: OR Output: NA
Т	Algae Cultivation	algae_cultivation	transportedurine, transportedblackwater, transportedeffluent, transportedgreywater	transportedsecondary_ effluent	Input: OR Output: NA
Т	Membrane Filtration	membrane_filtration	transportedurine, transportedeffluent, transportedgreywater	transportedconcentrat ed_urine	Input: OR Output: NA
Т	Carbonisation	carbonisation	transportedstored_faeces, transporteddried_faeces, transportedsludge, transportedprocessed_sludge, transportedtransferred_sludge	transportedbiochar	Input: OR Output: NA
Т	Mono-Incineration	mono_incineration	transportedstored_faeces, transporteddried_faeces, transportedsludge, transportedprocessed_sludge, transportedstabilized_sludge, transportedpithumus	transportedash	Input: OR Output: NA
Т	Biogas Reactor	biogas_reactor	blackwater, transportedblackwater, sludge, transportedsludge, transportedtransferred_sludge, stored_faeces, transportedstored_faeces, pithumus, transportedpithumus, organics, transportedorganics	processed_sludge, transportedprocessed_ sludge, biogas, transportedbiogas	Input: OR Output: AND
D	Application of Urine and Nutrient Solutions	application_of_urine	stored_urine, transportedstored_urine, stabilized_urine, transportedstabilized_urine	NA	Input: OR Output: NA
D	Application of Concentrated Urine	application_concentr ated_urine	concentrated_urine, transportedconcentrated_urine	NA	Input: OR Output: NA
D	Application of Struvite or Dried Urine	application_struvite_ driedurine	struvite, transportedstruvite, dried_urine, transporteddried_urine	NA	Input: OR Output: NA
D	Application of Dried Faeces	application_of_dried _faeces	dried_faeces, transporteddried_faeces	NA	Input: OR Output: NA
D	Application of Compost and Biochar	application_of_comp ost_biochar	compost, transportedcompost, pithumus, transportedpithumus, biochar, transportedbiochar, ash, transportedash	NA	Input: OR Output: NA

D	Application of Stabilized Sludge	application_of_sludg e	processed_sludge, transportedprocessed_sludge, stabilized_sludge, transportedstabilized_sludge, pithumus, transportedpithumus, pellets, transportedpellets, briquettes, transportedbriquettes	NA	Input: OR Output: NA
D	Fill and Cover	fill_and_cover	stored_faeces, transportedstored_faeces, dried_faeces, transporteddried_faeces, pithumus, transportedpithumus, stabilized_sludge, transportedstabilized_sludge	NA	Input: OR Output: NA
D	Biogas Combustion	biogas_combustion	biogas, transportedbiogas	NA	Input: OR Output: NA
D	Briquettes as Fuel	briquettes_as_fuel	briquettes, transportedbriquettes	NA	Input: OR Output: NA
D	Co-Combustion	co_combustion	transportedstored_faeces, transporteddried_faeces, transportedsludge, transportedprocessed_sludge, transportedstabilized_sludge, transportedpithumus	NA	Input: OR Output: NA
D	Soak Pit	soak_pit	effluent, secondary_effluent, greywater, urine, stored_urine, stabilized_urine	NA	Input: OR Output: NA
D	Leach Field	leach_field	effluent, transportedeffluent, secondary_effluent, transportedsecondary_effluent, greywater, transportedgreywater urine, transportedurine, stored_urine, transportedstored_urine	NA	Input: OR Output: NA
D	Irrigation	irrigation	effluent, transportedeffluent, secondary_effluent, transportedsecondary_effluent, stormwater, transportedstormwater	NA	Input: OR Output: NA
D	Fish Pond	fish_pond	effluent, transportedeffluent, secondary_effluent, transportedsecondary_effluent, greywater, transportedgreywater, stormwater, transportedstormwater	NA	Input: OR Output: NA
D	Floating Plant Pond	floating_plant_pond	effluent, transportedeffluent, secondary_effluent, transportedsecondary_effluent, greywater, transportedgreywater, stormwater, transportedstormwater	NA	Input: OR Output: NA
D	Surface Water Disposal	water_disposal	secondary_effluent, transportedsecondary_effluent, stormwater, transportedstormwater	NA	Input: OR Output: NA
D	Surface Disposal and Storage	surface_disposal_an d_storage	dried_faeces, transporteddried_faeces, processed_sludge, transportedprocessed_sludge, stabilized_sludge, transportedstabilized_sludge, pithumus, transportedpithumus, compost, transportedcompost	NA	Input: OR Output: NA
D	Borehole Latrine	borehole_latrine	faeces, excreta, blackwater	NA	Input: OR

- 2.4 REFERENCES PART B

- Gensch, R., Jennings, A., Renggli, S. and Reymond, P. (2018) Compendium of Sanitation Technologies in Emergencies, German WASH Network (GWN), Swiss Federal Institute of Aquatic Science and Technology (Eawag), Global WASH Cluster (GWC) and Sustainable Sanitation Alliance (SuSanA), Berlin, Germany. https://www.eawag.ch/en/department/sandec/projects/sesp/water-sanitation-and-hygiene-in-emergencies/.
- Mcconville, J., Niwagaba, C., Nordin, A., Ahlström, M., Namboozo, V. and Kiffe, M. 2020. Guide to Sanitation Resource-Recovery Products & Technologies: a supplement to the Compendium of Sanitation Systems and Technologies. http://urn.kb.se/resolve?urn=urn:nbn:se:slu:epsilon-p-109420.
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- 2.5 TECH FACTSHEETS

In the following pages, all the technology factsheets with its calculations, assumptions and references are listed.

March Marc	Handwashing Facility							
Control Cont	General Information		Data Source					
Column	UNIQUE IDENTIFIER (ID)) handwashing_facility	-	1				
March Marc			-	+				
Column C		For Santiago: NA		-				
Column C	RELATIONS	Input: NA	Genson, R. et al. (2018) -> 0.7	1				
March Marc		Output: NA	Spuhler, D et al. (2021)	-				
Company Comp	Pre-Filter Criteria	Values		I.				
Teach Continue	applicability_level		Gensch, R. et al. (2018)					
A Company Co	management_level	(household = 1, neighbourhood = 1,	Gensch, R. et al. (2018)					
March Anthony March Ma		3	Spuhler, D et al. (2021)					
## CONTROLLEGATION CONTROLLEGA								
Secret Control Contr		e (acute = 1, stabilisation = 1,						
Part	Screening Criteria		Applicable for this Functional Group?	Categories [Unit]	Technology Values (Data)	Data Source / Assumptions	Internal Review Done?	
March Marc	water_supply	Performance, Categorical	TRUE					
Second Content				public	- 0)	If water is not available, an alcohol-		
March Marc				none				
Management Man						(2018))		
Column								
Page 1972	fuel_supply	y Performance, Categorical	FALSE		NA	NA		
Controlled Con	frequency_of_or	PDF, Categorical	TRUE					
Application for the property of the property						constantly in public facilities and		
Part Color								
## A								
Page Color Page								
Page Color Page	nine sunnh	y Performance Categorical	FALSE	no pipes	NA .	NA .	NA .	
Companies Comp	pump_supply	y Performance, Categorical	FALSE	no pumps	NA	NA		
Control Cont	concrete_supply	/ Performance, Categorical	TRUE			no concrete needed		
Section Company Comp				concrete				
Principle Prin	spare_parts	PDF, Categorical	IRUE		(simple =1, technical = 0, special = 0)	handwashing stations are usually		
Committee Comm						cheap and locally available" (Gensch		
			FAISE		NA		NΔ	
March		0 0	FALSE	(NA NA	NA	NA	
Monte Monte Monte Monte March Marc	tompout us							
Section Sect								
Section Performance, Calegorian Performance, Traing VSCI Value Fight (n) VA. V								
Contraction								
Uniform Performance, Congregation Performance, Transper PACE Inches Performance, Transper PACE Inches Performance, Transper PACE Inches Performance, Congregation Performance, Con								
Control Cont								
C	surface_area_offsite							
division_water_equates Performance_Categories MAC MA								
Contracting_tilin	deinbing water evensure							
Construction_Asian	drinking_water_exposure	0 0	FALSE	(NA NA	NA		
International and internatio	construction skills						NA	
Performance, Categorical RUE	construction_skins	renormance, categorical	INGE	unskilled				
Unsafelde 12								
Unsafelde 12								
State Control Contro	design_skills	Performance, Categorical	TRUE					
Performance, Categorical PRICE				skilled	= 1)	et al. (2021))		
Unskilled 1								
Skilled Professional NA	om_skills	s Performance, Categorical	TRUE					
C								
O O FASE O NA NA NA NA NA NA NA		0 0	FAISE		NA NA	NA .	NA	
Clearating_method Performance_Categorical RUE Vasabers Soft wijeers 1, hard wijeers = 1, hard Soft wijeers 1, hard Soft wijeers = 1, hard Soft wijeers	(0 0	FALSE		NA NA	NA	NA	
Canada Performance, Categorical PRUE Washers Soft wipers Washers 1, foll wipers 1 Washers 1, foll wipers								
Mard wipers Name	cleansing_method			Washers	(washers = 1, soft wipers = 1, hard			
Control Cont				Soft wipers Hard wipers	wipers = 1)			
Infettine Performance, Categorical ALSE short (=1 year) NA NA NA NA NA NA NA N	C			(
Speed_Implement_totalet	lifetime							
Scalability Performance, Categorical FASE Construction	speed_implement_toilet	t PDF, Categorical	FALSE	rapid (< 3 days)	NA	NA	NA	
Construction_parts								
Special Cheap and locally available" (Gensch et al. (2018))				simple		"Soap bars and plastic buckets for		
et al. (2018)								
TP 1		formed how Works	ACCOLUMN TO THE PARTY OF THE PA					
TP	Transfer Coefficients	Greywater	Range	Airloss	Soilloss	Waterloss	Comments/Specifications	Reference
Supplier, D. et al.		P 1						Spuhler, D. et al. (2021)
med (R)	k	k 100			-	-		Spuhler, D. et al. (2021)
100				(* Assumption: Losses occur in storage	Spuhler, D. et al. (2021)
med (R)	k	k 100					* Accumption: ! '	Spubler, D. et al. (2021)
TS 1 - 0 0 0 4 Assumption: Losses occur in storage Spulher, D. et al. (2011) med (R) 1.00 - 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		1.00				0	Assumption: Losses occur in storage	Spuhler, D. et al. (2021) -
Med (R)					-		* Assumption: Losses occur in storage	Spuhler, D. et al. (2021) Spuhler, D. et al. (2021)
Influent	k			i '				-
Value [tag/pers/yr] Range Comments/Specifications Reference Spublier et al. (201 TP		S 1 1.00		(Cauchia D. at al. (2021)
TP - negligible Olupot et al. (2021), Spublier et al. (2021) med (R) 0 - negligible Spublier et al. (2021) TN - negligible Spublier et al. (2021) 0.009 0.0003-0.043 16.5 mg N/L Olupot et al. (2021) med (R) 0 - 0 0 42O 547.5 365-730 1-2L/pers/day for handwashing only and control of the		S 1 1.00						spunier, D. et al. (2021)
med (R) 0 - 0 0 TN - - negligible Spublier et al. (2021) 0.009 0.0003-0.043 16.5 mg N/L Olupot et al. (2021) med (R) 0 0 0 £ - - H2O 547.5 365-730 1-2L/pers/day for handwashing only Gensch et al. (2018) med (R) 547.5 - 0	med (R)	S 1 0 1.00 6 100		Commonte (Sq181141	Reference			
0.009 0.0003-0.043 16.5 mg N/L Olupot et al. (2021) med (R) 0 - 0 0 /	med (R k	S 1) 1.00 s 100 Value [kg/pers/yr]						Spuhler et al. (2021)
0.009 0.0003-0.043 16.5 mg N/L Olupot et al. (2021) med (R) 0 - 0 0 /	med (R	\$ 1 1.00 1.00 1.00 Value [kg/pers/yr] P -	Range	negligible	Olupot et al. (2021), Spuhler et al. (2021)			
med (R) 0 0 0 L 1 2 2 H2O 547.5 365-730 1-2L/pers/day for handwashing only Gensch et al. (2018) med (R) 547.5 0 0 k - - -	med (R) k Influent T I med (R) k	S 1 1.000 100 100 100 100 100 100 100 100	Range	negligible (Olupot et al. (2021), Spuhler et al. (2021)			
med (R) 547.5 - 0 0 k	med (R) k Influent T I med (R) k	S 1 1 1000 1000 1000 1000 1000 1000 100	Range	negligible (Olupot et al. (2021), Spuhler et al. (2021) Comparison of the com			
med (R) 547.5 - 0 0	med (R). Influent TT med (R).	S 1 1 1000 1001 Value [kg/pers/yr] P 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Range 0.0003-0.043	negligible negligible 16.5 mg N/L	Olupot et al. (2021), Spuhler et al. (2021) Spuhler et al. (2021) Olupot et al. (2021)			
	med (8). Influent TI med (8). Th med (8). 4. 4.4.4.4.4.4.4.4.4.4.4.4.4.4.4.4.4.	\$ 1 1000 Value [kg/pers/yr]	Range 0.0003-0.043	negligible negligible 16.5 mg N/L 1-2L/pers/day for handwashing only	Olupot et al. (2021), Spuhler et al. (2021) Spuhler et al. (2021) Olupot et al. (2021) Gensch et al. (2018)			
TS 0.33 0.14-0.657 613.8 mg TS/L [256.8-1200] Olupot et al. (2021)	med (R / / / / / / / / / / / / / / / / / /	S 1 1 1000 1000 1000 1000 1000 1000 100	Range 0.0003-0.043	negligible negligible 16.5 mg N/L 1-2L/pers/day for handwashing only	Olupot et al. (2021), Spuhler et al. (2021) Spuhler et al. (2021) Olupot et al. (2021) Gensch et al. (2018)			

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Spublier, D., de Morias Lima, P., Fritzsche, J., Jimanen, K., Jain, A., van Stoten, M., & Willimann, C. (2021). SanChoice Project Team. Department Sanitation, Water and Solid Waste for Development Countries (Sandec), Swiss Federal Institute of Aquatic Science and Technology (Eawag), Dübendorf, Switzerland. Olupot et al. (2020) Development and appraisal of handwash-wastewater treatment system for water recycling as a resilient response to COVID-19. Journal of Environmental Chemistry Engineering 9, 106113. https://doi.org/10.1016/j.jece.2021.106113

Sink							
General Information FUNCTIONAL GROUP	Values Uadd	Data Source					
UNIQUE IDENTIFIER (ID) DATA COMPILER	sink Basile Weber						
INPUT PRODUCT	freshwater For Santiago: NA	Spuhler et al. (2021)					
OUTPUT PRODUCT RELATIONS	greywater Input: NA	Spuhler et al. (2021)					
	Output: NA	Spuhler et al. (2021)					
Pre-Filter Criteria	Values	Data Source					
applicability level management level		NA NA					
capex reg level opex reg level		Spuhler et al. (2021) Spuhler et al. (2021)					
technical maturity development_phase	(acute = 0.5, stabilisation = 1,	Spuhler et al. (2021) Spuhler et al. (2021)					
Screening Criteria	development/recovery = 1) Type and Function	Applicable for this Functional Group?	Categories (Unit)	Technology Values (Data)	Data Source / Assumptions	Internal Review Done?	
water_supply	Performance, Categorical	TRUE	house yard public none	(house = 1, yard = 0.75, public = 0.5, none = 0)	Distance between stoves and sinks standard be minimized for ease of use, hand washing hygiene and to minimize circulation movement between appliances, mostly if the kitchen is shared (e.g. common kitchen in a refugee campi)		
water_volume electricity supply	Performance, Trapez Performance, Categorical		[L/cap/day] electricity	NA NA	NA NA	NA NA	
fuel_supply frequency_of_om	Performance, Categorical PDF, Categorical	FALSE TRUE	fuel Irregular regular continuous	NA ((rregular = 0.8, regular = 0.4, continuous = 0.2)	NA	NA .	
pipe_supply	Performance, Categorical	FALSE	no pipes	NA.	NA .	NA .	
pump_supply concrete supply	Performance, Categorical Performance, Categorical	FALSE	no pumps no concrete	NA (no concrete = 1, difficultly available	NA no concrete needed	NA .	
concrete_supply			difficultly available	= 1, no concrete = 1)			
spare_parts	PDF, Categorical		simple technical special	(simple =0.75, technical = 0.25, special = 0)	Sink can be made locally with concrete (providing that sand and cement are available), filterglass, porcelain or stalines steel. Wooden or metal moudds can be used to produce several units quickly and efficiently, Prefabricated units quickly and efficiently, Prefabricated units made from plastic are also available. Sink can be made from simple local material. However, further technical parts (e.g. sighton with a water scall are required. (Spuller, D. et al. (2021))		
0	0	FALSE FALSE	0		NA NA	NA NA	
0 temperature	0 Performance, Categorical	FALSE FALSE	very cold	NA NA	NA NA	NA NA	
flooding	Performance, Categorical	FALSE	flooding	NA NA	NA NA	NA NA	
vehicular_acces slope	Performance, Categorical	FALSE	no access flat	NA .	NA .	NA	
soil_type groundwater_depth	Performance, Categorical Performance, Trapez	FALSE	clay water depth [m]	NA NA	NA NA	NA NA	
excavation surface_area_onsite	Performance, Categorical Performance, Trapez	FALSE FALSE	easy [m2/plot]	NA NA	NA NA	NA NA	
surface_area_offsite	Performance, Trapez	FALSE FALSE	m2/pers	NA NA	NA NA	NA NA	
0	0	FALSE FALSE	0	NA NA	NA NA	NA NA	
drinking_water_exposure	Performance, Categorical	FALSE	Close	NA .	NA .	NA	
0	0	FALSE FALSE	0	NA NA	NA NA	NA NA	
construction_skills	Performance, Categorical	TRUE	Ladder: umskilled skilled professional	(unskilled = 0.5, skilled = 1, professional = 1)	Although it's possible to directly infilirate the effluent in the soil through a drainage channel or a soak pit if the sink is located outside, it's assumed that at least a plumber in needed as well for a proper installation: the plumber will ensure that all valves are connected and sealed properly, therefore, minimizing leakage, (Spuhler, D. et al.)		
design_skills	Performance, Categorical	TRUE	Ladder: unskilled skilled professional	(unskilled = 0.5, skilled = 1, professional = 1)	# 1973 N The design skills needed for the technology are the same as the construction skills needed. Here are also moderate skills of a specialist like a plumber necessary. (Spuhler, D. et al. (2021))		
om_skills	Performance, Categorical	TRUE	Ladder: Urskilled Skilled Professional	(unskilled = 1, skilled = 1, professional = 1)	Because there are no mechanical parts, sink are quite robust and rarely require repair. Despite the fact that it is a waterbased technology, it should be cleaned regularly to maintain hygiene and prevent the buildup of stains. (Spuhler, D. et al. (2021))		
0		FALSE FALSE	0	NA NA	NA NA	NA NA	
0	0	FALSE	0	NA NA	NA NA	NA NA	
cleansing_method	Performance, Categorical	FALSE TRUE	Washers Soft wipers Hard wipers	NA (washers = 1, soft wipers = 1, hard wipers = 1)	NA .	NA .	
0		FALSE FALSE	0	NA NA	NA NA	NA NA	
lifetime	Performance, Categorical	FALSE	short (< 1 year)	NA NA	NA NA	NA NA	
speed_implement_toilet speed_implement_treatment	PDF, Categorical	FALSE	rapid (< 3 days) rapid (few days to a week)	NA .	NA .	NA .	
scalability construction_parts construction_parts	Performance, Categorical PDF, Categorical	FALSE TRUE	easy simple technical special	NA (umple =0.75, technical = 0.25, special = 0)	NAL Sink can be made locally with concrete (providing that rand and coment are available), filterglass, porcelain or stainless steel. Wooden or metal moudis can be used to produce several units quickly and from plastic are also available Sink can be made from simple local material. However, further technical parts (e.g. siphon with a water sail) are required. (Sputher, D. et al. (2021))	NA.	
TF	Greywater 1	Range	Airloss 0	Soilloss	Waterloss 0		Reference Spuhler, D. et al. (2021)
med (R)	1.00		0	0	0		Spuhler, D. et al. (2021)
TN med (R)	1		0	0	0	* Assumption: Losses occur in storage	Spuhler, D. et al. (2021)
H2O	100		0	0	0	* Assumption: Losses occur in storage	Spuhler, D. et al. (2021) Spuhler, D. et al. (2021)
med (R)	1.00		0	0	0		Spuhler, D. et al. (2021)
TS med (R	1		0	0	0	* Assumption: Losses occur in storage	Spuhler, D. et al. (2021)
med (K							Spuhler, D. et al. (2021)
Influent in low water consum	ption context						
TF	Value [kg/pers/yr]	Range	Comments/Specifications 4-14 mg/l non-phosporus detergent	Reference Morel and Diener (2006)			
med (R)	1.48 1.12 0.89	0.41-2.55	42-280 mg/L phosporus detergent 67% of 4.6 g/p/d : average pollution loads	Morel and Diener (2006) Morel and Diener (2006) Lindstrom (2000), Morel and Diener (2006)			
å TN		0.05-0.46	5-50 mg/l	Morel and Diener (2006)			
	0.58		12% of 13.2 g/p/d: average pollution loads	Lindstrom (2000), Morel and Diener			
med (R)	0.42		in greywater compared to total loads in domestic WW	(2006)			
med (R)			20-30 L/p/d including kitchen, bathroom and laundry greywater for low-income				
med (R)	9125		areas with water scarcity 0	0			
TS	5.475 6.64		150 mg/l 26% of 70 g TSS /p/d average pollution loads in greywater compared to total loads in domestic WW	(2006)			
med (R)	6.06			0			
References							
Morel, A. and Diener, S. (2006) G	reywater Management in Low and Middle-I	ncome Countries, Review of different treats	ment systems for households or neighbourho	ods. Swiss Federal Institute of Aquatic Scien	ce and Technology (Eawag). Dübendorf, Swi	tzerland.	instructured
Spunter, D., de Morais Lima, P., F Lindstrom C. 2000 Greywati	ritzsche, J., Ilmanen, K., Jain, A., van Sloten, er, what it is, how to treat it, how to use	m., & Wittimann, C. (2021). SaniChoice Pro It	ject Team. Department Sanitation, Water and	a some Waste for Development Countries (Sa	musc. _J , Swiss Federal Institute of Aquatic Sc	ence and rechnology (Eawag), Dübendorf, S	wr.zeriálió.

Organic Waste Bin							
General Information FUNCTIONAL GROUP	Values	Data Source					
UNIQUE IDENTIFIER (ID)	organic waste bin						
DATA COMPILER	Basile Weber	-]				
INPUT PRODUCT							
0.170.17.00.00.107	For Santiago: NA	Spuhler, D. et al. (2021)	4				
OUTPUT PRODUCT		Spuhler, D. et al. (2021)	-				
RELATIONS	Output: NA	Spuhler, D. et al. (2021)					
COMMENTS	Output. NA	Spanier, D. et al. (2021)	1				
	Values	Data Source					
applicability_level		NA					
management_level	NA	NA					
capex_req_level		Spuhler, D. et al. (2021) Spuhler, D. et al. (2021)	-				
opex_req_level technical_maturity		Spuhler, D. et al. (2021)	1				
	(acute = 1, stabilisation = 1,	Spuhler, D. et al. (2021)					
	development/recovery = 1)						
	Type and Function Performance, Categorical	Applicable for this Functional Group?			Data Source / Assumptions	Internal Review Done?	
water_supply	Performance, Categorical	IRUE	house yard	(house = 1, yard = 1, public = 1, none = 1)	no water needed		
			public	1)			
water_volume	Performance, Trapez	FALSE	[L/cap/day]	NA	NA	NA	
electricity_supply	Performance, Categorical		electricity	NA	NA	NA	
fuel_supply	Performance, Categorical		fuel	NA	NA	NA	
frequency_of_om	PDF, Categorical		irregular	(irregular = 0.5, regular = 0.5,	only requires frequent emptying		
			regular	continuous = 0)			
alaa ayaabi	Deufermann Cotanonius	FALCE	continuous	NA	NA	NA	
pipe_supply pump_supply	Performance, Categorical Performance, Categorical		no pipes no pumps	NA NA	NA NA	NA NA	
concrete_supply	Performance, Categorical		no concrete	(no concrete = 1, difficultly available =	no concrete needed	INA.	
отположения,			difficultly available	1, no concrete = 1)			
			concrete				
spare_parts	PDF, Categorical	TRUE	simple	(simple =1, technical = 0, special = 0)	any type of bin or bucket are locally		
			technical		available		
			special				
0		FALSE		NA	NA	NA	
0		FALSE			NA NA	NA NA	
0 temperature	0 Performance, Categorical	FALSE	very cold	NA NA	NA NA	NA NA	
flooding	Performance, Categorical Performance, Categorical		flooding	NA NA	NA NA	NA NA	
vehicular_acces	Performance, Categorical		no access	NA NA	NA NA	NA NA	
slope	Performance, Categorical		flat	NA .	NA	NA	
soil_type	Performance, Categorical		clay	NA	NA	NA	
groundwater_depth	Performance, Trapez		water depth [m]	NA	NA	NA	
excavation	Performance, Categorical		easy	NA	NA	NA	
surface_area_onsite	Performance, Trapez		[m2/plot]	NA	NA	NA	
surface_area_offsite	Performance, Trapez		m2/pers	NA	NA	NA	
0		FALSE		NA NA	NA	NA	
0		FALSE		NA NA	NA	NA	
0		FALSE) NA	NA	NA	
drinking_water_exposure	Performance, Categorical	FALSE		NA NA	NA NA	NA NA	
0		FALSE		NA NA	NA NA	NA NA	
construction_skills	Performance, Categorical		Ladder:		No special skills needed. (Spuhler, D.		
			unskilled	= 1)	et al. (2021))		
			unskilled skilled	= 1)	et al. (2021))		
			unskilled skilled professional	= 1)	et al. (2021))		
design_skills	Performance, Categorical	TRUE	skilled professional Ladder:	(unskilled = 1, skilled = 1, professional	No special skills needed. (Spuhler, D.		
design_skills	Performance, Categorical	TRUE	skilled professional Ladder: unskilled				
design_skills	Performance, Categorical	TRUE	skilled professional Ladder: unskilled skilled	(unskilled = 1, skilled = 1, professional	No special skills needed. (Spuhler, D.		
			skilled professional Ladder: unskilled skilled professional	(unskilled = 1, skilled = 1, professional = 1)	No special skills needed. (Spuhler, D. et al. (2021))		
design_skills om_skills	Performance, Categorical Performance, Categorical		skilled professional Ladder: unskilled skilled professional Ladder:	(unskilled = 1, skilled = 1, professional = 1) (unskilled = 1, skilled = 1, professional	No special skills needed. (Spuhler, D. et al. (2021)) No special skills needed. (Spuhler, D.		
			skilled professional Ladder: unskilled skilled professional	(unskilled = 1, skilled = 1, professional = 1)	No special skills needed. (Spuhler, D. et al. (2021))		
			skilled professional Ladder: unskilled skilled professional Ladder: Unskilled	(unskilled = 1, skilled = 1, professional = 1) (unskilled = 1, skilled = 1, professional	No special skills needed. (Spuhler, D. et al. (2021)) No special skills needed. (Spuhler, D.		
om_skills 0	Performance, Categorical	TRUE	skilled professional Ladder: unskilled skilled professional Ladder: Unskilled Skilled Professional	(unskilled = 1, skilled = 1, professional = 1) (unskilled = 1, skilled = 1, professional = 1) NA	No special skills needed. (Spuhler, D. et al. (2021)) No special skills needed. (Spuhler, D. et al. (2021)) NA	NA NA	
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om_skills 0 0 0 0 cleansing_method cleansing_method cleansing_method ifetime speed_implement_toilet speed_implement_treatment scalability construction_parts Transfer Coefficients TP med(R) k H2O med(R) TS med(R) k influent TP med(R)	Performance, Categorical 0 0 0 0 0 Performance, Categorical 0 Performance, Categorical PPOF, Categorical PPOF, Categorical POF, Categorical POF, Categorical POF, Categorical POF, Categorical POF, Categorical 1 00 10 10 10 10 10 10 10 10 10 10 10	FALSE TRUE	skilled professional Ladder: unskilled skilled professional Ladder: Unskilled Skilled Professional Co Co Washers Soft wipers Hard wipers Soft wipers Hard wipers Ard wipers Shard (< 1 year) rapid (< 3 days) rapid (< 8 days) rapid (so days) simple technical special Airloss Comments/Specifications 0.46-0.85% w/w of 118,8 kg organics/p/d 0.1-2.4% w/w of 118,8 kg organics/p/d	(unskilled = 1, skilled = 1, professional = 1) (unskilled = 1, skilled = 1, professional = 1) NA NA NA NA NA NA NA NA NA N	No special skills needed. (Spuhler, D. et al. (2021)) No special skills needed. (Spuhler, D. et al. (2021)) NA N	NA N	Spuhler, D. et al. (2021) Spuhler, D. et al. (2021)
om_skills 0 0 0 0 cleansing_method iffetime speed_implement_treatment speed_implement_treatment scalability construction_parts Transfer Coefficients TP med (R) R H2O med (R) influent TP	Performance, Categorical 0 0 0 0 Performance, Categorical Performance, Categorical Performance, Categorical PDF, Categorical PPF, Categorical PPF, Categorical POF, Categorical POF, Categorical POF, Categorical POF, Categorical POF, Categorical POF, Categorical PORDANCE, Categorical PORDANCE, Categorical PORDANCE, Categorical PORDANCE, Categorical 1000 1000 1000 1100 1000 1000 1000 1	TRUE FALSE TRUE	skilled professional Ladder: unskilled skilled professional Ladder: unskilled skilled professional Ladder: Unskilled Skilled Professional Ladder: Unskilled Skilled Professional C.	(unskilled = 1, skilled = 1, professional = 1) (unskilled = 1, skilled = 1, professional = 1) (unskilled = 1, skilled = 1, professional = 1) NA NA NA NA NA NA NA NA NA N	No special skills needed. (Spuhler, D. et al. (2021)) No special skills needed. (Spuhler, D. et al. (2021)) NA N	NA N	Spuhler, D. et al. (2021) Spuhler, D. et al. (2021)
om_skills 0 0 0 0 cleansing_method cleansing_method lifetime speed_implement_treatment scalability construction_parts Transfer Coefficients TP med {R} RD Med {R} LZ Med {R} Influent TP med {R} R TS med {R} R TP med {R} R TT TP med {R} R TP med {R} R TP med {R} R TP med {R}	Performance, Categorical 0 0 0 0 0 Performance, Categorical Performance, Categorical PPF, Categorical PPF, Categorical PPF, Categorical PPF, Categorical PPF, Categorical POF, Categoric	FALSE TRUE Range 0.555-1.01 0.2-2.85	skilled professional Ladder: unskilled skilled professional Ladder: Unskilled Skilled Professional Co Co Washers Soft wipers Hard wipers Soft wipers Hard wipers Ard wipers Shard (< 1 year) rapid (< 3 days) rapid (< 8 days) rapid (so days) simple technical special Airloss Comments/Specifications 0.46-0.85% w/w of 118,8 kg organics/p/d 0.1-2.4% w/w of 118,8 kg organics/p/d	(unskilled = 1, skilled = 1, professional = 1) (unskilled = 1, skilled = 1, professional = 1) NA NA NA NA NA NA NA NA NA N	No special skills needed. (Spuhler, D. et al. (2021)) No special skills needed. (Spuhler, D. et al. (2021)) NA N	NA N	Spuhler, D. et al. (2021) Spuhler, D. et al. (2021)
om_skills 0 0 0 0 cleansing_method cleansing_method cleansing_method ifetime speed_implement_toilet speed_implement_treatment scalability construction_parts Transfer Coefficients TP med(R) k H2O med(R) TS med(R) k influent TP med(R)	Performance, Categorical 0 0 0 0 Performance, Categorical Performance, Categorical Performance, Categorical PDF, Categorical PPF, Categorical PPF, Categorical POF, Categorical POF, Categorical POF, Categorical POF, Categorical POF, Categorical POF, Categorical PORDANCE, Categorical PORDANCE, Categorical PORDANCE, Categorical PORDANCE, Categorical 1000 1000 1000 1100 1000 1000 1000 1	FALSE TRUE Range 0.555-1.01 0.2-2.85	skilled professional Ladder: unskilled skilled professional Ladder: unskilled skilled professional Ladder: Unskilled Skilled Professional Ladder: Unskilled Skilled Professional C.	(unskilled = 1, skilled = 1, professional = 1) (unskilled = 1, skilled = 1, professional = 1) (unskilled = 1, skilled = 1, professional = 1) NA NA NA NA NA NA NA NA NA N	No special skills needed. (Spuhler, D. et al. (2021)) No special skills needed. (Spuhler, D. et al. (2021)) NA N	NA N	Spubler, D. et al. (2021) Spubler, D. et al. (2021)
om_skills 0 0 0 0 cleansing_method cleansing_method lifetime speed_implement_treatment scalability construction_parts Transfer Coefficients TP med {R} RD Med {R} LZ Med {R} Influent TP med {R} R TS med {R} R TP med {R} R TT TP med {R} R TP med {R} R TP med {R} R TP med {R}	Performance, Categorical 0 0 0 0 0 0 Performance, Categorical Performance, Categorical POF, Categorical 1000 1000 1000 1100 1100 1000 1000 1	FALSE TRUE Range 0.555-1.01 0,2-2,85	skilled professional Ladder: unskilled skilled professional Ladder: Unskilled skilled professional Ladder: Unskilled Skilled Professional Comparison of Comp	(unskilled = 1, skilled = 1, professional = 1) (unskilled = 1, skilled = 1, professional = 1) (unskilled = 1, skilled = 1, professional = 1) NA NA NA NA NA NA NA NA NA N	No special skills needed. (Spuhler, D. et al. (2021)) No special skills needed. (Spuhler, D. et al. (2021)) NA N	NA N	Spubler, D. et al. (2021) Spubler, D. et al. (2021)
om_skills 0 0 0 0 cleansing_method 0 cleansing_method ilfetime speed_implement_tireat speed_implement_treat speed_implement_treat speed_implement_treatment scalability construction_parts Transfer Coefficients TP med (R) k H2DO med (R) k influent TP med (R) k TTS med (R) med (R) k Influent	Performance, Categorical 0 0 0 0 0 Performance, Categorical Performance, Categorical PPF, Categorical PPF, Categorical PPF, Categorical Performance, Categorical POF, Categorical POF, Categorical POF, Categorical POF, Categorical POF, Categorical 1000 1000 1100 1100 1000 1000 1000 1	FALSE TRUE TRUE 100622-36mm') Range 0,555-1,01 0,2-2,85 1,31-11,4	skilled professional Ladder: unskilled skilled professional Ladder: unskilled skilled professional Ladder: Unskilled Skilled Professional Ladder: Unskilled Skilled Sk	(unskilled = 1, skilled = 1, professional = 1) (unskilled = 1, skilled = 1, professional = 1) NA NA NA NA NA NA NA NA NA N	No special skills needed. (Spuhler, D. et al. (2021)) No special skills needed. (Spuhler, D. et al. (2021)) NA N	NA N	Spubler, D. et al. (2021) Spubler, D. et al. (2021)
om_skills 0 0 0 0 cleansing_method cleansing_method ifetime speed_implement_toilet speed_implement_treatment scalability construction_parts Transfer Coefficients TP med (R) k H20 med (R) k influent TP med (R) k H20 med (R) k H20 med (R) k H20 med (R)	Performance, Categorical	FALSE TRUE Range 0.555-1.01 0,2-2,85	skilled professional Ladder: unskilled skilled professional Ladder: Unskilled skilled professional Ladder: Unskilled Skilled Professional Comparison of Comp	(unskilled = 1, skilled = 1, professional = 1) (unskilled = 1, skilled = 1, professional = 1) (unskilled = 1, skilled = 1, professional = 1) NA NA NA NA NA NA NA NA NA N	No special skills needed. (Spuhler, D. et al. (2021)) No special skills needed. (Spuhler, D. et al. (2021)) NA N	NA N	Spubler, D. et al. (2021) Spubler, D. et al. (2021)
om_skills 0 0 0 0 cleansing_method 0 cleansing_method ilfetime speed_implement_tireat speed_implement_treat speed_implement_treat speed_implement_treatment scalability construction_parts Transfer Coefficients TP med (R) k H2DO med (R) k influent TP med (R) k TTS med (R) med (R) k Influent	Performance, Categorical 0 0 0 0 0 Performance, Categorical Performance, Categorical PPF, Categorical PPF, Categorical PPF, Categorical Performance, Categorical POF, Categorical POF, Categorical POF, Categorical POF, Categorical POF, Categorical 1000 1000 1100 1100 1000 1000 1000 1	FALSE TRUE Range 0.555-1.01 0,2-2,85	skilled professional Ladder: unskilled skilled professional Ladder: Unskilled skilled professional Ladder: Unskilled Skilled Professional Comparison of Comp	(unskilled = 1, skilled = 1, professional = 1) (unskilled = 1, skilled = 1, professional = 1) NA NA NA NA NA NA NA NA NA N	No special skills needed. (Spuhler, D. et al. (2021)) No special skills needed. (Spuhler, D. et al. (2021)) NA N	NA N	Spubler, D. et al. (2021) Spubler, D. et al. (2021)

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Stormwater Collection General Information	Values	Data Source					
FUNCTIONAL GROUP	Uadd	•					
UNIQUE IDENTIFIER (ID) DATA COMPILER		-					
INPUT PRODUCT	stormwater	Spuhler, D. et al. (2021)					
OUTPUT PRODUCT	For Santiago: NA	Spuhler, D. et al. (2021)					
RELATIONS	Input: NA	Spuhler, D. et al. (2021)					
COMMENTS	Output: NA						
Pre-Filter Criteria	Values	Data Source					
applicability_level management_level		NA NA					
capex_req_level	6	Spuhler, D. et al. (2021)					
opex_req_level technical_maturity	3	Spuhler, D. et al. (2021) Spuhler, D. et al. (2021)					
development_phase	(acute = 0.5, stabilisation = 1,	Spuhler, D. et al. (2021)					
Screening Criteria	development/recovery = 1) Type and Function	Applicable for this Functional Group?	Categories [Unit]	Technology Values (Data)	Data Source / Assumptions	Internal Review Done?	
water_supply			house	(house = 1, yard = 1, public = 1, none =			
			yard public	1)			
water_volume	Performance, Trapez	FALSE	[L/cap/day]	NA	NA	NA	
electricity_supply			electricity	NA NA	NA NA	NA NA	
fuel_supply frequency_of_om			fuel irregular	(irregular = 0.5, regular = 0.5,	annual or biannual cleaning of storage	IVA	
			regular continuous	continuous = 0)	tank, remove material from screen		
pipe_supply	Performance, Categorical	FALSE	no pipes	NA	NA	NA	
pump_supply	Performance, Categorical		no pumps	NA	NA	NA	
concrete_supply	Performance, Categorical	TRUE	no concrete difficultly available	(no concrete = 1, difficultly available = 1, no concrete = 0.8)	since it exists many different technologies to collect stormwater,		
			concrete	, ,	we decided here to avoid being too		
spare_parts	PDF, Categorical	TDIJE	simple	(simple =1, technical = 0, special = 0)	restrictive since it exists many different		
spare_parts	- Dr, Categorical		technical	pic -2, cecimical = 0, special = 0)	technologies to collect stormwater,		
			special		we decided here to avoid being too restrictive		
0	0	FALSE	() NA	NA	NA	
0		FALSE		NA NA	NA	NA	
0 temperature		FALSE FALSE	very cold	NA NA	NA NA	NA NA	
flooding			flooding	NA	NA NA	NA	
vehicular_acces			no access	NA NA	NA NA	NA NA	
slope soil_type			flat clay	NA NA	NA NA	NA NA	
groundwater_depth	Performance, Trapez	FALSE	water depth [m]	NA	NA	NA	
excavation surface_area_onsite			easy [m2/plot]	NA NA	NA NA	NA NA	
surface_area_offsite			m2/pers	NA NA	NA NA	NA NA	
0		FALSE		NA	NA	NA	
0		FALSE FALSE		NA NA	NA NA	NA NA	
drinking_water_exposure	Performance, Categorical	FALSE	Close	NA	NA	NA	
0		FALSE FALSE		NA NA	NA NA	NA NA	
construction_skills			Ladder:	(unskilled = 0.4, skilled = 1,	The necessary construction skills of a	INA	
			unskilled skilled	professional = 1)	stormwater collection facility is assumed to be rather moderate than		
			professional		high.		
design_skills	Performance, Categorical	TRUE	Ladder: unskilled	(unskilled = 0, skilled = 0.4, professional = 1)	"Design of Stormwater Drainage needs to be done by a skilled and		
			skilled	_,	experienced engineer." (Emersan)		
			professional		High level skills for design necessary.		
om_skills	Performance, Categorical	TRUE	Ladder:	(unskilled = 1, skilled = 1, professional	"Solid waste must be removed from		
			Unskilled Skilled	= 1)	stormwater channels on a regular basis and particularly before the start		
			Professional		of a rainy season or expected rainfall events to assure proper functioning.		
					After the rains it may be necessary to		
					empty sediments from storage tanks and channels, after the water flow has		
					decreased below the self-cleansing		
					velocity. Structural damages also need to be tended to on a regular basis.		
					These can occur especially in channels		
					with high gradients and runoff velocities." (Emersan)		
					Low operation and maintenance skills		
0		FALSE) NA	required.	NA .	
0	0	FALSE		NA NA	NA NA	NA NA	
0	0	FALSE	(NA NA	NA	NA	
0 cleansing_method		FALSE TRUE	Washers	NA (washers = 1, soft wipers = 1, hard	NA	NA	
cicansing_medica	, c. o	- -	Soft wipers	wipers = 1)			
-	-	EALCE	Hard wipers	NA A	NA.	NA.	
0		FALSE FALSE		NA NA	NA NA	NA NA	
lifetime	Performance, Categorical	FALSE	short (< 1 year)	NA	NA	NA	
speed_implement_toilet			rapid (< 3 days) rapid (few days to a week)	NA NA	NA NA	NA NA	
speed_implement_treatment scalability			easy	NA NA	NA NA	NA NA	
construction_parts			simple	(simple =1, technical = 0, special = 0)	since it exists many different		
			technical special		technologies to collect stormwater, we decided here to avoid being too		
					restrictive.		
Transfer Coefficients	(copied from "Sanitation_Technologies_TC_database_202 Stormwater	Range	Airloss	Soilloss	Waterloss	Comments/Specifications	Reference
TP	1	-	(0	0		Spuhler, D. et al. (2021)
med (R)	1.00			0	0		- Spuhler, D. et al. (2021)
TN	1	-	(* Assumption: Losses occur in storage	Spuhler, D. et al. (2021)
med (R)	1.00		(0	0		- Spuhler, D. et al. (2021)
H2O	1	-	(* Assumption: Losses occur in storage	Spuhler, D. et al. (2021)
med (R)	1.00	-	(0	0		- Spuhler, D. et al. (2021)
TS mod (P.)			(* Assumption: Losses occur in storage	Spuhler, D. et al. (2021)
med (R)	1.00			0	0		Spuhler, D. et al. (2021)
Influent							
Influent	Value [kg/pers/yr]	Range	Comments/Specifications	Reference			
				Spuhler, D. et al. (2021)	†		
TP	1 -	-	negligible				
TP med (R)	'	-	0.36 mg P/L for high urban areas	Fletcher et al. (2004)			

k			
TN	-	- negligible	Spuhler, D. et al. (2021)
		2.5 mg N/L fir high urban areas	Fletcher et al. (2004)
med (R)	0		
H2O	170138.9	122'500-437'500 tropical climate (2000mm/yr), 7200 cap/km2, runoff coefficient=0.6125	
	68055.6	49'000-175'000 temperate climate (800mm/yr), 7200 cap/km2, runoff coefficient=0.6125)
	17014	12'250-43'750 dry climate (200mm/yr), 7200 cap/kr runoff coefficient=0.6125	m2,
med (R)	85069.5	12'250-437'500 average	
k			

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Cistern-Flush Toilet General Information V	Values	Data Source					
FUNCTIONAL GROUP U	U						
UNIQUE IDENTIFIER (ID) ci DATA COMPILER N	Matthias van Sloten	-	†				
INPUT PRODUCT u	urine, faeces, flushwater,						
F	anal_cleansing_water For Santiago: NA	Spuhler, D. & Roller, L. (2020)					
OUTPUT PRODUCT b	blackwater	Spuhler, D. & Roller, L. (2020)	1				
	Input: OR, For Santiago: NA Output: NA	Spuhler, D. & Roller, L. (2020)					
COMMENTS			1				
Pre-Filter Criteria V applicability_level N	Values	Data Source NA					
management_level N	NA	NA	1				
capex_req_level	7	Spuhler, D. et al. (2021)	4				
opex_req_level technical_maturity	3	Spuhler, D. et al. (2021) Tilley, E. et al. (2014)	†				
development_phase (a	(acute = 0, stabilisation = 0.5,	Gensch, R. et al. (2018) -> U.4					
d	development/recovery = 1)	Flush Toilet Cistern toilets could also be considered as less suitable in the					
		acute emergency phase, as a pipe					
		system needs to be set up. (Spuhler, D. et al. (2021))					
Screening Criteria T	Type and Function	Applicable for this Functional Group?	Categories [Unit]	Technology Values (Data)	Data Source / Assumptions	Internal Review Done?	
	Performance, Categorical			(house = 1, yard = 0, public = 0, none	"The cistern flush toilet must be		
water_supply	r errormance, Categorical		house yard	(nouse = 1, yard = 0, public = 0, none = 0)	connected to a constant source of water	Yes (AJ)	Ì
			public		for flushing." (Tilley, E. et al. (2014))		l
			none		It is assumed that cistern flush toilets are not appropriate if there is no in-house		Ì
			1		water supply. (Spuhler, D. et al. (2021))		Ì
water_volume	Performance, Trapez Performance, Categorical		[L/cap/day]	NA NA	NA NA	NA NA	Ì
electricity_supply	rerrormance, Categorical	I ALJE	electricity intermittent	INO	ING.	INC.	İ.
	D. (FALCE	no electricity				Ì
fuel_supply	Performance, Categorical	FALSE	fuel no fuel	NA	NA	NA	Ì
frequency_of_om	PDF, Categorical	TRUE	irregular	(irregular = 0.7, regular = 0.3,	"Although flushwater continuously rinses	YES	Ì
			regular continuous	continuous = 0)	the bowl, the toilet should be scrubbed clean regularly to maintain hygiene and		Ì
			Conditions		prevent the buildup of stains.		Ì
					Maintenance is required for the		Ì
					replacement or repair of some mechanical parts or fittings." (Tilley, E. et		1
					al. (2014))		1
					Usually there's not often need for reparation. The design is similar but it		Ì
					contains more technical parts than a pour		1
					flush toilet, thats why its frequency of it is		İ
					asumed a little higher. (Spuhler, D. et al. (2021))		Ì
pipe_supply	Performance, Categorical	FALSE	no pipes	NA	NA NA	NA	Ì
			difficultly available				Ì
pump_supply	Performance, Categorical	FALSE	no pumps	NA	NA	NA	Ì
	,		difficultly available				Ì
concrete_supply	Performance, Categorical	TRUE	no concrete	(no concrete = 1, difficultly available =	"The cistern flush toilet is usually made of	YES	Ì
concrete_suppry	remornance, categorica	THOSE .	difficultly available	1, concrete = 1)	porcelain and is a mass-produced, factory-		1
			concrete		made User Interface." (Tilley, E. et al. (2014))		1
					(2014)) If there is no concrete available it's still		1
					possible to build up the toilet. If you have		1
					the porcelain user interface and any material similar to concrete like clay it		ĺ
					should easily be possible to build the		Ì
					superstructure of the user interface.		Ì
					Based on this we make the assumption, that the technology can be built with and		Ì
					without concrete. (Spuhler, D. et al.		Ì
spare_parts	PDF, Categorical	TRUE	simple	(simple = 0, technical = 1, special = 0)	(2021)) "The cistern flush toilet is usually made of	VES	Ì
ahare_har(2	r or, categorical		technical	pic - o, cerimical = 1, special = 0)	porcelain and is a mass-produced, factory-		Ì
			special		made User Interface." (Tilley, E. et al.		Ì
					(2014)) "A cistern flush toilet should not be		Ì
					considered unless all of the connections		Ì
					and hardware accessories are available		Ì
					locally." (Tilley, E. et al. (2014)) "Cannot be built and/or repaired locally		Ì
					with available materials" (Tilley, E. et al.		Ì
					(2014)) We assume that the only case where the		Ì
					reparation can be done easily is when a		Ì
					screw is missing or something similar to		Ì
					that. The value for technical spare parts is based on the assumption that also the		Ì
					reparation or replacement of parts like a		1
					siphon can be possible. There ist no big difference to the pour flush toilet despite		1
					of the flushing mechanism (cistern) that		ĺ
					makes it a little bit more technical.		Ì
0	0	FALSE		NA	(Spuhler, D. et al. (2021)) NA	NA	I
0	0	FALSE	0	NA	NA	NA	l
0 temperature	0 Performance, Categorical	FALSE FALSE	very cold	NA NA	NA NA	NA NA	ĺ
			cold				Ì
			temperate warm				Ì
		<u> </u>	hot				Ì
flooding	Performance, Categorical	FALSE	flooding	NA	NA	NA	Ì
vehicular_acces	Performance, Categorical	FALSE	no flooding no access	NA	NA	NA	Ì
	and a contegoritar		difficult				Ì
slope	Performance, Categorical	FALSE	full flat	NA	NA	NA	Ì
siopė			not flat				Ì
soil_type	Performance, Categorical	FALSE	clay	NA	NA	NA	Ì
			silt sand				Ì
			gravel				Ì
groundwater decat	Dorformanco T	EALSE	rock	NA	NA	MA	Ì
groundwater_depth	Performance, Trapez Performance, Categorical		water depth [m] easy	NA NA	NA NA	NA NA	Ì
excavation			hard				l
			[m2/plot]	NA	NA	NA	l
excavation surface_area_onsite	Performance, Trapez	FALSE				1	i .
	Performance, Trapez	FALSE	m2/pers	NA	NA	NA	
surface_area_onsite surface_area_offsite 0	Performance, Trapez	FALSE FALSE	m2/pers 0	NA	NA	NA	
surface_area_onsite surface_area_offsite	Performance, Trapez 0 0	FALSE	m2/pers 0 0				
surface_area_onsite surface_area_offsite 0 0	Performance, Trapez 0 0	FALSE FALSE FALSE FALSE	m2/pers 0 0 0 Close	NA NA	NA NA	NA NA	
surface_area_onsite surface_area_offsite 0 0 0	Performance, Trapez 0 0 0 Performance, Categorical	FALSE FALSE FALSE FALSE	m2/pers 0 0 0 Close Not close	NA NA NA	NA NA NA	NA NA	

construction_skills	Performance, Categorical	TRUE	Ladder:	(unskilled = 0, skilled = 1, professional	"A good plumber is required to install a		
construction_skins	renormance, categorical	INGE	unskilled	= 1)	flush toilet. The plumber will ensure that		
			skilled	- 1)	all valves are connected and sealed		
			professional		properly, therefore, minimizing		
			professional		leakage."(Tilley, E. et al. (2014))		
					For the construction of the technology is a		
					specialist like a plumber or similar		
dealer state	Performance, Categorical	TOUE	Ladder:	(unskilled = 0, skilled = 1, professional	necessary. (Spuhler, D. et al. (2021))		
design_skills	Performance, Categorical	TRUE	unskilled				
				= 1)	technology are the same as the		
			skilled		construction skills needed. Here are also		
			professional		moderate skills of a specialist like a		
					plumber necessary. (Spuhler, D. et al.		
					(2021))		
om_skills	Performance, Categorical	TRUE	Ladder:	(unskilled = 0.5, skilled = 1,	"the toilet should be scrubbed clean		
			Unskilled	professional = 1)	regularly to maintain hygiene and prevent		
			Skilled		the buildup of stains. Maintenance is		
			Professional		required for the replacement or repair of		
					some mechanical parts or fittings." (Tilley,		
					E. et al. (2014))		
					The operation of the technology needs no		
					special skills. The maintenance includes		
					the regular cleaning of the user interface		
					that can be done by everyone and the		
					reperation or replacement of technical		
1							
1					parts on the technology that has to be		
					done by a specialist like a plumber.		
					(Spuhler, D. et al. (2021))		
0		FALSE		NA	NA .	NA	
0		FALSE		NA	NA	NA	
0		FALSE		NA		NA	
0	0	FALSE	C	NA	NA	NA	
cleansing_method	Performance, Categorical	TRUE	Washers	(washers = 1, soft wipers = 1, hard	"Flush toilets are also unsuitable where		
			Soft wipers	wipers = 0)	bulky materials (e.g. maize cobs) are used		
			Hard wipers		for anal cleansing." (Loetscher, T. & Keller,		
					J. (2002))		
					Cleaning material can only be used if it's		
					small and light enough or if they are		
					soluble in water like paper. Any other		
					material is unsuitable and the use of it		
					would cause clogging. (Spuhler, D. et al.		
0					(2021))		
	0	FALSE		NA NA	NA NA	NA NA	
0	0	FALSE	C	NA	NA	NA	
	0 Performance, Categorical	FALSE	short (< 1 year)				
0	0	FALSE	short (< 1 year) medium (1-5 years)	NA	NA	NA	
0 lifetime	Performance, Categorical	FALSE FALSE	short (< 1 year) medium (1-5 years) long (>5 years)	NA NA	NA NA	NA NA	
0	0	FALSE FALSE	short (< 1 year) medium (1-5 years) long (>5 years) rapid (< 3 days)	NA	NA	NA	
0 lifetime	Performance, Categorical	FALSE FALSE	short (< 1 year) medium (1-5 years) long (>5 years) rapid (< 3 days) moderate (3 days to 2 weeks)	NA NA	NA NA	NA NA	
0 lifetime speed_implement_toilet	O Performance, Categorical PDF, Categorical	FALSE FALSE	control (1 year) medium (1-5 years) long (>5 years) rapid (<3 days) moderate (3 days to 2 weeks) slow (>2 weeks)	NA NA	NA NA	NA NA	
0 lifetime	Performance, Categorical	FALSE FALSE	short (< 1 year) medium (1-5 years) long (>5 years) rapid (< 3 days) moderate (3 days to 2 weeks) slow (> 2 weeks) rapid (ways to a week)	NA NA	NA NA	NA NA	
0 lifetime speed_implement_toilet	O Performance, Categorical PDF, Categorical	FALSE FALSE	short (< 1 year) medium (1-5 years) long (5 years) rapid (< 3 days) moderate (3 days to 2 weeks) slow (> 2 weeks) rapid (few days to a week) moderate (few weeks up to three	NA NA	NA NA	NA NA	
0 lifetime speed_implement_toilet	O Performance, Categorical PDF, Categorical	FALSE FALSE	short (< 1 year) medium (1-5 years) long (55 years) rapid (< 3 days) moderate (3 days to 2 weeks) slow (> 2 weeks) rapid (few days to a week) moderate (few weeks up to three months)	NA NA	NA NA	NA NA	
0 lifetime speed_implement_toilet speed_implement_treatment	Performance, Categorical PDF, Categorical PDF, Categorical	FALSE FALSE FALSE	short (< 1 year) medium (1-5 years) long (>5 years) rapid (< 3 days) moderate (3 days to 2 weeks) slow (>2 weeks) rapid (few days to a week) moderate (few days to a week) moderate (few days to a week) slow (>3 moderate (few days)	NA NA NA	NA NA NA	NA NA	
0 lifetime speed_implement_toilet	O Performance, Categorical PDF, Categorical	FALSE FALSE FALSE	short (< 1 year) medium (1-5 years) long (55 years) rapid (< 3 days) moderate (3 days to 2 weeks) slow (> 2 weeks) rapid (tew days to a week) moderate (few weeks up to three months) slow (< 3 months) easy	NA NA	NA NA	NA NA	
O lifetime speed_implement_toilet speed_implement_treatment scalability	Performance, Categorical PDF, Categorical PDF, Categorical Performance, Categorical	FALSE FALSE FALSE FALSE	short (< 1 year) medium (1-5 years) long (55 years) rapid (< 3 days) moderate (3 days to 2 weeks) slow (> 2 weeks) moderate (few weeks up to three months) slow (> 3 months) easy difficult	NA NA NA NA NA	NA NA NA NA NA	NA NA NA NA	
0 lifetime speed_implement_toilet speed_implement_treatment	Performance, Categorical PDF, Categorical PDF, Categorical	FALSE FALSE FALSE FALSE	short (< 1 year) medium (1-5 years) long (5-5 years) rapid (< 3 days) moderate (3 days to 2 weeks) slow (> 2 weeks) rapid (few days to a week) moderate (few weeks up to three months) slow (> 3 months) easy difficult	NA NA NA NA (simple = 0, technical = 0.5, special =	NA NA NA NA NA *The cistern flush toilet is usually made of	NA NA NA NA	
O lifetime speed_implement_toilet speed_implement_treatment scalability	Performance, Categorical PDF, Categorical PDF, Categorical Performance, Categorical	FALSE FALSE FALSE FALSE	short (< 1 year) medium (1-5 years) long (55 years) rapid (< 3 days) moderate (3 days to 2 weeks) slow (> 2 weeks) moderate (few weeks up to three months) slow (> 3 months) easy difficult	NA NA NA NA NA	NA NA NA NA NA	NA NA NA NA	
O lifetime speed_implement_toilet speed_implement_treatment scalability	Performance, Categorical PDF, Categorical PDF, Categorical Performance, Categorical	FALSE FALSE FALSE FALSE	short (< 1 year) medium (1-5 years) long (5-5 years) rapid (< 3 days) moderate (3 days to 2 weeks) slow (> 2 weeks) rapid (few days to a week) moderate (few weeks up to three months) slow (> 3 months) easy difficult	NA NA NA NA (simple = 0, technical = 0.5, special =	NA NA NA NA The cistern flush toilet is usually made of porcelain and is a mass-produced, factory-	NA NA NA NA	
O lifetime speed_implement_toilet speed_implement_treatment scalability	Performance, Categorical PDF, Categorical PDF, Categorical Performance, Categorical	FALSE FALSE FALSE FALSE	short (< 1 year) medium (1-5 years) long (55 years) rapid (< 3 days) moderate (3 days to 2 weeks) show (> 2 weeks) rapid (few days to a week) moderate (few weeks up to three months) slow (> 3 months) easy difficult simple technical	NA NA NA NA (simple = 0, technical = 0.5, special =	NA NA NA NA The distern flush toilet is usually made of porcelain and is a mass-produced, factory-made User Interface." (Tilley, E. et al.	NA NA NA NA	
O lifetime speed_implement_toilet speed_implement_treatment scalability	Performance, Categorical PDF, Categorical PDF, Categorical Performance, Categorical	FALSE FALSE FALSE FALSE	short (< 1 year) medium (1-5 years) long (55 years) rapid (< 3 days) moderate (3 days to 2 weeks) show (> 2 weeks) rapid (few days to a week) moderate (few weeks up to three months) slow (> 3 months) easy difficult simple technical	NA NA NA NA (simple = 0, technical = 0.5, special =	NA NA NA NA The cistern flush toilet is usually made of porcelain and is a mass-produced, factory-made User Interface." (Tilley, E. et al. (2014))	NA NA NA NA	
O lifetime speed_implement_toilet speed_implement_treatment scalability	Performance, Categorical PDF, Categorical PDF, Categorical Performance, Categorical	FALSE FALSE FALSE FALSE	short (< 1 year) medium (1-5 years) long (55 years) rapid (< 3 days) moderate (3 days to 2 weeks) show (> 2 weeks) rapid (few days to a week) moderate (few weeks up to three months) slow (> 3 months) easy difficult simple technical	NA NA NA NA (simple = 0, technical = 0.5, special =	NA NA NA NA The cistern flush toilet is usually made of porcelain and is a mass-produced, factory-made User Interface." (Tilley, E. et al. (2014)) "A cistern flush toilet should not be	NA NA NA NA	
O lifetime speed_implement_toilet speed_implement_treatment scalability	Performance, Categorical PDF, Categorical PDF, Categorical Performance, Categorical	FALSE FALSE FALSE FALSE	short (< 1 year) medium (1-5 years) long (55 years) rapid (< 3 days) moderate (3 days to 2 weeks) show (> 2 weeks) rapid (few days to a week) moderate (few weeks up to three months) slow (> 3 months) easy difficult simple technical	NA NA NA NA (simple = 0, technical = 0.5, special =	NA NA NA The cistern flush tollet is usually made of porcelain and is a mass-produced, factory-made User Interface. "(Tilley, E. et al. (2014)) "A cistern flush tollet should not be considered unless all of the connections	NA NA NA NA	
O lifetime speed_implement_toilet speed_implement_treatment scalability	Performance, Categorical PDF, Categorical PDF, Categorical Performance, Categorical	FALSE FALSE FALSE FALSE	short (< 1 year) medium (1-5 years) long (55 years) rapid (< 3 days) moderate (3 days to 2 weeks) show (> 2 weeks) rapid (few days to a week) moderate (few weeks up to three months) slow (> 3 months) easy difficult simple technical	NA NA NA NA (simple = 0, technical = 0.5, special =	NA NA NA NA The cistern flush toilet is usually made of porcelain and is a mass-produced, factory-made User Interface." (Tilley, E. et al. (2014)) "A cistern flush toilet should not be considered unless all of the connections and hardware accessories are available	NA NA NA NA	
O lifetime speed_implement_toilet speed_implement_treatment scalability	Performance, Categorical PDF, Categorical PDF, Categorical Performance, Categorical	FALSE FALSE FALSE FALSE	short (< 1 year) medium (1-5 years) long (55 years) rapid (< 3 days) moderate (3 days to 2 weeks) show (> 2 weeks) rapid (few days to a week) moderate (few weeks up to three months) slow (> 3 months) easy difficult simple technical	NA NA NA NA (simple = 0, technical = 0.5, special =	NA NA NA The cistern flush toilet is usually made of porcelain and is a mass-produced, factory-made User Interface." (Tilley, E. et al. (2014)) A cistern flush toilet should not be considered unless all of the connections and hardware accessories are available locally." (Tilley, E. et al. (2014))	NA NA NA NA	
O lifetime speed_implement_toilet speed_implement_treatment scalability	Performance, Categorical PDF, Categorical PDF, Categorical Performance, Categorical	FALSE FALSE FALSE FALSE	short (< 1 year) medium (1-5 years) long (55 years) rapid (< 3 days) moderate (3 days to 2 weeks) show (> 2 weeks) rapid (few days to a week) moderate (few weeks up to three months) slow (> 3 months) easy difficult simple technical	NA NA NA NA (simple = 0, technical = 0.5, special =	NA NA NA NA The cistern flush toilet is usually made of porcelain and is a mass-produced, factory-made User Interface." (Tilley, E. et al. (2014)) Stein flush toilet should not be considered unless all of the connections and hardware accessories are available locally. "Cilley, E. et al. (2014)) "Cannot be built and/or repaired locally."	NA NA NA NA	
O lifetime speed_implement_toilet speed_implement_treatment scalability	Performance, Categorical PDF, Categorical PDF, Categorical Performance, Categorical	FALSE FALSE FALSE FALSE	short (< 1 year) medium (1-5 years) long (55 years) rapid (< 3 days) moderate (3 days to 2 weeks) show (> 2 weeks) rapid (few days to a week) moderate (few weeks up to three months) slow (> 3 months) easy difficult simple technical	NA NA NA NA (simple = 0, technical = 0.5, special =	NA NA NA The cistern flush toilet is usually made of porcelain and is a mass-produced, factory-made User Interface." (Tilley, E. et al. (2014) "A cistern flush toilet should not be considered unless all of the connections and hardware accessories are available locally." (Tilley, E. et al. (2014) "Cannot be built and/or repaired locally with available materials" (Tilley, E. et al. (2014)	NA NA NA NA	
O lifetime speed_implement_toilet speed_implement_treatment scalability	Performance, Categorical PDF, Categorical PDF, Categorical Performance, Categorical	FALSE FALSE FALSE FALSE	short (< 1 year) medium (1-5 years) long (55 years) rapid (< 3 days) moderate (3 days to 2 weeks) show (> 2 weeks) rapid (few days to a week) moderate (few weeks up to three months) slow (> 3 months) easy difficult simple technical	NA NA NA NA (simple = 0, technical = 0.5, special =	NA NA NA NA NA The cistern flush toilet is usually made of porcelain and is a mass-produced, factory-made User Interface." (Tilley, E. et al. (2014)) "A cistern flush toilet should not be considered unless all of the connections and hardware accessories are available locally." (Tilley, E. et al. (2014)) "Cannot be built and/or repaired locally with available materials" (Tilley, E. et al. (2014))	NA NA NA NA	
O lifetime speed_implement_toilet speed_implement_treatment scalability	Performance, Categorical PDF, Categorical PDF, Categorical Performance, Categorical	FALSE FALSE FALSE FALSE	short (< 1 year) medium (1-5 years) long (55 years) rapid (< 3 days) moderate (3 days to 2 weeks) show (> 2 weeks) rapid (few days to a week) moderate (few weeks up to three months) slow (> 3 months) easy difficult simple technical	NA NA NA NA (simple = 0, technical = 0.5, special =	NA NA NA NA The cistern flush toilet is usually made of porcelain and is a mass-produced, factory-made User Interface." (Tilley, E. et al. (2014)) "A cistern flush toilet should not be considered unless all of the connections and hardware accessories are available locally." (Tilley, E. et al. (2014)) "Cannot be built and/or repaired locally with available materials" (Tilley, E. et al. (2014)) We assume that specially manufactured	NA NA NA NA	
O lifetime speed_implement_toilet speed_implement_treatment scalability	Performance, Categorical PDF, Categorical PDF, Categorical Performance, Categorical	FALSE FALSE FALSE FALSE	short (< 1 year) medium (1-5 years) long (55 years) rapid (< 3 days) moderate (3 days to 2 weeks) show (> 2 weeks) rapid (few days to a week) moderate (few weeks up to three months) slow (> 3 months) easy difficult simple technical	NA NA NA NA (simple = 0, technical = 0.5, special =	NA NA NA NA NA NA NA NA NA NA	NA NA NA NA	
O lifetime speed_implement_toilet speed_implement_treatment scalability	Performance, Categorical PDF, Categorical PDF, Categorical Performance, Categorical	FALSE FALSE FALSE FALSE	short (< 1 year) medium (1-5 years) long (55 years) rapid (< 3 days) moderate (3 days to 2 weeks) show (> 2 weeks) rapid (few days to a week) moderate (few weeks up to three months) slow (> 3 months) easy difficult simple technical	NA NA NA NA (simple = 0, technical = 0.5, special =	NA NA NA NA The cistern flush toilet is usually made of porcelain and is a mass-produced, factory-made User Interface." (Tilley, E. et al. (2014)) "A cistern flush toilet should not be considered unless all of the connections and hardware accessories are available locally." (Tilley, E. et al. (2014)) "Cannot be built and/or repaired locally with available materials" (Tilley, E. et al. (2014)) We assume that specially manufactured	NA NA NA NA	
O lifetime speed_implement_toilet speed_implement_treatment scalability	Performance, Categorical PDF, Categorical PDF, Categorical Performance, Categorical	FALSE FALSE FALSE FALSE	short (< 1 year) medium (1-5 years) long (55 years) rapid (< 3 days) moderate (3 days to 2 weeks) show (> 2 weeks) rapid (few days to a week) moderate (few weeks up to three months) slow (> 3 months) easy difficult simple technical	NA NA NA NA (simple = 0, technical = 0.5, special =	NA NA NA NA The cistern flush toilet is usually made of porcelain and is a mass-produced, factory-made User interface." (Tilley, E. et al. (2014)) "A cistern flush toilet should not be considered unless all of the connections and hardware accessories are available locally." (Tilley, E. et al. (2014)) "Cannot be built and/or repaired locally with available materials" (Tilley, E. et al. (2014)) which available materials" (Tilley, E. et al. (2014)) south as pre-fabricated User interfaces are necessary to construct the	NA NA NA NA	
speed_implement_toilet speed_implement_treatment scalability construction_parts	Performance, Categorical PDF, Categorical PDF, Categorical Performance, Categorical PDF, Categorical	FALSE FALSE FALSE FALSE	short (< 1 year) medium (1-5 years) long (55 years) rapid (< 3 days) moderate (3 days to 2 weeks) show (> 2 weeks) rapid (few days to a week) moderate (few weeks up to three months) slow (> 3 months) easy difficult simple technical	NA NA NA NA (simple = 0, technical = 0.5, special =	NA NA NA NA NA NA NA NA NA NA	NA NA NA NA	
O lifetime speed_implement_toilet speed_implement_treatment scalability	Performance, Categorical PDF, Categorical PDF, Categorical Performance, Categorical	FALSE FALSE FALSE FALSE	short (< 1 year) medium (1-5 years) long (55 years) rapid (< 3 days) moderate (3 days to 2 weeks) show (> 2 weeks) rapid (few days to a week) moderate (few weeks up to three months) slow (> 3 months) easy difficult simple technical	NA NA NA NA (simple = 0, technical = 0.5, special =	NA NA NA NA "The cistern flush toilet is usually made of porcelain and is a mass-produced, factory-made User Interface." (Tilley, E. et al. (2014)) "A cistern flush toilet should not be considered unless all of the connections and hardware accessories are available locally." (Tilley, E. et al. (2014)) "Cannot be built and/or repaired locally with available materials" (Tilley, E. et al. (2014)) We assume that specially manufactured parts, such as pre-fabricated User interfaces are necessary to construct the cistern flush tollet. (Spuhler, D. et al	NA NA NA NA	
o lifetime speed_implement_toilet speed_implement_treatment scalability construction_parts	Performance, Categorical PDF, Categorical PDF, Categorical Performance, Categorical PDF, Categorical	FALSE FALSE FALSE FALSE TRUE	short (< 1 year) medium (1-5 years) long (55 years) rapid (< 3 days) moderate (3 days to 2 weeks) show (> 2 weeks) rapid (few days to a week) moderate (few weeks up to three months) slow (> 3 months) easy difficult simple technical	NA NA NA NA (simple = 0, technical = 0.5, special = 0.5)	NA NA NA NA "The cistern flush toilet is usually made of porcelain and is a mass-produced, factory-made User Interface." (Tilley, E. et al. (2014)) "A cistern flush toilet should not be considered unless all of the connections and hardware accessories are available locally." (Tilley, E. et al. (2014)) "Cannot be built and/or repaired locally with available materials" (Tilley, E. et al. (2014)) We assume that specially manufactured parts, such as pre-fabricated User interfaces are necessary to construct the cistern flush tollet. (Spuhler, D. et al	NA NA NA VES	Reference
o lifetime speed_implement_toilet speed_implement_treatment scalability construction_parts	Performance, Categorical PDF, Categorical PDF, Categorical PDF, Categorical PPF Categorical PPF Categorical PDF, Categorical	FALSE FALSE FALSE FALSE	short (c 1 year) medium (1-5 years) long (5-5 years) rapid (3 days) moderate (3 days to 2 weeks) slow (> 2 weeks) rapid (few days to a week) moderate (few weeks up to three months) slow (> 3 months) easy difficult simple technical special	NA NA NA NA (simple = 0, technical = 0.5, special =	NA NA NA NA NA The cistern flush tollet is usually made of porcelain and is a mass-produced, factory-made User Interface. "(Tilley, E. et al. (2014)) "A cistern flush tollet should not be considered unless all of the connections and hardware accessories are available locally." (Tilley, E. et al. (2014)) "Cannot be built and/or repaired locally with available materials" (Tilley, E. et al. (2014)) We assume that specially manufactured parts, such as pre-fabricated User interfaces are necessary to construct the cistern flush toilet. (Spuhler, D. et al (2021)) Waterloss	NA NA NA VES Comments	Reference Spuhler, D. et al. (2021)
o lifetime speed_implement_troilet speed_implement_treatment scalability construction_parts	Performance, Categorical PDF, Categorical PDF, Categorical PDF, Categorical PPF Categorical PPF Categorical PDF, Categorical	FALSE FALSE FALSE FALSE FALSE TRUE TRUE Range	short (c 1 year) medium (1-5 years) long (5-5 years) rapid (3 days) moderate (3 days to 2 weeks) slow (> 2 weeks) rapid (few days to a week) moderate (few weeks up to three months) slow (> 3 months) easy difficult simple technical special	NA NA NA NA (simple = 0, technical = 0.5, special = 0.5)	NA NA NA NA NA The cistern flush tollet is usually made of porcelain and is a mass-produced, factory-made User Interface. "(Tilley, E. et al. (2014)) "A cistern flush tollet should not be considered unless all of the connections and hardware accessories are available locally." (Tilley, E. et al. (2014)) "Cannot be built and/or repaired locally with available materials" (Tilley, E. et al. (2014)) We assume that specially manufactured parts, such as pre-fabricated User interfaces are necessary to construct the cistern flush toilet. (Spuhler, D. et al (2021)) Waterloss	NA NA NA VES Comments	
O lifetime speed_implement_toilet speed_implement_treatment scalability construction_parts	Performance, Categorical PDF, Categorical	FALSE FALSE FALSE TRUE TRUE Range	short (c 1 year) medium (1-5 years) long (5-5 years) rapid (3 days) moderate (3 days to 2 weeks) slow (> 2 weeks) rapid (few days to a week) moderate (few weeks up to three months) slow (> 3 months) easy difficult simple technical special	NA NA NA NA (simple = 0, technical = 0.5, special = 0.5)	NA NA NA NA NA The cistern flush tollet is usually made of porcelain and is a mass-produced, factory-made User Interface. "(Tilley, E. et al. (2014)) "A cistern flush tollet should not be considered unless all of the connections and hardware accessories are available locally." (Tilley, E. et al. (2014)) "Cannot be built and/or repaired locally with available materials" (Tilley, E. et al. (2014)) We assume that specially manufactured parts, such as pre-fabricated User interfaces are necessary to construct the cistern flush toilet. (Spuhler, D. et al (2021)) Waterloss	NA NA NA VES Comments	Spuhler, D. et al. (2021)
O lifetime speed_implement_troilet speed_implement_treatment scalability construction_parts Transfer Coefficients TP med (8)	Performance, Categorical PDF, Categorical PDF, Categorical PDF, Categorical PDF, Categorical PDF, Categorical PDF, Categorical	FALSE FALSE FALSE TRUE TRUE Range	short (c 1 year) medium (1-5 years) long (5-5 years) rapid (3 days) moderate (3 days to 2 weeks) slow (> 2 weeks) rapid (few days to a week) moderate (few weeks up to three months) slow (> 3 months) easy difficult simple technical special	NA NA NA NA (simple = 0, technical = 0.5, special = 0.5)	NA NA NA NA The cistern flush toilet is usually made of porcelain and is a mass-produced, factory-made User Interface." (Tilley, E. et al. (2014)) "A cistern flush toilet should not be considered unless all of the connections and hardware accessories are available locally." (Tilley, E. et al. (2014)) "Cannot be built and/or repaired locally with available materials' (Tilley, E. et al. (2014)) Wassume that specially manufactured parts, such as pre-fabricated User interfaces are necessary to construct the cistern flush toilet. (Spuhler, D. et al (2021)) Waterloss 0 0	NA NA NA NA NA VES Comments *Assumption: Losses occur in storage	
O lifetime speed_implement_toilet speed_implement_treatment scalability construction_parts Transfer Coefficients TP med [8]	Performance, Categorical PDF, Categorical	FALSE FALSE FALSE FALSE FALSE FALSE FALSE RANGE TRUE	short (c 1 year) medium (1-5 years) long (5-5 years) rapid (3 days) moderate (3 days to 2 weeks) slow (> 2 weeks) rapid (few days to a week) moderate (few weeks up to three months) slow (> 3 months) easy difficult simple technical special	NA NA NA NA (simple = 0, technical = 0.5, special = 0.5)	NA NA NA NA The cistern flush toilet is usually made of porcelain and is a mass-produced, factory-made User Interface." (Tilley, E. et al. (2014)) "A cistern flush toilet should not be considered unless all of the connections and hardware accessories are available locally." (Tilley, E. et al. (2014)) "Cannot be built and/or repaired locally with available materials' (Tilley, E. et al. (2014)) Wassume that specially manufactured parts, such as pre-fabricated User interfaces are necessary to construct the cistern flush toilet. (Spuhler, D. et al (2021)) Waterloss 0 0	NA NA NA NA NA VES Comments *Assumption: Losses occur in storage	Spuhler, D. et al. (2021) - Spuhler, D. et al. (2021)
O lifetime speed_implement_treatment scalability construction_parts Transfer Coefficients TP med (R) TN	Performance, Categorical PDF, Categorical	FALSE FALSE FALSE TRUE TRUE TRUE TRUE	short (c 1 year) medium (1-5 years) long (5-5 years) rapid (3 days) moderate (3 days to 2 weeks) slow (> 2 weeks) rapid (few days to a week) moderate (few weeks up to three months) slow (> 3 months) easy difficult simple technical special	NA NA NA NA (simple = 0, technical = 0.5, special = 0.5)	NA NA NA NA The cistern flush toilet is usually made of porcelain and is a mass-produced, factory-made User interface." (Tilley, E. et al. (2014)) "A cistern flush toilet should not be considered unless all of the connections and hardware accessories are available locally." (Tilley, E. et al. (2014)) "Cannot be built and/or repaired locally with available materials" (Tilley, E. et al. (2014)) We assume as pre-fabricated User interfaces are necessary to construct the cistern flush toilet. (Spuhler, D. et al (2021)) Waterloss 0 0 0 0	NA NA NA NA NA YES Comments * Assumption: Losses occur in storage * Assumption: Losses occur in storage	Spuhler, D. et al. (2021) Spuhler, D. et al. (2021) Spuhler, D. et al. (2021) Spuhler, D. et al. (2021)
Speed_implement_toilet speed_implement_treatment scalability construction_parts Transfer Coefficients TP med (R) 1 TN med (R)	Performance, Categorical PDF, Categorical	FALSE FALSE FALSE TRUE TRUE TRUE TRUE	short (c 1 year) medium (1-5 years) long (5-5 years) rapid (3 days) moderate (3 days to 2 weeks) slow (> 2 weeks) rapid (few days to a week) moderate (few weeks up to three months) slow (> 3 months) easy difficult simple technical special	NA NA NA NA (simple = 0, technical = 0.5, special = 0.5)	NA NA NA NA The cistern flush toilet is usually made of porcelain and is a mass-produced, factory-made User interface." (Tilley, E. et al. (2014)) "A cistern flush toilet should not be considered unless all of the connections and hardware accessories are available locally." (Tilley, E. et al. (2014)) "Cannot be built and/or repaired locally with available materials" (Tilley, E. et al. (2014)) We assume as pre-fabricated User interfaces are necessary to construct the cistern flush toilet. (Spuhler, D. et al (2021)) Waterloss 0 0 0 0	NA NA NA NA NA YES Comments * Assumption: Losses occur in storage * Assumption: Losses occur in storage	Spuhler, D. et al. (2021) - Spuhler, D. et al. (2021) Spuhler, D. et al. (2021) -
O lifetime speed_implement_toilet speed_implement_treatment scalability construction_parts Transfer Coefficients TP med (R) TN med (R)	Performance, Categorical PDF, Categorical	FALSE FALSE FALSE TRUE TRUE TRUE TRUE	short (c 1 year) medium (1-5 years) long (5-5 years) rapid (3 days) moderate (3 days to 2 weeks) slow (> 2 weeks) rapid (few days to a week) moderate (few weeks up to three months) slow (> 3 months) easy difficult simple technical special	NA NA NA NA (simple = 0, technical = 0.5, special = 0.5)	NA NA NA NA The cistern flush toilet is usually made of porcelain and is a mass-produced, factory-made User interface." (Tilley, E. et al. (2014)) "A cistern flush toilet should not be considered unless all of the connections and hardware accessories are available locally." (Tilley, E. et al. (2014)) "Cannot be built and/or repaired locally with available materials" (Tilley, E. et al. (2014)) We assume as pre-fabricated User interfaces are necessary to construct the cistern flush toilet. (Spuhler, D. et al (2021)) Waterloss 0 0 0 0	NA NA NA NA NA YES Comments * Assumption: Losses occur in storage * Assumption: Losses occur in storage	Spuhler, D. et al. (2021) Spuhler, D. et al. (2021) Spuhler, D. et al. (2021) Spuhler, D. et al. (2021)
Speed_implement_toilet speed_implement_treatment scalability construction_parts Transfer Coefficients TP med (8) med (8) 12 H20	Performance, Categorical PDF, Categorical	FALSE FALSE FALSE FALSE FALSE FALSE TRUE INSECTION OF THE PROPERTY OF THE	short (c 1 year) medium (1-5 years) long (5-5 years) rapid (3 days) moderate (3 days to 2 weeks) slow (> 2 weeks) rapid (few days to a week) moderate (few weeks up to three months) slow (> 3 months) easy difficult simple technical special	NA NA NA NA (simple = 0, technical = 0.5, special = 0.5)	NA NA NA NA The cistern flush toilet is usually made of porcelain and is a mass-produced, factory-made User interface." (Tilley, E. et al. (2014)) "A cistern flush toilet should not be considered unless all of the connections and hardware accessories are available locally." (Tilley, E. et al. (2014)) "Cannot be built and/or repaired locally with available materials" (Tilley, E. et al. (2014)) We assume as pre-fabricated User interfaces are necessary to construct the cistern flush toilet. (Spuhler, D. et al (2021)) Waterloss 0 0 0 0	NA NA NA NA NA YES Comments * Assumption: Losses occur in storage * Assumption: Losses occur in storage * Assumption: Losses occur in storage	Spuhler, D. et al. (2021)
speed_implement_toilet speed_implement_treatment scalability construction_parts Transfer Coefficients TP med (R) med (R) 120 med (R) 120 med (R) 120 med (R) 120 med (R) 120	Performance, Categorical PDF, Categorical 1.000 1.000 1.10	FALSE FALSE FALSE FALSE FALSE FALSE TRUE 100023-300m ¹ Range	short (c 1 year) medium (1-5 years) long (5-5 years) rapid (3 days) moderate (3 days to 2 weeks) slow (> 2 weeks) rapid (few days to a week) moderate (few weeks up to three months) slow (> 3 months) easy difficult simple technical special	NA NA NA NA (simple = 0, technical = 0.5, special = 0.5)	NA NA NA NA NA The cistern flush tollet is usually made of porcelain and is a mass-produced, factory-made User Interface." (Tilley, E. et al. (2014)) "A cistern flush tollet should not be considered unless all of the connections and hardware accessories are available locally." (Tilley, E. et al. (2014)) "Cannot be built and/or repaired locally with available materials" (Tilley, E. et al. (2014)) We assume that specially manufactured parts, such as pre-fabricated User interfaces are necessary to construct the cistern flush toilet. (Spuhler, D. et al (2021)) Waterloss O O O O O O O O O O O O	NA NA NA NA NA YES Comments * Assumption: Losses occur in storage * Assumption: Losses occur in storage * Assumption: Losses occur in storage	Spuhler, D. et al. (2021) Spuhler, D. et al. (2021) Spuhler, D. et al. (2021) Spuhler, D. et al. (2021) Spuhler, D. et al. (2021) Spuhler, D. et al. (2021)
speed_implement_toilet speed_implement_treatment scalability construction_parts Transfer Coefficients TP med (R) med (R) 120 med (R) 120 med (R) 120 med (R) 120 med (R) 120	Performance, Categorical PDF, Categorica	FALSE FALSE FALSE FALSE FALSE FALSE TRUE 100023-300m ¹ Range	short (c 1 year) medium (1-5 years) long (5-5 years) rapid (3 days) moderate (3 days to 2 weeks) slow (> 2 weeks) rapid (few days to a week) moderate (few weeks up to three months) slow (> 3 months) easy difficult simple technical special	NA NA NA NA (simple = 0, technical = 0.5, special = 0.5)	NA NA NA NA NA The cistern flush tollet is usually made of porcelain and is a mass-produced, factory-made User Interface." (Tilley, E. et al. (2014)) "A cistern flush tollet should not be considered unless all of the connections and hardware accessories are available locally." (Tilley, E. et al. (2014)) "Cannot be built and/or repaired locally with available materials" (Tilley, E. et al. (2014)) We assume that specially manufactured parts, such as pre-fabricated User interfaces are necessary to construct the cistern flush toilet. (Spuhler, D. et al (2021)) Waterloss O O O O O O O O O O O O	NA NA NA NA NA YES Comments * Assumption: Losses occur in storage * Assumption: Losses occur in storage * Assumption: Losses occur in storage	Spuhler, D. et al. (2021)
Speed_implement_troilet speed_implement_treatment scalability construction_parts Transfer Coefficients TP med (R) RE RE RE RE RE RE RE RE RE RE RE RE RE	Performance, Categorical PDF, Categorical 1.000 1.000 1.10	FALSE FALSE FALSE TRUE TRUE TRUE	short (c 1 year) medium (1-5 years) long (5-5 years) rapid (3 days) moderate (3 days to 2 weeks) slow (> 2 weeks) rapid (few days to a week) moderate (few weeks up to three months) slow (> 3 months) easy difficult simple technical special	NA NA NA NA (simple = 0, technical = 0.5, special = 0.5)	NA NA NA NA NA The cistern flush tollet is usually made of porcelain and is a mass-produced, factory-made User Interface." (Tilley, E. et al. (2014)) "A cistern flush tollet should not be considered unless all of the connections and hardware accessories are available locally." (Tilley, E. et al. (2014)) "Cannot be built and/or repaired locally with available materials" (Tilley, E. et al. (2014)) We assume that specially manufactured parts, such as pre-fabricated User interfaces are necessary to construct the cistern flush toilet. (Spuhler, D. et al (2021)) Waterloss O O O O O O O O O O O O	NA NA NA NA NA YES Comments * Assumption: Losses occur in storage * Assumption: Losses occur in storage * Assumption: Losses occur in storage	Spuhler, D. et al. (2021)

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Gersch, R., Jennings, A., Renggli, S., & Reymond, P. (2018). Compendium of Sanitation Technologies in Emergencies . German WASH Network (GWN), Swiss Federal Institute of Aquatic Science and Technology (Eawag), Global WASH Cluster (GWC) and Sustainable Sanitation Alliance (SuSanA). Loestsher, T., & Reller, J. (2002). A decision support system for selecting sanitation systems in developing countries. Socio-Economic Planning Sciences, 36 (A), 267–290. https://doi.org/10.1016/S0038-0121(0)200007-1

Spuhler, D., de Morissi Lima, P., Fritsche, L., Ilmanen, K., Jain, A., van Sloten, M., & Williannan, C. (2021.) Sanitation Science and Technology (Eawag), Dübendorf, Switzerland. Spuhler, D., & Roller, L. (2020). Sanitation technology library: Details and data sources for appropriateness profiles and transfer coefficients . Eawag-Swiss Federal Institute of Aquatic Science and Technology (EawAG).

Tilley, E., Ulrich, L., Lüthi, C., Reymond, P., & Zurbrügg, C. (2014). Compendium of Sanitation Systems and Technologies—2nd revised edition . Swiss Federal Institute of Aquatic Science and Technology (EAWAG).

FUNCTIONAL GROUP L UNIQUE IDENTIFIER (ID) P							
FUNCTIONAL GROUP L UNIQUE IDENTIFIER (ID) P							
UNIQUE IDENTIFIER (ID) P		Data Source					
	pour_flush						
DATA COMPILER J	Julian Fritzsche anal_cleansing_water	-					
F	For Santiago: NA	Spuhler, D. & Roller, L. (2020)					
OUTPUT PRODUCT b	blackwater Input: OR, For Santiago: NA	Spuhler, D. & Roller, L. (2020)					
	Input: OR, For Santiago: NA Output: NA	Spuhler, D. & Roller, L. (2020)					
COMMENTS		Spurier, D. & Noller, L. (2020)					
		Data Source					
applicability_level N management_level N		NA NA					
capex_req_level	5	Spuhler, D. et al. (2021)					
opex_req_level		Spuhler, D. et al. (2021)					
technical_maturity development phase (a	(acute = 1, stabilisation = 1,	Tilley, E. et al. (2014) Gensch, R. et al. (2018)					
d	development/recovery = 1)						
ening Criteria T water_supply	Type and Function Performance, Categorical	Applicable for this Functional Group?	Categories [Unit] house	Technology Values (Data) (house = 1, yard = 1, public = 0.5, none	Under the assumption that water	Internal Review Done? Yes (AJ)	
			yard public none	=0)	carriers suffice for pour flush toilets, the performance for house and yard connection equals 1. Water carriers can also be filled up at public or community-managed standpipes, but the distance is mostly further and therefore the effort much bigger. Therefore, the score for public equals 0.5 (only half the performance). (Spublic, D. et al. (2021) "Water carriers suffice for pour-flush toilets" (Loetscher & Keller (2002))		
water_volume	Performance, Trapez	FALSE	[L/cap/day]	NA	NA	NA	
electricity_supply	Performance, Categorical	FALSE	electricity	NA	NA	NA	
fuel_supply	Performance, Categorical	FALSE	fuel	NA (irregular = 0.8, regular = 0.2,	NA	NA	
frequency_of_om	PDF, Categorical		irregular regular continuous	continuous = 0)	"Because there are no mechanical parts, pour flush toilets are quite robust and rarely require repair. Despite the fact that it is a waterbased toilet, it should be cleaned regularly to maintain hygiene and prevent the buildup of stains." (Tilley, E. et al. (2014)) simple design, usually requires repair not very often, but still should be cleaned more or less regularly to prevent buildup of stains and therefore clogging. (Spuhler, D. et al. (2021))	yes	
pipe_supply	Performance, Categorical		no pipes	NA	NA	NA	
pump_supply concrete_supply	Performance, Categorical Performance, Categorical		no pumps no concrete	NA (no concrete = 0.5, difficultly available	NA Concrete is mostly used for the	NA yes	
			concrete		practical for building the toilets. However, if no concrete is available, the superstructure can still be built with stone, brick, clay or similiar materials. Concrete is not essential for this technology. The construction process is faster if a mould is used that can be filled with concrete, compared to the performance if built with anything else but concrete. (Spuhler, D. et al. (2023).		
		TRUE	simple	(simple =0.2, technical = 0.8, special =	"Requires materials and skills for		
spare_parts	PDF, Categorical		technical special	0)	production that are not available everywhere" (Tilley, E. et al. (2014)) Requires a siphon with a water seal. (Spuhler, D. et al. (2021))	yes	
0	0	FALSE	technical special 0	NA NA	production that are not available everywhere" (Tilley, E. et al. (2014)) Requires a siphon with a water seal. (Spuhler, D. et al. (2021)) NA	NA	
0	0 0	FALSE FALSE	technical special 0	NA NA	production that are not available everywhere" (Tilley, E. et al. (2014)) Requires a siphon with a water seal. (Spuhler, D. et al. (2021)) NA NA	NA NA	
0	0 0 0 Performance, Categorical	FALSE FALSE FALSE FALSE FALSE	technical special 0	NA NA	production that are not available everywhere" (Tilley, E. et al. (2014)) Requires a siphon with a water seal. (Spuhler, D. et al. (2021)) NA	NA NA NA NA	
0 0 0 temperature flooding	0 0 0 Performance, Categorical Performance, Categorical	FALSE FALSE FALSE FALSE FALSE FALSE FALSE	technical special 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	NA NA NA NA	production that are not available everywhere" (Tilley, E. et al. (2014)) Requires a siphon with a water seal. (Spubler, D. et al. (2021)) NA NA NA NA NA NA NA	NA NA NA NA	
0 0 0 temperature flooding vehicular_acces	0 0 Performance, Categorical Performance, Categorical Performance, Categorical	FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE	technical special	NA NA NA NA NA	production that are not available everywhere" (Tilley, E. et al. (2014)) Requires a siphon with a water seal. (Spublier, D. et al. (2021)) NA NA NA NA NA NA NA NA NA NA	NA NA NA NA NA	
0 0 temperature flooding vehicular_acces	0 0 0 Performance, Categorical Performance, Categorical	FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE	technical special 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	NA NA NA NA NA NA	production that are not available everywhere" (Tilley, E. et al. (2014)) Requires a siphon with a water seal. (Spuhler, D. et al. (2021)) NA NA NA NA NA NA NA NA NA NA NA NA	NA NA NA NA	
0 0 0 temperature flooding vehicular acces slope soil_type groundwater depth	0 0 Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Tapeze	FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE	technical special 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	NA NA NA NA NA NA NA NA NA NA NA NA	production that are not available everywhere" (Tilley, E. et al. (2014)) Requires a siphon with a water seal. (Spuhler, D. et al. (2021)) NA NA NA NA NA NA NA NA NA NA NA NA NA	NA NA NA NA NA NA NA NA NA NA NA NA NA	
0 0 0 0 0 temperature flooding vehicular acces slope soll, type groundwater depth excavation	0 Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Tategorical Performance, Tategorical Performance, Tategorical	FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE	technical special 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	NA NA NA NA NA NA NA NA NA NA NA NA NA N	production that are not available everywhere ("Itleg, E. et al. (2014)) Requires a siphon with a water seal. (Spuhler, D. et al. (2021)) NA NA NA NA NA NA NA NA NA NA NA NA NA	NA NA NA NA NA NA NA NA NA NA NA NA NA N	
0 0 0 temperature flooding vehicular acces slope soil_type groundwater_depth excavation	0 0 Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Trapez Performance, Trapez	FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE	technical special 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	NA NA NA NA NA NA NA NA NA NA NA NA NA N	production that are not available everywhere" (Tilley, E. et al. (2014)) Requires a siphon with a water seal. (Spublier, D. et al. (2021)) NA NA NA NA NA NA NA NA NA NA NA NA NA	NA NA NA NA NA NA NA NA NA NA NA NA NA	
0 0 temperature flooding vehicular acces slope groundwater depth surface area onsite surface area onsite	0 Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Trapez	FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE	technical special 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	NA NA NA NA NA NA NA NA NA NA NA NA NA N	production that are not available everywhere" (Tilley, E. et al. (2014)) Requires a siphon with a water seal. (Spuhler, D. et al. (2021)) NA NA NA NA NA NA NA NA NA NA NA NA NA	NA NA NA NA NA NA NA NA NA NA NA NA NA N	
0 0 0 temperature flooding vehicular acces slope groundwater depth excavation surface area onsite surface area offsite 0 0	0 0 0 Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Trapez Performance, Trapez Performance, Trapez Performance, Trapez O 0	FALSE FALSE	technical special	NA NA NA NA NA NA NA NA NA NA NA NA NA N	production that are not available everywhere" (Tilley, E. et al. (2014)) Requires a siphon with a water seal. (Sputher, D. et al. (2021)) NA NA NA NA NA NA NA NA NA NA NA NA NA	NA NA NA NA NA NA NA NA NA NA NA NA NA N	
0 0 0 temperature flooding vehicular_acces slopee groundwater depth excavation surface_area_onsite surface_area_offsite ourface_area_offsite 0 0 0	0 Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Trapez Performance, Trapez Performance, Trapez Performance, Trapez O 0 0	FALSE FALSE	technical special	NA NA NA NA NA NA NA NA NA NA NA NA NA N	production that are not available everywhere" (Tilley, E. et al. (2014)) Requires a siphon with a water seal. (Spuhler, D. et al. (2021)) NA NA NA NA NA NA NA NA NA NA NA NA NA	NA NA NA NA NA NA NA NA NA NA NA NA NA N	
0 0 0 temperature flooding vehicular_acces slopee groundwater depth exexavation surface_area_onsite surface_area_offsite ourface_area_offsite 0 0 0	0 Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Tapeze Performance, Trapeze Performance, Trapeze Performance, Trapeze Performance, Trapeze O O Performance, Categorical	FALSE FALSE	technical special	NA NA NA NA NA NA NA NA NA NA NA NA NA N	production that are not available everywhere" (Tilley, E. et al. (2014)) Requires a siphon with a water seal. (Spuhler, D. et al. (2021)) NA NA NA NA NA NA NA NA NA NA NA NA NA	NA NA NA NA NA NA NA NA NA NA NA NA NA N	
0 0 temperature flooding vehicular acces slopee groundwater depth excavation surface area onsite surface area offsite o 0 drinking water exposure 0	0 0 0 0 0 Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Trapez Performance, Trapez Performance, Trapez O 0 0 Performance, Categorical	FALSE FALSE	technical special 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	NA NA NA NA NA NA NA NA NA NA NA NA NA N	production that are not available everywhere" (Tilley, E. et al. (2014)) Requires a siphon with a water seal. (Spublier, D. et al. (2021)) NA NA NA NA NA NA NA NA NA NA NA NA NA	NA NA NA NA NA NA NA NA NA NA NA NA NA N	
0 0 1 temperature flooding vehicular_acces slopee groundwater_depth excavation surface_area_onsite surface area offsite offsite area offsite definition of the control of t	0 Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Trapez Performance, Trapez Performance, Trapez Performance, Trapez Performance, Categorical Performance, Categorical Performance, Categorical O Performance, Categorical O Performance, Categorical	FALSE FALSE	technical special	NA NA NA NA NA NA NA NA NA NA NA NA NA N	production that are not available everywhere" (Tilley, E. et al. (2014)) Requires a siphon with a water seal. (Spuhler, D. et al. (2021)) NA NA NA NA NA NA NA NA NA NA NA NA NA	NA NA NA NA NA NA NA NA NA NA NA NA NA N	
0 0 0 1 temperature flooding vehicular acces slope soil_type groundwater_depth excavation surface_area_onsite surface_area_offsite 0 0 drinking_water_exposure 0 construction_skills	0 Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Trapez Performance, Trapez Performance, Trapez O O O Performance, Categorical Performance, Trapez Performance, Categorical O Performance, Categorical O Performance, Categorical	FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE TALSE FALSE TALSE TALSE FALSE TALSE TRUE	technical special 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	NA NA NA NA NA NA NA NA NA NA NA NA NA N	production that are not available everywhere" (Tilley, E. et al. (2014)) Requires a siphon with a water seal. (Spublier, D. et al. (2021)) NA NA NA NA NA NA NA NA NA NA NA NA NA	NA NA NA NA NA NA NA NA NA NA NA NA NA N	
0 0 1 temperature flooding vehicular_acces slopee groundwater_depth excavation surface_area_onsite surface_area_onsite of the control of the	0 Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Trapez Performance, Trapez Performance, Trapez O O Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical	FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE TALSE FALSE TALSE TALSE FALSE TALSE TRUE	technical special 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	NA NA NA NA NA NA NA NA NA NA NA NA NA N	production that are not available everywhere" (Tilley, E. et al. (2014)) Requires a siphon with a water seal. (Spublier, D. et al. (2021)) NA NA NA NA NA NA NA NA NA NA NA NA NA	NA NA NA NA NA NA NA NA NA NA NA NA NA N	
0 0 0 temperature flooding vehicular_acces slope groundwater depth surface area offsite surface area offsite official offsite construction_skills design_skills design_skills	0 Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Trapez Performance, Trapez Performance, Trapez Performance, Trapez O O Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical O Performance, Categorical Performance, Categorical	FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE TALSE FALSE TALSE TRUE	technical special 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	NA	production that are not available everywhere" (Tilley, E. et al. (2014)) Requires a siphon with a water seal. (Spublier, D. et al. (2021)) NA NA NA NA NA NA NA NA NA NA NA NA NA	NA NA NA NA NA NA NA NA NA NA NA NA NA N	

cleansing_method	Performance, Categorical	TRUE	Washers	(washers = 1, soft wipers = 1, hard	"Flush toilets are also unsuitable		
			Soft wipers	wipers = 0)	where bulky materials (e.g. maize		
			Hard wipers		cobs) are used for anal cleansing."		
					(Loetscher, T. & Keller, J. (2002))		
					Cleaning material can only be used if		
					it's small and light enough or if they		
					are soluble in water like paper. Any		
					other material is unsuitable and the		
					use of it would cause clogging.		
0		E110E			(Spuhler, D. et al. (2021))		
-		FALSE		NA	NA	NA	
0		FALSE		NA	NA	NA	
lifetime		FALSE	short (< 1 year)	NA	NA	NA	
speed_implement_toilet	PDF, Categorical		rapid (< 3 days)	NA	NA	NA	
peed_implement_treatment	PDF, Categorical		rapid (few days to a week)	NA	NA	NA	
scalability	Performance, Categorical	FALSE	easy	NA	NA	NA]
construction_parts	PDF, Categorical	TRUE	simple		"Requires materials and skills for	yes	
_			technical		production that are not available		
			special		everywhere" (Tilley, E. et al. (2014))		
			[]		"Squatting slabs can be made locally		
					with concrete (providing that sand		
					and cement are available), fibreglass,		
					porcelain or stainless steel. Wooden		
					or metal moulds can be used to		
					produce several units quickly and		
					efficiently. Prefabricated pedestals		
					and squatting slabs made from plastic		
					are also available, as are water seal		
					devices that can be attached to		
					squatting slabs." (Gensch, R. et al.		
					(2018))		
					Slabs can be made from simple local		
					material. However, further technical		
					parts (e.g. siphon with a water seal)		
					are required. (Spuhler, D. et al. (2021))		
					are required. (Spurier, D. et al. (2021))		
ransfer Coefficients	(copied from "Sanitation_Technologies_TC_database_202	10622.xism")					
		Range	Airloss	Soilloss	Waterloss	Comments	Reference
TP	1	nunge.		5011055		* Assumption: Losses occur in storage	Spuhler, D. et al. (2021)
med (R)	1		1			Assumption, cosses occur in storage	Spanier, D. Ct al. (2021)
med (R)	100		U		,	-	Spuhler, D. et al. (2021)
, K	. 100		- 0				
TN	1		- 0	0	0	* Assumption: Losses occur in storage	Spuhler, D. et al. (2021)
med (R)	1		0	C	0		-
k	100		·		·		Spuhler, D. et al. (2021)
H2O	1		- O		0	* Assumption: Losses occur in storage	Spuhler, D. et al. (2021)
med (R)	1		- O	C	0		-
k	100						Spuhler, D. et al. (2021)
					1	* Assumption: Losses occur in storage	Spuhler, D. et al. (2021)
TS	1	·	· u				
TS med (R)	1		- 0		0	Assumption: Losses occur in storage	-
			- 0	C	0	Assumption: Losses occur in storage	- Spuhler, D. et al. (2021)

References

Gensch, R., Jennings, A., Renggil, S., & Reymond, P. (2018). Compendium of Sanitation Technologies in Emergencies . German WASH Network (GWN), Swiss Federal Institute of Aquatic Science and Technology (Eawag), Global WASH Cluster (GWC) and Sustainable Sanitation Alliance (SuSanA). Luestscher, T., & Reller, J. (2002). A decision support system for selecting sanitation systems in developing countries. Socio-Economic Planning Sciences, 38 (4), 267–290. https://doi.org/10.1016/S0038-0121(02)00007-1.
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Tilley, E., Ulrich, L., Lüthi, C., Reymond, P., & Zurbrügg, C. (2014). Compendium of Sanitation Systems and Technologies—2nd revised edition. Swiss Federal Institute of Aquatic Science and Technology (EAWAG).

Ory Toilet							
eneral Information FUNCTIONAL GROUP	Values	Data Source					
UNIQUE IDENTIFIER (ID)		-					
DATA COMPILER	Julian Fritzsche urine, faeces, anal_cleansing_water	- Spuhler, D. & Roller, L. (2020)					
	For Santiago: NA						
	Input: OR, For Santiago: NA	Spuhler, D. & Roller, L. (2020) Spuhler, D. & Roller, L. (2020)					
COMMENTS	Output: NA						
	Values	Data Source					
applicability_level management_level		NA NA					
capex_req_level	3	Spuhler, D. et al. (2021)					
opex_req_level technical_maturity		Spuhler, D. et al. (2021) Tilley, E. et al. (2014)					
	(acute = 1, stabilisation = 1,	Gensch, R. et al. (2018)					
	development/recovery = 1)						
reening Criteria water_supply	Type and Function Performance, Categorical	Applicable for this Functional Group?	house [Unit]	Technology Values (Data) (house = 1, yard = 1, public = 1, none =	Data Source / Assumptions "Does not require a constant source	Internal Review Done? Yes (AJ)	
water_suppry	renomance, categorical		yard	1)	of water". Water required for washing	1.55(1.5)	
			public		hands is not considered here, but as a		
			none		separate Uadd Technology (Hand Washing facility). (Tilley, E. et al.		
					(2014))		
water_volume electricity_supply	Performance, Trapez Performance, Categorical		[L/cap/day] electricity	NA NA	NA NA	NA NA	
fuel_supply	Performance, Categorical		fuel	NA NA	NA NA	NA NA	
frequency_of_om	PDF, Categorical		irregular	(irregular = 1, regular = 0, continuous	"The sitting or standing surface should		
			regular	= 0)	be kept clean and dry to prevent		
			continuous		pathogen/disease transmission and to limit odours. There are no mechanical		
					parts; therefore, the dry toilet should		
					not need repairs except in the event		
					that it cracks." (Tilley, E. et al. (2014)) No special maintenance required.		
					Even if dry toilet is not maintained		
					properly, the performance is still		
					ensured. However, hygienic conditions probably suffer. (Spuhler, D. et al.		
					(2021))		
pipe_supply	Performance, Categorical	FALSE	no pipes	NA	NA NA	NA	
pump_supply	Performance, Categorical	FALSE	no pumps	NA	NA	NA	
concrete_supply	Performance, Categorical	TRUE	no concrete	(no concrete = 0.5, difficultly available	"The Vietnamese dry toilet works as a	yes	
			difficultly available concrete	= 0.75, no concrete = 1)	batch process. It consists of two chambers of 0.3 cubic metres each,		
			concrete		built above the ground with a		
					squatting slab with two holes on top		
					of the chambers. This system is constructed with concrete, stone or		
					unbaked brick. " (Kaczala, F. (2006))		
					Vietnamese dry toilets refer to urine		
					diversion toilets. However, it is assumed that dry toilets can also be		
					built with locally available building		
					materials (stone, brick, clay etc.) and		
					therefore not only relies on concrete		
					available for construction. The construction process is faster if a		
					mould is used that can be filled with		
					concrete, compared to the		
					performance if built with anything else but concrete. (Spuhler, D. et al. (2021))		
spare_parts	PDF, Categorical	TRUE	simple technical	(simple = 1, technical = 0, special = 0)	"There are no mechanical parts; therefore, the dry toilet should not	yes	
			special		need repairs except in the event that it		
					cracks." - (Tilley, E. et al. (2018))		
					Dry toilets have a very simple design and no special parts. (Spuhler, D. et al.		
					(2021))		
0		FALSE FALSE		NA NA	NA	NA	
0 temperature					NA	NA	
temberature		FALSE	(NA NA	NA	NA NA	
flooding	Performance, Categorical Performance, Categorical	FALSE FALSE FALSE			NA NA	NA	
flooding vehicular_acces	Performance, Categorical Performance, Categorical Performance, Categorical	FALSE FALSE FALSE FALSE	very cold flooding no access	NA NA NA NA	NA NA NA	NA NA NA NA	
flooding vehicular_acces slope	Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical	FALSE FALSE FALSE FALSE FALSE	very cold flooding no access flat	NA NA NA NA	NA NA NA NA	NA NA NA NA NA NA	
flooding vehicular_acces	Performance, Categorical Performance, Categorical Performance, Categorical	FALSE FALSE FALSE FALSE FALSE FALSE FALSE	very cold flooding no access	NA NA NA NA	NA NA NA NA NA NA	NA NA NA NA	
flooding vehicular_acces slope soil_type groundwater_depth excavation	Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical	FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE	very cold flooding no access flat clay water depth [m] easy	NA NA NA NA NA NA NA NA	NA NA NA NA NA NA NA	NA NA NA NA NA NA NA NA NA NA NA NA NA N	
flooding vehicular_acces slope soil_type groundwater_depth excavation surface_area_onsite	Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical	FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE	very cold flooding no access flat clay water depth [m] easy [m2/plot]	NA NA NA NA NA NA NA NA NA NA NA NA NA N	NA NA NA NA NA NA NA NA NA NA NA NA NA N	NA NA NA NA NA NA NA NA NA NA NA NA NA N	
flooding vehicular_acces slope soil_type groundwater_depth excavation	Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Tapeze Performance, Trapez Performance, Categorical Performance, Trapez Performance, Trapez	FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE	very cold flooding no access flat clay water depth [m] easy [m2/plot] m2/pers	NA NA NA NA NA NA NA NA	NA NA NA NA NA NA NA NA NA NA NA NA NA N	NA NA NA NA NA NA NA NA NA NA NA NA NA N	
flooding vehicular_acces slope soil_type groundwater_depth excavation surface_area_onsite surface_area_offsite 0 0	Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Trapez Performance, Trapez O O	FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE	very cold flooding no access flat clay water depth [m] easy [mz/plot] mz/pers	NA	NA NA NA NA NA NA NA NA NA NA NA NA NA N	NA NA NA NA NA NA NA NA NA NA NA NA NA N	
flooding vehicular_acces slope soil_type groundwater_depth excavation surface_area_onsite surface_area_offsite 0 0 0	Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Tageper Performance, Trapez Performance, Trapez O O O O	FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE	very cold flooding no access flat clay water depth [m] easy [m2/plot] m2/pers	NA	NA NA NA NA NA NA NA NA NA NA NA NA NA N	NA NA NA NA NA NA NA NA NA NA NA NA NA N	
flooding vehicular_acces slope soil_type groundwater_depth excavation surface_area_onsite surface_area_offsite 0 0	Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Trapez Performance, Trapez Performance, Trapez O O Performance, Categorical O Performance, Categorical	FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE	very cold flooding no access flat clay water depth [m] easy [m2/pot] m2/pers (Close	NA	NA NA NA NA NA NA NA NA NA NA NA NA NA N	NA NA NA NA NA NA NA NA NA NA NA NA NA N	
flooding vehicular acces slope soil type groundwarf depth excavation surface area onsite surface area onsite of drinking water exposure inking water exposure 0 0	Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Trapez Performance, Trapez Performance, Trapez Performance, Trapez Performance, Trapez Performance, Trapez Performance, Trapez Performance, Categorical O Performance, Categorical	FALSE FALSE	very cold Rooding no access flat clay water depth [m] easy [m2/plot] m2/pers (Close	NA	NA NA NA NA NA NA NA NA NA NA NA NA NA N	NA NA NA NA NA NA NA NA NA NA NA NA NA N	
flooding vehicular_acces slope soil_type groundwater_depth excavation surface_area_onsite surface_area_offsite 0 0 0	Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Trapez Performance, Trapez Performance, Trapez Performance, Trapez O O Performance, Categorical	FALSE FALSE	very cold flooding no access flat clay water depth [m] easy [mz/plot] mz/pers (Close (Close (Ladder:	NA	NA NA NA NA NA NA NA NA NA NA NA NA NA N	NA NA NA NA NA NA NA NA NA NA NA NA NA N	
flooding vehicular acces slope soil type groundware depth excavation surface area onsite surface area onsite of drinking water exposure inking water exposure 0 0	Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Trapez Performance, Trapez Performance, Trapez Performance, Trapez Performance, Trapez Performance, Trapez Performance, Trapez Performance, Categorical O Performance, Categorical	FALSE FALSE	very cold Rooding no access flat clay water depth [m] easy [m2/plot] m2/pers (Close	NA	NA NA NA NA NA NA NA NA NA NA NA NA NA N	NA NA NA NA NA NA NA NA NA NA NA NA NA N	
flooding vehicular acces slope soil type groundwarf depth excavation surface area onsite surface area onsite of drinking water exposure inking water exposure 0 0	Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Trapez Performance, Trapez Performance, Trapez Performance, Trapez Performance, Trapez Performance, Trapez Performance, Trapez Performance, Categorical O Performance, Categorical	FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE TALSE	very cold flooding no access flat clay water depth [m] easy [mz/plot] mz/pers (Close (Ladder: unskilled skilled Ladder:	NA	NA NA NA NA NA NA NA NA NA NA NA NA NA N	NA NA NA NA NA NA NA NA NA NA NA NA NA N	
flooding vehicular_acces slope soil_type groundwater_depth excavation surface_area_onsite surface_area_onsite 0 0 drinking_water_exposure 0 construction_skills	Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Trapez Performance, Trapez Performance, Trapez Performance, Trapez Performance, Trapez Performance, Trapez O O Performance, Categorical O Performance, Categorical	FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE TALSE	very cold flooding no access flat clay water depth (m) easy [m2/plot] m2/pers (close (close (dader: unskilled kadder: unskilled Ladder: unskilled	NA	NA NA NA NA NA NA NA NA NA NA NA NA NA N	NA NA NA NA NA NA NA NA NA NA NA NA NA N	
flooding vehicular_acces slope soil_type groundwater_depth excavation surface_area_onsite surface_area_onsite 0 0 drinking_water_exposure 0 construction_skills	Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Trapez Performance, Trapez Performance, Trapez Performance, Trapez Performance, Trapez Performance, Trapez O O Performance, Categorical O Performance, Categorical	FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE TALSE	very cold flooding no access flat clay water depth [m] easy [mz/plot] mz/pers (Close (Close (Ladder: unskilled skilled Ladder: unskilled skilled	NA	NA NA NA NA NA NA NA NA NA NA NA NA NA N	NA NA NA NA NA NA NA NA NA NA NA NA NA N	
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flooding vehicular acces slope soil type groundware depth excavation surface_area_onsite surface_area_onsite 0 0 drinking_water_exposure 0 construction_skills design_skills	Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Trapez Performance, Trapez Performance, Trapez O O Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical	FALSE TALSE FALSE FALSE TALSE FALSE TALSE TALSE FALSE TALSE TALSE FALSE TALSE TRUE	very cold flooding no access flat clay water depth (m) easy [m2/plot] m2/pers (close (close (destriction)) Ladder: unskilled skilled Ladder: unskilled skilled Ladder: unskilled skilled Ladder: unskilled Ladder: Unskilled	NA	NA NA NA NA NA NA NA NA NA NA NA NA NA N	NA NA NA NA NA NA NA NA NA NA NA NA NA N	
flooding vehicular acces slope soil type groundware depth excavation surface_area_onsite surface_area_onsite 0 0 drinking_water_exposure 0 construction_skills design_skills	Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Trapez Performance, Trapez Performance, Trapez O O Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical	FALSE TALSE FALSE FALSE TALSE FALSE TALSE TALSE FALSE TALSE TALSE FALSE TALSE TRUE	very cold flooding no access flat clay water depth [m] easy [m2/pers (close (day) Close (day) Close (day) Close (day) Ladder: urskilled skilled skilled skilled skilled urskilled skilled Urskilled Skilled	NA	NA NA NA NA NA NA NA NA NA NA NA NA NA N	NA NA NA NA NA NA NA NA NA NA NA NA NA N	
flooding vehicular acces slope soil type groundware depth excavation surface_area_onsite surface_area_onsite 0 0 drinking_water_exposure 0 construction_skills design_skills	Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Trapez Performance, Trapez Performance, Trapez Performance, Trapez Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical	FALSE TALSE FALSE FALSE TALSE FALSE TALSE TALSE FALSE TALSE TALSE FALSE TALSE TRUE	very cold Rooding Rood	NA	NA NA NA NA NA NA NA NA NA NA NA NA NA N	NA NA NA NA NA NA NA NA NA NA NA NA NA N	
flooding vehicular_acces slope soil_type groundwater_depth excavation surface_area_onsite o drinking_water_exposure construction_skills design_skills om_skills om_skills	Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Trapez Performance, Trapez Performance, Trapez Performance, Trapez Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical	FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE TALSE FALSE TALSE FALSE	very cold Rooding Rood	NA	NA NA NA NA NA NA NA NA NA NA NA NA NA N	NA NA NA NA NA NA NA NA NA NA NA NA NA N	
flooding vehicular acces slope soil type groundwater depth excavation surface_area_onsite surface_area_offste 0 0 drinking_water_exposure 0 construction_skills design_skills om_skills 0 0 0 0	Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Trapez Performance, Trapez Performance, Trapez Performance, Trapez Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical	FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE TAUSE FALSE	very cold flooding no access flat clay water depth [m] easy [m2/plot] m2/pers (close (close (depth close) (NA	NA NA NA NA NA NA NA NA NA NA NA NA NA N	NA NA NA NA NA NA NA NA NA NA NA NA NA N	
flooding vehicular_acces slope soil_type groundwater_depth excavation surface_area_onsite o drinking_water_exposure construction_skills design_skills om_skills om_skills	Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Trapez Performance, Trapez Performance, Trapez Performance, Trapez Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical	FALSE FALSE	very cold flooding no access flat clay water depth [m] easy [m2/plot] m2/pers (close (close (depth close) (NA	NA NA NA NA NA NA NA NA NA NA NA NA NA N	NA NA NA NA NA NA NA NA NA NA NA NA NA N	
flooding whicular_acces slope soil_type groundwater_depth excavation surface_area_onsite surface_area_onsite o drinking_water_exposure o construction_skills design_skills om_skills om_skills 0 0 0 0	Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Trapez Performance, Trapez Performance, Trapez Performance, Trapez Performance, Trapez Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical	FALSE FALSE	very cold flooding no access flat clay water depth [m] easy [m2/pot] m2/pers (close (close (close (defended to the close) (de	NA	NA NA NA NA NA NA NA NA NA NA NA NA NA N	NA NA NA NA NA NA NA NA NA NA NA NA NA N	
flooding vehicular_acces slope soil type groundwater_depth excavation surface_area_onsite surface_area_ons	Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Trapez Performance, Trapez Performance, Trapez Performance, Trapez Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical	FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE TAUE FALSE TRUE TRUE	very cold Rooding Rood	NA	NA NA NA NA NA NA NA NA NA NA NA NA NA N	NA NA NA NA NA NA NA NA NA NA NA NA NA N	
flooding vehicular_acces slope solid type groundwater_depth excavation surface_area_onfisite surface_area_onfisite odd design_skills design_skills om_skills	Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Trapez Performance, Trapez Performance, Trapez Performance, Trapez Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical	FALSE FALSE	very cold flooding no access flat clay water depth [m] easy [m2/pers (close (close (close (close) (close (close) (close (close) (close (close) (close (close) (close (close) (close (close) (close (close) (close (close) (close (close) (close (close) (close (close) (close (close) (close (close) (close (close) (close) (close (close) (c	NA	NA NA NA NA NA NA NA NA NA NA NA NA NA N	NA NA NA NA NA NA NA NA NA NA NA NA NA N	
flooding vehicular_acces slope solid ypee solid ypee groundwater_depth excavation surface_area_onfiste surface_area_onfiste surface_area_onfiste odd of the solid ypee solid ypee solid yee yee solid yee yee solid yee yee yee yee yee yee yee yee yee ye	Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Trapez Performance, Trapez Performance, Trapez Performance, Trapez Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical	FALSE TRUE TRUE FALSE	very cold flooding no access flat clay water depth [m] easy [m2/pot] m2/pers (close (close (close (close) (close (close) (close (close) (close (close) (close (close) (close (close) (close (close) (close (close) (close (close) (close (close) (close (close) (close (close) (close (close) (close (close) (close) (close (close) (NA	NA NA NA NA NA NA NA NA NA NA NA NA NA N	NA NA NA NA NA NA NA NA NA NA NA NA NA N	
flooding vehicular_acces slope solid type groundwater_depth excavation surface_area_onfisite of design_skills surface_area_offsite of design_skills design_skills om_skills om_s	Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Trapez Performance, Trapez Performance, Trapez Performance, Trapez Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical	FALSE TRUE TRUE FALSE FALSE TRUE FALSE	very cold Rooding Rood	NA	NA NA NA NA NA NA NA NA NA NA NA NA NA N	NA NA NA NA NA NA NA NA NA NA NA NA NA N	

					la		1
construction_parts	PDF, Categorical	TRUE	simple	(simple = 1, technical = 0, special = 0)	"Pedestals and squatting slabs can be	yes	
			technical		made locally with concrete (provided		
			special		that sand and cement are available).		
					Fibreglass, porcelain, plastic and		
					stainless steel versions may also be		
					available. Wooden or metal moulds		
					can be used to produce several units		
					quickly and efficiently.", "Can be built		
					and repaired with locally available		
					materials" (Gensch, R. et al. (2018))		
					"There are no mechanical parts;		
					therefore, the dry toilet		
					should not need repairs except in the		
					event that it cracks." - (Tilley, E. et al.		
					(2014))		
Transfer Coefficients	(copied from "Sanitation_Technologies_TC_database_202	10622.xlsm")					
	Excreta	Range	Airloss	Soilloss	Waterloss	Comments	Reference
TP	1		0	0		* Assumption: Losses occur in storage	Spuhler, D. et al. (2021)
med (R)	1		0	0			-
k	100						Spuhler, D. et al. (2021)
TN	0.99		0.01	0		* Assumption: Losses occur in storage	Spuhler, D. et al. (2021)
med (R)	0.99		0.01	0			-
k	25						Spuhler, D. et al. (2021)
H2O	1	-		0		* Assumption: Losses occur in storage	Spuhler, D. et al. (2021)
med (R)	1		0	0			-
k	100						Spuhler, D. et al. (2021)
TS	1		0	0		* Assumption: Losses occur in storage	Spuhler, D. et al. (2021)
med (R)	1		0	0			-
k	100						Spuhler, D. et al. (2021)
							,, , , , , , , , , , , , , , , , , , , ,

References

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Michael Color Michael Colo		Volume	Data Course					
March 1985 Mar		Values U	Data Source					
Control Cont	UNIQUE IDENTIFIER (ID)	uddt						
The Content of the			- Souhler, D. & Roller 1 (2020)	-				
1987年 1		For Santiago: NA						
Part				-				
March Marc	VETWINNS							
Marchester Mar	A0			-				
Page Page			Data Source					
Age Age	applicability_level	NA	NA					
Table Tabl		NA -		-				
Montange Montange			Spuhler, D. et al. (2021)	-				
Marie Mari	technical_maturity	3						
March Marc	development_phase		Gensch, R. et al. (2018)					
March Marc		Type and Function						
March Marc	water_supply	Performance, Categorica	TRUE		(house = 1, yard = 1, public = 1, none = 1)		Yes (AJ)	
Commonwealth Comm								
ADMINISTRATION CONTINUE CON				none				
March Marc								
Month Mont						(Spuhler, D. et al. (2021))		
March Marc	water_volume			[L/cap/day]				
Mathematical Companies Mathematical Compan	стесателу_зарріу	i criormance, caregorica		intermittent				
	fuel events	Darformanco Catal	EALSE		NA	NA.	NA	
Property of the Control of State Property Congress of Congress	ruei_supply	-			110		ING.	
Part	frequency_of_om	PDF, Categorica	TRUE	irregular	(irregular = 0, regular = 1, continous = 0)		yes	
Professionary Company				regular				
April						odour seal also requires occasional		
Prince P								
Part Part						(2014)) (11lley, E. et al.		
Portunation Company Portunation Portunation Company Portunation Portunat	pipe_supply	Performance, Categorica	FALSE		NA		NA	
Post Performance Congogned PLE								
Mindrag southine Mindrag southine Mindrag southine Mindrag southine Mindrag south to Mindrag south	pump_supply	Performance, Categorica	FALSE	no pumps	NA	NA	NA	
Control Section Performance Congrant No. Section Secti				difficultly available				
Ministry and Market Ministry and Market	concrete supnly	Performance, Categorical	TRUE		(no concrete = 0.5, difficultly available =	"The UDDT is simple to design and build.	yes	
Processor Proc		,,		difficultly available		using such materials as concrete and wire		
Secretor Performance Categorial PASE Secretor Performance Categorial PASE Secretor Performance Categorial PASE Secretor Performance Categorial PASE Secretor Performance Categorial PASE Secretor Performance Categorial PASE Secretor Performance Categorial PASE Secretor Performance Categorial PASE Secretor Performance Categorial PASE Secretor Performance Categorial PASE Secretor Secretor Performance Categorial PASE Secretor				concrete				
PRESCRIPTION PRES								
Webster Webs								
Webster Webs	snare narts	PDF. Categorica	TRUE	simple	(simple = 1, technical = 0, special = 0)	"Can be built and repaired with locally	yes	
Communication Communicatio		,		technical	,	available materials" (Tilley, E. et al.		
Comparison Com				special				
0 0 0 0 0 0 0 0 0 0								
Description						NA		
September Performance, Categorial PLASE September Septembe								
	-			very cold				
March Marc								
Month Mont								
Mail	e	Budana 6 · · ·	EALCE	hot	NA.	NA.	NA.	
Vehicular_acces	Tlooding	Performance, Categorical	FALSE		INA .	NA .	IVA	
Sign	vehicular_acces	Performance, Categorica	FALSE	no access	NA	NA	NA	
Solit Performance, Categorical PASE Only NA NA NA NA NA NA NA N								
Performance, Categorical PALSE Section Performance, Categorica	slope	Performance, Categorica	FALSE	flat	NA	NA	NA	
State Stat	coll to	Darformanco Cataca-da-	FALSE		NΔ	NΔ	NΔ	
groundwater_degrets Reformance, Trapes FALSE water degret (n) NA NA NA NA NA NA NA N	soii_type	renormance, categorica						
moundwater depth Performance, Trapper (ALSE water depth (in) NA NA NA NA NA NA NA N								
groundwater_depth Performance, Trapper FALSE swater_depth NA								
Surface_area_onide				water depth [m]				
Surface_area_oriside	excavation	Performance, Categorical	FALSE		NA	NA	NA	
Surface area offitite Performance, Tage FALSE M2, per NA NA NA NA NA NA NA N	surface_area_onsite	Performance, Trapez	FALSE		NA	NA	NA	
O PASE O NA NA NA NA					NA.	N/A	NA.	
O O FALSE O NA NA NA NA NA NA NA								
Description Performance, Categorical FALSE Close NA NA NA NA NA NA NA N	0	C	FALSE	C	NA NA	NA	NA	
Not close O FALSE O NA O O OFFALSE Ladder: Unskilled = 0, skilled = 1, professional = 1) Performance, Categorical TRUE design_skills Performance, Categorical TRUE Unskilled = 0, skilled = 1, professional = 1) Performance, Categorical TRUE Unskilled = 0, skilled = 1, professional = 1) Skilled design_skills Performance, Categorical TRUE Unskilled = 0, skilled = 1, professional = 1) Unskilled = 0, skilled = 1, professional = 1) Skilled Skilled Skilled = 1, skilled = 1, professional = 1) Unskilled = 1, skilled = 1, professional = 1) Unskilled = 1, skilled = 1, skilled = 1, professional = 1) Unskilled = 1, skilled = 1, professional = 1) Skilled S								
O O O FALSE		_		Not close				
Ladder:				0				
unskilled skilled grofessonal unskilled skilled grofessonal grofes								
design_skills Performance, Categorical TRUE Ladder: unskilled skilled = 1, professional = 1) Om_skills Performance, Categorical TRUE Ladder: Unskilled = 1, skilled = 1, professional = 1) Om_skills Performance, Categorical TRUE Ladder: Unskilled = 1, skilled = 1, professional = 1) Ladder: Unskilled = 1, skilled = 1, professional = 1) AUDIT is slightly more difficult to keep elean compared to other clotlets because of both the lack of swater and the need to separate the solid faces and liquid urine. An odour seal also requires occasional maintenance. It is critical to regularly check is functioning." (Tilley, E et al. [2014)) O DFALSE O NA O O OFALSE O NA NA O O OFALSE O NA NA O PERFORMANCE, Categorical TRUE Washers Cleansing, method Performance, Categorical TRUE Washers Hard wipers O NA NA O O OFALSE O NA NA O O OFALSE O NA NA NA O O OFALSE O NA NA NA O O OFALSE O NA NA NA O O OFALSE O NA NA NA O O OFALSE O NA NA NA O O OFALSE O NA NA NA O O OFALSE O NA NA NA O O OFALSE O NA NA NA O O OFALSE O NA NA NA O O OFALSE O NA NA NA O O OFALSE O NA NA NA O O OFALSE O NA NA NA O O O OFALSE NA O O O OFALSE O NA NA NA NA O O O OFALSE O NA NA NA O O O OFALSE O NA NA NA O O O OFALSE O NA NA NA NA O O O OFALSE O NA NA NA NA NA O O O OFALSE O NA NA NA NA NA O O O OFALSE O NA NA NA NA NA O O O OFALSE O NA NA NA NA NA O O O OFALSE O NA NA NA NA NA NA NA NA NA NA				unskilled	,, -, -, -, -, -, -, -, -, -, -	using such materials as concrete and wire		
design_skills						mesh or plastic". (Tilley, E. et al. (2014))		
unskilled skilled professional Make and professional Performance, Categorical TRUE Ladder: Unskilled skilled professional Ladder: Unskilled skilled professional professio	design_skills	Performance, Categorica	TRUE	Ladder:	(unskilled = 0, skilled = 1, professional = 1)		yes	
professional professional				unskilled		using such materials as concrete and wire		
Description Performance, Categorical TRUE Constitution Categorical TRUE Categori						mesn or piastic". (Tilley, E. et al. (2014))		
Skilled Professional Skilled Professional	om_skills	Performance, Categorica	TRUE	Ladder:	(unskilled = 1, skilled = 1, professional = 1)		yes	e e
Professional Professional Separate the solid facese and liquid urine. An odour seal also requires occasional maintenance. It is critical to regularly check its functioning*, Tillley, E. et al. (2014) Still, no specific knowledge is required. (Spuhler), Cet kits functioning*, Tillley, E. et al. (2014) Still, no specific knowledge is required. (Spuhler), Detail (2014) NA NA NA NA NA NA NA N								
An odour seal also requires occasional maintenance. It is critical to regularly check its functioning* (Tilley, E. et al. (2014)) Still, no specific knowledge is required. (Spubler, D. et al.(2021)) 0						separate the solid faeces and liquid urine.		
Check its functioning**, Tillery, E. et al. (2014) Still, no specific knowledge is required. (Spublier, D. et al. (2011)) Still, no specific knowledge is required. (Spublier, D. et al. (2012)) Still, no specific knowledge is required. (Spublier, D. et al. (2012)) Still, no specific knowledge is required. (Spublier, D. et al. (2012)) Still, no specific knowledge is required. NA NA NA NA NA NA NA NA NA NA NA NA NA						An odour seal also requires occasional		
C2014 Still, no specific knowledge is required. Spulher, D. et al.(2021) Still, no specific knowledge is required. Spulher, D. et al.(2021) Spulh								
Speed_implement_toilet PDF, Categorical FALSE Sol NA NA NA NA NA NA NA NA NA NA NA NA NA						(2014))		
0 FALSE 0 NA NA NA NA NA NA NA								
O O FALSE	0		FALSE) NA		NA .	
O O O FALSE O NA NA NA NA NA O	0	C	FALSE	C	NA NA	NA	NA	
Cleansing_method Performance, Categorical TRUE Washers Washers Washers = 1, soft wipers = 1, hard wipers method can be used, not vulnerable to clogging, [Spuhler, D. et al. (2021)] MA								
Soft wipers 1 method can be used, not vulnerable to clogging. (Spunher, D. et al. (2021))				Washers	(washers = 1, soft wipers = 1, hard wipers	Similar to a dry toilet. Any cleansing		
0 0 0 FALSE 0 NA NA NA 0 0 0 FALSE 0 NA NA NA lifetime Performance, Categorical FALSE short (< 1 year) NA NA NA speed_implement_toilet PDF, Categorical FALSE rapid (< 3 days to 2 weeks) speed_implement_toilet PDF, Categorical FALSE rapid (< 3 days to 2 weeks)				Soft wipers		method can be used, not vulnerable to		
0	n		FALSE) NA		NA	
medium (1-5 years)	0	C	FALSE	0	NA NA	NA	NA	
long (>5 years) NA NA speed_implement_tollet PDF, Categorical FALSE rapid (< 3 days) no deverate (3 days to 2 weeks)	lifetime	Performance, Categorical	FALSE	short (< 1 year) medium (1-5 years)	NA	NA	NA	
speed_implement_toilet PDF, Categorical FALSE rapid (< 3 days) NA NA NA NA noderate (3 days to 2 weeks)				long (>5 years)				
	speed_implement_toilet	PDF, Categorica	FALSE	rapid (< 3 days)	NA	NA	NA	
				moderate (3 days to 2 weeks) slow (> 2 weeks)				

		NA	NA	NA	rapid (few days to a week)	FALSE	PDF, Categorical	peed_implement_treatment
					moderate (few weeks up to three	171606	r Di , categoricai	pcca_mplement_treatment
					months)			
					slow (> 3 months)			
		NA	NA	NA	easy	EALCE	Performance, Categorical	scalability
		NA .	NA .	NA .	difficult	FALSE	renormance, categorical	Scalability
		yes	"Can be built and repaired with locally	(simple = 1, technical = 0, special = 0)	simple	TRUE	PDF, Categorical	construction_parts
			available materials". (Tilley, E. et al.		technical		-	_
			(2014))		special			
						22.xism")	copied from "Sanitation_Technologies_TC_database_2021062	ansfer Coefficients
nents Refere	Commen	Waterloss	Soilloss	Airloss	Faeces	Range	Urine	
Tilley,	0 * as P			0	0.39		0.61	TP
al. (20:								
Kirchm	0 * see)		0.33		0.68	
	calculation							
.1 Petter	in 2.2.1							
S. (199								
Conrac	0 * as P			0	0.9	-	0.5	
K. et a								
(2010)								
Schou	0 * as P			0	0.38	-	0.62	
L. et al								
(2002)								
-	0			0	0.38		0.62	med (R)
Spuhle	•	-				[0,2]	25	k
et al. (
	0 * as N			! 0	0.12	-	0.88	TN
al. (20:								
Kirchm	0 * see			0	0.15	-	0.85	
	calculation							
	in 2.2.1							
S. (199								
	0 * as N	o l		. 0	0.2	-	0.8	
K. et a								
(2010)								
	0 * as N	이		0	0.13	-	0.87	
L. et al								
(2002)								
	0			0	0.14	0,5 - 0,7	0.86	med (R)
Spuhle	•	-					100	k
et al. (
Rose, 0	0 * see	1	1	0	0.14	-	0.86	H2O
ations al. (20								
	in 2.2.2			 			0.93	
Vinner	0 * see	1	1	'l "	0.07	-	0.93	
	calculation in 2.2.3							
	0 Spuhler e	1			0.1:	0,86-0,93	0.9	med (R)
	al. (2021)	1			0.1.	0,86-0,93	0.9	mea (K)
Spuhle	di. (2021					[0.07]	100	
et al. ([0.07]		к
et al. (
Rose, 0	0 * see)) 0	0.39		0.61	TS
	calculatio	•			0.3:		0.01	13
	in 2.2.2							
Vinner	0 * see)		ı	0.34	_	0.66	
ations B. et a		-			0.3		0.00	
	in 2.2.3							
	0)		, 0	0.33	0,33-0,34	0.64	med (R)
							100	k
Spuhle								

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rine Diversion Flush Toilet				Urine Divertion Flush Toilet		
eneral Information FUNCTIONAL GROUP	Values U	Data Source				
UNIQUE IDENTIFIER (ID)		-				
INPUT PRODUCT	blackwater, urine	Spuhler, D. & Roller, L. (2020)				
OUTPUT PRODUCT RELATIONS	blackwater, urine Input: OR, For Santiago: NA Output: AND	Spuhler, D. & Roller, L. (2020) Spuhler, D. & Roller, L. (2020)				
COMMENTS						
re-Filter Criteria applicability_level	Values	Data Source NA				
management_level	NA	NA				
capex_req_level opex_req_level		Spuhler, D. et al. (2021) Spuhler, D. et al. (2021)	1			
technical_maturity	3	Spuhler, D. et al. (2021)				
development_phase	(acute = 0.5, stabilisation = 1, development/recovery = 1)	Same values as for a UDDT are assumed by Spuhler, D. et al. (2021) based on Gensch, R. et al. (2018): U.2 Urine- Diverting Dry Toilet (UDDT).				
	Type and Function	Applicable for this Functional Group?		Technology Values (Data)	Data Source / Assumptions	Internal Review Done?
water_supply	Performance, Categorical	TRUE	house yard public none	{house = 1, yard = 0, public = 0, none = 0}	"Requires a constant source of water" "Requires less water than a traditional Cistern Flush Toilet" (Tilley, E. et al. (2014)) It is assumed that UDFTs are not appropriate if there is no in-house water	Yes (AI)
					supply. (Spuhler, D. et al. (2021))	
water_volume electricity_supply	Performance, Trapez Performance, Categorical	FALSE	[L/cap/day] electricity	NA NA	NA NA	NA NA
electricity_supply	renormance, categorical	FALSE	intermittent	INA	INA	INA
find annot	Performance, Categorical	FAISE	no electricity fuel	NA .	NA .	NA .
fuel_supply			no fuel			
frequency_of_om	PDF, Categorical	TRUE	irregular regular continuous	(irregular = 0, regular = 1, continuous = 0)	"Is prone to misuse and clogging" (Tilley, E. et al. (2014)) Therefore needs to be maintained regularly. Usually there's not often need for reparation. The design is similar but it contains more technical parts than other tollets which can potentially fall. Regular frequency of operation and maintenance. (Spuhler, D. et al. (2021))	yes
pipe_supply	Performance, Categorical	FALSE	no pipes difficultly available	NA	NA	NA
pump_supply	Performance, Categorical	FALSE	no pumps	NA	NA	NA
			difficultly available pumps			
concrete_supply	Performance, Categorical	TRUE	no concrete difficultly available concrete	(no concrete = 1, difficultly available = 1, concrete = 1)	they both require concrete in a similar way. (Tilley, E. et al. (2014)); (Spuhler, D.	yes
spare_parts	PDF, Categorical	TRUE	simple	(simple = 0, technical = 0.7, special = 0.3)	et al. (2021))	yes
spare_parts	rur, Categorica	INCE	technical special	isimple = 0, technical = 0.7, special = 0.3)	repaired locally" (Tilley, E. et al. (2014)) Might require technical spare parts (e.g. siphon) or even specially manufactured piping and odour seals. (Spuhler, D. et al. (2021))	yes
0		FALSE FALSE		NA NA	NA NA	NA NA
0	0	FALSE	0	NA	NA	NA
temperature	Performance, Categorical	FALSE	very cold cold temperate	NA	NA	NA
			warm hot			
flooding	Performance, Categorical	FALSE	flooding no flooding	NA	NA	NA
vehicular_acces	Performance, Categorical	FALSE	no access	NA	NA	NA
slope	Performance, Categorical	FALSE	difficult full flat	NA	NA	NA .
soil_type	Performance, Categorical	FALSE	not flat clay	NA .	NA .	NA .
			silt sand gravel			
groundwater_depth	Daufe	FAISE	rock	NA .	NA.	NA .
groundwater_depth excavation	Performance, Trapez Performance, Categorical	FALSE	easy	NA NA	NA NA	NA NA
			hard			
surface_area_onsite			[m2/plot]	NA	NA	NA
surface_area_offsite		FALSE		NA NA	NA NA	NA NA
0		FALSE FALSE		NA NA	NA NA	NA NA
0	0	FALSE	0	NA	NA	NA
drinking_water_exposure	Performance, Categorical	FALSE	Close Not close	NA	NA	NA
0		FALSE FALSE	0	NA NA	NA NA	NA NA
construction_skills			Ladder: unskilled skilled professional	(unskilled = 0, skilled = 1, professional = 1)	"Since this technology requires separate pipes for urine and brownwater collection, the plumbing is more complicated than for Cistern Flush Toilets. Particularly, the proper design and installation of the urine pipes is crucial, and requires expertise." (Tilley,	yes
design_skills	Performance, Categorical	TRUE	Ladder: unskilled skilled professional	(unskilled = 0, skilled = 0, professional = 1)	E. et al. (2014) "Since this technology requires separate pipes for urine and brownwater collection, the plumbing is more complicated than for Cistern Flush Tollets. Particularly, the proper design and installation of the urine pipes is crucial, and requires expertise." (Tilley, E. et al. (2014)	yes
om_skills	Performance, Categorical		Ladder: Unskilled Skilled Professional	(unskilled = 0.5, skilled = 1, professional = 1)	"Labour-intensive maintenance. In some cases manual removal may be required." (Tilley, E. et al. (2014))	
0	0	FALSE FALSE	0	NA	NA NA	NA NA
0	0	FALSE	0	NA	NA	NA NA
•		TRUE TRUE	Washers Soft wipers	NA (washers = 1, soft wipers = 1, hard wipers = 0)	NA Similar to a pour flush toilet. "Flush toilets are also unsuitable where bulky materials (e.g. maize cobs) are used for	NA
0 cleansing_method	To tomate, augusta		Hard wipers		anal cleansing." (Loetscher, T. & Keller, J. (2002)) Cleaning material can only be used if it's small and light enough or if they are soluble in water like paper. Any other material is unsuitable and the use of it	
		FALSE		NA NA	anal cleansing." (Loetscher, T. & Keller, J. (2002)) Cleaning material can only be used if it's small and light enough or if they are soluble in water like paper. Any other	NA NA

			1					
lifetime	Performance, Categorica	FALSE	short (< 1 year) medium (1-5 years)	NA	NA	NA		
and to do at the test of	PDF Cohomics	I SUCC	long (>5 years)					
speed_implement_toilet	PDF, Categorica	IFALSE	rapid (< 3 days) moderate (3 days to 2 weeks)	NA	NA	NA		
speed_implement_treatment	PDF, Categorica	FALSE	slow (> 2 weeks) rapid (few days to a week)	NA .	NA .	NA .		
	,		moderate (few weeks up to three					
			months) slow (> 3 months)					
scalability	Performance, Categorica	FALSE	easy	NA	NA	NA		
construction_parts	PDF, Categorica	TRUE	difficult simple	(simple = 0, technical = 0.3, special = 0.7)	"Limited availability; cannot be built or	yes		
			technical		repaired locally" (Tilley, E. et al. (2014))			
			special		"Since this technology requires separate pipes for urine and brownwater			
					collection, the plumbing is more complicated than for Cistern Flush			
					Toilets." (Tilley, E. et al. (2014))			
					We assume that due to its dual plumbing it requires even more specially			
					manufactured piping compared to a			
					cistern flush toilet. (Spuhler, D. et al. (2021))			
Transfer Coefficients	(copied from "Sanitation_Technologies_TC_database_2021062 Urine	22.xism") Range	Brownwater	Airloss	Soilloss	Waterloss	Comments	Reference
TP	0.6		0.3) (* as P	Tilley, E. et
	0.60	8	0.3	2 0)	0	* see	al. (2014) Kirchmann,
							calculations in 2.2.1	H. & Pettersson,
								S. (1995)
	0.9	5	0.	5 (0	0	* as P	Conradin, K. et al. (2010)
	0.63	ž .	0.3	8 (0	* as P	Schouw, N.
								L. et al. (2002)
med (R)	0.6		0.3	9		0		Spuhler, D.
- ×								et al. (2021)
TN	0.81		0.1			0	* as N	Tilley, E. et al. (2014)
	0.89	š	0.1	5		0	* see calculations	Kirchmann, H. &
							in 2.2.1	Pettersson,
	0.0	B	0.	2		0	* as N	S. (1995) Conradin, K.
	0.8	7	0.1				* as N	et al. (2010) Schouw, N.
	0.0.		0.1				23.1	L. et al.
med (R)	0.80	6 0,5 - 0,7	0.1	4 (0		(2002)
k	100	0 [0,1]						Spuhler, D. et al. (2021)
H2O	0.80	6	0.1	4 0		0	* see	Rose, C. et
							in 2.2.2	al. (2015)
	0.93	3	0.0	7	0	0	* see calculations	Vinnerås, B. et al. (2006)
							in 2.2.3	Ct ui. (2000)
med (R)	0.9	9 0,86-0,93	0.	1		0	Spuhler et al. (2021)	-
k	100	0.07]						Spuhler, D. et al. (2021)
TS	0.6	1	0.3	9 0			* see	Rose, C. et
							calculations in 2.2.2	al. (2015)
	0.60	ś -	0.3	4 ()		* see calculations	Vinnerås, B. et al. (2006)
med (R)	0.63	5 0,33-0,34	0.36	5 ()		in 2.2.3	,
k	100					-		Spuhler, D.
								et al. (2021)
Additional Information	(Data from: Kirchmann, H. & Pettersson, S. (400511						
2.2.1	N [kg/P*a] (Median)	Range	P[kg/P*a] (Median)	Range	TC_TN	TC_TP		
Urine Faeces	3.4	4 2.5 - 4.3 6 0.5-0.7	0.8	5 0.7 - 1.0 4 0.3 - 0.5	0.85 0.15	0.68		
Calculation	0.0) 0.5-0.7	0.	4 0.3 - 0.5	TC_TN Urine = Mass N in Urine [kg/P*a]/	TC_TP Urine = Mass P in Urine [kg/P*a]/		
					Total Mass N (in Urine and Faeces) [kg/P*a]	Total Mass P (in Urine and Faeces) [kg/P*a]		
					TC_TN Faeces = Mass N in Faeces [kg/P*a]/ Total Mass N (in Urine and Faeces) [kg/P*a]	TC_TP Faeces = Mass P in Faeces [kg/P*a]/		
					Total Wass N (III Offile and Faeces) [kg/P a]	Total Mass P (III Offfice and Paeces) [kg/P - a]		
2.2.2	(Data from: Rose, C. et al. (2015))							
k	10	0,01						ı
Additional Information	100	b [0,01						
2.2.1	100 (Data from: Kirchmann, H. & Pettersson, S. (:		Blog (BPa) (Modian)		TC TN	TC TD		
2.2.1	100 (Data from: Kirchmann, H. & Pettersson, S. (: N [kg/P*a] (Median)	Range 4 2.5 - 4.3		Range 5 0.7-1.0	TC_TN 0.85	TC_TP 0.68		
2.2.1 Urine Faeces	100 (Data from: Kirchmann, H. & Pettersson, S. (: N [kg/P*a] (Median)	Range	0.8		0.85 0.15	0.68		
2.2.1 Urine	100 (Data from: Kirchmann, H. & Pettersson, S. (: N [kg/P*a] (Median)	Range 4 2.5 - 4.3	0.8	5 0.7 - 1.0	0.85	0.68 0.32 TC_TP Urine = Mass P in Urine [kg/P*a]/		
2.2.1 Urine Faeces	100 (Data from: Kirchmann, H. & Pettersson, S. (: N [kg/P*a] (Median)	Range 4 2.5 - 4.3	0.8	5 0.7 - 1.0	0.85 0.15 TC_TN Urine = Mass N in Urine [kg/P*a]/	0.68 0.32 TC_TP Urine = Mass P in Urine [kg/P*a]/ Total Mass P (in Urine and Faeces) [kg/P*a]		
2.2.1 Urine Faeces	100 (Data from: Kirchmann, H. & Pettersson, S. (: N [kg/P*a] (Median)	Range 4 2.5 - 4.3	0.8	5 0.7 - 1.0	$0.85\\ TC_TN\ Urine = Mass\ N\ in\ Urine\ [kg/P^a]/\\ Total\ Mass\ N\ (in\ Urine\ and\ Faeces)\ [kg/P^a]$	0.68 0.32 TC_TP Urine = Mass P in Urine [kg/P*a]/ Total Mass P (in Urine and Faeces) [kg/P*a] TC_TP Faeces = Mass P in Faeces [kg/P*a]/		
2.2.1 Urine Faeces Calculation	(Data from: Kirchmann, H. & Pettersson, S. (N [kg/P*a] (Median) 3.0	Range 4 2.5 - 4.3	0.8	5 0.7 - 1.0	0.85 O.15 TC_TN Urine = Mass N in Urine [kg/P*a]/ Total Mass N (in Urine and Faeces) [kg/P*a] TC_TN Faeces = Mass N in Faeces [kg/P*a]/	0.68 0.32 TC_TP Urine = Mass P in Urine [kg/P*a]/ Total Mass P (in Urine and Faeces) [kg/P*a] TC_TP Faeces = Mass P in Faeces [kg/P*a]/		
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2.2.1 Urine Faeces Calculation	(Data from: Kirchmann, H. & Pettersson, S. (N [kg/P*a] (Median) 3.0	Range 4 2.5 - 4.3	0.8	5 0.7 - 1.0	0.81 TC_TN Urine = Mass N in Urine Rg/P*a]/ Total Mass N (in Urine and Facces) kg/P*a]/ Total Mass N (in Urine and Facces) kg/P*a]/ Total Mass N (in Urine and Facces) kg/P*a] H20 Facces = Water content Facces kg/cap*a] Water content Total kg/cap*a] H20 Urine = Water content Urine	0.68 0.32 TC_TP Urine = Mass P in Urine [kg/P*a]/ Total Mass P (in Urine and Facecs) [kg/P*a]/ Total Mass P (in Urine and Facecs) [kg/P*a]/ Total Mass P (in Urine and Facecs) [kg/P*a] TS Facecs = Dry weight Facecs [kg/ap*a] / Dry weight Total [kg/cap*a] TS Urine = Dry weight Urine [kg/cap*a]/ Dry		
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References Gensch, R., Jennings, A., Renggli, Loetscher, T., & Keller, J. (2020). Spuller, D., de Morais Lima, P., F. Spulher, O., de Norias Lima, P., F. Spulher, O., de Norias Lima, P., F. Spulher, O., de Roller, I. (2020). Schrichmann, H. and S. Pettersson. Cornadin, K., et al. (2020). "Comparison, V., et al. (2020). "Tomar School, N. L., et al. (2000). "The children School, "The children School, "The children School," The children School, "The children School," Comparison.	(Data from: Kirchmann, H. & Pettersson, S. (N [kg/**a] (Median) 3./ 0.1 (Data from: Rose, C. et al. (2015)) (Data from: Rose, C. et al. (2015)) 5. & Reymond, P. (2018). Compendium of Sor A decision support system for selecting sanitaritische, L. Jimane, V. Jain, A., van Soten, M. ontotation technology library: Details and data with the composition of the selecting sanitarities of the composition of human excrete a — a case study from http://www.sswm.info.position of human excrete a — a case study for interistration of fees and uline: A Review of it haracteristics of household wastewater and b of compositing sorting and uniter a treatment of compositions or compositions contained and uniteral reviews of the composition of compositing sorting and uniteral restriction of fees contained and uniteral restriction of fees contained and uniteral restriction of fees contained and uniteral restrictions of fees contained and uniteral rest	Range 4 25 - 4 3 6 0 5-07 Intation Technologies in Emergencies . German vitation systems in developing countries . Socio-Ec 8, & Williaman C. (2021). SaniChoice Project Tr ownces for appropriateness profiles and transfer and fortilizer use efficiency." Fertilizer Mesaura om Southern Thailand." Science of The Total En te Uterature to Inform Advanced Treatment in the Uterature to Inform Advanced Treatment or Technological Society Maxter — A proposal available and the Company of the	0.8 0. VASH Network (GWN), Swiss Federal Institute nonmin Phonning Sciences, 36(4), 267–290, httm: Department Similation, Water and Similation, Water and institute or had(p); 149–154. vironment 286(1-3): 155–166. chronology, "Crit Rev Environ Sci Technol 45(17 Swedish design values." Urban Water Journal Segrour Environdery 186(17): 3317–33211.	of Aquatic Science and Technology (Eawag), 6, ps;//doi.org/10.1016/S0038-0121(20)00097-1 Water for Development Countries (Sandec), Sv Aquatic Science and Technology. 1:1827-1879. 3(1): 3-11.	0.85 O.85 O.85 O.85 O.87 T.C. TN Urine = Mass N in Urine [kg/p*n/] Total Mass N (in Urine land Facces) [kg/p*a] Total Mass N (in Urine and Facces) [kg/p*a] Total Mass N (in Urine and Facces) [kg/p*a] H3.0 Facces = Water content Facces [kg/cap*a] / Water content Total [kg/cap*a] H3.0 Urine = Water content Urine [kg/cap*a] / Water content Urine [kg/cap*a] / Water content Urine	0.68 TC_TP Urine = Mass P in Urine (lg/P*a) Total Mass P in Urine (access) lg/P*a Total Mass P in Urine and Facces) lg/P*a Total Mass P in Urine and Facces lg/g*p*a Total Mass P in Urine and Facces lg/g*p*a Total Mass P in Urine and Facces lg/g*p*a Total lg/cap*a TS Facces = Dry weight Facces (lg/cap*a)/ Dry weight Total lg/cap*a) TS Urine = Dry weight Urine (lg/cap*a)/ Dry weight Total lg/cap*a) Weight Total lg/cap*a itation Alliance (SuSanA).		

Jrinal	Values	Data Saussa					
FUNCTIONAL GROUP		Data Source					
UNIQUE IDENTIFIER (ID) DATA COMPILER	urinal SaniChoice Project Team		-				
INPUT PRODUCT	urine For Santiago: NA	Spuhler, D. & Roller, L. (2020)					
OUTPUT PRODUCT	urine	Spuhler, D. & Roller, L. (2020)	1				
RELATIONS	Input: NA Output: NA	Spuhler, D. & Roller, L. (2020)					
COMMENTS Pre-Filter Criteria	Values	Data Source					
applicability_level	NA	NA					
management_level capex_req_level		NA Spuhler, D. et al. (2021)	-				
opex_req_level	3	Spuhler, D. et al. (2021) Tilley, E. et al. (2014)					
technical_maturity development_phase	(acute = 1, stabilisation = 1,	Gensch, R. et al. (2018)					
creening Criteria	development/recovery = 1) Type and Function	Applicable for this Functional Group?	Categories [Unit]	Technology Values (Data)	Data Source / Assumptions	Internal Review Done?	
water_supply	Performance, Categorical		house	(house = 1, yard = 1, public = 1, none =	"Waterless urinals do not require a	Yes (AJ)	
			yard public none	0.5)	constant source of water". (Tilley, E. et al. (2014)) "Water-saving or waterless technologies should be favoured" (Tilley, E. et al. (2014)). "Particularly, in waterless urinals, calcium- and magnesium-based minerals and salts can precipitate and build up in pipes and on surfaces where urine is constantly present. Washing the bowl with a mild acid (e.g., vinegar) and/or hot water can prevent the build-up of mineral deposits and scaling." (Tilley, E. et al. (2014)) It is assumed that to ensure proper maintenance, at least basic water		
water_volume electricity_supply	Performance, Trapez Performance, Categorical	FALSE FALSE	[L/cap/day] electricity	NA NA	supply might be necessary. (Spuhler, D. et al. (2021) NA NA	NA NA	
			intermittent no electricity				
fuel_supply	Performance, Categorical	FALSE	fuel no fuel	NA	NA	NA	
frequency_of_om	PDF, Categorical	TRUE	irregular regular continuous	(irregular = 0, regular = 1, continuous = 0)	"Maintenance is simple, but should be done frequently, especially for waterless urinals". (Tilley, E. et al.	yes	
pipe_supply	Performance, Categorical	FALSE	no pipes difficultly available pipes	NA	(2014)) NA	NA	
pump_supply	Performance, Categorical	FALSE	no pumps difficultly available	NA	NA	NA	
concrete_supply	Performance, Categorica	TRUE	no concrete	(no concrete = 1, difficultly available =	Adapted from Cistern Flush Toilet. The	yes	
spare_parts	PDF, Categorical	TRUE	difficulty available concrete simple technical	1, concrete = 1) (simple = 1, technical = 0, special = 0)	technology can be built with and without concrete. The performance with concrete is assumed to be the same. (Spuhler, D. et al. (2021)) "Can be built and repaired with locally available materials" (Tilley, E. et al.	yes	
			special		(2014)) No need for technical or special parts is expected. (Spuhler, D. et al. (2021))		
0	0	FALSE FALSE	(NA D NA	NA NA	NA NA	
0 temperature		FALSE FALSE	very cold	NA NA	NA NA	NA NA	
temperature	renominate, enegones		cold temperate warm hot				
flooding	Performance, Categorical	FALSE	flooding	NA	NA	NA	
vehicular_acces	Performance, Categorical	FALSE	no flooding no access	NA	NA	NA	
slope	Performance, Categorical	FALSE	difficult full flat	NA .	NA	NA	
soil_type	Performance, Categorical		not flat clay	NA	NA	NA	
зоп_суре	. comunice, categorical		silt sand gravel				
groundwater_depth	Performance, Trapez	FALSE	rock water depth [m]	NA	NA	NA	
excavation	Performance, Categorical		easy	NA NA	NA NA	NA NA	
surface_area_onsite	Performance, Trapez	FALSE	hard [m2/plot]	NA	NA	NA	
surface_area_offsite			m2/pers	NA	NA	NA	
0	0	FALSE	(NA NA	NA	NA	
0	0	FALSE FALSE	(NA D NA	NA NA	NA NA	
drinking_water_exposure	Performance, Categorical		Close Not close	NA	NA	NA	
0		FALSE	(NA	NA	NA	
0 construction_skills	Performance, Categorical	TRUE	Ladder:	NA (unskilled = 0, skilled = 1, professional	NA "Waterless urinals are available in a	NA yes	
			unskilled skilled professional	= 1)	range of styles and complexities". (Tilley, E. et al. (2014)) Some plumbing knowledge is		
design_skills	Performance, Categorical	TRUE	Ladder: unskilled skilled professional	(unskilled = 0, skilled = 1, professional = 1)	necessary. (Spuhler, D. et al. (2021)) "Waterless urinals are available in a range of styles and complexities". (Tilley, E. et al. (2014)) Some plumbing knowledge is	yes	
om_skills	Performance, Categorical	TRUE	Ladder: Unskilled Skilled Professional	(unskilled = 1, skilled = 1, professional = 1)	necessary. (Spuhler, D. et al. (2021)) "Maintenance is simple, but should be done frequently, especially for waterless urinals". (Tilley, E. et al. (2014))	yes	
0		FALSE	(NA NA	NA	NA NA	
0	0	FALSE FALSE	(D NA D NA	NA NA	NA NA	
0 cleansing_method		FALSE TRUE	Washers Soft wipers Hard wipers	NA (washers = 1, soft wipers = 1, hard wipers = 1)	NA Since an urinal has only urine as input no cleansing method is needed. In other words, it is possible in every seco. (Souther D. et al. (2021))	NA	
0	0	FALSE) NA	case. (Spuhler, D. et al. (2021)) NA	NA .	
0		FALSE		NA NA	NA NA	NA NA	1

lifetime	Performance, Categorical	FALSE	short (< 1 year) medium (1-5 years)	NA	NA	NA	
			long (>5 years)				-
speed_implement_toilet	PDF, Categorical	FALSE	rapid (< 3 days)	NA	NA	NA	
			moderate (3 days to 2 weeks)				
			slow (> 2 weeks)				
speed_implement_treatment	PDF, Categorical	FALSE	rapid (few days to a week)	NA	NA	NA	
			moderate (few weeks up to three				
			months)				
			slow (> 3 months)				
scalability	Performance, Categorical	FALSE	easy	NA	NA	NA	
			difficult				
construction_parts	PDF, Categorical	TRUE	simple	(simple = 1, technical = 0, special = 0)	"Can be built and repaired with locally	yes	
			technical		available materials" (Tilley, E. et al.		
			special		(2014))		
Transfer Coefficients	(copied from "Sanitation_Technologies_TC_database_202	10622.xlsm")					
	Urine	Range	Airloss	Soilloss	Waterloss	Comments	Reference
TP		Range	Airloss - C	Soilloss		Comments * Assumption: Losses occur in storage	Reference Spuhler, D. et al. (2021)
		Range	- (C	Soilloss C			
TP			Airloss (Soilloss C			
TP	1 1		Airloss	C	C .		Spuhler, D. et al. (2021)
TP med (R)	1 1 100		- (C	C .	* Assumption: Losses occur in storage	Spuhler, D. et al. (2021) - Spuhler, D. et al. (2021)
TP med (R)	1 1 100		- (C	C .	* Assumption: Losses occur in storage * Assumption: Losses occur in storage,	Spuhler, D. et al. (2021) - Spuhler, D. et al. (2021)
TP med (R) k TN	1 1 100 0.99		- C	C	C .	* Assumption: Losses occur in storage * Assumption: Losses occur in storage,	Spuhler, D. et al. (2021) - Spuhler, D. et al. (2021)
TP med (R) k TN	1 1 1 100 0.99 0.99		- C	C	C	* Assumption: Losses occur in storage * Assumption: Losses occur in storage, very little volatilization of ammonia	Spuhler, D. et al. (2021) Spuhler, D. et al. (2021) - Spuhler, D. et al. (2021) -
TP med (R) <i>k</i> TN med (R)	1 1 1 100 0.99 0.99		- C	C	C	* Assumption: Losses occur in storage * Assumption: Losses occur in storage, very little volatilization of ammonia	Spuhler, D. et al. (2021) - Spuhler, D. et al. (2021) Spuhler, D. et al. (2021) Spuhler, D. et al. (2021) Spuhler, D. et al. (2021)
TP med (R)	1 1 1 100 0.99 0.99		- C	C	C	* Assumption: Losses occur in storage * Assumption: Losses occur in storage, very little volatilization of ammonia	Spuhler, D. et al. (2021)
TP med (R)	1 1 100 0.99 0.99 100 1		- C	C		* Assumption: Losses occur in storage * Assumption: Losses occur in storage, very little volatilization of ammonia	Spuhler, D. et al. (2021) - Spuhler, D. et al. (2021) Spuhler, D. et al. (2021) Spuhler, D. et al. (2021) Spuhler, D. et al. (2021)
TP med (R) k TN med (R) k H200 med (R) k 75	1 1 100 0.99 0.99 100 1		- C	C		* Assumption: Losses occur in storage * Assumption: Losses occur in storage, very little volatilization of ammonia * Assumption: Losses occur in storage * Assumption: Losses occur in storage	Spuhler, D. et al. (2021)
TP med (R) k TN TN med (R) ### ### ### ### ### ### ### ### ###	1 1 100 0.99 0.99 100 1		- C	C		* Assumption: Losses occur in storage * Assumption: Losses occur in storage, very little volatilization of ammonia * Assumption: Losses occur in storage * Assumption: Losses occur in storage	Spuhler, D. et al. (2021) Spuhler, D. et al. (2021) Spuhler, D. et al. (2021) Spuhler, D. et al. (2021) Spuhler, D. et al. (2021) Spuhler, D. et al. (2021) Spuhler, D. et al. (2021) Spuhler, D. et al. (2021) Spuhler, D. et al. (2021)
TP med (R)	1 1 1 100 100 100 100 100 100 11 1 1 1		- C	C		* Assumption: Losses occur in storage * Assumption: Losses occur in storage, very little volatilization of ammonia * Assumption: Losses occur in storage * Assumption: Losses occur in storage	Spuhler, D. et al. (2021) - Spuhler, D. et al. (2021) Spuhler, D. et al. (2021) Spuhler, D. et al. (2021) Spuhler, D. et al. (2021) Spuhler, D. et al. (2021) Spuhler, D. et al. (2021) Spuhler, D. et al. (2021)

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Spuhler, D., & Rovinasi Lima, P., Fritzsche, J., Ilmanae, K., Jain, A., van Slotten, M., & Williaman, C. (2021). Sanitation technology (Eawag), Dübendorf, Switzerland. Spuhler, D., & Roller, L. (2020). Sanitation technology library: Details and data sources for appropriateness profiles and transfer coefficients . Eawag- Swiss Federal Institute of Aquatic Science and Technology (EawAG).

Tilley, E., Ulrich, L., Lüthi, C., Reymond, P., & Zurbrügg, C. (2014). Compendium of Sanitation Systems and Technologies—2nd revised edition. Swiss Federal Institute of Aquatic Science and Technology (EAWAG).

FUNCTIONAL GROUP UNIQUE IDENTIFIER (ID)	Values	Data Source				
UNIQUE IDENTIFIER (ID)						
DATA CO. 10		-				
DATA COMPILER INPUT PRODUCT	Kukka Ilmanen	- Spuhler, D. & Roller, L. (2020)				
	For Santiago: NA					
OUTPUT PRODUCT RELATIONS		Spuhler, D. & Roller, L. (2020) Spuhler, D. & Roller, L. (2020)				
COMMENTS	Output: NA					
re-Filter Criteria	Values	Data Source				
applicability_level management_level		NA NA				
capex_req_level	6	Spuhler, D. et al. (2021) Spuhler, D. et al. (2021)				
opex_req_level technical_maturity		No technical components. Spuhler, D.				
develonment phase	(acute = 1, stabilisation = 0,	et al. (2021) Gensch, R. et al. (2018) -> U.6 Shallow				
	development/recovery = 0)	Trench Latrine				
		This is a dummy technology only implemented to have a technology in				
		FG U that can be the input into the technologies Controlled open				
		defecation and Shallow trench				
		latrines. It is assumed to have the same development phase values as				
		Shallow Trench Latrines. (Spuhler, D. et al. (2021))				
reening Criteria	Type and Function	Applicable for this Functional Group?	Categories [Unit]	Technology Values (Data)	Data Source / Assumptions	Internal Review Done?
water_supply	Performance, Categorical		house	(house = 1, yard = 1, public = 1, none =	This is a dummy technology only	yes
.такезарріу			yard	1)	implemented to have a technology in	
			public none		FG U that can be the input into the technologies Controlled open	
					defecation and Shallow trench	
water_volume	Performance, Trapez		[L/cap/day]	NA	latrines. (Spuhler, D. et al. (2021)) NA	NA
electricity_supply	Performance, Categorical		electricity intermittent	NA	NA	NA
_			no electricity			
fuel_supply	Performance, Categorical		fuel no fuel	NA	NA	NA
frequency_of_om	PDF, Categorical	TRUE	irregular	(irregular = 1, regular = 0, continous =	This is a dummy technology only	yes
			regular continuous	0)	implemented to have a technology in FG U that can be the input into the	
					technologies Controlled open defecation and Shallow trench	
		FALCE		ALA	latrines. (Spuhler, D. et al. (2021))	
pipe_supply	Performance, Categorical	FALSE	no pipes difficultly available	NA	NA	NA
pump_supply	Performance, Categorical	FALSE	pipes no pumps	NA	NA	NA .
Poip_aupply	. c. o		difficultly available			
concrete_supply	Performance, Categorical	TRUE	pumps no concrete	(no concrete = 1, difficultly available =	This is a dummy technology only	yes
			difficultly available concrete	1, concrete = 1)	implemented to have a technology in FG U that can be the input into the	
			concrete		technologies Controlled open	
					defecation and Shallow trench latrines. (Spuhler, D. et al. (2021))	
spare_parts	PDF, Categorical	TRUE	simple	(simple = 1, technical = 0, special = 0)	This is a dummy technology only	yes
			technical special		implemented to have a technology in FG U that can be the input into the	
					technologies Controlled open defecation and Shallow trench	
					latrines. (Spuhler, D. et al. (2021))	
0		FALSE FALSE		NA NA	NA NA	NA NA
0 temperature		FALSE		NA NA	NA NA	NA NA
temperature	renormance, Categorical	I DESE	cold	no.	INO.	ING.
			temperate warm			
		FALCE	hot	ALA		
flooding	Performance, Categorical		flooding no flooding	NA	NA	NA
vehicular_acces	Performance, Categorica	FALSE	no access difficult	NA	NA	NA
			full			
slope	Performance, Categorical	FALSE	flat not flat	NA	NA	NA
soil_type	Performance, Categorical	FALSE	clay	NA	NA	NA
			silt sand			
			gravel rock			
groundwater_depth			water depth [m]	NA	NA	NA
excavation	Performance, Categorical	FALSE	easy hard	NA	NA	NA
surface_area_onsite	Performance, Trapez	FALSE	[m2/plot]	NA	NA	NA
surface_area_offsite	Performance, Trapez			NA	NA	NA
0	0	FALSE FALSE	0	NA NA	NA NA	NA NA
0	0	FALSE	0	NA	NA	NA
drinking_water_exposure	Performance, Categorical	FALSE	Close Not close	NA	NA	NA
0		FALSE FALSE	0	NA NA	NA NA	NA NA
construction_skills	Performance, Categorical		Ladder:	NA (unskilled = 1, skilled = 1, professional	NA This is a dummy technology only	yes
			unskilled skilled	= 1)	implemented to have a technology in FG U that can be the input into the	
			professional		technologies Controlled open	
					defecation and Shallow trench latrines. (Spuhler, D. et al. (2021))	
design_skills	Performance, Categorical	TRUE	Ladder: unskilled	(unskilled = 1, skilled = 1, professional = 1)	This is a dummy technology only implemented to have a technology in	yes
			skilled		FG U that can be the input into the	
			professional		technologies Controlled open defecation and Shallow trench	
		TO 1.5			latrines. (Spuhler, D. et al. (2021))	
om_skills	Performance, Categorical	IKUE	Ladder: Unskilled	(unskilled = 1, skilled = 1, professional = 1)	This is a dummy technology only implemented to have a technology in	yes
			Skilled Professional		FG U that can be the input into the technologies Controlled open	
1			1.0.C33IO1Id1		defecation and Shallow trench	
					latrines. (Spuhler, D. et al. (2021))	i e
0	0	FALSE	0	NA	NA	NA
0	0	FALSE FALSE FALSE	0	NA NA NA	NA NA	NA NA NA

cleansing_method	Performance, Categorical	TRUE	Washers	(washers = 1, soft wipers = 1, hard	This is a dummy technology only	yes	
			Soft wipers	wipers = 1)	implemented to have a technology in	,	
				wipers = 1)			
			Hard wipers		FG U that can be the input into the		
					technologies Controlled open		
					defecation and Shallow trench		
					latrines. (Spuhler, D. et al. (2021))		
0		FALCE		200		N/A	
		FALSE		NA NA	NA	NA	
0		FALSE		NA NA	NA	NA	
lifetime	Performance, Categorical	FALSE	short (< 1 year)	NA	NA	NA	
			medium (1-5 years)				
			long (>5 years)				
speed implement toilet	PDF, Categorical	EALSE	rapid (< 3 days)	NA	NA	NA	
speed_implement_toilet	PDF, Categorical	FALSE		INA	NA .	INA	
			moderate (3 days to 2 weeks)				
			slow (> 2 weeks)				
speed_implement_treatment	PDF, Categorical	FALSE	rapid (few days to a week)	NA	NA	NA	
			moderate (few weeks up to three				
			months)				
			slow (> 3 months)				
		54105					
scalability	Performance, Categorical	FALSE	easy	NA	NA	NA	
			difficult				
construction_parts	PDF, Categorical	TRUE	simple	(simple = 1, technical = 0, special = 0)	This is a dummy technology only	yes	
			technical		implemented to have a technology in		
			special		FG U that can be the input into the		
		I	special				
I					technologies Controlled open		
					defecation and Shallow trench		
					latrines. (Spuhler, D. et al. (2021))		
Transfer Coefficients	(copied from "Sanitation_Technologies_TC_database_202	210622.xlsm")					
	Open Defecation Excreta	Range	Airloss	Soilloss	Waterloss	Comments	Reference
TP	1		-	0		* This is a dummy technology only	Spuhler, D. et al. (2021)
						implemented to have a technology in FG	
						U that can be the input into the	
						technologies Controlled open defecation	
						and Shallow trench latrines. No losses	
	1.00						
med (R)	1.00		-	0) (and Shallow trench latrines. No losses	
k	1.00 100)		and Shallow trench latrines. No losses occur.	Spuhler, D. et al. (2021)
						and Shallow trench latrines. No losses occur. This is a dummy technology only	- Spuhler, D. et al. (2021) Spuhler, D. et al. (2021)
k						and Shallow trench latrines. No losses occur. This is a dummy technology only implemented to have a technology in FG	
k				0		and Shallow trench latrines. No losses occur. 7 This is a dummy technology only implemented to have a technology in FG U that can be the input into the	
k						and Shallow trench latrines. No losses occur. * This is a dummy technology only implemented to have a technology in FG U that can be the input into the technologies controlled open defecation	
k			-			and Shallow trench latrines. No losses occur. 7 This is a dummy technology only implemented to have a technology in FG U that can be the input into the	
k						and Shallow trench latrines. No losses occur. * This is a dummy technology only implemented to have a technology in FG U that can be the input into the technologies controlled open defecation	
k TN	100 1					and Shallow trench latrines. No losses occur. This is a dummy technology only implemented to have a technology in FG U that can be the input into the technologies Controlled open defecation and Shallow trench latrines. No losses	
k	100					and Shallow trench latrines. No losses occur. This is a dummy technology only implemented to have a technology in FG U that can be the input into the technologies Controlled open defecation and Shallow trench latrines. No losses	Spuhler, D. et al. (2021)
/s TN med (R) /k	100 1					and Shallow trench latrines. No losses occur. * This is a dummy technology only implemented to have a technology in FG U that can be the input into the technologies Controlled open defecation and Shallow trench latrines. No losses occur.	Spuhler, D. et al. (2021)
k TN	100					and Shallow trench latrines. No losses occur. * This is a dummy technology only implemented to have a technology in FG Uthat can be the input into the technologies Controlled open defectation and Shallow trench latrines. No losses occur. * This is a dummy technology only	Spuhler, D. et al. (2021)
/s TN med (R) /k	100					and Shallow trench latrines. No losses occur. * This is a dummy technology only implemented to have a technology in FG U that can be the input into the technologies Controlled open defecation and Shallow trench latrines. No losses occur. * This is a dummy technology only implemented to have a technology in FG	Spuhler, D. et al. (2021)
/s TN med (R) /k	100					and Shallow trench latrines. No losses occur. * This is a dummy technology only implemented to have a technology in FG Uthat can be the input into the technologies Controlled open defectation and Shallow trench latrines. No losses occur. * This is a dummy technology only implemented to have a technology in FG Uthat can be the input into the Uthat can be the input into the	Spuhler, D. et al. (2021)
/s TN med (R) /k	100					and Shallow trench latrines. No losses occur. * This is a dummy technology only implemented to have a technology in FG U that can be the input into the technologies Controlled open defecation and Shallow trench latrines. No losses occur. * This is a dummy technology only implemented to have a technology only U that can be the input into the technologies Controlled open defecation	Spuhler, D. et al. (2021)
/s TN med (R) /k	100					and Shallow trench latrines. No losses occur. * This is a dummy technology only implemented to have a technology in FG U that can be the input into the technologies Controlled open defecation and Shallow trench latrines. No losses occur. * This is a dummy technology only implemented to have a technology in FG U that can be the input into the technologies Controlled open defecation and Shallow trench latrines. No losses occur.	Spuhler, D. et al. (2021)
# TN med (R) # H2O	100 1 1.00 100 10					and Shallow trench latrines. No losses occur. * This is a dummy technology only implemented to have a technology in FG U that can be the input into the technologies Controlled open defecation and Shallow trench latrines. No losses occur. * This is a dummy technology only implemented to have a technology only U that can be the input into the technologies Controlled open defecation	Spuhler, D. et al. (2021)
/s TN med (R) /k	100					and Shallow trench latrines. No losses occur. * This is a dummy technology only implemented to have a technology in FG U that can be the input into the technologies Controlled open defecation and Shallow trench latrines. No losses occur. * This is a dummy technology only implemented to have a technology in FG U that can be the input into the technologies Controlled open defecation and Shallow trench latrines. No losses occur.	Spuhler, D. et al. (2021)
# TN med (R) # H2O	100 1 1.00 100 10					and Shallow trench latrines. No losses occur. * This is a dummy technology only implemented to have a technology in FG U that can be the input into the technologies Controlled open defecation and Shallow trench latrines. No losses occur. * This is a dummy technology only implemented to have a technology in FG U that can be the input into the technologies Controlled open defecation and Shallow trench latrines. No losses occur.	Spuhler, D. et al. (2021) Spuhler, D. et al. (2021) Spuhler, D. et al. (2021) -
# TN med (R) # H2O med (R) # # med (R) # # # # # # # # # # # # # # # # # # #	100 1 1.000 100 1					and Shallow trench latrines. No losses occur. * This is a dummy technology only implemented to have a technology in FG Uthat can be the input into the technologies Controlled open defecation and Shallow trench latrines. No losses occur. * This is a dummy technology only implemented to have a technology in FG U that can be the input into the technologies Controlled open defectation and Shallow trench latrines. No losses occur.	
k TN med (R) k H2O med (R)	100 1 1.000 100 1					and Shallow trench latrines. No losses occur. * This is a dummy technology only implemented to have a technology in FG U that can be the input into the technologies Controlled open defectation and Shallow trench latrines. No losses occur. * This is a dummy technology only implemented to have a technologies Controlled open defectation and Shallow trench latrines. No losses occur. * This is a dummy technology only implemented to have a technologies controlled open defectation and Shallow trench latrines. No losses occur.	Spuhler, D. et al. (2021) Spuhler, D. et al. (2021) Spuhler, D. et al. (2021) -
# TN med (R) # H2O med (R) # # med (R) # # # # # # # # # # # # # # # # # # #	100 1 1.000 100 1					and Shallow trench latrines. No losses occur. * This is a dummy technology only implemented to have a technology in FG Uthat can be the input into the technologies Controlled open defecation and Shallow trench latrines. No losses occur. * This is a dummy technology only implemented to have a technology in FG Uthat can be the input into the technologies Controlled open defecation and Shallow trench latrines. No losses occur. * This is a dummy technology only implemented to have a technology only implemented to have a technology only implemented to have a technology only implemented to have a technology in FG	
# TN med (R) # H2O med (R) # # med (R) # # # # # # # # # # # # # # # # # # #	100 1 1.000 100 1					and Shallow trench latrines. No losses occur. * This is a dummy technology only implemented to have a technology in FG U that can be the input into the technologies Controlled open defecation and Shallow trench latrines. No losses occur. * This is a dummy technology only implemented to have a technologies Controlled open defecation and Shallow trench latrines. No losses occur. * This is a dummy technology only implemented to have a technologies controlled open defecation and Shallow trench latrines. No losses occur. * This is a dummy technology only implemented to have a technologies for the control of the control open defecation and Shallow trench latrines. No losses occur.	
# TN med (R) # H2O med (R) # # med (R) # # # # # # # # # # # # # # # # # # #	100 1 1.000 100 1					and Shallow trench latrines. No losses occur. * This is a dummy technology only implemented to have a technology in FG Uthat can be the input into the technologies Controlled open defecation and Shallow trench latrines. No losses occur. * This is a dummy technology only implemented to have a technology in FG Uthat can be the input into the technologies Controlled open defecation and Shallow trench latrines. No losses occur. * This is a dummy technology only implemented to have a t	
# TN med (R) # H2O med (R) # # med (R) # # # # # # # # # # # # # # # # # # #	100 1 1.000 100 1					and Shallow trench latrines. No losses occur. * This is a dummy technology only implemented to have a technology in FG U that can be the input into the technologies Controlled open defecation and Shallow trench latrines. No losses occur. * This is a dummy technology only implemented to have a technology only implemented to have a technology in FG U that can be the input into the technologies Controlled open defecation and Shallow trench latrines. No losses occur. * This is a dummy technology only implemented to have a technology only implemented to have a technology only implemented to have a technology only implemented to have a technology only implemented to have a technology only and the controlled open defecation and Shallow trench latrines. No losses	
med (R) R H20 med (R) F 75	100 1 1,000 100 1 1,000 100 1					and Shallow trench latrines. No losses occur. * This is a dummy technology only implemented to have a technology in FG Uthat can be the input into the technologies Controlled open defecation and Shallow trench latrines. No losses occur. * This is a dummy technology only implemented to have a technology in FG Uthat can be the input into the technologies Controlled open defecation and Shallow trench latrines. No losses occur. * This is a dummy technology only implemented to have a t	
# TN med (R) # H2O med (R) # # med (R) # # # # # # # # # # # # # # # # # # #	100 1 1.000 100 1 1.000 100 1					and Shallow trench latrines. No losses occur. * This is a dummy technology only implemented to have a technology in FG U that can be the input into the technologies Controlled open defecation and Shallow trench latrines. No losses occur. * This is a dummy technology only implemented to have a technology only implemented to have a technology in FG U that can be the input into the technologies Controlled open defecation and Shallow trench latrines. No losses occur. * This is a dummy technology only implemented to have a technology only implemented to have a technology only implemented to have a technology only implemented to have a technology only implemented to have a technology only and the controlled open defecation and Shallow trench latrines. No losses	
med (R) k H2O med (R) rs	100 1 1,000 100 1 1,000 100 1					and Shallow trench latrines. No losses occur. * This is a dummy technology only implemented to have a technology in FG U that can be the input into the technologies Controlled open defecation and Shallow trench latrines. No losses occur. * This is a dummy technology only implemented to have a technology only implemented to have a technology in FG U that can be the input into the technologies Controlled open defecation and Shallow trench latrines. No losses occur. * This is a dummy technology only implemented to have a technology only implemented to have a technology only implemented to have a technology only implemented to have a technology only implemented to have a technology only and the controlled open defecation and Shallow trench latrines. No losses	
med (R) k H20 med (R) rs	100 1 1.000 100 1 1.000 100 1					and Shallow trench latrines. No losses occur. * This is a dummy technology only implemented to have a technology in FG U that can be the input into the technologies Controlled open defecation and Shallow trench latrines. No losses occur. * This is a dummy technology only implemented to have a technology only implemented to have a technology in FG U that can be the input into the technologies Controlled open defecation and Shallow trench latrines. No losses occur. * This is a dummy technology only implemented to have a technology only implemented to have a technology only implemented to have a technology only implemented to have a technology only implemented to have a technology only and the controlled open defecation and Shallow trench latrines. No losses	
med (R) k H20 med (R) rs	100 1 1.000 100 1 1.000 100 1					and Shallow trench latrines. No losses occur. * This is a dummy technology only implemented to have a technology in FG U that can be the input into the technologies Controlled open defecation and Shallow trench latrines. No losses occur. * This is a dummy technology only implemented to have a technology only implemented to have a technology in FG U that can be the input into the technologies Controlled open defecation and Shallow trench latrines. No losses occur. * This is a dummy technology only implemented to have a technology only implemented to have a technology only implemented to have a technology only implemented to have a technology only implemented to have a technology only and the controlled open defecation and Shallow trench latrines. No losses	
## TN med (R) ## H2O med (R) ## TS med (R) ## References	100 1 1,000 100 1 1,000 100 1 1,000 1,000					and Shallow trench latrines. No losses occur. * This is a dummy technology only implemented to have a technology in FG U that can be the input into the technologies Controlled open defecation and Shallow trench latrines. No losses occur. * This is a dummy technology only implemented to have a technology in FG U that can be the input into the technologies Controlled open defecation and Shallow trench latrines. No losses occur. * This is a dummy technology only implemented to have a technology in FG U that can be the input into the technologies Controlled open defectation and Shallow trench latrines ho losses occur.	
med (R) med (R) med (R) keferences ensch, R., Jennings, A., Rengeli,	100 1 1.00 100 1 1.00 100 100 100 100 10	Sonitation Technologies in Emergencies . Ge	rman WASH Network (GWN), Swiss Federa	I Institute of Aquatic Science and Technolog	y (Eawag), Global WASH Cluster (GWC) and	and Shallow trench latrines. No losses occur. * This is a dummy technology only implemented to have a technology in FG U that can be the input into the technologies Controlled open defecation and Shallow trench latrines. No losses occur. * This is a dummy technology only implemented to have a technology in FG U that can be the input into the technologies Controlled open defecation and Shallow trench latrines. No losses occur. * This is a dummy technology only implemented to have a technology in FG U that can be the input into the technologies Controlled open defectation and Shallow trench latrines ho losses occur.	
med (R) med (R) # ### M20 100 1 1.00 100 1 1 1.00 100 100 100 100	Sanitation Technologies in Emergencies . Ge	rman WASH Network (GWN), Swiss Federacio-Economic Planning Sciences, 36 (4), 267	I Institute of Aquatic Science and Technology	y (Eawag), Global WASH Cluster (GWC) and	and Shallow trench latrines. No losses occur. * This is a dummy technology only implemented to have a technology in FG Uthat can be the input into the technologies Controlled open defectation and Shallow trench latrines. No losses occur. * This is a dummy technology only implemented to have a technology in FG Uthat can be the input into the technologies Controlled open defectation and Shallow trench latrines. No losses occur. * This is a dummy technology only implemented to have a technology in FG Uthat can be the input into the technologies Controlled open defectation and Shallow trench latrines. No losses occur. Sustainable Sanitation Alliance (SuSanA).	Spuhler, D. et al. (2021) Spuhler, D. et al. (2021) Spuhler, D. et al. (2021) Spuhler, D. et al. (2021) Spuhler, D. et al. (2021) Spuhler, D. et al. (2021)	
med (R) med (R) med (R) med (R) k fr med (R)	100 1 100 100 100 100 100 100 100 100 1	Sanitation Technologies in Emergencies . Ge itation systems in developing countries. So M., & Williams (, (2021) Sanitos).	rman WASH Network (GWN), Swiss Federa cio-Economic Planning Sciences, 36 (4), 267 joet Team. Depoiet Team. Depoiet Team.	Institute of Aquatic Science and Technolog 230. https://doi.org/10.1016/50038-017-01	ty (Eawag), Global WASH Cluster (GWC) and 02,00007-1	and Shallow trench latrines. No losses occur. * This is a dummy technology only implemented to have a technology in FG U that can be the input into the technologies Controlled open defecation and Shallow trench latrines. No losses occur. * This is a dummy technology only implemented to have a technology in FG U that can be the input into the technologies Controlled open defecation and Shallow trench latrines. No losses occur. * This is a dummy technology only implemented to have a technology in FG U that can be the input into the technologies Controlled open defectation and Shallow trench latrines ho losses occur.	Spuhler, D. et al. (2021) Spuhler, D. et al. (2021) Spuhler, D. et al. (2021) Spuhler, D. et al. (2021) Spuhler, D. et al. (2021) Spuhler, D. et al. (2021)
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med (R) med (R) med (R) med (R) fr med (R) med (R) k eferences med, R, Jennings, A, Renggli, publich, J. (2002), 64 publich, J., & Morais Lima, P, F, F publier, D, & Morais Lima, P, F, F publier, D, & Morais Lima, P, F, F	100 1 1.000 100 1 1.000 100 100 100 100	Sanitation Technologies in Emergencies . Ge Itation systems in developing countries . So, M., & Willimann, C. (2021). SainChoice Pro- sources for opportainess profiles and it	rman WASH Network (GWN), Swiss Federa cio-Economic Planning Sciences, 36 (d), 267 oject Team. Department Sanitation, Water confercoefficients. Sawag - Swiss Federal	Institute of Aquatic Science and Technolog 230. https://doi.org/10.1016/50038-017-01	y (Eawag), Global WASH Cluster (GWC) and 02)00007-1 (Sandec), Swiss Federal Institute of Aquatin	and Shallow trench latrines. No losses occur. * This is a dummy technology only implemented to have a technology in FG Uthat can be the input into the technologies Controlled open defectation and Shallow trench latrines. No losses occur. * This is a dummy technology only implemented to have a technology in FG Uthat can be the input into the technologies Controlled open defectation and Shallow trench latrines. No losses occur. * This is a dummy technology only implemented to have a technology in FG Uthat can be the input into the technologies Controlled open defectation and Shallow trench latrines. No losses occur. Sustainable Sanitation Alliance (SuSanA).	Spuhler, D. et al. (2021) Spuhler, D. et al. (2021) Spuhler, D. et al. (2021) Spuhler, D. et al. (2021) Spuhler, D. et al. (2021) Spuhler, D. et al. (2021)

Urine Storage Tank General Information	Values	Data Source					
FUNCTIONAL GROUP UNIQUE IDENTIFIER (ID)	S						
DATA COMPILER	Matthias van Sloten						
INPUT PRODUCT OUTPUT PRODUCT	stored_urine	Spuhler, D. & Roller, L. (2020) Spuhler, D. & Roller, L. (2020)					
RELATIONS		Spuhler, D. & Roller, L. (2020)					
COMMENTS		Data Saura					
	Values (household = 1, neighbourhood = 1,	Tilley, E. et al. (2014)					
	city = 0.5) (household = 1, shared = 1, public = 1)	Tilley, E. et al. (2014)					
	.,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,						
capex_req_level opex_req_level		Spuhler, D. et al. (2021) Spuhler, D. et al. (2021)					
technical_maturity development phase	(acute = 1, stabilisation = 1,	McConville, J. et al. (2020) Values for urine storage tank and					
	development/recovery = 1)	single faeces storage chamber are assumed to be similar.					
		> Gensch, R. et al. (2018)					
Screening Criteria	Type and Function	Applicable for this Functional Group?	Categories [Unit]	Technology Values (Data)	Data Source / Assumptions	Internal Review Done?	
water_supply	Performance, Categorical	FALSE	house yard	NA	NA	NA	
			public				
water_volume	Performance, Trapez	TRUE	none [L/cap/day]	(a = 0, b = 0, c = 999, d = 999)	"When urine cannot be used immediately	Yes	
					or transported using a Conveyance technology (i.e., Jerrycans, see C.1), it can		
					be stored onsite in containers or tanks."		
					(Compendium) No additional water needed.		
					Santiago algorithm ensures this technology is connected to FG U techs that have urine		
					diversion, therefore, default maximum value of 999L/cap/day remains since upper		
					bound of water entering the system is not		
					an issue. (Akanksha Jain)		
electricity_supply	Performance, Categorical	TRUE	electricity intermittent	(electricity = 1, intermittent = 1, no electricity = 1)	No electricity needed.	yes	
			no electricity				
fuel_supply	Performance, Categorical		fuel no fuel	NA	NA	NA	
frequency_of_om	PDF, Categorical	TRUE	irregular	(irregular = 0, regular = 1, continous = 0)	"May require frequent emptying (depending on tank size)" (Compendium)	yes	
			continuous	-,	"When the storage tank is emptied, the		
					sludge will usually be emptied along with the urine, but if a tap is used and the tank is		
					never fully emptied, it may require desludging. The desludging period will		
					depend on the composition of the urine		
					and the storage conditions. Mineral and salt build-up in the tank or in connecting		
					pipes can be manually removed (sometimes with difficulty) or dissolved		
					with a strong acid (24% acetic)."		
					(Compendium) All together regular OM can be expectet.		
pipe_supply	Performance, Categorical	TRUE	no pipes difficultly available	(no pipes = 1, difficultly available = 1, pipes = 1)	No pipes needed.	yes	
		TRUE	pipes		No commenced of		
pump_supply	Performance, Categorical	TRUE	no pumps difficultly available	(no pumps = 1, difficultly available = 1, pumps = 1)	No pumps needed.	yes	
concrete_supply	Performance, Categorical	TRUE	pumps no concrete	(no concrete = 0.75, difficultly	"Mobile storage tanks should be made of	yes	
элегее_зарру		-	difficultly available	available = 0.75, concrete = 1)	plastic or fibreglass, but permanent ones		
			concrete		can be comprised of concrete or plastic." (Compendium)		
					Concrete not necessary, but can perform a bit better for long-term solutions.		
spare_parts	PDF, Categorical	TRUE	simple	(simple = 1, technical = 0, special = 0)	"Can be built and repaired with locally	yes	
			technical special		available materials" (Compendium)		
0	0	FALSE FALSE	0	NA NA	NA NA	NA NA	
0 temperature	Darfarman - C-1 '	FALSE		NA (very cold = 1, cold = 1, temperate =	NA "Urina storage tanks can be installed	NA Ves	
temperature	Performance, Categorical	INVE	very cold cold	(very cold = 1, cold = 1, temperate = 1, warm = 1, hot = 1)	"Urine storage tanks can be installed indoors, outdoors, above ground and	yes	
			temperate warm		below ground depending on the climate, space available, and soil." (Compendium)		
			hot		If installed below ground the technology should be feasible in cold climates as well.		
flooding	Performance, Categorical	TRUE	flooding	(flooding = 1, no flooding= 1)	"Low risk of pathogen transmission"	yes	
			no flooding		(Compendium) There should be no problem with frequent		
					flooding. The tank should be watertight anyway.		
vehicular_acces	Performance, Categorical	TRUE	no access	(no access = 0.8, difficult = 0.8, full = 1)	"If the storage tank is emptied using a	yes	
			difficult full		vacuum truck []" (Compendium) At a large scale a vacuum truck might be		
					required. At smaller distances can be transported manually. Large volumes of		
					urine are produced and might need to be		
					transported. However, since it can also be used locally, it is assumed that motorized		
					vehicles can only slightly improve the		
slope	Performance, Categorical	FALSE	flat	NA	operation efficiency. NA	NA	
soil_type	Performance, Categorical	TRUE	not flat clay		Technology does not rely on soil	yes	
			silt sand	rock = 1)	absorbtion. No difference between soil types.		
			gravel				
groundwater_depth	Performance, Trapez	TRUE	rock water depth [m]	(a = 0, b = 0, c = 999, d = 999)	Technology does not rely on soil	yes	
					absorbtion. Water depth has no influence on the performance of the technology.		
excavation	Performance, Categorical	TRUE	easy hard	(easy = 1, hard = 0.75)	"Urine storage tanks can be installed	yes	
			ner d		indoors, outdoors, above ground and below ground depending on the climate,		
					space available, and soil." (Compendium) Excavation needed in colder climates.		
surface_area_onsite	Performance, Trapez	TRUE	[m2/plot]	(a = 0, b = 0.5, c = 999, d = 999)	"Small land area required" (Compendium).		
					As the technology is movable, it is assumed that it can be used starting from space		
					requirements of zero m2/plot! Since there are many different variations of urine		
					storage tank, common sense is applied		
					here to define 0.5 m2/plot as the minimum space required for 100% performance		
surface_area_offsite	Performance, Trapez	FALSE	m2/pers	NA .	(Eawag, 2021). NA	NA .	
0	0	FALSE	0	NA	NA	NA	
0		FALSE FALSE		NA NA	NA NA	NA NA	

med (R) / k TN med (R)	100 0.98 0.99	- - - 0,98-0,99		0	0	* 1% of N precipitates/volatizes in storage * "volatilization is marginal"	Etter et al. (2011) Maurer et al. (2006) Udert et al. (2006) -
k TN	0.98 0.99 0.99	-	0.01	0	0	* 1% of N precipitates/volatizes in storage * "volatilization is marginal"	Maurer et al. (2006)
k	0.98 0.99	-	0.01	0	0	* 1% of N precipitates/volatizes in storage	Maurer et al. (2006)
k	100 0.98	-					
			0	0	0		PA
17	1	-	0	0	0		Maurer et al. (2006)
TP		Range -	Airloss 0	Soilloss 0	Waterloss 0	* 28% of P settle in storage, see 6.2	Reference Etter et al. (2011)
Transfer Coefficients		210622.xlsm*)					
			technical special		available materials" (Compendium)		
construction_parts	PDF, Categorical	TRUE	simple	(simple = 1, technical = 0, special = 0)	2021) "Can be built and repaired with locally	yes	
			difficult		and tanks can be changed to scale the technology up. (Kukka Ilmanen, Eawag		
scalability	Performance, Categorical	TRUE	slow (> 3 months) easy	(easy = 1, difficult = 1)	The number of urine storage containers	yes	
			months)				
speed_implement_treatment	PDF, Categorical	FALSE	rapid (few days to a week) moderate (few weeks up to three	NA	NA	NA	
					UDDT/Urine Storage Tank. (Akanksha Jain, Eawag 2021)		
					literature available for Single Vault		
					since they both elements of a Single Vault UDDT and values are based on the		
					Single faeces storage chamber and urine storage tanks are awarded same values		
					(Emersan Compendium)		
					plastic or fibreglass, but permanent ones can be comprised of concrete or plastic."		
					"Mobile storage tanks should be made of		
					jerricans." (Single Vault UDDT- Emersan Compendium)		
					iron, tarpaulin, plastic buckets and		
			slow (> 2 weeks)		UDDTs can be constructed with local materials, e.g. bamboo, wood, corrugated		
speed_implement_toilet	PDF, Categorical	INUE	moderate (3 days to 2 weeks)	(i apiu = 0.5, moderate = 0.5, slow = 0)	enough space is available." "Single Vault	yes	
sneed implement to "	PDF, Categorical	TRUE	rapid (< 3 days)	(rapid = 0.5, moderate = 0.5, slow = 0)	easily. (Kukka Ilmanen, Eawag 2021)	ves	
					actual storage devices, such as urine containers and tanks, can be replaced		
					can therefore be used at anytime. The		
					considered here. In general, the concept of storing urine does not have a lifetime and		
					technologies for short lifetimes are not		
					Therefore, lifetimes of less than 1 month are in theory not suitable, but limitations of		
			long (>5 years)		specific storage and application guidelines)." (Compendium)		
lifetime	Performance, Categorical	INVE	short (< 1 year) medium (1-5 years)	(short = 1, medium = 1, long = 1)	month before use (see WHO guidelines for	yes	
0	0	FALSE	0	NA	NA "all urine should be stored for at least 1	NA	
0		FALSE	Hard wipers 0		NA	NA	
cleansing_method	Performance, Categorical	FALSE	Washers Soft wipers	NA	NA	NA	
0	0	FALSE	0	NA	NA	NA	
0	0	FALSE FALSE	0		NA NA	NA NA	
0		FALSE			recommended. NA	NA	
					tasks, there are a few things to take in account. Moderate OM skills are		
					Even though OM contains not very difficult		
					with a strong acid (24% acetic)." (Compendium)		
					(sometimes with difficulty) or dissolved		
					salt build-up in the tank or in connecting pipes can be manually removed		
					depend on the composition of the urine and the storage conditions. Mineral and		
					desludging. The desludging period will		
					with the urine, but if a tap is used and the tank is never fully emptied, it may require		
					tank. When the storage tank is emptied, the sludge will usually be emptied along		
					accumulate on the bottom of the storage		
			Professional		ensure that the tank does not implode due to the vacuum. A viscous sludge will		
			Unskilled Skilled	professional = 1)	vacuum truck (see C.3), the inflow of air must be maintained at a sufficient rate to		
om_skills	Performance, Categorical	TRUE	Ladder:	(unskilled = 0.5, skilled = 1,	"If the storage tank is emptied using a	yes	
					the urine from spraying and avoid the backflow of air." (Compendium)		
					down through a pipe and be released near the bottom of the tank. This will prevent		
					nitrogen loss, the tank should be filled from the bottom, i.e., the urine should flow		
					case of blockages. To minimize odours and		
					diameters (up to 110 mm for underground pipes). They should be easily accessible in		
					accumulate. Pipes should have a steep slope (> 1%), no sharp angles, and large		
					the length of the pipe since precipitates will		
					connected with a pipe to the toilet or urinal, care should be taken to minimize		
					pumped out. If the storage tank is directly		
					urine storage should have an opening large enough so that it can be cleaned and/or		
					the bottom of the tank. Any tank used for		
					precipitated minerals (primarily calcium and magnesium phosphates) will form on		
					corroded by the high pH of stored urine. Over time, a layer of organic sludge and		
			professional		Metal should be avoided as it can easily be		
			unskilled skilled	professional = 1)	plastic or fibreglass, but permanent ones can be comprised of concrete or plastic.		
design_skills	Performance, Categorical	TRUE	Ladder:	(unskilled = 0, skilled = 0.5,	the design requirements. "Mobile storage tanks should be made of	yes	
			proressional		Some very basic skills are necessary to fulfil		
			skilled professional		"Can be built and repaired with locally available materials" (Compendium)		
construction_skills	Performance, Categorical	IKUE	Ladder: unskilled	(unskilled = 0.5, skilled = 1, professional = 1)	"Simple and robust technology" (Compendium)	yes	
0	0	FALSE	0	NA NA	NA	NA	
0		FALSE		N/A	technology.	NA .	
					Exposure to drinking water has no influence on the performance of the		
					"Low risk of pathogen transmission" (Compendium)		
drinking_water_exposure	Performance, Categorical	IKUE	Close Not close	(close = 1, not close = 1)	"Simple and robust technology" (Compendium)	yes	

med (R)	1.00	-	0	0	0	-
k	100					Spuhler et al. (2021)

References
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McCornille, R., et al. (2020). Structured Approach for Comparison of Treatment Options for Vintrien-Recovery From Fecal Sludge.* Frontiers in Environmental Science 8.

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Maurer, M., et al. (2006). "Faite of major compounds in source-separated urine." Water Science and Technology 54(11-12): 413-420.

Tilley, E., Urich, L., Litth, C., Reymond, P., & Zurbrügg, C. (2014). Compendium of Sanitation Systems and Technology 5-101 revised edition. Swiss Federal Institute of Aquatic Science and Technology (EAWAG).

		Data Source					
FUNCTIONAL GROUP UNIQUE IDENTIFIER (ID)	double_dehydration_vaults	-					
DATA COMPILER INPUT PRODUCT	Matthias van Sloten	- Spuhler, D. & Roller, L. (2020)					
OUTPUT PRODUCT	dried_faeces	Spuhler, D. & Roller, L. (2020)					
RELATIONS	Input: NA Output: NA	Spuhler, D. & Roller, L. (2020)					
COMMENTS							
Pre-Filter Criteria	Values	Data Source					
applicability_level	(household = 1, neighbourhood = 0.5, city = 0)	Tilley, E. et al. (2014)					
management_level	(household = 1, shared = 1, public =	Tilley, E. et al. (2014)					
capex_req_level		Spuhler, D. et al. (2021)					
opex_req_level technical_maturity		Spuhler, D. et al. (2021) Tilley, E. et al. (2014)					
	(acute = 0, stabilisation = 1,	Gensch, R. et al. (2018)					
Screening Criteria	development/recovery = 1) Type and Function	Applicable for this Functional Group?	Categories [Unit]	Technology Values (Data)	Data Source / Assumptions	Internal Review Done?	
water_supply	Performance, Categorical	FAISE	house	NA .	NA	NA	
			yard				
			public none				
water_volume	Performance, Trapez	TRUE	[L/cap/day]	(a = 0, b = 0, c = 999, d = 999)	"Dehydration vaults are especially appropriate for water-scarce and rocky areas or where the groundwater table is high" (Compendium). No additional water required. This technology is not impacted by flooding and/or high groundwater tables. The only possible way high water volumes could enter this technology would be by means of a FG U technology that introduces high amount of water into the system (i.e., due to anal cleansing or flush water). Maximum values (c & d) are assumed to remain 999 J/cap/day since the FG U technology that will be connected with this tech according to santiago algorithm, based on input-output products will never be a technology that leads to high water volumes entering dehydration vaults (because blackwater/anal cleansing water is not an input for dehydration vaults). For e.g. Clearn flush y-fer we will never be the	Yes	
					recommended FG U tech for dehydration		
electricity_supply	Performance, Categorical	TRUE	electricity	(electricity = 1, intermittent = 1, no	vaults. (Akanksha Jain) No electricity needed.	yes	
cicculatiy_supply	reformance, categorical	11102	intermittent	electricity = 1)	To circularly needed.	yes	
fuel_supply	Performance, Categorical	FALSE	no electricity fuel	NA	NA .	NA	
frequency_of_om	PDF, Categorical	TRUE	no fuel irregular	(irregular = 0, regular = 1, continous =	"Key operation and maintenance tasks	yes	
			regular continuous	0)	include regular emptying and replacing of urine collection containers (if urine is not drained away), cleaning, checking availability of hygiene items, water and dry cleaning materials, conducting mimor repairs and advising on proper use. Ample supply of cover material must be secured. Accumulated faeces beneath the toilet should occasionally be pushed to the sides of the chamber. (Temersan)		
pipe_supply	Performance, Categorical	TRUE	no pipes difficultly available pipes	(no pipes = 1, difficultly available = 1, pipes = 1)	"A vent pipe is required to remove humidity from vaults and control files and odours" (Emersan Compendium) 'Connection pipes [for urine]" (Emersan Compendium) Ventilation pipes can be produced with local material. The pipes to connect user interface and storage containers are though necessary.	yes	
pump_supply	Performance, Categorical	TRUE	no pumps difficultly available	(no pumps = 1, difficultly available = 1,	"Manual removal of dried faeces is	yes	
concrete_supply	Performance, Categorical	TRUE	difficulty available pumps no concrete difficulty available concrete	pumps = 1) (no concrete = 0.5, difficultly available = 0.75, concrete = 1)	required" (Compendium) No pumps needed. "Can be built and repaired with locally available materials" (Compendium) "They should be made of sealed brickwork or concrete to ensure that surface runoff cannot enter." (Compendium) Concrete not necessary. However, availability of concrete could ease the construction.	yes	
spare_parts			simple technical special	(simple = 1, technical = 0, special = 0)	"Can be built and repaired with locally available materials" (Compendium) "They should be made of sealed brickwork or concrete to ensure that surface runoff cannot enter." (Compendium) Concrete not necessary. However, availability of concrete could ease the construction.	yes	
0		FALSE FALSE		NA NA	NA NA	NA NA	
0	0	FALSE	0	NA	NA	NA	
temperature			very cold cold temperate warm hot	(very cold = 0.5, cold = 0.6, temperate = 0.8, warm = 1, hot = 1)	"The WHO recommends a minimum storage time of 6 months if sah or lime are used as cover material (alkaline treatment), otherwise the storage should be for at least 1 year for warm climates (>20 "C average) and for 1.5 to 2 years for colder climates" (Compendium) Performance decreases for lower temperatures.	yes	
	i						
flooding	Performance, Categorical	TRUE	flooding no flooding	(flooding = 1, no flooding = 1)	"They are also suitable in areas that are frequently flooded because they are built	Yes	

vehicular_acces	Performance, Categorical	TRUE	no access	(no access = 0.8, narrow = 0.8, full = 1)	"If used in an urban context, this	yes
			difficult full		technology relies on a transport service for the dried faeces (and urine) since urban	ĺ
					users normally do not have an interest	Ì
					and/or opportunity to use it locally." (Compendium)	1
					"faeces in the first vault dry and decrease	1
					in volume", emptying every 6 months upto	ĺ
					2 years. (Emersan Compendium) Dried faeces have low volume and require	ĺ
					infrequent emptying, so that a motorized	1
					transport service only slightly improves the	1
					performance of the technology.	1
					Large volumes of urine are produced and might need to be transported. However,	1
					since it can also be used locally, it is	1
					assumed that motorized vehicles can only	1
					slightly improve the operation efficiency.	1
slope	Performance, Categorical	FALSE	flat	NA	NA	NA
			not flat		IITh and a standard to the sta	
soil_type	Performance, Categorical	TRUE	clay	(clay = 0.7, silt = 0.9, sand = 1, gravel = 0.9, rock = 0.7)	"They are also suitable in areas that are frequently flooded because they are built	yes
			sand	,	to be watertight." (Compendium)	1
			gravel		"If reuse is not intended and soil	1
			rock		conditions allow, urine can be in filtrated directly into the ground, avoiding regular	1
					urine management and may increase user	1
					acceptance." (Emersan) Technology can be built to rely on soil	ĺ
					percolation and filtration, but does not	ĺ
					necessarily have to.	ļ
groundwater_depth	Performance, Trapez	TRUE	water depth [m]	(a = 0, b = 3, c = 999 d = 999)	"Dehydration vaults are especially	Ì
					appropriate for water-scarce and rocky areas or where the groundwater table is	ĺ
					high." (Compendium)	ĺ
					Usually does not affect the groundwater,	ĺ
					however, it can be built to rely on soil absorption and therefore might affect the	ĺ
					groundwater.	
excavation	Performance, Categorical	TRUE	easy	(easy = 1, hard = 1)	They can be built above ground indoor or	yes
surface_area_onsite	Performance, Trapez	TRUE	hard [m2/plot]	(a = 2, b = 2, c = 999, d = 999)	outdoor. No excavation needed. Based on a comparison of different	
sui iace_area_onsite	renonnance, trapez	THOSE STATE OF THE	[2/piot]	(u - 2, u - 2, c - 333, u - 333)	technologies, we derive the space	ĺ
					requirements of double dehydration vaults	ĺ
					to be (at least) twice the space of the	Ì
					space requirements of a single pit. This is based on the assumption that the excreta	Ì
					ends up in two alternating chambers	ĺ
					below the user, instead of just one	ĺ
					chamber. There are no further significant differences in terms of space requirements	Ì
					between a single pit and double	1
					dehydration vaults and therefore, using	ĺ
					twice the space (2m2/plot) is justified	ĺ
					(Eawag, 2021). Note that this does not involve any visual protection. A	Ì
					superstructure could require more space.	
surface_area_offsite	Performance, Trapez	FALSE FALSE		NA NA	NA	NA NA
0		FALSE		NA NA		NA NA
0	0	FALSE		NA NA		NA NA
drinking_water_exposure	Performance, Categorical		Close	(close = 0.5, not close = 1)	"They are also suitable in areas that are	yes
				(0.000 0.0)		
			Not close	(***** ***, **** **** **,	frequently flooded because they are built	ľ
			Not close	,		
			Not close		frequently flooded because they are built to be watertight." (Compendium) Since the vaults are built watertight there is no danger of drinking water	
			Not close	,	frequently flooded because they are built to be watertight." (Compendium) Since the vaults are built watertight there is no danger of drinking water contamination. Technology can be built to	
			Not close	,	frequently flooded because they are built to be watertight." (Compendium) Since the vaults are built watertight there is no danger of drinking water contamination. Technology can be built to rely on soil percolation and filtration, but	
					frequently flooded because they are built to be watertight." (Compendium) Since the vaults are built watertight there is no danger of drinking water contamination. Technology can be built to rely on soil percolation and filtration, but does not necessarily have to. This could then contaminate groundwater.	
0		FALSE	c	NA NA	frequently flooded because they are built to be waterlight. (Compendium) Since the vaults are built waterlight there is no danger of drinking water contamination. Technology can be built to rely on soil percolation and filtration, but does not necessarily have to. This could then contaminate groundwater.	NA NA
0	0	FALSE	C	NA NA	frequently flooded because they are built to be watertight. (Compendium) since the vaults are built watertight there is no danger of drinking water contamination. Technology can be built to rely on soil percolation and filtration, but does not necessarily have to. This could then contaminate groundwater. NA NA	NA NA
0 0 construction_skills		FALSE	C Ladder: unskilled	NA NA	frequently flooded because they are built to be watertight. (Compendium) Since the vaults are built watertight there is no danger of drinking water contamination. Technology can be built to rely on soil percolation and filtration, but does not necessarily have to. This could then contaminate groundwater. NA NA To ensure proper function of some important attributes of the technology	NA NA
0	0	FALSE	C Ladder: unskilled skilled	NA NA (unskilled = 0, skilled = 1, professional	frequently flooded because they are built to be watertight. (Compendium) Since the vaults are built watertight there is no danger of drinking water contamination. Technology can be built to rely on soil percolation and filtration, but does not necessarily have to. This could then contaminate groundwater. NA NA TO ensure proper function of some important attributes of the technology such as water lightness at least moderate	NA NA
0 construction_skills	O Performance, Categorical	FALSE TRUE	C Ladder: unskilled skilled professional	NA NA (unskilled = 0, skilled = 1, professional = 1)	frequently flooded because they are built to be watertight. (Compendium) Since the vaults are built watertight there is no danger of drinking water contamination. Technology can be built to rely on soil percolation and filtration, but does not necessarily have to. This could then contaminate groundwater. NA NA To ensure proper function of some important attributes of the technology such as water tightness at least moderate construction skills are needed.	NA NA yes
0	0	FALSE TRUE	C Ladder: unskilled skilled	NA NA (unskilled = 0, skilled = 1, professional = 1)	frequently flooded because they are built to be watertight. (Compendium) Since the vaults are built watertight there is no danger of drinking water contamination. Technology can be built to rely on soil percolation and filtration, but does not necessarily have to. This could then contaminate groundwater. NA NA To ensure proper function of some important attributes of the technology such as water tightness at least moderate constructions skills are needed.	NA NA
0 construction_skills	O Performance, Categorical	FALSE TRUE	Ladder: C unskilled skilled skilled ladder: unskilled skilled	NA NA (unskilled = 0, skilled = 1, professional = 1) (unskilled = 0, skilled = 0, professional	frequently flooded because they are built to be watertight. (Compendium) Since the vaults are built watertight there is no danger of drinking water contamination. Technology can be built to rely on soil percolation and filtration, but does not necessarily have to. This could then contaminate groundwater. NA. NA. To ensure proper function of some important attributes of the technology such as water tightness at least moderate construction. Skills are needed. Whenever the material is intended to be applied onto fields without further treatment, it is recommended to	NA NA yes
0 construction_skills	O Performance, Categorical	FALSE TRUE	C Ladder: unskilled skilled professional Ladder: unskilled	NA NA (unskilled = 0, skilled = 1, professional = 1) (unskilled = 0, skilled = 0, professional	frequently flooded because they are built to be waterlight. (Compendium) Since the vaults are built waterlight there is no danger of drinking water contamination. Technology can be built to rely on soil percolation and filtration, but does not necessarily have to. This could then contaminate groundwater. NA NA To ensure proper function of some important attributes of the technology such as water tightness at least moderate construction skills are needed. "Whenever the material is intended to be applied onto flesh without further treatment, it is recommended to separately collect and dispose of the dry	NA NA yes
0 construction_skills	O Performance, Categorical	FALSE TRUE	Ladder: C unskilled skilled skilled ladder: unskilled skilled	NA NA (unskilled = 0, skilled = 1, professional = 1) (unskilled = 0, skilled = 0, professional	frequently flooded because they are built to be watertight. (Compendium) Since the vaults are built watertight there is no danger of drinking water contamination. Technology can be built to rely on soil percolation and filtration, but does not necessarily have to. This could then contaminate groundwater. NA NA To ensure proper function of some important attributes of the technology such as water tightness at least moderate construction. Skills are needed. "Whenever the material is intended to be applied onto fields without further treatment, it is recommended to separately collect and dispose of the dry cleaning materials. Occasionally, the	NA NA yes
0 construction_skills	O Performance, Categorical	FALSE TRUE	Ladder: C unskilled skilled skilled ladder: unskilled skilled	NA NA (unskilled = 0, skilled = 1, professional = 1) (unskilled = 0, skilled = 0, professional	frequently flooded because they are built to be watertight. (Compendium) Since the vaults are built watertight there is no danger of drinking water contamination. Technology can be built to rely on soil percolation and filtration, but does not necessarily have to. This could then contaminate groundwater. NA NA To ensure proper function of some important attributes of the technology such as water tightness at least moderate constructions skills are needed. "Whenever the material is intended to be applied not leftles without further treatment, it is recommended to separately collect and dispose of the dry cleaning materials. Occasionally, the facees that have accumulated beneath the fullest should be pushed to the sides of the	NA NA yes
0 construction_skills	O Performance, Categorical	FALSE TRUE	Ladder: C unskilled skilled skilled ladder: unskilled skilled	NA NA (unskilled = 0, skilled = 1, professional = 1) (unskilled = 0, skilled = 0, professional	frequently flooded because they are built to be waterlight. (Compendium) Since the vaults are built waterlight there is no danger of drinking water contamination. Technology can be built to rely on soil percolation and filtration, but does not necessarily have to. This could then contaminate groundwater. NA NA TO ensure proper function of some important attributes of the technology such as water tightness at least moderate construction skills are needed. "Whenever the material is intended to be applied onto fields without further treatment, it is recommended to separately collect and dispose of the dry cleaning materials. Occasionally, the facecs that have accumulated beneath the toilet should be pushed to the sides of the chamber. Care should be taken to ensure	NA NA yes
0 construction_skills	O Performance, Categorical	FALSE TRUE	Ladder: C unskilled skilled skilled ladder: unskilled skilled	NA NA (unskilled = 0, skilled = 1, professional = 1) (unskilled = 0, skilled = 0, professional	frequently flooded because they are built to be watertight. (Compendium) Since the vaults are built watertight there is no danger of drinking water contamination. Technology can be built to rely on soil percolation and filtration, but does not necessarily have to. This could then contaminate groundwater. NA NA To ensure proper function of some important attributes of the technology such as water tightness at least moderate constructions skills are needed. "Whenever the material is intended to be applied not lefick without further treatment, it is recommended to separately collect and dispose of the dry cleansing materials. Occasionally, the faeces that have accumulated beneath the tollet should be pushed to the sides of the chamber. Care should be taken to ensure that no water or urine gets into the	NA NA yes
0 construction_skills	O Performance, Categorical	FALSE TRUE	Ladder: C unskilled skilled skilled ladder: unskilled skilled	NA NA (unskilled = 0, skilled = 1, professional = 1) (unskilled = 0, skilled = 0, professional	frequently flooded because they are built to be waterlight. (Compendium) Since the vaults are built waterlight there is no danger of drinking water contamination. Technology can be built to rely on soil percolation and filtration, but does not necessarily have to. This could then contaminate groundwater. NA NA TO ensure proper function of some important attributes of the technology such as water tightness at least moderate construction skills are needed. "Whenever the material is intended to be applied onto fields without further treatment, it is recommended to separately collect and dispose of the dry cleaning materials. Occasionally, the facecs that have accumulated beneath the toilet should be pushed to the sides of the chamber. Care should be taken to ensure	NA NA yes
0 construction_skills	O Performance, Categorical	FALSE TRUE	Ladder: C unskilled skilled skilled ladder: unskilled skilled	NA NA (unskilled = 0, skilled = 1, professional = 1) (unskilled = 0, skilled = 0, professional	frequently flooded because they are built to be waterlight. (Compendium) Since the vaults are built waterlight there is no danger of drinking water contamination. Technology can be built to rely on soil percolation and filtration, but does not necessarily have to. This could then contaminate groundwater. NA NA To ensure proper function of some important attributes of the technology such as water lightness at least moderate construction skills are needed. "Whenever the material is intended to be applied onto fledis without further treatment, it is recommended to separately collect and dispose of the dry cleansing materials. Occasionally, the facces that have accumulated beneath the toilet should be pushed to the sides of the chamber. Care should be taken to ensure that no water or urine gets into the dehydration vault. If this happens, extra ash, lime, soil or sawdust can be added to help absorb the fliquid. To empty the	NA NA yes
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oconstruction_skills design_skills design_skills om_skills om_skills occupation occu	Performance, Categorical Performance, Categorical Performance, Categorical 0 0 0 0 Performance, Categorical	TRUE TRUE TRUE TRUE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE	Ladder: unskilled skilled professional Ladder: unskilled skilled professional Ladder: Unskilled skilled professional Comparison Co	NA NA (unskilled = 0, skilled = 1, professional = 1) (unskilled = 0, skilled = 0, professional = 1) (unskilled = 0, skilled = 1, professional = 1) NA NA NA NA NA NA NA NA NA NA NA NA NA	frequently flooded because they are built to be waterlight. (Compendium) Since the vaults are built waterlight there is no danger of drinking water contamination. Technology can be built to rely on soil percolation and filtration, but does not necessarily have to. This could then contaminate groundwater. NA NA TO ensure proper function of some important attributes of the technology such as water tightness at least moderate construction skills are needed. "Whenever the material is intended to be applied onto fields without further treatment, it is recommended to separately collect and dispose of the dry cleansing materials. Occasionally, the facees that have accumulated beneath the toilet should be pushed to the sides of the chamber. Care should be taken to ensure that no water or urine gets into the deleydration vault; if this happens, extra ash, lime, soil or sawdust can be added to help absorb the liquid. To empty the vaults, a shovel, gloves and possibly a facemask (cloth) should be used to avoid contact with the dried facees." (Compendium) "Care should be taken to ensure that no water or urine gets into the dehydration vault. If this happens, extra ash, lime, soil or sawdust can be added to help absorb the liquid. To empty the vaults, a shovel, gloves and possibly a facemask (cloth) should be used to avoid contact with the dried facees." (Compendium) Care should be taken to ensure that no water or urine gets into the dehydration vault. If this happens, extra ash, lime, soil or sawdust can be added to help absorb the liquid. To compty the vaults, a shovel, gloves and possibly a facemask (cloth) should be used to avoid contact with the dried facees." (Compendium) Na Na Na Na Na Na Na Na Na Na Na Na Na	yes yes NA NA NA NA NA NA NA NA NA NA NA NA NA
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eed implement treatment	PDF, Categorical	FALSE	rapid (few days to a week)	NA	NA	NA	
	,		moderate (few weeks up to three				
			months)				
			slow (> 3 months)				
scalability	Performance, Categorical		easy	(easy = 1, difficult = 0.8)	"Capacity limited by vault size", "The	ves	7
·			difficult		capital costs for constructing a Double		
					Vault UDDT may vary depending on		
					availability and costs of local materials and		
					prefabricated slabs/toilet seats but are		
					generally low to moderate." (Emersan)		
					Technology is complete and it's not easy to		
					extend the vault size, however it is		
					possible to build new units. This depends		1
					on the availability of construction material.		
					It has a lower performance compared to		
					single faeces storage chambers, because		
					more material and space are required.		
					(Kukka Ilmanen, Eawag 2021)		
construction_parts	PDF, Categorical	TRUE	simple	(simple = 1, technical = 0, special = 0)	"Can be built and repaired with locally	yes	
			technical		available materials" (Compendium)		
			special				
morer coemicients	(copied from "Sanitation_Technologies_TC_database_202						,
		Range	Airloss	Soilloss	Waterloss	Comments	Reference
TP		-	C	0	0	* as P	Stintzing, A. et al. (2004)
med (R)	1.00	-	C	0	0	_	-
k	100						PA
TN	0.5	-	0.5		0	* as N	Stintzing, A. et al. (2004)
med (R)	0.50	-	0.50	0	0		-
k	25						PA
H2O	0.2	-	0.8		0		Esrey and et al. (1998)
	0.25		0.75		O C		Rieck et al. (2012)
med (R)	0.225	0,2-0,25		C	0		-
k	100	[0,05]			-		PA
TS		<u> </u>	0.19		0	*Organic matter containment: 70% (assumption for TS= 85%)	Regmi (2005)
med (R)	0.85	-	0.15	C	0		-
, L	ς.						PA

References
Gensch, R., Jennings, A., Renggli, S., & Reymond, P. (2018). Compendium of Sanitation Technologies in Emergencies. German WASH Network (GWN), Swiss Federal Institute of Aquatic Science and Technology (Eawag), Global WASH Cluster (GWC) and Sustainable Sanitation Alliance (SuSanA).
Luestscher, T., & Relier, J. (2002). A decision support system for selecting sanitation systems in developing countries. Socio-Economic Plannings Science, 36 (A), 267–290. https://doi.org/10.1016/S0038-0121(02)00007-1.
Spubler, D., de Morais itums, P. (Fristsche, J., Ilamaner, K., Jain, A., van Solten, M., & Willimann, C. (2021.). Sanitotice, 1.0016-0.0018-0.

ingle Faeces Storage Chambi	er					
eneral Information	Values	Data Source				
FUNCTIONAL GROUP UNIQUE IDENTIFIER (ID)	S single_faeces_storage_chamber	-				
DATA COMPILER	SaniChoice Project Team	-				
INPUT PRODUCT OUTPUT PRODUCT		Spuhler, D. & Roller, L. (2020) Spuhler, D. & Roller, L. (2020)				
RELATIONS	Input: NA	Spuhler, D. & Roller, L. (2020)				
	Output: NA					
COMMENTS						
e-Filter Criteria applicability_level	Values (household = 0.5, neighbourhood = 1,	Data Source Gensch, R. et al. (2018)				
	city = 0)					
management_level	(household = 0.5, shared = 1, public = 1)	Gensch, R. et al. (2018)				
capex_req_level		Spuhler, D. et al. (2021)				
opex_req_level technical_maturity		Spuhler, D. et al. (2021) Gensch, R. et al. (2018)				
	(acute = 0, stabilisation = 1,	Gensch, R. et al. (2018)				
eening Criteria	development/recovery = 1) Type and Function	Applicable for this Functional Group?	Categories (Unit)	Technology Values (Data)	Data Source / Assumptions	Internal Review Done?
	<i>"</i>		1		,	
water_supply	Performance, Categorical	FALSE	house yard	NA	NA	NA
			public			
water_volume	Performance, Trapez	TRUE	none [L/cap/day]	(a = 0, b = 0, c = 999, d = 999)	(s.10) that operates without water" (Emersan). "As no water is needed for operation it is a viable solution for water scarce areas" (Emersan). This technology is not impacted by flooding and/or high groundwater tables. The only possible way too high water volumes could enter this technology would be by means of a FG U technology that introduces high amount of water into the system (i.e., due to anal cleansing or flush water). Maximum values (c & d) are assumed to remain 999 (Logo/day since the FG U technology that will be connected with this tech according to santiago algorithm, based on input-output products, will never be a technology that leads to high water volumes entering single faeces storage chamber (Decause blackwater is not a defined input).	Yes
electricity_supply	Performance, Categorical	TRUE	electricity intermittent no electricity	(electricity = 1, intermittent = 1, no electricity = 1)	For e.g. Cistern flush sytems will never be the recommended FO I tech for single faeces storage chamber. (Akanksha Jain) No need for electricity.	yes
fuel_supply	Performance, Categorical	FALSE	fuel	NA	NA	NA
frequency_of_om	PDF, Categorical	TDLIE	no fuel irregular	(irregular = 0, regular = 1, continuous	"Key operation and maintenance (O & M) tasks	yes
			continuous		containers, cleaning, checking availability of hygiene items, soap, cover material, dry cleansing materials and water for handwashing and anal cleansing, conducting minor repairs and advising on proper use. Care should be taken to ensure that no water or urine gets into the faeces container. If this happens, extra cover material can be added to help absorb the liquid. Service personnel should wear proper personal protective equipment including a mask, gloves, boots, an apron or protective suit. Division of 0 & M responsibilities between users and potential service providers need to be clearly defined." (Emersan) Regular maintenance required.	
pipe_supply	Performance, Categorical	TRUE	no pipes difficultly available pipes	(no pipes = 0, difficultly available = 0.5, pipes = 1)	"All connection pipes should be as short as possible with no sharp bends and installed with at least at 1 % slope.", "A vent pipe is suggested to remove humidity from the vaults and control flies and odours." (Emersan) Ventilation pipes can be produced with local material. The pipes to connect user interface and storage containers are though necessary.	
pump_supply	Performance, Categorical	TRUE	no pumps difficultly available pumps	(no pumps = 1, difficultly available = 1, pumps = 1)	No pumps are required.	yes
concrete_supply	Performance, Categorical		no concrete difficultly available concrete	(no concrete = 1, difficultly available = 1, concrete = 1)	"Single Vault UDDTs can be constructed with local materials, e.g. bamboo, wood, corrugated iron, tarpaulin, plastic buckets and jerricans" (Emersan) No concrete required.	yes
spare_parts	PDF, Categorical	TRUE	simple technical special	(simple = 1, technical = 0, special = 0)	"Single Vault UDDTs can be constructed with local materials, e.g. bamboo, wood, corrugated iron, tarpaulin, plastic buckets and jerricans. Depending on local availability potential cover/drying material that can be used include ash, lime, sawdust, dried soil or dried agricultural waste products. Urine diversion toilet seats or squatting pans can be obtained or produced locally." (Emersan) All material and consequent spare parts are simple and should be found locally.	yes
0		FALSE		NA		NA
0		FALSE FALSE		NA NA		NA NA
temperature	Performance, Categorical		very cold cold temperate warm hot	(very cold = 0.7, cold = 0.9, temperate = 1, warm = 1, hot = 1)	Can be used in every climate. If urine is to be infiltrated in the soil, lower temperatures might not allow the leachate to infiltrate (Emersan). Since this is only one possible configuration, the performances are better than for other technologies relying on percolation.	yes
flooding	Performance, Categorical	TRUE	flooding no flooding	(flooding = 1, no flooding = 1)		Yes

vehicular_acces	Performance, Categorical	TRUE	no access difficult full	(no access = 0.8, difficult = 0.8, full = 1)	"Manual removal of faeces (and urine) containers required", "The collected urine and faeces must be emptied on a regular basis." (Emersan) Manual removal of containers is possible and vehicular access is not required. However motoritzed transport can improve the performance slightly due to the regular transport of the not-voluminous faeces. Large volumes of urine are produced and might need to be transported. However, since it can also be used locally, it is assumed that motorized vehicles can only slightly improve the operation efficiency.	yes	
slope	Performance, Categorical	FALSE	flat	NA NA	NA	NA	
soil_type	Performance, Categorical	TRUE	not flat clay silt sand gravel rock	(clay = 0.7, silt = 0.9, sand = 1, gravel = 0.9, rock = 0.7)	"If reuse is not intended and soil conditions allow, urine can be in filtrated directly into the ground, avoiding regular urine management and may increase user acceptance." (Emersan) The technology can be built to rely on soil percolation and filtration, but does not necessarily have to.	yes	
groundwater_depth	Performance, Trapez	TRUE	water depth [m]	(a = 0, b = 0, c = 999, d = 999)	"Single Vault UDDTs are suitable for floodprone, high	yes	
excavation	Performance, Categorical	TRUE	easy hard	(easy = 1, hard = 1)	water table and rocky areas" (Emersan) "Single Vault UDDTs are suitable for floodprone, high water table and rocky areas" (Emersan) No excavation is required as the vaults are above	yes	
surface_area_onsite	Performance, Trapez	TRUE	[m2/plot]	(a = 1, b = 1, c = 999, d = 999)	ground. Based on a comparison of different technologies, we derive the space requirements of a single faeces storage chamber to be very similar to a single pit (as the excreta is also ends up in a chamber below the user) and use the same minimum space requirement of 1m2/plot (Eawag, 2021). Note that this does not involve any visual protection. A superstructure could require more space.		
surface_area_offsite		FALSE FALSE	m2/pers	NA NA	NA NA	NA NA	
0	0	FALSE	C	NA NA	NA	NA	
drinking_water_exposure	Performance, Categorical	FALSE TRUE FALSE	Close Not close	NA (close = 1, not close = 1)	NA "Containers should be sealable" (Emersan) Faeces should not get into contact with the soil. Urine might be discharged into the soil, but this would be part of another technology. In this storage chamber urine is solely stored. NA	NA yes	
0	0	FALSE	C	NA	NA	NA	
construction_skills	Performance, Categorical		Ladder: unskilled skilled professional	(unskilled = 0, skilled = 1, professional = 1)	Technical skills required for construction.	yes	
design_skills	Performance, Categorical		Ladder: unskilled skilled professional	= 1)	Adapted from double dehydration vaults due to similar setup.	yes	
om_skills	Performance, Categorical		Ladder: Unskilled Skilled Professional	(unskilled = 0, skilled = 1, professional = 1)	"Requires well-trained service personnel" (Emersan).	yes	
0		FALSE FALSE		NA NA	NA NA	NA NA	
0	0	FALSE FALSE	C	NA NA	NA NA	NA NA	
cleansing_method			Washers Soft wipers	NA NA	NA NA	NA	
0		FALSE		NA NA	NA .	NA	
0 lifetime	Performance, Categorical		short (< 1 year) medium (1-5 years) long (>5 years)	NA (short = 1, medium = 1, long = 1)	NA "Single Vault UDDTs can be temporary solutions, making them more attractive in situations with landownership issues that do not permit permanent structures." (Emersan), "The Iffe-span of a UDDT is expected, under normal circumstances, to be at least 15 years." (Rieck C. et al. [2012]) The technology can be used for a short lifetime, but mostly it is expected to have a long lifetime.	NA yes	
speed_implement_toilet	PDF, Categorical	TRUE	rapid (< 3 days) moderate (3 days to 2 weeks) slow (> 2 weeks)	(rapid = 0.5, moderate = 0.5, slow = 0)	"They can be replicated quickly given enough space is available." "Single Vault UDDTs can be constructed with local materials, e.g. bamboo, wood, corrugated iron, tarpaulin, plastic buckets and jerricans." (Single Vault UDDT- Emersan Compendium) Single faeces storage chamber and urine storage tanks are awarded same values since they both elements of a Single Vault UDDT and values are based on the literature available for Single Vault UDDT. (Akanksha Jain, Eawag 2021)	yes	
speed_implement_treatment	PDF, Categorical		rapid (few days to a week) moderate (few weeks up to three months) slow (> 3 months)	NA	NA .	NA	
scalability	Performance, Categorical		easy difficult	(easy = 1, difficult = 1)	available." (Emersan)	yes	
construction_parts	PDF, Categorical		simple technical special	(simple = 1, technical = 0, special = 0)	"Single Vault UDDTs can be constructed with local materials, e.g. bamboo, wood, corrugated iron, tarpaulin, plastic buckets and jerricans. [] Urine diversion toilet seats or squatting pans can be obtained or produced locally, "Emersan) Can be constructed from locally available material.	yes	
Transfer Coefficients	(copied from "Sanitation_Technologies_TC_database_202 Stored Faeces	10622.xism") Range	Airloss	Soilloss	Waterloss	Comments	Reference
TP med (R)	1		C	0	0		Jönsson et al. (2004)
k TN	25 0.8		0.2			* at constant air	PA Jönsson et al. (2004)
med (R)	0.8		0.2			moisture, loss of N is low	
k	5						PA PA
H2O med (R)	0.7 0.7		0.3 0.3		0		PA -
k TS	5 0.85		0.1		0	*Assumption: similar to	PA Regmi (2005)
						dehydration vault	
med (R)	0.9		0.1		0	dehydration vault	PA

Gensch, R., Jennings, A., Renggil, S., & Reymond, P. (2018). Compendium of Sanitation Technologies in Emergencies. German WASH Network (GWN), Swiss Federal Institute of Aquatic Science and Technology (Eawag), Global WASH Cluster (GWC) and Sustainable Sanitation Alliance (SuSanA). Loetscher, T., & Keller, J. (2002). A decision support system for selecting sanitation systems in developing countries. Socio-Economic Planning Sciences, 36 (4), 267–290. https://doi.org/10.1016/S0038-0121(02)00007-1
Spulher, D., & Robler, J. (2003). Sonitation technology (Favore) states of proproprietoress profiles and transmers shrifted in the Spulher, D. & Boller, L. (2003). Sonitation technology (Bravry, Details and data sources profiles and transmers profiles and tran

ontainer-Based Toilet eneral Information	Values	Data Source				
FUNCTIONAL GROUP	S	- Data Source				
	Matthias van Sloten	-				
INPUT PRODUCT OUTPUT PRODUCT	faeces	Gensch, R. et al. (2018) Gensch, R. et al. (2018)				
RELATIONS	Input: NA	Gensch, R. et al. (2018)				
COMMENTS	Output: NA					
e-Filter Criteria		Data Source				
	city = 0)	Gensch, R. et al. (2018)				
management_level	(household = 0.5, shared = 1, public = 1)	Gensch, R. et al. (2018)				
capex_req_level		Spuhler, D. et al. (2021) Spuhler, D. et al. (2021)				
opex_req_level technical_maturity	3	Gensch, R. et al. (2018)				
	development/recovery = 0.5)	Gensch, R. et al. (2018)				
reening Criteria water_supply	Type and Function Performance, Categorical	Applicable for this Functional Group?	Categories [Unit] house	Technology Values (Data) NA		Internal Review Done?
water_supply water_volume	Performance, Categorical Performance, Trapez		[L/cap/day]	(a = 0, b = 0, c = 999, d = 999)	"Dry Technology" (Emersan).	Yes
					This technology is not impacted by flooding and/or high groundwater tables. The only possible way too high water volumes could enter this technology would be by means of a FG U technology that introduces high amount of water into the system (i.e., due to flush water). Maximum values (c. & d) are assumed to remain 999 L/cap/day since the FG U technology that will be connected with this tech according to santiago algorithm, based on input-output products, will never be a technology that leads to high water volumes entering container-based toilet (because blackwater is not an input). For e.g. Cistern flush sytems will in ever be the recommended FG U tech for container-based toilet (Akanska Jain)	
electricity_supply	Performance, Categorical	TRUE	electricity	(electricity = 1, intermittent = 1, no	No need for electricity.	yes
			intermittent no electricity	electricity = 1)		
fuel_supply	Performance, Categorical	FALSE	fuel no fuel	NA	NA	NA
frequency_of_om	PDF, Categorical	TRUE	inregular regular continuous	(irregular = 0, regular = 0.7, continous = 0.3)	"Key O & M tasks include the regular emptying, cleaning and replacing of the collection containers (depending on the size of the containers and the number of users), by either the user or a collector/service provider. Containers require careful cleaning by trained staff in a designated cleaning area that can safely manage the hazardous cleaning water. Each Container-Based Tollet needs to be supplied with the appropriate anal cleansing material." (Emersan) Maintenance is required very often.	yes
pipe_supply	Performance, Categorical	TRUE	no pipes difficultly available pipes	(no pipes = 1, difficultly available = 1, pipes = 1)	No need for pipes.	yes
pump_supply	Performance, Categorical	TRUE	no pumps difficultly available	(no pumps = 1, difficultly available = 1, pumps = 1)	No need for pumps.	yes
concrete_supply	Performance, Categorical	TRUE	no concrete			yes
			difficultly available concrete	1, concrete = 1)	accommodating the needs of mobile, or transient residents" ("Emersan) "Container-Based Toilets are either prefabricated containers or can be a mixture of both prefabricated containers and a locally- made box for holding the container." (Emersan) No concrete needed.	
spare_parts	PDF, Categorical	TRUE	simple technical special	(simple = 0.5, technical = 0, special = 0.5)	prefabricated containers or can be a mixture of both prefabricated containers and a locally-made box for holding the container. (Emersan) Some specially manufactured spare parts by the manufacturares might be necessary. If they are locally-made also simple spare parts can work.	yes
0	0	FALSE	0	NA	NA	NA
0 temperature		FALSE	0 very cold cold	NA (very cold = 1, cold = 1, temperate = 1, warm = 1, hot = 1)	NA	NA yes
0 0	potence * · · ·	TRUE	temperate warm hot	(fleeding = 1 c = 0 = d)	"Suitable where experience	Voc
flooding	Performance, Categorical	IRUE	flooding no flooding	(flooding = 1, no flooding = 1)	flooding, high water table, rocky ground or	Yes
vehicular_acces	Performance, Categorical	TRUE	no access difficult full	(no access = 0.3, difficult = 0.6, full = 1)	collapsing soil exist" (Emersan) The containers are then transported by Manual or Motorised Transport to the treatment or resource recovery centres where the contents can be safely managed." (Emersan) Manual transport is possible, but due to regular transport requirements motorized transport performs a lot better.	yes
sinis	Performance. Categorical	FALSE	flat	NA	NA .	NA
slope soii_type	Performance, Categorical Performance, Categorical	TRUE	clay silt sand gravel rock	(clay = 1, silt = 1, sand = 1, gravel = 1, rock = 1)	Not affected by soil type.	yes
		TRUE	clay silt sand gravel	(clay = 1, silt = 1, sand = 1, gravel = 1,	Not affected by soil type.	
soil_type	Performance, Categorical	TRUE	clay silt sand gravel rock	(clay = 1, silt = 1, sand = 1, gravel = 1, rock = 1)	Not affected by soil type. "Suitable where constraints such as risk of flooding, high water table, rocky ground or collapsing soil exist" (Emersan)	yes

					1	
surface_area_onsite	Performance, Trapez Performance, Trapez	FALSE	m2/pers	(a = 0, b = 0.5, c = 999, d = 999)	As the technology is movable, it is assumed that it can be used starting from space requirements of zero m2/plot1 Since there are many different variations of container based toilets, common sense is applied here to define 0.5 m2/plot as the minimum space required for 100% performance (Eawag, 2021). Note that this does not involve any visual protection. A superstructure could require more space. NA NA	NA MA
0		FALSE		NA NA	NA NA	NA NA
0	0	FALSE FALSE		NA NA	NA NA	NA NA
drinking_water_exposure	Performance, Categorical		Close Not close	(close = 1, not close = 1)	"Suitable where constraints such as risk of flooding, high water table, rocky ground or collapsing soil exist" (Emersan) There is no contamination of drinking water to be expected.	yes NA
0		FALSE		NA NA	NA NA	NA NA
construction_skills	U Performance, Categorical		Ladder: unskilled skilled professional	NA (unskilled = 1, skilled = 1, professional = 1)	"No need for permanent structures, thereby accommodating the needs of mobile, or transient residents" (Emersan) "Container-Based Toilets are either prefabricated containers or can be a mixture of both prefabricated containers and a locally-made box for holding the container." (Emersan) Low constructions skills should be sufficient.	NA yes
design_skills	Performance, Categorical	TOUE	Ladder:	(unskilled = 0, skilled = 0.5,	"The division of operation and maintenance (O	yes
om_skills	Performance, Categorical		Ladder: Unskilled Skilled Skilled Unskilled Skilled Skilled	(unskilled = 0, skilled = 1, professional = 1)	My tasks and responsibilities between users and potential service providers need to be dearly defined and considered in the planning process." (Emersan) "The size of the Container-Based Toilet vault must be chosen according to the anticipated number of users and the collection capacity and interval. The size of the collection container should not exceed 50-60 to tensure easy and manual removal and transport. Containers should be fully sealable and equipped with handles to ensure safe handling, intermediate storage (if required), storage and transport. A simple cubical can be constructed within the home to increase privacy. Where squatting is preferred, a wooden box can be built to create a platform for the user over the container." (Emersan) "Container-Based Toilets are either prefabricated containers or can be a mixture of both prefabricated containers or can be a mixture of both prefabricated containers or can be a mixture of both prefabricated containers and a locally-made box for holding the container." (Emersan) No specific knowledge necessary, but determining the size of the vault requires at "Key O & M tasks include the regular emptying, cleaning and replacing of the collection containers (depending on the size of the containers and the number of users), by either the user or a collector/Service provider. Containers require careful cleaning by trained staff in a designated cleaning area that can safely manage the hazardous cleaning water. Each Container-Rassed Toilets are either user or a container (Generalan) "Requires well-trained user and service personnel for use, maintenance, servicing and monitoring" (Emersan) "Container-Based Toilets are either prefabricated containers or can be a mixture of both prefabricated containers and a locally-made box for holding the container." (Emersan)	yes
0		FALSE FALSE		NA NA	NA NA	NA NA
0		FALSE		NA NA	NA NA	NA NA
0		FALSE		NA NA	NA NA	NA .
cleansing_method	Performance, Categorical		Washers Soft wipers Hard wipers	NA .	NA	NA .
0		FALSE		NA NA	NA NA	NA NA
O lifetime	O Performance, Categorical	FALSE TRUE	short (< 1 year) medium (1-5 years) long (>5 years)	NA (short = 1, medium = 1, long = 1)	NA Container-Based Toilets can be an appropriate solution in all phases of an emergency, provided a company or other organisation is ensuring regular collection, transport and emptying. "Container-Based Toilets are moderately expensive to implement. However, they can be implemented rapidly and once managed well can be used sustainably in the long-term." (Emersan) "Life span of 5+ years" (Hakspiel, D. et al. (2018))	NA yes
speed_implement_tollet	PDF, Categorical		rapid (< 3 days) moderate (3 days to 2 weeks) slow (> 2 weeks)	(rapid = 1, moderate = 0, slow = 0)	"Container-Based Toilets can be implemented relatively quickly and distributed by hand, if stocks are readily available. They do not need a permanent structure" (Emersan Compendium) "The entire construction, assembly, and installation process takes approximately 3 days and trained staff should be able to produce 4 toilets per person per day" (Hakspiel, D. et al. (2018))	yes
speed_implement_treatment	PDF, Categorical	FALSE	rapid (few days to a week) moderate (few weeks up to three months) slow (> 3 months)	NA	NA	NA
scalability	Performance, Categorical	TRUE	difficult	(easy = 1, difficult = 1)	"No need for permanent structures, thereby accommodating the needs of mobile, or transient residents.", (Emersan) Technology can be easily scaled-up as long as new containers are available.	yes

			I		T		į
construction_parts	PDF, Categorical	TRUE	simple	(simple = 1, technical = 0, special = 0)	"Container-Based Toilets are either	yes	
			technical		prefabricated containers or can be a mixture of		
			special		both prefabricated containers and a locally-		
					made box for holding the container. The holding		
					box and the cubicles can be made from wood,		
					woven mats, ferro-cement or metal sheets.		
					Toilet seats or squatting pans can be obtained or		
					produced locally or prefabricated alternatives		
					may be used. Some models of Container-Based		
					Toilets require a bag-type lining, a supplier of		
					these will need to be secured." (Emersan)		
					Mostly locally-made. It is assumed that specially-		
					made prefabricated containers are only used if a		
					local supplier exists.		
	opied from "Sanitation_Technologies_TC_database_202:	21010 de 20					
Transici cocincicito			Airloss	Soilloss	lar.	Comments	Reference
TP	xcreta	Range	AIrioss	Sollioss	Waterloss		
IP IP	1	-	U	0		* Nutrients besides N are contained	Spuhler et al. (2021)
	1	-	U	U		* Nutrients besides N are contained	Jönsson et al. (2004)
med (R)	1.00		0	0			-
k	100		-				
TN	0.43	0.16 - 0.7		0		* as N	Jacks et al. (1999)
	0.99	-	0.01	0			Maurer et al. (2006)
<u> </u>	0.6		0.4	U			Osada et al. (2001)
		0.67-0.81		0		*7-10 days-emission of Ntot+NH3 in	Sommer et al. 2001
med (R)	0.8	0.43-0.99	0.2	0		* at constant air moisture, loss of N is low	Jönsson et al. (2004)
med (K)	0.7	0.43-0.99		0			
H2O	0.9					*PA	5
		0.8 - 1		0		T'PA	Spuhler et al. (2021)
med (R)	0.9	0.8 - 1		0			-
k .		[0.2]	-	-		***	S. 11 (2024)
TS	1	-	0	0		* PA, no TS losses assumed due to frequent emptying (weekly/biweekly)	Spuhler et al. (2021)
H +	0.96	0.95-0-97	0.04			0.71 VSS in 50 days, >0.95 VSS in 7 days	Regmi (2005)
	0.96	0.95-0-97	0.04	0		(assumption: VSS=0.8-0.9*TS)	negiii (2005)
			1		1		
	0.00	0.05.1	0.02				
med (R)	0.98						

Additional Information

Even though the container based toilet can be sealed, it is assumed that ammonia volatilization and denitrification takes place. The values were therefore adapted from "raised_latrine" (same assumptions). Also no blackwater should be diverted into this technology

References
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Jonsson, H., et al. (2004). Guidelines on the use of urine and faces in crop production. Stockholm Evolution in shallow apulfers on the use of urine and faces in crop production. Stockholm Evolution in shallow apulfers on the use of urine and faces in crop production. Stockholm Evolution in shallow apulfers on the use of urine and faces in crop production on Stockholm Evolution in shallow apulfers underlying pit latrines and domestic solid waste dumps in urban slums." Journal of Environmental Management 122: 15–24.
Regmi, M. R. (2005). "A sustainable approach towards ruril development: Dry toiles in Negal." Water Science and Technology S(1(2): 19.0
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Osada, T. et al. (2001). "Geseous emission and changes in nutrient composition during deep litter composition during deep litter composition shallow application of Sanitation Systems and Te

Single Pit General Information FUNCTIONAL GROUP						
	Values	Data Source	T			
UNIQUE IDENTIFIER (ID)		-	}			
DATA COMPILER	Matthias van Sloten	continue of the state of the st]			
OUTPUT PRODUCT		Spuhler, D. & Roller, L. (2020) Spuhler, D. & Roller, L. (2020)	1			
RELATIONS	Input: OR Output: NA	Spuhler, D. & Roller, L. (2020)				
COMMENTS Pre-Filter Criteria	Values	Data Source				
applicability_level	(household = 1, neighbourhood = 0.5,	Tilley, E. et al. (2014)				
management_level	city = 0) (household = 1, shared = 1, public = 0)	Tilley, E. et al. (2014)	1			
capex_req_level		Spuhler, D. et al. (2021)	-			
opex_req_level	4	Spuhler, D. et al. (2021)	1			
technical_maturity development_phase	(acute = 1, stabilisation = 1,	Gensch, R. et al. (2018) Tilley, E. et al. (2014)				
	development/recovery = 1)		Cotton for the second	Table de V. C.	Data Comment of the c	Internal Profession - A
Screening Criteria	Type and Function	Applicable for this Functional Group?	Categories [Unit]	Technology Values (Data)	Data Source / Assumptions	Internal Review Done?
water_supply	Performance, Categorical	FALSE	house yard	NA	NA	NA
			public			
water_volume	Performance, Trapez	TRUE	none [L/cap/day]	(a = 0, b = 0, c = 8, d = 33)	- Minimal volume: can be used without flushing	yes
water_volume	renormance, irapez	- NOL	(c, cap) day)	(u - u, u - u, c = 0, u = 33)	water (a,b = 0)	7-3
					- Maximal volume: can be used with pour-flush toilet (1-3 l/use) and anal cleansing water (0.3-3	
					I/use) assuming 6 visits per persons per day	
electricity_supply	Performance, Categorical	TRUE	electricity intermittent	(electricity = 1, intermittent = 1, no electricity = 1)	No electriciy needed	yes
			no electricity			
fuel_supply	Performance, Categorical	FALSE	fuel	NA	NA	NA
frequency_of_om	PDF, Categorical	TRUE	no fuel irregular	(irregular = 1, regular = 0, continous =	"There is no daily maintenance associated with a	yes
			regular	0)	single pit apart from keeping the facility clean.	
			continuous		However, when the pit is full it can be a) pumped out and reused or b) the superstructure and	
					squatting plate can be moved to a new pit and the	
					previous pit covered and decommissioned, which is only advisable if plenty of land area is available."	
					(Compendium)	
					"Depending on how deep they are dug, some pits may last 20 or more years without emptying."	
					(Compendium)	
pipe_supply	Performance, Categorical	TRUE	no pipes		Irregular frequency of OM can be expected. No pipes needed.	yes
			difficultly available	pipes = 1)		
pump_supply	Performance, Categorical	TRUE	no pumps	(no pumps = 1, difficultly available =	No pumps needed.	yes
			difficultly available	1, pumps = 1)		
concrete_supply	Performance, Categorical	TRUE	no concrete	(no concrete = 1, difficultly available =	"Can be built and repaired with locally available	yes
	· · ·		difficultly available	1, concrete = 1)	materials" (Compendium)	
			concrete		"Pit lining materials can include brick, rotresistant timber, bamboo, concrete, stones, or mortar	
					plastered onto the soil." (EmersanCompendium)	
spare_parts	PDF, Categorical	TRUE	simple	(simple = 1, technical = 0, special = 0)	But concrete is not specifically needed. "Can be built and repaired with locally available	yes
. –			technical special		materials" (Compendium)	
0	0	FALSE	0	NA	NA NA	NA
0	0	FALSE FALSE	0	NA NA	NA NA	NA NA
temperature	Performance, Categorical		very cold	(very cold = 0.5, cold = 0.7, temperate	A single pit can be built in colder climates but there	yes
			cold temperate	= 1, warm = 1, hot = 1)	has to be taken in account that leachate respectively soil absorbtion performance can be	
			warm		lower if the bottom of the pit is frozen.	
flooding	Performance, Categorical	TRUE	hot flooding	(flooding = 0.5, no flooding = 1)	"Pits are susceptible to failure and/or overflowing	Yes
	, and a second		no flooding		during floods." (Compendium)	
					"[] A raised pit can also be constructed in an area where flooding is frequent in order to keep water	
					from flowing into the pit during heavy rain."	
					(Compendium) All technologies where raised configurations are	
					possible get a 50% performance for category	
vehicular_acces	Performance, Categorical	l .				
	Performance, Categorical	TRUE	no access	(no access = 0.3, difficult = 0.6, full =	"floodine". (Akanksha Jain) "However, when the pit is full it can be a) pumped	yes
	renormance, categorical	TRUE	difficult	(no access = 0.3, difficult = 0.6, full = 1)	"floodine". (Akanksha Jain) "However, when the pit is full it can be a) pumped out and reused or b) the superstructure and	yes
	Performance, Categorical	TRUE		(no access = 0.3, difficult = 0.6, full = 1)	"floodine". (Akanksha Jain) "However, when the pit is full it can be a) pumped	yes
	Performance, Categorica	TRUE	difficult	(no access = 0.3, difficult = 0.6, full = 1)	"floodine". Akanksha Jain! "However, when the pit is full it can be a) pumped out and reused or b) the superstructure and squatting plate can be moved to a new pit and the previous pit covered and decommissioned, which is only advisable if plenty of land area is available."	yes
	renormance, categorica	TRUE	difficult	(no access = 0.3, difficult = 0.6, full = 1)	"floodine". (Akanksha Jain) "However, when the pit is full it can be a) pumped out and reused or b) the superstructure and squatting plate can be moved to a new pit and the previous pit covered and decommissioned, which is	yes
	Periormance, Categorica	TRUE	difficult	(no access = 0.3, difficult = 0.6, full = 1)	"flooding". (Akanska) alm! 'However, when the pit is full it can be a) pumped out and reused or b) the superstructure and squatting plate can be moved to a new pit and the previous pit covered and decommissioned, which is only advisable if plenty of land area is available." (Compendium) Pumps might be needed depending on the configuration of the technology, in cases where	yes
	renomance, categoria	TRUE	difficult	(no access = 0.3, difficult = 0.6, full = 1)	"floodine". (Akanksha Jain) "However, when the pit is full it can be a) pumped out and reused or b) the superstructure and squatting plate can be moved to a new pit and the previous pit covered and decommissioned, which is only advisable if plenty of land area is available." (Compendium) Pumps might be needed depending on the	yes
	renomance, categorica	TRUE	difficult	(no access = 0.3, difficult = 0.6, full = 1)	"Hoodine". (Akanskha Jain) "However, when the pit is full it can be a) pumped out and reused or b) the superstructure and squatting plate can be moved to a new pit and the previous pit covered and decommissioned, which is only advisable if plenty of land area is available." (Compendium) Pumps might be needed depending on the configuration of the technology. In cases where pumps are needed a pumping truck can be used as well. Single Pits need to be emptled frequently, so that	yes
			difficult	(no access = 0.3, difficult = 0.6, full = 1)	"flooding". (Akanska) alm! Thowever, when the pit is full it can be a) pumped out and reused or b) the superstructure and squatting plate can be moved to a new pit and the previous pit covered and decommissioned, which is only advisable if plenty of land area is available." (Compendium) Pumps might be needed depending on the configuration of the technology, in cases where pumps are needed a pumping truck can be used as well.	yes
stope	Performance, Categorical		difficult full	(no access = 0.3, difficult = 0.6, full = 1)	"Hoodine". (Akanska) alain! 'However, when the pit is full it can be a) pumped out and reused or b) the superstructure and susuting plate can be moved to a new poit and the previous pit covered and decommissioned, which is only advisable if plenty of land area is available." (Compendium) Pumps might be needed depending on the configuration of the technology, in cases where pumps are needed a pumping truck can be used as well. Single Pits need to be emptide frequently, so that motorized emptying and transport can improve the	yes
slope soil_type	Performance, Categorical	FALSE	difficult full flat not flat	NA NA	"Hoodine". (Akanskha Jain) "However, when the pit is full it can be a) pumped out and reused or b) the superstructure and squatting plate can be moved to a new pit and the previous pit covered and decommissioned, which is only advisable if plenty of land area is available." (Compendium) Pumps might be needed depending on the configuration of the technology, in cases where pumps are needed a pumping truck can be used as well. Single Pits need to be emptied frequently, so that motorized emptying and transport can improve the performance strongly. NA	
		FALSE	difficult full flat not flat clay silt	1)	"Hoodine". (Akanska) alain 'Hoower, when the pit is full it can be a) pumped out and reused or b) the superstructure and squatting plate can be moved to a new pit and the previous pit covered and decommissioned, which is only advisable if plenty of land area is available." (Compendium) Pumps might be needed depending on the configuration of the technology, in cases where pumps are needed a pumping truck can be used as well. Single Pits need to be emptied frequently, so that motorized emptying and transport can improve the performance strongly. NA "As the single pit fills, two processes limit the rate of accumulation: leaching and degradation. Urine	NA NA
	Performance, Categorical	FALSE	difficult full flat not flat clay	NA (clay = 0.25, silt = 0.5, sand = 1, gravel	"Hoodine". (Akanska) alain 'Hoower, when the pit is full it can be a) pumped out and reused or b) the superstructure and suparting plate can be moved to a new poit and the previous pit covered and decommissioned, which is only advisable if plenty of land area is available." (Compendium) Pumps might be needed depending on the configuration of the technology, in cases where pumps are needed a pumping truck can be used as well. Single Pits need to be emptied frequently, so that motorized emptying and transport can improve the performance stronely. NA	NA NA
	Performance, Categorical	FALSE	difficult full flat not flat clay silt sand	NA (clay = 0.25, silt = 0.5, sand = 1, gravel	"flooding". (Akanska Jain) "However, when the pit is full it can be a) pumped out and reused or b) the superstructure and squatting plate can be moved to a new pit and the previous pit covered and decommissioned, which is only advisable is plenty of land area is available." (Compendium) Pumps might be needed depending on the configuration of the technology, in cases where pumps are needed a pumping truck can be used as well. Single Pits need to be emptied frequently, so that motorized emptying and transport can improve the nerformance stronely. NA "As the single pit fills, two processes limit the rate of accumulation: leaching and degradation. Urine and water percolate into the soil through the bottom of the pit and wall, while microbial action degrades part of the organic fraction."	NA NA
	Performance, Categorical	FALSE	difficult full flat not flat clay silt sand gravel	NA (clay = 0.25, silt = 0.5, sand = 1, gravel	"Hoodine". (Akanska) alain 'Hoower, when the pit is full it can be a) pumped out and reused or b) the superstructure and squatting plate can be moved to a new pit and the previous pit covered and decommissioned, which is only advisable if plenty of land area is available." (Compendium) Pumps might be needed depending on the configuration of the technology, in cases where pumps are needed a pumping truck can be used as well. Single Pits need to be emptied frequently, so that motorized emptying and transport can improve the neef or accommission of the solid plate in the performance strongly. NA As the single pit fills, two processes limit the rate of accumulation: leaching and degradation. Urine and water percolate into the soil through the bottom of the pit and wall, while incribal action degrades part of the organic fraction."	NA NA
	Performance, Categorical	FALSE	difficult full flat not flat clay silt sand gravel	NA (clay = 0.25, silt = 0.5, sand = 1, gravel	"Hoodine". (Akanska) alain 'Hoower, when the pit is full it can be a) pumped out and reused or b) the superstructure and squatting plate can be moved to a new pit and the previous pit covered and decommissioned, which is only advisable if plenty of land area is available." (Compendium) Pumps might be needed depending on the configuration of the technology, in cases where pumps are needed a pumping truck can be used as well. Single Pits need to be emptied frequently, so that motorized emptying and transport can improve the netformance stronely. NA *as the single pit fills, two processes limit the rate of accumulation: leaching and degradation. Urine and water percolate into the soil through the bottom of the pit and wall, while incriball action degrades part of the organic fraction." (Compendium) They are not suited for rocky or compactede soils (that are difficult to dig), or for areas that flood	NA NA
	Performance, Categorical	FALSE	difficult full flat not flat clay silt sand gravel	NA (clay = 0.25, silt = 0.5, sand = 1, gravel	"Hoodine". (Akanska) alm! "However, when the pit is full it can be a) pumped out and reused or b) the superstructure and squatting plate can be moved to a new pit and the previous pit covered and decommissioned, which is only advisable if plenty of land area is available." (Compendium) Pumps might be needed depending on the configuration of the technology, in cases where pumps are needed a pumping truck can be used as well. Single Pits need to be emptied frequently, so that motorized emptying and transport can improve the operformance strongly. NA "As the single pit fills, two processes limit the rate of accumulation: leaching and degradation. Urine and water percolate into the soil through the bottom of the pit and wall, while microbial action degrades part of the organic fraction." (Compendium) They are not suited for rocky or compactede soils (that are difficult to dig), or for areas that flood frequently." (Compendium)	NA NA
soil_type	Performance, Categorical Performance, Categorical	FALSE	flat not flat clay silt sand gravel rock	NA (clay = 0.25, silt = 0.5, sand = 1, gravel = 0.5, rock = 0.25)	"Hoodine". (Akanska) alin! "However, when the pit is full it can be a) pumped out and reused or b) the superstructure and squatting plate can be moved to a new pit and the previous pit covered and decommissioned, which is only advisable if plenty of land area is available." (Compendium) Pumps might be needed depending on the configuration of the technology, in cases where pumps are needed a pumping truck can be used as well. Single Pits need to be emptied frequently, so that motorized emptying and transport can improve the performance strongly. NA "As the single pit fills, two processes limit the rate of accumulation: leaching and degradation. Urine and water percolate into the soil through the bottom of the pit and wall, while incriboilal action degrades part of the organic fraction." (Compendium) They are not suited for rocky or compactede soils (that are difficult to digl, or for areas that flood frequently." (Compendium) Soil percolation and filtration is desired resulting in lower desidading rates.	NA yes
	Performance, Categorical	FALSE	difficult full flat not flat clay silt sand gravel	NA (clay = 0.25, silt = 0.5, sand = 1, gravel	"Hoodine". (Akanska Jain") "Hoower, when the pit is full it can be a) pumped out and reused or b) the superstructure and suputing plate can be moved to a new put and the previous pit covered and decommissioned, which is only advisable if plenty of land area is available." (Compendium) Pumps might be needed depending on the configuration of the technology, in cases where pumps are needed a pumping truck can be used as well. Single Pits need to be emptied frequently, so that motorized emptying and transport can improve the nerformance stronely. NA "As the single pit fills, two processes limit the rate of accumulation: leaching and degradation. Urine and water percolate into the soll through the bottom of the pit and wall, while microbial action degrades part of the organic fraction." (Compendium) They are not suited for rocky or compactede soils (that are difficult to dig,) or for areas that flood frequently." (Compendium)	NA NA
soil_type	Performance, Categorical Performance, Categorical	FALSE	flat not flat clay silt sand gravel rock	NA (clay = 0.25, silt = 0.5, sand = 1, gravel = 0.5, rock = 0.25)	"Hoodine". (Akanska) alin! "Hoower, when the pit is full it can be a) pumped out and reused or b) the superstructure and suputing plate can be moved to a new poil and the previous pit covered and decommissioned, which is only advisable if plenty of land area is available." (Compendium) Pumps might be needed depending on the configuration of the technology, in cases where pumps are needed a pumping truck can be used as well. Single Pits need to be emptied frequently, so that motorized emptying and transport can improve the nerformance stronely. NA "As the single pit fills, two processes limit the rate of accumulation: leaching and degradation. Urine and water percolate into the soll through the bottom of the pit and wall, while microbial action degrades part of the organic fraction." (Compendium) They are not suited for rocky or compactede soils (that are difficult to dig, or for areas that flood frequently. "(Compendium) Soil percolation and filtration is desired resulting in lower desiudaine rates. "Leechate can contominate groundwater" (Compendium) When it is not possible to dig a deep pit or the	NA yes
soil_type	Performance, Categorical Performance, Categorical	FALSE	flat not flat clay silt sand gravel rock	NA (clay = 0.25, silt = 0.5, sand = 1, gravel = 0.5, rock = 0.25)	"Hoodine". (Akanska) alain 'Hoower, when the pit is full it can be a) pumped out and reused or b) the superstructure and squatting plate can be moved to a new pit and the previous pit covered and decommissioned, which is only advisable if plenty of land area is available." (Conpendium) Pumps might be needed depending on the configuration of the technology, In cases where pumps are needed a pumping truck can be used as well. Single Pits need to be emptied frequently, so that motorized emptying and transport can improve the performance strongly. NA As the single pit fills, two processes limit the rate of accumulation: leaching and degradation. Urine and water percolate into the soil through the bottom of the pit and wall, while microbial action degrades part of the organic fraction." (Conpendium) "They are not suited for rocky or compactede soils (that are difficult to dig), or for areas that flood frequently." (Compendium) "They are not suited for rocky or compactede soils (that are difficult to dig), or for areas that flood frequently." (Compendium) "They are not suited for for or areas that flood frequently." (Compendium) "They are not suited for for areas that flood frequently." (Compendium) "They are not suited for for areas that flood frequently." (Compendium) "They are not suited for locky or compactede soils (that are difficult to dig), or for areas that flood frequently." (Compendium) "They are not suited for journel pumper definition is desired resulting in lower desinduin rates. "Leachate can contaminate proundwater" (Compendium) "When it is not possible to dig a deep pit or the groundwater level is too high, a raised pit can be a	NA yes
soil_type	Performance, Categorical Performance, Categorical	FALSE	flat not flat clay silt sand gravel rock	NA (clay = 0.25, silt = 0.5, sand = 1, gravel = 0.5, rock = 0.25)	"Hooding". (Akanska) alain 'Hoower, when the pit is full it can be a) pumped out and reused or b) the superstructure and squatting plate can be moved to a new pot and the previous pit covered and decommissioned, which is only advisable if plenty of land area is available." (Compendium) Pumps might be needed depending on the configuration of the technology, in cases where pumps are needed a pumping truck can be used as well. Single Pits need to be emptied frequently, so that motorized emptying and transport can improve the neeformance strongly. NA As the single pit fills, two processes limit the rate of accumulation: leaching and degradation. Urine and water percolate into the soil through the bottom of the pit and wall, while unicrobial action degrades part of the organic fraction." (Compendium) "They are not suited for rocky or compactede soils that are difficult to dig), or for areas that flood frequently." (Compendium) "When it is not possible to dig a deep pit or the groundwater level is too high, a raised pit can be a viable alternative: the shallow pit can be extended by building the plut powards with the use of concrete	NA yes
soil_type	Performance, Categorical Performance, Categorical	FALSE	flat not flat clay silt sand gravel rock	NA (clay = 0.25, silt = 0.5, sand = 1, gravel = 0.5, rock = 0.25)	"Hoodine". (Akanska Jain") "Hoower, when the pit is full it can be a) pumped out and reused or b) the superstructure and sustained pate can be moved to a new poil and the previous pit covered and decommissioned, which is only advisable if plenty of land area is available." (Compendium) Pumps might be needed depending on the configuration of the technology, in cases where pumps are needed a pumping truck can be used as well. Single Pits need to be emptied frequently, so that motorized emptying and transport can improve the nerformance stronely. NA "As the single pit fills, two processes limit the rate of accumulation: leaching and degradation. Urine and water percolate into the soil through the bottom of the pit and wall, while microbial action degrades part of the organic fraction." (Compendium) "They are not suited for rocky or compactede soils (that are difficult to dig), or for areas that flood frequently." (Compendium) "These are not suited for rocky or compactede soils (that are difficult to dig), or for areas that flood frequently." (Compendium) "Hen it is not possible to dig a deep pit or the groundwater level is too high, a raised pit can be a visible alternative: the shallow pit can be extended by building the pit upwards with the use of concrete rings or blocks." (Compendium)	NA yes
soil_type	Performance, Categorical Performance, Categorical	FALSE	flat not flat clay silt sand gravel rock	NA (clay = 0.25, silt = 0.5, sand = 1, gravel = 0.5, rock = 0.25)	"Hooder". (Akanska Jain) "Hoower, when the pit is full it can be a) pumped out and reused or b) the superstructure and sustainting bate can be mowed to a new poil and the previous pit covered and decommissioned, which is only advisable in plenty of land area is available." (Compendium) Pumps might be needed depending on the configuration of the technology, in cases where pumps are needed a pumping truck can be used as well. Single Pits need to be emptided frequently, so that motorized emptying and transport can improve the performance strongly. NA "As the single pit fills, two processes limit the rate of accumulation: leaching and degradation. Urine and water percotate into the soil through the bottom of the pit and wall, while microbial action degrades part of the organic fraction." (Compendium) They are not suited for rocky or compactede soils (that are difficult to digl, or for areas that flood frequently." (Compendium) Soil percolation and filtration is desired resulting in lower desludding rates. "Leachate can contaminate groundwater" (Compendium) "When it is not possible to dig a deep pit or the groundwater level is too high, a raised pit can be a visible alternative the shallow pit can be extended by building the pit upwards with the use of concrete rings or blocks." (Compendium) "Typically, the pit is at least 3 m deep and 1 m in diameter." (Compendium)	NA yes
soil_type	Performance, Categorical Performance, Categorical	FALSE	flat not flat clay silt sand gravel rock	NA (clay = 0.25, silt = 0.5, sand = 1, gravel = 0.5, rock = 0.25)	"Hoodine". (Akanska) alain 'Hoower', when the pit is full it can be a) pumped out and reused or b) the superstructure and squatting plate can be moved to a new put and the previous pit covered and decommissioned, which is only advisable if plenty of land area is available." (Compendium) Pumps might be needed depending on the configuration of the technology, in cases where pumps are needed a pumping truck can be used as well. Single Pits need to be emptied frequently, so that motorized empting and transport can improve the nerformance stronely. *As the single pit fills, two processes limit the rate of accumulation: leaching and degradation. Ursine and water percolate into the soil through the bottom of the pit and wall, while microbial action degrades part of the organic fraction." (Compendium) They are not susted for rocky or compactede soils (that are difficult to dig), of or areas that flood frequently." (Compendium) "As the single pit fills, two processes limit the rate of accumulation and firstration is desired resulting in lower desludding rates." "L'eachate can contaminate groundwater" (Compendium) "When it is not possible to dig a deep pit or the groundwater level is to o high, a raised pit can be a viable alternative: the shallow pit can be be extended by building the pit upwards with the use of concrete rings or blocks." (Compendium) If the technology is constructed in areas with a high if the technology is constructed in areas with a high if the technology is constructed in areas with a high	NA yes
soil_type	Performance, Categorical Performance, Categorical	FALSE	flat not flat clay silt sand gravel rock	NA (clay = 0.25, silt = 0.5, sand = 1, gravel = 0.5, rock = 0.25)	"Hooder". (Akanska Jain) "Hoower, when the pit is full it can be a) pumped out and reused or b) the superstructure and sustainting bate can be mowed to a new poil and the previous pit covered and decommissioned, which is only advisable in plenty of land area is available." (Compendium) Pumps might be needed depending on the configuration of the technology, in cases where pumps are needed a pumping truck can be used as well. Single Pits need to be emptided frequently, so that motorized emptying and transport can improve the performance strongly. NA "As the single pit fills, two processes limit the rate of accumulation: leaching and degradation. Urine and water percotate into the soil through the bottom of the pit and wall, while microbial action degrades part of the organic fraction." (Compendium) They are not suited for rocky or compactede soils (that are difficult to digl, or for areas that flood frequently." (Compendium) Soil percolation and filtration is desired resulting in lower desludding rates. "Leachate can contaminate groundwater" (Compendium) "When it is not possible to dig a deep pit or the groundwater level is too high, a raised pit can be a visible alternative the shallow pit can be extended by building the pit upwards with the use of concrete rings or blocks." (Compendium) "Typically, the pit is at least 3 m deep and 1 m in diameter." (Compendium)	NA yes
soil_type	Performance, Categorical Performance, Categorical	FALSE	flat not flat clay silt sand gravel rock	NA (clay = 0.25, silt = 0.5, sand = 1, gravel = 0.5, rock = 0.25)	"Hoodine", Inkanskala Jaim 'Hoower', Men the pit is full it can be a) pumped out and reused or b) the superstructure and squatting plate can be mowed to a new pit and the previous pit covered and decommissioned, which is only advisable ip plenty of land area is available." (Compendium) Pumps might be needed depending on the configuration of the technology, in cases where pumps are needed a pumping truck can be used as well. Single Pits need to be emptide frequently, so that motorized emptying and transport can improve the nerformance stronely. NA "As the single pit fills, two processes limit the rate of accumulation: leaching and degradation. Urine and water percotate into the soil through the bottom of the pit and wall, while microbial action degrades part of the organic fraction." (Compendium) They are not suited for rocky or compactede soils (that are difficult to digl, or for areas that flood frequently." (Compendium) "When it is not possible to dig a deep pit or the groundwater level is to night, a rised pit can be a viable alternative: the shallow pit can be extended by building the pit upwards with the use of concrete rings or blocks." (Compendium) "Typically, the pit is at least 3 m deep and 1 m in diameter." (Compendium) "It he technology is constructed in areas with a high groundwater floomedum! If the technology is constructed in areas with a high groundwater level the risk for contamination is higher and some further design and effort is a fleed. It is assumed that a pit is at least 3 m deep	NA yes
soil_type	Performance, Categorical Performance, Categorical	FALSE	flat not flat clay silt sand gravel rock	NA (clay = 0.25, silt = 0.5, sand = 1, gravel = 0.5, rock = 0.25)	"Hooding". (Akanska) alin! "Hoower, when the pit is full it can be a) pumped out and reused or b) the superstructure and valuating plate can be moved to a new put and the previous pit covered and decommissioned, which is only advisable if plenty of land area is available." (Compendium) Pumps might be needed depending on the configuration of the technology, in cases where pumps are needed a pumping truck can be used as well. Single Pits need to be emptied frequently, so that motorized emptying and transport can improve the nerformance stronely. "As the single pit fills, two processes limit the rate of accumulation: leaching and degradation. Urine and water percotate into the soli through the bottom of the pit and wall, while microbial action degrades part of the organic fraction." (Compendium) "They are not susted for rocky or compactede soils (that are diffictut to dig), of or areas that flood frequently." (Compendium) "When it is not possible to dig a deep pit or the groundwater level is too high, a raised pit can be a visible alternative: the shallow pit can be extended by building the pit upwards with the use of concrete rings or blocks." (Compendium) If the technology is constructed in areas with a high groundwater level the the fish for contaminate provide in the provide or the providence of the pit upwards with the use of concrete rings or blocks." (Compendium) if the technology is constructed in areas with a high groundwater table the risk for contamination is higher and some further design and effort is.	NA yes

excavation	Performance, Categorical	TOUR	T	(easy = 1, hard = 0.5)	"The volume of the pit should be designed to	T	Ī
	remormance, categorical	INGE	easy hard	(easy = 1, hard = 0.5)	contain at least 1,000 L." (Compendium)	yes	
					"When it is not possible to dig a deep pit or the		
					groundwater level is too high, a raised pit can be a		
					viable alternative: the shallow pit can be extended by building the pit upwards with the use of concrete		
					rings or blocks. A raised pit can also be constructed		
					in an area where flooding is frequent in order to		
					keep water from flowing into the pit during heavy		
					rain. Another variation is the unlined shallow pit that may be appropriate for areas where digging is		
					difficult." (Compendium)		
					Excavation for a bigger volume needed. If		
					excavation is not possible other solutions are an		
surface_area_onsite	Performance, Trapez	TRUE	[m2/plot]	(a = 1, b = 1, c = 999, d = 999)	ontion. But these lead to further design and effort. "Typically, the pit is at least 3 m deep and 1 m in		
***************************************				(- 4,5 4,5 556,5 556,	diameter. If the pit diameter exceeds 1.5 m, there is		
					an increased risk of collapse." (Compendium). Based		
					on this, we derive a minimum space requirement of		
					1m2/plot for a single pit (Eawag, 2021). Note that this only involves the pit and not any visual		
					protection. A superstructure could require more		
					space.		
surface_area_offsite	Performance, Trapez	FALSE	m2/pers	NA NA	NA NA	NA NA	
0		FALSE		NA NA	NA NA	NA NA	
0	0	FALSE		NA NA	NA	NA	
drinking_water_exposure	Performance, Categorical	TRUE	Close	(close = 0, not close = 1)	"Leachate can contaminate groundwater"	yes	
			Not close		(Compendium) "A minimum horizontal distance of 30m between a		
					pit and a water source [] is normally		
					recommended to limit exposure to microbial		
					contamination." (Compendium)		
					Technology must not be exposed to a drinking water source.		
0		FALSE		NA NA	NA	NA	
0		FALSE		NA Constitute O.S. stilled A	NA	NA	
construction_skills	Performance, Categorical	INUL	Ladder: unskilled	(unskilled = 0.5, skilled = 1, professional = 1)	"Can be built and repaired with locally available materials" (Compendium)	yes	
			skilled	p. arcamonar = 1)	Even though high design skills are recommended,		
			professional		moderate or even low construction skills should be		
					sufficient. The only case where moderate		
					construction skills are necessary needed is to install technical components such as a pump. But there are		
					lots of configurations without technical components.		
design_skills	Performance, Categorical	TRUE	Ladder:	(unskilled = 0, skilled = 1, professional	"If the pit is to be reused, it should be lined. Pit	yes	
			unskilled skilled	= 1)	lining materials can include brick, rot-resistant timber, concrete, stones, or mortar plastered onto		
			professional		the soil. If the soil is stable (i.e., no presence of sand		
					or gravel deposits or loose organic materials), the		
					whole pit need not be lined. The bottom of the pit		
					should remain unlined to allow for the infiltration of		
					liquids out of the pit. As liquid leaches from the pit and migrates through the unsaturated soil matrix,		
					pathogenic germs are absorbed to the soil surface.		
					In this way, pathogens can be removed prior to		
					contact with groundwater. The degree of removal		
					varies with soil type, distance travelled, moisture		
					and other environmental factors and, thus, it is difficult to estimate the distance necessary between		
					a pit and a water source. A minimum horizontal		
					distance of 30 m is normally recommended to limit		
					exposure to microbial contamination. (Compendium)		
					Lots of things to take in account and different		
					configurations possible depending on the circumstances. High design skills recommended,		
					moderate design skills could be sufficient for simple		
					variations.		
om_skills	Performance, Categorical	TRUE	Ladder:	(unskilled = 0.5, skilled = 1,	"There is no daily maintenance associated with a		
om_skiiis	Performance, Categorical	TRUE	Unskilled	professional = 1)	single pit apart from keeping the facility clean.	yes	
			Skilled	professional = 1)	However, when the pit is full it can be a) pumped		
			Professional		out and reused or b) the superstructure and		
					squatting plate can be moved to a new pit and the		
					previous pit covered and decommissioned, which is only advisable if plenty of land area is available."		
					(Compendium)		
					Pumps might be needed depending on the		
					configuration of the technology. In cases where		
					pumps are needed a pumping truck can be used as		
					well. If there are no technical components such as pumps low OM skills should be sufficient.		
0	0	FALSE	(NA NA	NA	NA	
0		FALSE		NA NA	NA	NA	
0		FALSE FALSE		NA NA	NA NA	NA NA	
cleansing_method	Performance, Categorical		Washers	NA NA	NA NA	NA NA	
	and a second second		Soft wipers				
			Hard wipers				
0		FALSE		NA NA	NA NA	NA NA	
0 lifetime	Performance, Categorical	FALSE TRUE	short (< 1 year)	(short = 1, medium = 0.5, long = 0)	NA "Expected lifetime: 1-3 yrs", "Short lifetime (can be	NA yes	
			medium (1-5 years)		<1 year)", "New land required for each new latrine		
			long (>5 years)		after one fills up" (BCG, 2014) for pit latrines in		
speed_implement_toilet	PDF, Categorical	TRUE	rapid (< 3 days)	(rapid = 1, moderate = 0, slow = 0)	refugee camps. "Single Pit Latrines can be constructed quickly with	ves	
speca_implement_tollet	r Di , Categorical		moderate (3 days to 2 weeks)		local materials during the acute phase of an	,	
			slow (> 2 weeks)		emergency." "minimal materials and minimal skills		
					for construction are needed."(Emersan		
	PDF, Categorical	FALSE	rapid (few days to a week)	NA	Compendium) NA	NA	
speed implement treatment	r Di , Categorical		moderate (few weeks up to three				
speed_implement_treatment		İ	months)				
speed_implement_treatment			slow (> 3 months)	(annu = 1 diff = it = 1)	Helicals Distriction		
		TRUE		(easy = 1, difficult = 1)	"Single Pit Latrines can be constructed quickly with	yes	
speed_implement_treatment	Performance, Categorical	TRUE	easy				
	Performance, Categorical	TRUE	difficult		local materials during the acute phase of an		
	Performance, Categorical	TRUE					
scalability			difficult		local materials during the acute phase of an emergency.", (Emersan) "It can be replicated quickly and implemented at scale given sufficient space." (Single VIP - Emersan)		
	Performance, Categorical PDF, Categorical		difficult	(simple = 1, technical = 0, special = 0)	local materials during the acute phase of an emergency.", (Emersan) "It can be replicated quickly and implemented at scale given sufficient space." (Single VIP - Emersan) "Can be built and repaired with locally available	yes	
scalability			difficult simple technical		local materials during the acute phase of an emergency.", (Emersan) "It can be replicated quickly and implemented at scale given sufficient space." (Single VIP - Emersan)	yes	
scalability construction_parts		TRUE	difficult		local materials during the acute phase of an emergency," (Emersan) "It can be replicated quickly and implemented at scale given sufficient space," (Single VIP - Emersan) "Can be built and repaired with locally available materials" (Compendium)	yes	
scalability construction_parts Transfer Coefficients s	PDF, Categorical Specifical Technologies, Tr., distabase, 2021	TRUE	difficult simple technical	(simple = 1, technical = 0, special = 0) Soilloss	local materials during the acute phase of an emergency. "Emersan) "It can be replicated quickly and implemented at scale given sufficient space." (Single VIP - Emersan) "Can be built and repaired with locally available materials" (Compendium) Waterloss	Comments	Reference
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Is frequent in order to keep water from flowing into the pit during heavy rain." (Compendium) All technologies where raised configurations are possible get a 50% performance for category "flooding". All technologies where raised configurations are possible get a 50% performance for category "flooding". Alanichia Jain) The only design differente to a Single plant of the province of the pit of the pit of the pit of the pit of the pit of the pit of the province of th						"[] A raised pit can also be		
rain." (Compendium) All technologies where raised configurations are possible get a 50% performance for category "flooding". (Akanskha Jain) Wehicular_acces Performance, Categorical TRUE no access difficult full (no access = 0.3, difficult = 0.6, full = 1). The only design difference to a Single Pit Latrine is the ventilation." (Emersan) "However, when the pit is full it can be a) pumped out and reused or b) the superstructure and squatting plate can be moved to a new pit and the previous pit covered and decommissioned, which is only advisable in flenty of land are as a wailable." (Compendium > 5.2 Single Pit) Pumps might be needed depending on the configuration of the technology. In cases where pumps are needed a pumping truck can be used as well. Single Pits need to be emptiled frequently, so that motorized emptying and transport can improve the performance strongly		i .						
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superstructure and squarting plate can be moved to a new pit and the previous pit covered and decommissioned, which is only advisable if pienty of land area is available. "(Compendium -> 5.2 Single Pit) Pumps might be needed depending on the configuration of the technology. In cases where pumps are needed a pumping truck can be used as well. Single Pits need to be emptied frequently, so that motorized empty, so that motorized emptying and transport can improve the performance strongly	vehicular_acces	Performance, Categorical	TRUE	difficult	(no access = 0.3, difficult = 0.6, full = 1)	All technologies where raised configurations are possible get a 50% performance for category "flooding". (Akanksha Jain) "The only design difference to a Single Pit Latrine is the ventilation." (Emersan)	yes	
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advisable if plenty of land area is available." (Compendium -> S.2 Single Pt) Pumps might be needed ended ehicular_acces	Performance, Categorical	TRUE	difficult	(no access = 0.3, difficult = 0.6, full = 1)	All technologies where raised configurations are possible get a 50% performance for category "flooding". (Akanksha Jain) "The only design difference to a Single PL Latrine is the ventilation." (Emersan) "However, when the pit is full it can be a) pumped out and reused or b) the superstructure and squatting plate can be moved to a new pit and the moved to a new pit and the moved to a new pit and the	yes		
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cases where pumps are needed a pumping truck can be used as well. Single Pits need to be emptied frequently, so that motorized emptying and transport can improve the performance strongly	vehicular_acces	Performance, Categorical	TRUE	difficult	(no access = 0.3, difficult = 0.6, full = 1)	All technologies where raised configurations are possible get a 50% performance for category "flooding". (Akanksha Jain) "The only design difference to a Single Pit Latrine is the ventilation." (Emersan) "However, when the pit is full it can be a pumped out and reused or b) the superstructure and squatting plate can be moved to a new pit and the previous pit covered and decommissioned, which is only advisable if plenty of land area is available." (Compendium > 5.2 Single Pit)	yes	
Single Pits need to be emptied frequently, so that motorized emptying and transport can improve the performance strongly	vehicular_acces	Performance, Categorical	TRUE	difficult	(no access = 0.3, difficult = 0.6, full = 1)	All technologies where raised configurations are possible get a 50% performance for category "flooding". (Akanksha Jain) "The only design difference to a Single Pit Latrine is the ventilation." (Emersan) "However, when the pit is full it can be a pumped out and reused or b) the superstructure and squatting plate can be moved to a new pit and the previous pit covered and decommissioned, which is only advisable if plenty of land area is available." (Compendium > 5.2.5 single Pit) Pumps might be needed depending on the configuration of the technology. In	yes	
frequently, so that motorized emptying and transport can improve the performance strongly	vehicular_acces	Performance, Categorical	TRUE	difficult	(no access = 0.3, difficult = 0.6, full = 1)	All technologies where raised configurations are possible get a 50% performance for category "flooding". (Akanksha Jain) "The only design difference to a Single Pit Latrine is the ventilation." (Emersan) "Hoowever, when the pit is full it can be a) pumped out and reused or b) the superstructure and squatting plate can be moved to a new pit and the previous pit covered and decommissioned, which is only advisable if plenty of land area is available." (Compendium -> S.2 Single Pl) Pumps might be needed depending on the configuration of the technology. In cases where pumps are needed a	yes	
the performance strongly	vehicular_acces	Performance, Categorical	TRUE	difficult	(no access = 0.3, difficult = 0.6, full = 1)	All technologies where raised configurations are possible get a 50% performance for category "flooding". (Akanksha Jain) "The only design difference to a Single Pit Latrine is the ventilation." (Emersan) "However, when the pit is full it can be a) pumped out and reused or b) the superstructure and squarting plate can be moved to a new pit and the previous pit covered and decommissioned, which is only advisable if plenty of land area is available." (Compendium -> 5.2 Single Pit) Pumps might be needed depending on the configuration of the technology. In cases where pumps are needed a pumping truck can be used as well.	yes	
	vehicular_acces	Performance, Categorical	TRUE	difficult	(no access = 0.3, difficult = 0.6, full = 1)	All technologies where raised configurations are possible get a 50% performance for category "flooding". (Akankha Jain) "The only design difference to a Single Pit Latrine is the ventilation." (Emersan) "However, when the pit is full it can be a) pumped out and reused or b) the superstructure and squatting plate can be mowed to a new pit and the previous pit covered and decommissioned, which is only advisable if plenty of land area is available." (Compendium > 5.2 Single Pit) Pumps might be needed depending on the configuration of the technology. In cases where pumps are needed a pumping truck can be used as well. Single Pits need to be empited frequently, so that motorized	yes	
slope Performance, Categorical FALSE flat NA NA NA	vehicular_acces	Performance, Categorical	TRUE	difficult	(no access = 0.3, difficult = 0.6, full = 1)	All technologies where raised configurations are possible get a 50% performance for category "flooding". (Akanksha Jain) "The only design difference to a Single Pit Latrine is the ventilation." (Emersan) "Hoower, when the pit is full it can be a pumped out and reused or b) the superstructure and squatting plate can be moved to a new pit and the previous pit covered and decommissioned, which is only advisable if plenty of land area is available." (Compendium > 5.2.5 Ingle Pits needed depending on the configuration of the technology, in cases where pumps are needed a pumping truck can be used as well. Single Pits need to be emptied frequently, so that motorized emptying and transport can improve	yes	
				difficult full		All technologies where raised configurations are possible get a 50% performance for category "flooding". (Akanksha Jain) "The only design difference to a Single Pit Latrine is the ventilation." (Emersan) "However, when the pit is full it can be a pumped out and reused or b) the superstructure and squatting plate can be moved to a new pit and the previous pit covered and decommissioned, which is only advisable if plenty of land area is available." (Compendium - S.Z. Single Pit) Pumps might be needed depending on the configuration of the technology, in cases where pumps are needed a pumpling truck can be used as well. Single Pits need to be emptied frequently, so that motorized emptying and transport can improve the performance strongly		

				T.	To	
soil_type	Performance, Categorical		clay silt sand gravel rock	(clay = 0.25, silt = 0.5, sand = 1, gravel = 0.5, rock = 0.25)	"The only design difference to a Single PIL tatrine is the ventilation." [Emersan] "As the single pit fills, two processes limit the rate of accumulation: leaching and degradation. Urine and water percolate into the soil through the bottom of the pit and wall, while microbial action degrades part of the organic fraction." (Compendium -> 5.2 Single Pit) "They are not suited for rocky or compactede soils (that are difficult to dig), or for areas that flood frequently." (Compendium os Silp percolation and filtration is desired resulting in lower desludging rates.	yes
groundwater_depth	Performance, Trapez		water depth [m]	(a = 6, b = 9, c = 999, d = 999)	"Leachate can contaminate groundwater" (Compendium) "When it is not possible to dig a deep pit or the groundwater level is too high, a raised pit can be a viable alternative: the shallow pit can be extended by building the pit upwards with the use of concrete rings or blocks." (Compendium) "Typically, the pit is at least 3 m deep and 1 m in diameter." (Compendium) if the technology is constructed in areas with a high groundwater table the risk for contamination is higher and some further design and effort is eneeded. It is assumed that a pit is at least 3 m deep and optimally 6 m deep. A vertical safety distance of 3 meters is applied.	yes
excavation	Performance, Categorical		easy hard	(easy = 1, hard = 0.5)	"The volume of the pit should be designed to contain at least 1,000 L." (Compendium) "When it is not possible to dig a deep pit or the groundwater level is too high, a raised pit can be a viable alternative: the shallow pit can be a viable alternative: the shallow pit can be a viable attended by building the pit upwards with the use of concrete rings or blocks. A raised pit can also be constructed in an area where flooding is frequent in order to keep water from flowing into the pit during heavy rain. Another variation is the unlined shallow pit that may be appropriate for areas where digging is difficult." (Compendium) Excavation for a bigger volume needed. If excavation for not possible other solutions are an option. But these lead to further design and effort.	yes
surface_area_onsite	Performance, Trapez	TRUE	[m2/plot]	(a = 1, b = 1, c = 999, d = 999)	Based on a comparison of different technologies, we derive the space requirements of a single VIP to be very similar to a single pit (as the excreta is also ends up in a chamber below the user) and use the same minimum space requirement of 1mz/plot (Eawag, 2021). Note that this does not involve any visual protection. A superstructure could require more	
surface_area_offsite	Performance, Trapez		m2/pers	NA	space. NA	NA
0		FALSE FALSE		NA NA	NA NA	NA NA
0	0	FALSE	0	NA	NA	NA
drinking_water_exposure	Performance, Categorical	FALSE	Close Not close	(close = 0, not close = 1)	"Leachate can contaminate groundwater" (Compendium) "A minimum horizontal distance of 30m between a pit and a water source [] is normally recommended to limit exposure to microbial contamination." (Compendium) Technology must not be exposed to a drinking water source.	yes
0	0	FALSE	0	NA	NA	NA
construction_skills	Performance, Categorical		Ladder: unskilled skilled professional	(unskilled = 0, skilled = 1, professional = 1)	"Can be built and repaired with locally available materials" (Compendium) Even though high design skills are recommended, moderate or even low construction skills should be sufficient. The only case where moderate construction skills are necessary needed is to install technical components such as a pump. But there are lots of configurations without technical components.	yes
design_skills	Performance, Categorical		Ladder: uskilled skilled professional	(unskilled = 0, skilled = 0.5, professional = 1)	"The only design difference to a Single Pit Latrine is the ventilation." [Emersan] "The vent pipe should have an internal diameter of at least 110 mm and reach more than 300 mm above the highest point of the toilet superstructure. [] Care should be taken that objects, such as trees or houses, do not interfere with the air stream. The vent works best in windy areas, but where there is little wind, its effectiveness can be improved by painting the pipe black. [] The mesh size of the fly screen must be large enough to prevent clogging with dust and allow air to circulate freely. Aluminium screens, with a hole-size of 12 to 1.5 mm, have proven to be the most effective. [] As liquid leaches from the pit and migrates through the unsaturated soil matrix, pathogenic germs are sorbed to the soil surface. In this way, pathogens can be removed prior to contact with groundwater. The degree of removal	yes

om_skills	Performance, Categorical	TRUE	Ladder:	(unskilled = 0, skilled = 1, professional	"To keep the single VIP free of flies	yes	
			Unskilled	= 1)	and odours, regular cleaning and	,	
			Skilled	- 1)	maintenance is required. Dead flies,		
			Professional		spider webs, dust and other debris		
					should be removed from the		
					ventilation screen to ensure a good		
					flow of air." (Compendium). "The		
					latrine should be cleaned with		
					disinfectant, emptying should		
					preferably be carried out by a		
					professional." (Monvois et al> A02		
					Ventilated Improved Pit Latrine (VIP))		
					ventilated improved the Editine (viii))		
_							
0		FALSE		NA	NA	NA	
0	0	FALSE	0	NA NA	NA	NA	
0	0	FALSE	0	NA	NA	NA	
0		FALSE			NA .	NA .	
cleansing_method	Performance, Categorical	FALSE	Washers	NA	NA	NA	
			Soft wipers				
			Hard wipers				
0	•	FALSE		NA NA	NA	NA	1
0		FALSE		NA NA	NA	NA	
lifetime	Performance, Categorical	TRUE	short (< 1 year)	(short = 1, medium = 0.5, long = 0)	"Expected lifetime: 1-3 yrs", "Short	yes	
			medium (1-5 years)		lifetime (can be <1 year)", "New land		
			long (>5 years)	I	required for each new latrine after	1	
			ione (- 2 years)				
					one fills up" (BCG, 2014) for pit		
					latrines in refugee camps.	1	
speed_implement_toilet	PDF, Categorical	TRUE	rapid (< 3 days)	(rapid = 0.9, moderate = 0.1, slow = 0)	"can be considered a viable solution	yes	
			moderate (3 days to 2 weeks)		in all phases of an emergency.""The		
			slow (> 2 weeks)		only design difference to a Single Pit		
			SIOW (> 2 WEEKS)				
					Latrine is the ventilation." (Emersan		
					Compendium)		
					A slightly lower value is allotted to the		
					category "Rapid" (90%) than a Single		
					Pit Latrine as the complexity of		
					construction if slightly higher owing to		
					the ventilation system that needs to		
					be established.		
					oc established.		
speed_implement_treatment	PDF, Categorical	FALSE	rapid (few days to a week)	NA	NA	NA	
			moderate (few weeks up to three				
			months)				
			slow (> 3 months)				
scalability	Performance, Categorical	TRUE	easy	(easy = 1, difficult = 1)	"It can be replicated quickly and	yes	
scalability	renormance, categorical	INGL		(casy = 1, ullilcuit = 1)		yes	
			difficult		implemented at scale given sufficient		
					space." (Emersan)		
construction_parts	PDF, Categorical	TRUE	simple	(simple = 1, technical = 0, special = 0)	"Can be built and repaired with locally	yes	
			technical		available materials" (Compendium)		
ransfer Coefficients	(copied from "Sanitation_Technologies_TC_database_202	10622 vism")	1	1		1	·
			1	1	I	1-	
		Range	Airloss	Soilloss	Waterloss	Comments	Reference
TP	0.29	0,18 - 0,4	O.	0.71	4	* as P	Montangero and Belevi (2007)
med (R)	0.29	(0.18 - 0.4)	0	0.71	l c		-
- L		[0.22]					PA
- A	242					* ac N	
TN	0.18) * as N	Montangero and Belevi (2007)
ļ	0.18) * as N	Jacks et al. (1999)
	0.2		0.6			* TC Soilloss: N reaching the groundwater	Nyenje et al. (2013)
med (R)	0.18	0,09-0,27	0.55	0.27	7		-
k	25	[0.18]					PA
H2O	0.15		0.15	0.7	7	*PA; high variability depending on soil	PA
1120	0.13	0.03 - 0.3	0.13	1	1	permeability	
	0.15	(0.05 - 0.3)	0.15	0.70		permeability	
med (R)	0.15			0.70	,	,	
k	5	[0.25]					PA
TS	0.6	0.5 - 0.7	0	0.4	1	*TSS retainment range: 0.7-0.9	Montangero and Belevi (2007)
						(Assumption for TS: 0.5 - 0.7)	
13							
	0.60	0.5 - 0.7	0	0.40			
med (R)	0.60			0.40			- ΡΔ
	0.60 5	0.5 - 0.7 [0.2]		0.40	-		PA Spuhler et al. (2021)

Additional Information
Copied from "single_pit". It is assumed, that both the technologies carry the same transfer coefficients, as the reference of "Jacks et al. (1999)" already deals with ventilated improved pits.

References

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Montangero, A. and H. Belevi (2001). "Assessing universit how in septic tanks by eliciting expert judgement: a promising method in the context of developing countries." Water Res 4(15): 1052-1064.

Spuller, D., & Roller, L. (2003). "Nutrient pollution in shallow aquifers underlying it latrines and donestic solid waste dumps in urban slums." Journal of Environmental Management 122: 15–24.

Montangero, A. and H. Belevi (2007). "Assessing nutrient flows in septic tanks by eliciting expert judgement: a promising method in the context of developing countries." Water Res 4(15): 1052-1064.

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Group, T. B. C. (2014). "Improving sharitation in Befugee Camps." Unline Advisors High Commissioner for Refugees (UNHCR), The Unline Appeal Response (DNHCR), The Unline Appeal Response Constitute of Aquatic Science and Technology (EAWAG).

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Double Ventilated Improved	Dit					
neral Information	Values	Data Source	1			
FUNCTIONAL GROUP UNIQUE IDENTIFIER (ID		-	-			
DATA COMPILER	Matthias van Sloten	-	1			
INPUT PRODUCT OUTPUT PRODUCT	faeces, excreta	Tilley, E. et al. (2014) Tilley, E. et al. (2014)	-			
RELATIONS	Input: OR	Tilley, E. et al. (2014)	1			
	Output: NA		-			
COMMENTS re-Filter Criteria	Values	Data Source				
	(household = 1, neighbourhood = 0.5,	Tilley, E. et al. (2014)				
management level	city = 0) (household = 1, shared = 1, public =	Tilley, E. et al. (2014)				
management_iever	(10useriolu = 1, silareu = 1, public = 0.5)	Tilley, E. et al. (2014)				
capex_req_level	6	Spuhler, D. et al. (2021)				
opex_req_level technical_maturity	3	Spuhler, D. et al. (2021) Tilley, E. et al. (2014)				
	(acute = 0, stabilisation = 1,	Gensch, R. et al. (2018)				
creening Criteria	development/recovery = 1) Type and Function	Applicable for this Functional Group?	Catagories [Linit]	Technology Values (Data)	Data Source / Assumptions	Internal Review Done?
water_supply	Performance, Categorical			NA NA	NA	NA
water_volume	Performance, Trapez	INCE	[L/cap/day]	(a = 0, b = 0, c = 8, d = 33)	"The double VIP has almost the same design as the Single VIP (S.3) with the added advantage of a second pit []." (Compendium) "The only design difference to a Single Pit Latrine is the ventilation." (Emersan -> S.4 Single Ventilated Improved Pit (VIP)) "Large quantities of water should not be poured down the toilet (from the shower, etc.). Water can, however, be used for anal cleansing." (Monvois et al> A01 Simple Univentilated Pit Latrine) No additional water needed but a high water consumption should be prevented. - Minimal volume: can be used without flushing water (a,b = 0) - Maximal volume: can be used with pour-flush toilet (1.3 Juxe) and anal cleansing water (0.3-3 Juxe)	Yes
electricity_supply	Performance, Categorical	I TRUE	electricity intermittent	(electricity = 1, intermittent = 1, no electricity = 1)	assuming 6 visits ner nersons ner dav No electricity needed.	yes
fuel_supply	Performance, Categorical	I FALSE	no electricity	NA .	NA .	NA .
			no fuel			
frequency_of_om	PDF, Categorical	TRUE	irregular regular continuous	(irregular = 0.5, regular = 0.5, continous = 0)	To keep the double VIP free of files and odours, regular cleaning and maintenance is required. Dead files, spider webs, dust and other debris should be removed from the ventilation screen to ensure a good from of air. The should be well sealed to reduce water infiltration and a proper alternating schedule must be maintained. (Compendium) Maintenance is between regular and irregular.	yes
pipe_supply	Performance, Categorical	TRUE		(no pipes = 1, difficultly available = 1, pipes = 1)	No pipes needed.	yes
pump_supply	Performance, Categorical	TRUE	no pumps difficultly available pumps	(no pumps = 1, difficultly available = 1, pumps = 1)	"After the resting time, the soil-like material is manually emptied (it is dug out, not pumped out), so vacuum truck access to the pits is not necessary." (Compendium)	yes
concrete_supply	Performance, Categorical	TRUE	no concrete difficultly available concrete	(no concrete = 1, difficultly available = 1, concrete = 1)	No <u>numps</u> needed. "Can be built and repaired with locally available materials" (Compendium) "Pit Ilning materials can include brick, rotresistant timber, bamboo, concrete, stones, or mortar plastered onto the soil." (EmersanCompendium) But concrete is not specifically needed.	yes
spare_parts	PDF, Categorical	I TRUE	simple	(simple = 1, technical = 0. special = 0)	"Can be built and repaired with locally available	yes
			technical		materials" (Compendium)	
0		FALSE		NA	NA NA	NA
0		FALSE FALSE		NA NA	NA NA	NA NA
temperature			very cold cold temperate warm hot		A double VIP can be built in colder climates but there has to be taken in account that leachate respectively soil absorbtion performance can be lower if the bottom of the pit is frozen.	yes
flooding	Performance, Categorical	TRUE	not flooding no flooding	(flooding = 0.5, no flooding = 1)	"Pits are susceptible to failure and/or overflowing during floods." (Compendium) "] A raised pit can also be constructed in an area where flooding is frequent in order to keep water from flowing into the pit during heavy rain." (Compendium) All technologies where raised configurations are possible get a 50% performance for category "flooding". (Akanksha Jain)	Yes
vehicular_acces	Performance, Categorical	TRUE		(no access = 0.8, difficult = 0.8, full = 1)	"After the resting time, the soil-like material is manually emptied (it is dug out, not pumped out), so vacuum truck access to the pits is not necessary." (Compendium) The emptying and transport is slightly improved by motorized transport as the dug-out material can be transported transport as the dug-out material can be transported more efficiently.	yes
slope soil_type	Performance, Categorical Performance, Categorical			NA (clay = 0.25, silt = 0.5, sand = 1, gravel = 0.5, rock = 0.25)	NA. The double VIP has almost the same design as the Single VIP (S.3) with the added advantage of a second pit []. (Compendium) The only design difference to a Single PIt Latrine is the ventilation." (Emersan - S.4 Single Ventilated Improved PIt (VIII), two processes limit the rate of accumulation: leaching and degradation. Urine and water percolate into the soil through the bottom of the organic fraction." (Compendium -> S.2 Single Pit) They are not susted for rocky or compacted exists.	NA yes

groundwater_depth	Performance, Trapez	TRUE	water depth [m]	(a = 6, b = 9, c = 999, d = 999)	"Leachate can contaminate groundwater" (Compendium) The double VIP has almost the same design as the Single VIP (S.3) with the added advantage of a second pit []." (Compendium) "When it is not possible to dig a deep pit or the groundwater level is too high, a raised pit can be a viable alternative: the shallow pit can be extended by building the pit upwards with the use of concreter rings or blocks." (Compendium) > 5.3 Single VIP) "Typically, the pit is at least 3 m deep and 1 m in diameter." (Compendium) if the technology is constructed in areas with a high groundwater table the risk for contamination is higher	yes
excavation	Performance, Categorical	TOLIC	easy	(easy = 1, hard = 0.5)	and some further design and effort is needed. It is assumed that a pit is at least 3 m deep and optimally 6 m deep. A vertical safety distance of 3 meters is applied. "The double VIP has almost the same design as the	yes
EAL VALUE	renominae, categoria		hard	(ess) = 1, init = 0.3)	Single VIP (5.3) with the added advantage of a second pit []." (Compendium) The volume of the pit should be designed to contain at least 1,000 L." (Compendium) ~ 5.3 Single VIP) "When It is not possible to dig a deep pit or the groundwater level is too high, a raised pit can be a viable alternative: the shallow pit can be extended by building the pit upwards with the use of concrete rings or blocks. A raised pit can also be constructed in an area where flooding is frequent in order to keep water from flowing into the pit during heavy rain. Another variation is the unlined shallow pit that may be appropriate for areas where digging is difficult." (Compendium > 5.3 Single VIP) Excavation for a bigger volume needed. If excavation is not possible other solutions are an option. But these	yes .
surface_area_onsite	Performance, Trapez		[m2/plot]	(a = 2, b = 2, c = 999, d = 999)	Based on a comparison of different technologies, we derive the space requirements of a double IVP to be (at least) twice the space of the space requirements of a single pit. This is based on the assumption that the excrete and su pit two alternating chambers below the user, instead of just one chamber. There are no further significant differences in terms of space requirements between a single pit and a double VIP and therefore, using twice the space [2m.Zpiot] is justified [Eawag, 2021]. Note that this does not involve any visual protection. A superstructure could require more space.	
surface_area_offsite	Performance, Trapez	FALSE FALSE	m2/pers	NA NA		NA NA
0		FALSE) NA		NA .
0 drinking_water_exposure	0 Performance, Categorical	FALSE	Close	NA (close = 0, not close = 1)	NA "Leachate can contaminate groundwater"	NA
0		FALSE FALSE		NA NA		NA NA
construction_skills	Performance, Categorical	TRUE	Ladder: umskilled skilled professional	(unskilled = 0, skilled = 1, professional = 1)	"Can be built and repaired with locally available materials" (Compendium) Even though high design skills are recommended, moderate or even low construction skills should be sufficient. The only case where moderate construction skills are necessary needed is to install technical components such as a pump. But there are lots of configurations without technical components.	yes
design_skills	Performance, Categorical	TRUE	Ladder: umskilled skilled professional	(unskilled = 0, skilled = 0.5, professional = 1)	The double VIP has almost the same design as the Single VIP (S.3) with the added advantage of a second pit ()." (Compendium) The superstructure may either extend over both holes or it may be designed to move from one pit to the other. In either case, the pit that is not being filled should be fully covered and sealed to prevent water, garbage and animals, or people from falling into the pit. The ventilation of the two pits can be accomplished using one ventilation pipe moved back and forth between the pits, or each pit can be equipped with its own dedicated pipe. The two pits in the double VIP are continually used and should be well lined and supported to ensure longevity." (Compendium) Lots of things to take in account and different configurations possible depending on the circumstances. Kighl design skills recommended, moderate design skills could be sufficient for simple configurations.	yes
om_skills		FALSE		(unskilled = 0, skilled = 1, professional = 1)	To keep the single VIP free of flies and odours, regular cleaning and maintenance is required. Dead flies, spider webs, dust and other debris should be removed from the ventilation screen to ensure a good flow of air." (Compendium) The double VIP has almost the same design as the Single VIP (S.3) with the added advantage of a second pit [.]." (Compendium) "the latrine should be cleaned with disinfectant, emptying should preferably be carried out by a professional." (Monvois et al. – AO2 Ventilated Improved Pit Latrine (VIPI)	NA .
0	0	FALSE FALSE		NA NA		NA NA
0	0	FALSE	(NA NA	NA	NA
cleansing_method	Performance, Categorical	FALSE	Washers Soft wipers Hard wipers	NA NA	NA NA	NA NA
0	0	FALSE		NA NA	NA	NA
lifetime	Performance, Categorical		short (<1 year) medium (1-5 years) long (>5 years)	(short = 1, medium = 1, long = 1)	"Pits designed to last 25 to 30 years are not uncommon and a design life of 15 to 20 years is perfectly reasonable. The longer a pit lasts, the lower will be the average annual economic cost and the greater the social benefits from the original input (WHO 1992)." (Double Pits SWM Toolbox)	

speed_implement_toilet	PDF, Categorical	TRUE	rapid (< 3 days)	(rapid = 0.8, moderate = 0.2, slow = 0)	A slightly lower value is allotted to the category	yes	
			moderate (3 days to 2 weeks)		"Rapid" (80%) than a Single VIP as the complexity of		
			slow (> 2 weeks)		construction if slightly higher, owing to the		
					implementation of ventilation system + double pits		
					(double the efforts and consequently time). (Akanksha		
					Jain, Eawag 2021)		
					"Twin pit systems include double Ventilated Improved		
					Pits (VIP), and the fossa alterna (FA)." (Twin pit		
					systems- Emersan Compendium)		
					Same values are allotted to both Fossa Alterna and		
					Double VIPs because of the text above.		
					Orb :		
					Other important text from Emersan Compendium that		
					bear some relevance for this technology and criteria:		
					"The slab can be fabricated on-site		
					with a mould and cement. In the acute emergency		
					phase, pre-fabricated plastic slabs may be used." "As		
					the second pit only comes into operation when the first		
					pit is full, which may take between 6 to 24 months,		
					Twin Pit Dry Systems are recommended as longer-term		
					solutions in prolonged emergency situations."		
eed_implement_treatment	PDF, Categorical	FALSE	rapid (few days to a week)	NA	NA	NA	
			moderate (few weeks up to three				
			months)				
			slow (> 3 months)				
scalability	Performance, Categorical	TRUE	easy	(easy = 1, difficult = 0.8)	"Easier excavation than single pit systems, [but] double	yes	
			difficult		the space and materials required" (Emersan)		
					Technology is complete and it's not easy to extend the		
					pit size, however it is possible to build new units. It has		
					a lower performance compared to single pit latrines,		
					because more material and space are required. (Kukka		
					Ilmanen, Eawag 2021)		
construction_parts	PDF, Categorical	TRUE	simple	(simple = 1, technical = 0, special = 0)	"Can be built and repaired with locally available	yes	
			technical		materials" (Compendium)		
	(copied from "Sanitation_Technologies_TC_database_2021)			,	,	,	
	Pit Humus		Airloss	Soilloss	Waterloss		Reference
TP		0,18 - 0,4	0	0.71			Montangero and Belevi (2007)
med (R)	0.29		0	0.71	C		
TN	5	[0.22]		0.00			PA
IN	0.18 0.18					* as N * as N	Montangero and Belevi (2007) Jacks et al. (1999)
	0.18	0.15 - 0.2	0.55			* TC Soilloss: N reaching the groundwater	Nyenje et al. (1999)
med (R)	0.18	0.09-0.27	0.55			TC Soliloss: N reaching the groundwater	Nyenje et al. (2013)
med (K)	0.18	[0.18]	0.33	0.27	į.		PA
H2O	0.15		0.15	2.7		ADA bish sociability describes as sail	PA PA
HZU	0.15	0.05 - 0.3	0.15	0.7		*PA; high variability depending on soil permeability	PA
med (R)	0.15	(0.05 - 0.3)	0.15	0.70		permeability	
med (K)	0.15	(0.05 - 0.3)	0.15	0.70			- DΔ
TS			-	0.4		ATCCt-it0 7.00	I A
TS	0.6	0.5 - 0.7	0	0.4	1	*TSS retainment range: 0.7-0.9 (Assumption for TS: 0.5 - 0.7)	Montangero and Belevi (2007)
med (R)	0.60	0.5 - 0.7		0.40		(/ssumption for 15: 0.5 - 0.7)	
med (K)	0.60	[0.2]		0.40			PA
		[0.2]					
							Spuhler et al. (2021)

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ts for Pour-Flush Toilet	he .						
I Information	Values	Data Source					
FUNCTIONAL GROUP NIQUE IDENTIFIER (ID)			-				
DATA COMPILER	Matthias van Sloten	-					
OUTPUT PRODUCT		Spuhler, D. & Roller, L. (2020) Spuhler, D. & Roller, L. (2020)					
RELATIONS	Input: NA	Spuhler, D. & Roller, L. (2020)					
COMMENTS	Output: NA						
er Criteria	Values	Data Source					
applicability_level	(household = 1, neighbourhood = 0.5,	Tilley, E. et al. (2014)					
management_level	city = 0) (household = 1, shared = 1, public =	Tilley, E. et al. (2014)					
	0.5)						
capex_req_level opex_req_level		Spuhler, D. et al. (2021) Spuhler, D. et al. (2021)					
technical_maturity	3	Tilley, E. et al. (2014)					
development_phase	(acute = 0, stabilisation = 0.5, development/recovery = 1)	Gensch, R. et al. (2018)					
ng Criteria	Type and Function	Applicable for this Functional Group?	Categories [Unit]	Technology Values (Data)	Data Source / Assumptions	Internal Review Done?	
water_supply	Performance, Categorical		house	NA	NA	NA	
water_volume	Performance, Trapez	IRUE	[L/cap/day]	(a = 8, b = 20, c = 21, d = 33)	"As this is a water-based (wet) technology, the full pits require a	yes	
					longer retention time (two years is		
					recommended) to degrade the material before it can be excavated		
					safely." (Compendium)		
					Since it is a water-based technology a		
					minimum of water volume entering the pits is necessery.		
					Calculations for minimum water		
					required are based on following assumptions: Pour flush toilets require		
					1-3L of flush water for every flush and		
					anal cleansing water 0.3-3L/use		
					(Compendium) assuming 6 toilet visits (or flushes) per person per day.		
					The performance of the technology is		
					depending on a minimum but not on a maximum of water consumption even		
					though high amount of inflitration		
					water should be optimally avoided.		
electricity_supply	Performance, Categorical	TRUE	electricity	(electricity = 1, intermittent = 1, no	No electricity needed.	yes	
			intermittent no electricity	electricity = 1)			
fuel_supply	Performance, Categorical	FALSE	fuel	NA	NA	NA	
frequency_of_om	PDF, Categorical		no fuel irregular	(irregular = 0.5, regular = 0.5,	"The pits must be regularly emptied	yes	
rrequency_or_om	PDF, Categorical	IKUE	regular	(irregular = 0.5, regular = 0.5, continous = 0)	(after the recommended two year	yes	
			continuous		resting time), and care must be taken		
					to ensure that they do not flood during rainy seasons. Emptying is done		
					manually using long handled shovels		
					and proper personal protection." (Compendium)		
					Maintenance is between regular and		
nine com	Dorforman C-4	TRUE	no nines	(no pines = 0.75 difficulation with the	irregular.	vec	
pipe_supply	Performance, Categorical	IKUE	no pipes difficultly available	(no pipes = 0.75, difficultly available = 0.75, pipes = 1)	"The twin pits for pour flush technology can be designed in various	yes	
			pipes		ways; the toilet can be located directly		
					over the pits or at a distance from them." (Compendium)		
					"Alternatively, the Flush toilet could		
					also be connected to the pit in use by a single straight pipe" (Emersan		
					Compendium)		
					Flush toilets are either above the pits		
					or connected to via pipes. The configuration with pipes performs		
					slightly better due to distance		
pump_supply	Performance, Categorical	TRUF	no pumps	(no pumps = 1, difficultly available = 1,	between pits "The dewatered, solid material is	yes	
pump_supply	veriormance, categorical		difficultly available	pumps = 1, difficultly available = 1,	manually emptied from the pits (it is	,	
			pumps		dug, not pumped out)"(Compendium)		
					"Emptying is done manually [it is dug not pumped out], e.g. using long		
					handled shovels and proper personal		
					protective equipment or emptying can be done with mobile desludging		
					machines" (Emersan Compendium)		
					Pumps are not required		
concrete_supply	Performance, Categorical	TRUE	no concrete	(no concrete = 1, difficultly available =	"Can be built and repaired with locally	yes	
			difficultly available concrete	1, concrete = 1)	available materials" (Compendium) "The pit lining can be made of		
					concrete or bricks among other		
					materials" (Emersan Compendium) But concrete is not specifically needed.		
spare_parts	PDF, Categorical	TRUE	simple	(simple = 1, technical = 0, special = 0)	"Can be built and repaired with locally	yes	
			technical special		available materials" (Compendium) "The latrine superstructure can be		
			1.		made from local materials, such as		
					bamboo, grass matting, cloth or wood, plastic or metal sheeting		
					(though this often heats up the		
					interior)." (Emersan)		
0		FALSE FALSE		D NA	NA NA	NA NA	
0		FALSE		D NA	NA NA	NA NA	
temperature			very cold	(very cold = 0.5, cold = 0.7, temperate	Twin pits can be built in colder	yes	
			cold	= 1, warm = 1, hot = 1)	climates but there has to be taken in account that leachate respectively soil		
			temperate warm		absorbtion performance can be lower		
			hot		if the bottom of the pit is frozen.		
flooding	Performance, Categorical	TRUE	flooding	(flooding = 0.1, no flooding = 1)	"This technology is not suitable for	Yes	
			no flooding		areas with a high groundwater table or where there is frequent flooding."		
					(Compendium)		
		I .			A low performance of 10% is allotted		
					to the category "flooding" given that there exists the possibility that twin		
					there exists the possibility that twin pits pour flush technology could be		
					there exists the possibility that twin		

vehicular_acces	Performance, Categorical		no access difficult full	(no access = 0.8, difficult = 0.8, full = 1)	manually emptied from the pits (it is dug, not pumped out), therefore, space is not required for vacuum trucks to access them." (Compendium) "Emptying is dom emanually lit is dug not pumped out], e.g. using long handled showels and proper personal protective equipment or emptying can be done with mobile desludging machines" (Emersan Compendium) The emptying and transport is slightly improved by motorized transport as the dug-out material can be transported more efficiently.	yes
slope	Performance, Categorical		flat	NA	NA	NA
soil_type	Performance, Categorical		clay silt sand gravel rock	(clay = 0.25, silt = 0.5, sand = 1, gravel = 0.5, rock = 0.25)	"In order for the pits to drain properly, the soil must have a good absorptive capacity; clay, tightly packed or rocky soils are not appropriate." (Compendium) Soil percolation and filtration is desired resulting in lower desludging rates.	yes
groundwater_depth	Performance, Trapez	TRUE	water depth [m]	(a = 6, b = 9, c = 9999, d = 999)	"This technology is not suitable for areas with a high groundwater table or where there is frequent flooding." (Compendium) "There is a risk of groundwater pollution when pits are located in areas with a high or variable water table, and/or fissures or cracks in the bedrock" (Compendium) It is assumed that a pit is at least 3 m deep and optimally 6 m deep. A vertical safety distance of 3 meters is applied.	yes
excavation	Performance, Categorical	TRUE	easy hard	(easy = 1, hard = 0.5)	Excavation for a bigger volume needed. If excavation is not possible other solutions are an option. But these lead to further design and effort. A bigger volume than for a single pit is necessary, but we assume the performance is the same.	yes
surface_area_onsite	Performance, Trapez	TRUE	[m2/plot]	(a = 5, b = 5, c = 999, d = 999)	Emersan: "It is recommended that the twin pits are constructed at least 1 m apart to minimise cross-contamination between the maturing pit and the one in use. Pits should be constructed over 1 m from any structural foundation as leachate can negatively impact structural supports." It is assumed that the space requirements of the separate components of a twin pit for pour and flush setup resembles the size requirements of a single pit, meaning that 1 m2 is allotted to each the toilet and the two pits. Due to the required distance between the two pits and further walls, it is assumed that the whole twin pit for pour and flush requires at least 5m2/plot (Eawag, 2021). Note that this does not involve any visual protection. A	
					superstructure could require more space.	
surface_area_offsite	Performance, Trapez	FALSE	m2/pers	NA	NA	NA
0	0	FALSE	C	NA	NA	NA
0		FALSE		NA	NA	NA
O drinking_water_exposure	Performance, Categorical	FALSE	Close Not close	NA (close = 0, not close = 1) NA	NA **As soil and groundwater properties are often unknown, it is difficult to estimate the distance necessary between a pit and a water source. It is normally recommended to have a minimum horizontal distance of 30 m between then to limit exposing the water source to microbial contamination." (Compendium) NA	NA NA
0		FALSE		NA (unskilled = 0, skilled = 1, professional	NA "Can be built and repaired with locally	NA
construction_skills	Performance, Categorical		Ladder: unskilled skilled professional	= 1)	available materials" (Compendium) Moderate construction skills are recommended, low construction skills could be sufficient.	yes
design_skills	Performance, Categorical	INVE	Ladder: unskilled skilled professional	(unskilled = 0, skilled = 1, professional = 1)	"The pits should be of an adequate size to accommodate a volume of waste generated over one or two years. [] It is recommended that the twin pits be constructed in apart from each other to minimize cross-contamination between the maturing pit and the one in use. It is also recommended that the pits be constructed over 1 m from any structural foundation as leachate can negatively impact structural supports. Water within the pit can impact its stability. Therefore, the full depth of the pit valls should be finded to prevent collapse and the top 30 cm should be fully mortared to prevent direct infilitation and to support the superstructure. To ensure that only one of the two pits is used at any time, the idle pipe of the junction connecting to the outof-use pit should be closed (e.g., with cement or bricks). Alternatively, the Pour Flush Toilet could also be directly connected to the pit in use by a single straight pipe	yes

om_skills 0 0 0 0 0 cleansing_method	0 0 0 Performance, Categorical	FALSE FALSE FALSE FALSE FALSE FALSE	0 0 Washers Soft wipers Hard wipers	(unskilled = 0.5, skilled = 1, professional = 1) NA NA NA NA NA NA	"The pits must be regularly emptied (after the recommended two year resting time), and care must be taken to ensure that they do not flood during rainy seasons. Emptying is don annually using long handled shovels and proper personal protection." (Compendium) Moderate OM skills can ensure proper operation but low OM skills could be sufficient. NA NA NA NA NA NA NA NA NA NA NA NA NA	NA NA NA NA NA	
0		FALSE		NA NA	NA NA	NA NA	
O lifetime	u Performance, Categorical	FALSE TRUE	short (< 1 year) medium (1.5 years) long (>5 years)	NA (short = 1, medium = 1, long = 1)	NA "Because double pits are used alternately, they can have a long life" (Emersan) "Expected lifetime: "5 years with supersize communal pits (10m3 +; 10+ years if twin vaults are alternated & empited", "Longevity: If pit is large enough with sufficient leaching, can last "5 years," Empty-able" pits can be re-used; No trash increases lifespan of pits (up to 25% of basic latrine= trash)" (Pour-flush to pit BGC, 2014)	NA yes	
speed_implement_toilet	PDF, Categorical	TRUE	rapid (< 3 days) moderate (3 days to 2 weeks) slow (> 2 weeks)	(rapid = 0, moderate = 0.5, slow = 0.5)	"If possible, materials should be used that are locally available. The pit lining can be made of concrete or bricks among other materials. Moreover, piping is needed." (Emersan Compendium) "The pits are either constructed with a porous material, in open-joint brick lines (like a honeycomb, to facilitate the liquid to flow out) or with perforated concrete tubes (i.e. pre-fabricated). "ESWM) Given that concrete could be used for construction and/or masonny brick structures need to be built, curing itself would take some time. Plus, the construction is underground (i.e., digging required). All these elements point towards longer speeds of implementation and it is unlikely that this technology be implemented in 43 days. (Akanksha Jain, Eawag 2021)	yes	
speed_implement_treatment	PDF, Categorical		rapid (few days to a week) moderate (few weeks up to three months) slow (> 3 months)	NA	NA	NA	
scalability	Performance, Categorical	TRUE	easy difficult	(easy = 1, difficult = 0.5)	Twin Pits for Pour Flush are appropriate for areas where it is not possible to continuously build new pit latrines or regular desiudging might be an issue and where there is water available and desired for flushing. It is recommended not to concentrate pits in a small area as the soil may not have sufficient capacity to absorb the fliguid and the ground could become water-logged (oversaturated)" (Emersan) A unit of technology is complete and it is difficult to increase the pit size, because it is designed specifically. The alternative option would be to build new units, which is difficult in close proximity due to limited soil absorption. (Kukka limanen, Eawag 2021)	yes	
	PDF, Categorical PDF, Categorical	20622-size*)	simple technical special	(simple = 1, technical = 0, special = 0)	"Can be built and repaired with locally available materials" (Compendium) "The latrine superstructure can be made from local materials, such as bamboo, grass matting, cloth or wood, plastic or metal sheeting (though this often heats up the interior)." (Emersan)	yes	
TP	Pit Humus 0.29		Airloss 0	Soilloss 0.71	Waterloss		Reference Montangero and Belevi (2007)
TP med (R)	0.29 0.29	(0.18 - 0.4)		0.71 0.71			- Langero and Belevi (2007)
k	5	[0.22]	-			8 as N	PA Mantanassa and Rel - (2007)
TN	0.18 0.18		0.55	0.82 0.27			Montangero and Belevi (2007) Jacks et al. (1999)
	0.2	-	0.6	0.2	0	* TC Soilloss: N reaching the groundwater	Nyenje et al. (2013)
med (R)	0.18	0,09-0,27	0.55	0.27	0		PA .
k H2O	0.15		0.15	0.7	0	*PA; high variability depending on soil	PA PA
						permeability	
med (R)	0.15		0.15	0.70	0		PA .
k TS	5 0.6	(0.25) 0.5 - 0.7	- 0	0.4		*TSS retainment range: 0.7-0.9	PA Montangero and Belevi (2007)
						(Assumption for TS: 0.5 - 0.7)	
med (R)	0.60		0	0.40	0		PA
- к		[0.2]					Spuhler et al. (2021)
Additional Information	oth an angerobic and a gerobic directic	on can occur and therefore the transfer co	nafficients are assumed to be similar to t	he ones of a single pit. Come of the k fa	ctors were decreased if they weren't airs		.,

Copied from "single pit" since both an anaerobic and a aerobic digestion can occur and therefore the transfer coefficients are assumed to be similar to the ones of a single pit. Some of the k-factors were decreased if they weren't already the minimum possible value.

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West Property Company Composting Chamber								
Section 1.	General Information		Data Source					
Activity Column	UNIQUE IDENTIFIER (ID) DATA COMPILER	composting_chamber Matthias van Sloten	- - -					
March Marc	INPUT PRODUCT OUTPUT PRODUCT	faeces, excreta, organics compost, effluent	Spuhler, D. & Roller, L. (2020)					
Control of Control o		Output: AND						
Part Part		composting chamber should be emptied every 2 to 10 years."						
The second control of the control of								
Accordance of the control of the con		city = 0)						
Secretary (Control of Control of								
designation from the control of the		3	McConville, J. et al. (2020)					
Section (Continue) and section (Continue) (C		development/recovery=1)	speed of response, and it is essential that 1st phase technologies to contain excreta can be installed quickly. Normally, LID technology and composting toilets are associated with 2nd phase responses, particularly in flood prone areas. However, novel solutions to rapid onset floods have been tried and tested in Latin America." (Oxfam Policy & Practice, 2009)	Categories [Unit]	Technology Values (Data)	Data Source / Assumptions	Internal Review Done?	
Pellermane, Tropic TESE Schaller Schall		Performance, Categorical	FALSE	house				
Professionary, Capper (INC) Applications of the company of the co				public				
Intermetent In orientation In orient				[L/cap/day]		especially sulted in areas where land and water are limitted, or when there is a need for compost." (Compendium) This technology cannot be used for the collection of anal cleansing water or greywater; if the reactor becomes too wet, anaerobic conditions will cause odour problems and improper degradation." (Compendium) No additional water needed. This technology is not impacted by flooding and/or high groundwater tables. The only possible way high water outliers of the control o		
frequency_of_om FOF, Categorical TRUE regular regula	electricity_supply			intermittent	(electricity = 1, intermittent = 0.9, no elec	configurations [] More complex designs can include a small wentitation fan or a mechanical mixer." (Compendium) Depending on the configuration the technology must not run with electricity. However, the technology performs better if ventilation or mixing can be applied. For mixing and ventilation intermittent electricity is not	yes	
contribucus Performance, Categorical TRUE no pipes difficulty available pipe pump_upply Performance, Categorical TRUE no pumps difficulty available pipes Performance, Categorical TRUE no pumps difficulty available pipes (no pipes = 1, difficulty available = 1, pip the compositing disable to build it with other (concrete_supply) Performance, Categorical TRUE no pumps difficulty available pipes (no pumps difficulty available = 1, pip the compositing disable to build it with other (concrete_supply) Performance, Categorical TRUE no pumps difficulty available pumps difficulty available pumps difficulty available pumps difficulty available pumps difficulty available pumps difficulty available pumps difficulty available pumps difficulty available pumps difficulty available pumps difficulty available pumps difficulty available pumps difficulty available pumps difficulty available pumps difficulty available concrete dif				no fuel	NA		NA	
pipe_supply Performance, Categorical TRUE no pipes = 1, difficulty available = jupes the compositing chamber contains a ventilation pipe, air difficulty available pipes difficulty available = jupes = 1, difficulty available = jupes to the ton excessary, if there are no jupes available et about also be possible to build it with cher (becal) material such as between an include a small ventilation fan or a mechanical make." Concrete _supply Performance, Categorical TRUE no concrete _difficulty available = jumps for concrete _supply Performance, Categorical TRUE no concrete _difficulty available = jumps for concrete _supply Performance, Categorical TRUE no concrete _difficulty available = jumps for concrete _supply Performance, Categorical TRUE no concrete _difficulty available = jumps for concrete = 0.5, difficulty availa	frequency_of_om	PDF, Categorical	TRUE	irregular regular	(irregular = 0, regular = 1, continuous = 0)	quality of the compost has to be checked regularly every several weeks and the chamber must be emptied every several years. In dependence of the operation of the composting process there might also other maintanance actions be necessary such as watering or turning over	yes	
difficulty available pumps Configurations, [] More complex designs can include a small weritlation fan or a mechanical mixer, " (Compendium)				difficultly available pipes		The composting chamber contains a ventilation pipe, air ducts as well as an excess liquid drain, (Compendium) These components might work the best if they are built with pvc pipes but its not necessary. If there are no pipes available it should also be possible to build it with other (local) material such as bamboo or similar.		
difficultly available concrete 0.75, no concrete = 1) to build up the technology. Even though its easier to build the technology with concrete it's also possible to build the technology with concrete it's also possible to build it with other (weather-proof) material like day. spare_parts PDF, Categorical TRUE simple technical special (simple = 0, technical = 0.5, special = 0.5) rise technology usally requires four main parts: (1) a reactor (storage chamber); (2) a ventilation unit to provide oxygen and allow gases (200, water vapour) to escape; (3) a leachate collection system; and (4) an access door to remove the mature product. [] A composting chamber can be designed in various configurations. [] Ventilation channels (air ducts) under the heap can be beneficial for aeration. More complex designs can include a small ventilation fan, a mechanical mixer, or multiple compartments to allow for increased storage and degradation time. [] A drainage system is important to ensure the removal of leachate. [] May require some specialized parts and electricity." (Compendium) The technology can be designed in various configurations. Some of them require specially-manufactured parts, while any system requires some kind of technical parts for mixing and ventilation. O D FALSE O NA NA	pump_supply	Performance, Categorical	IKUÉ	difficultly available	(no pumps = 1, difficutly available = 1, pui	configurations [] More complex designs can include a small ventilation fan or a mechanical mixer." (Compendium) Depending on the configuration the technology can have	yes	
spare_parts PDF, Categorical TRUE simple technical special spec	concrete_supply	Performance, Categorical	TRUE	difficultly available		to build up the technology. Even though its easier to build the technology with concrete it's also possible to build it with other (weather-		
	spare_parts			technical special		"This technology usually requires four main parts: (1) a reactor (storage chamber); (2) a wentilation unit to provide oxygen and allow gases (CO2, water vapour) to escape; (3) a leachate collection system; and (4) an access door to remove the mature product. [] A composting chamber can be designed in various configurations. [] Ventilation channels (air ducts) under the heap can be beneficial for aeration. More complex designs can include a small ventilation fan, a mechanical mixer, or multiple compartments to allow for increased storage and degradation time. [] A drainage system is important to ensure the removal of leachate. [] May require some specialized parts and electricity." (Compendium) The technology can be designed in various configurations. Some of them require specially-manufactured parts, while any system requires some and of technical parts for mixing and ventilation.		
U U) ALSE UNA NA NA NA O O O O FALSE O O NA NA NA NA	0		FALSE			NA NA	NA NA	

	Desference Cotenation		constructed	/	IITh	
temperature	Performance, Categorical	TRUE	very cold cold	(very cold = 0.5, cold = 0.7, temperate = 0	"There are four factors that ensure the good functioning of the system: [] internal (heap) temperature of 40 to	yes
			temperate		50 °C" (Compendium)	
			warm		Retention time during winter months was double the retention time in summer, therefore we adapted a	
			hot		performance (=1) in summer, therefore we adapted a performance (=0.5)	
					in winter. The ambient temperatures were measured as	
					-20 to 0 °C in winter (performance 0.5 for "very cold")	
					and 10 to 30° in summer. It is assumed that a composting chamber works up to ambient temperatures	
					of up to 60 °C because the composting chamber still	
					works if the pile temperature is at this level. (McCartney,	
flooding	Performance, Categorical	TRUE	flooding	(flooding = 1, no flooding = 1)	2005) "It can also be installed in rocky areas, or where the	yes
nooning	renormance, categorical		no flooding	(10001116 - 1, 110 110001116 - 1)	groundwater table is high." (Compendium)	,
					The technology is neither based on soil absorption nor	
					relying on stormwater drains for sewage collection. That means that the performance is not directly affected by	
					flooding.	
vehicular_acces	Performance, Categorical	TRUE	no access	(no access = 0.8, difficult = 0.8, full = 1)	There is no need for any special vehicle to empty the	yes
			difficult full		chamber and it can easily be done manual. However, a vehicle can be used to empty the chamber. If a vehicle	
					might be useful depends on the dimension of the	
					chamber. If it is designed for a big load of material a	
					vehicle like an excavator might ease the operating work.	
slope	Performance, Categorical	FALSE	flat	NA	NA	NA
soil_type	Performance, Categorical	TRUE	not flat clay	(clay = 1 silt = 1 sand = 1 grayel = 1 rock	The compost in the chamber is not lying directly on the	yes
30II_type	renormance, categorical	INGE	silt	(clay = 1, 311t = 1, 311tt = 1, graver = 1, 10ce	ground what means that there is no contact of the	yes
			sand		substrate in the chamber to the soil. (Compendium)	
			gravel		Technology does not rely on soil absorbtion. No	
groundwater_depth	Performance, Trapez	TRUE	rock water depth [m]	(a = 0, b = 0, c = 999, d = 999)	difference between soil types. The compost in the chamber is not lying directly on the	yes
				•	ground and exiting liquids leave the system by a	
					drainage. (Compendium) That means that no content of the chamber should	
					reach the ground and that the groundwater is not	
					affected by the technology.	
excavation	Performance, Categorical	IKUE	easy hard	(easy = 1, hard = 0.75)	"A composting chamber can be designed in various configurations and constructed above or below ground,	yes
					indoors or with a separate superstructure."	
					(Compendium)	
					Excavation is not necessary needed since its possible to build the superstructure above ground. However, can be	
					built underground.	
surface_area_onsite	Performance, Trapez	TRUE	[m2/plot]	(a = 2, b = 2, c = 999, d = 999)	The space area requirements of composting chambers	
					are derived based on a comparable approach with other technologies. Its space requirements are certainly similar	
					to a single pit (1m2/plot), as it also requires just one	
					chamber below the user where the excreta ends up.	
					However, composting chambers generally require a bit	
					more space than other technologies based on one chamber (Eawag, 2021). It is therefore assumed that	
					composting chambers require at least 2m2/plot (Eawag,	
					2021). Note that this does not involve any visual	
					protection. A superstructure could require more space.	
surface_area_offsite	Performance, Trapez		m2/pers	NA	NA	NA
0		FALSE FALSE		NA NA	NA NA	NA NA
0		FALSE		NA	NA	NA
0 drinking_water_exposure	Performance, Categorical		Close	NA (close = 1, not close = 1)	The compost in the chamber is not lying directly on the	yes
					The compost in the chamber is not lying directly on the ground and exiting liquids leave the system by a	
			Close		The compost in the chamber is not lying directly on the ground and exiting liquids leave the system by a drainage. (Compendium) The technology doesnt rely on soil absorbtion and no	
			Close		The compost in the chamber is not lying directly on the ground and exiting liquids leave the system by a drainage. (Compendium) The technology doesnt rely on soil absorbtion and no content of the chamber should reach the ground. That	
	Performance, Categorical	TRUE	Close Not close	(close = 1, not close = 1)	The compost in the chamber is not lying directly on the ground and exiting liquids leave the system by a drainage. (Compendium) The technology doesnt rely on soil absorbtion and no content of the chamber should reach the ground. That means that the groundwater is not affected by the technology.	
drinking_water_exposure	Performance, Categorical	TRUE	Close Not close	(close = 1, not close = 1) NA	The compost in the chamber is not lying directly on the ground and exiting liquids leave the system by a drainage. (Compendium) The technology doesnt rely on soil absorbtion and no content of the chamber should reach the ground. That means that the groundwater is not affected by the technology. NA	yes
drinking_water_exposure	Performance, Categorical	TRUE FALSE FALSE	Close Not close	(close = 1, not close = 1)	The compost in the chamber is not lying directly on the ground and exiting liquids leave the system by a drainage. (Compendium) The technology doesnt rely on soil absorbtion and no content of the chamber should reach the ground. That means that the groundwater is not affected by the technology.	yes
drinking_water_exposure	Performance, Categorical 0	TRUE FALSE FALSE	Close Not close 0 Ladder: unskilled	(close = 1, not close = 1) NA NA	The compost in the chamber is not lying directly on the ground and exiting liquids leave the system by a drainage. (Compendium) The technology doesnt rely on soil absorbtion and no content of the chamber should reach the ground. That means that the groundwater is not affected by the technology. NA NA "Requires expert design and construction" (Compendium)	yes NA NA
drinking_water_exposure	Performance, Categorical 0	TRUE FALSE FALSE	Close Not close 0 Ladder: unskilled	(close = 1, not close = 1) NA NA NA (unkilled = 0, skilled = 1, professional =	The compost in the chamber is not lying directly on the ground and exiting liquids leave the system by a drainage. (Compendium) The technology doesnt rely on soil absorbtion and no content of the chamber should reach the ground. That means that the groundwater is not affected by the technology. NA NA Requires expert design and construction* (Compendium) To build up the technology a skilled labour with technical	yes NA NA
drinking_water_exposure	Performance, Categorical 0	FALSE FALSE TRUE	Close Not close 0 Ladder: unskilled	(close = 1, not close = 1) NA NA NA (unkilled = 0, skilled = 1, professional =	The compost in the chamber is not lying directly on the ground and exiting liquids leave the system by a drainage. (Compendium) The technology doesnt rely on soil absorbtion and no content of the chamber should reach the ground. That means that the groundwater is not affected by the technology. NA NA "Requires expert design and construction" (Compendium)	yes NA NA
drinking_water_exposure 0 construction_skills	Performance, Categorical 0 0 Performance, Categorical	FALSE FALSE TRUE	Close Not close O Ladder: unskilled skilled professional Ladder: unskilled	(close = 1, not close = 1) NA NA (unskilled = 0, skilled = 1, professional = 1)	The compost in the chamber is not lying directly on the ground and exiting liquids leave the system by a drainage. (Compendium) The technology doesnt rely on soil absorbtion and no content of the chamber should reach the ground. That means that the groundwater is not affected by the technology. NA NA "Requires expert design and construction" (Compendium) To build up the technology a skilled labour with technical knowledge is necessary. "Requires expert design and construction" (Compendium)	yes NA NA NA yes
drinking_water_exposure 0 construction_skills	Performance, Categorical 0 0 Performance, Categorical	FALSE FALSE TRUE	Close Not close 0 Ladder: unskilled skilled professional Ladder: unskilled skilled	(close = 1, not close = 1) NA NA (unskilled = 0, skilled = 1, professional = 1) (unskilled = 0, skilled = 0.5, professional	The compost in the chamber is not lying directly on the ground and exiting liquids leave the system by a drainage. (Compendium) The technology doesnt rely on soil absorbtion and no content of the chamber should reach the ground. That means that the groundwater is not affected by the technology. NA NA "Requires expert design and construction" (Compendium) To build up the technology a skilled labour with technical knowledge is necessary. Requires expert design and construction " (Fequires expert design and construction)"	yes NA NA NA yes
drinking_water_exposure 0 construction_skills	Performance, Categorical 0 0 Performance, Categorical	FALSE FALSE TRUE	Close Not close O Ladder: unskilled skilled professional Ladder: unskilled	(close = 1, not close = 1) NA NA (unskilled = 0, skilled = 1, professional = 1) (unskilled = 0, skilled = 0.5, professional	The compost in the chamber is not lying directly on the ground and exiting liquids leave the system by a drainage. (Compendium) The technology doesnt rely on soil absorbtion and no content of the chamber should reach the ground. That means that the groundwater is not affected by the technology. NA NA "Requires expert design and construction" (Compendium) To build up the technology a skilled labour with technical knowledge is necessary. Requires expert design and construction" (Compendium) To build up the technology a skilled labour with technical knowledge is necessary. (Compendium) The composting chamber is well designed, the users	yes NA NA NA yes
drinking_water_exposure 0 construction_skills	Performance, Categorical 0 0 Performance, Categorical	FALSE FALSE TRUE	Close Not close 0 Ladder: unskilled skilled professional Ladder: unskilled skilled	(close = 1, not close = 1) NA NA (unskilled = 0, skilled = 1, professional = 1) (unskilled = 0, skilled = 0.5, professional	The compost in the chamber is not lying directly on the ground and exiting liquids leave the system by a drainage. (Compendium) The technology doesnt rely on soil absorbtion and no content of the chamber should reach the ground. That means that the groundwater is not affected by the technology. NA NA Requires expert design and construction" (Compendium) To build up the technology a skilled labour with technical knowledge is necessary. (Compendium) The equires expert design and construction" (Compendium) "The equires expert design and construction" (Compendium) "If the composting chamber is well designed, the users will not have to handle the material during the first year. A well-functioning composting chamber should not produce odours." (Compendium)	yes NA NA NA yes
drinking_water_exposure 0 construction_skills	Performance, Categorical 0 0 Performance, Categorical	FALSE FALSE TRUE	Close Not close 0 Ladder: unskilled skilled professional Ladder: unskilled skilled	(close = 1, not close = 1) NA NA (unskilled = 0, skilled = 1, professional = 1) (unskilled = 0, skilled = 0.5, professional	The compost in the chamber is not lying directly on the ground and exiting liquids leave the system by a drainage. (Compendium) The technology doesnt rely on soil absorbtion and no content of the chamber should reach the ground. That means that the groundwater is not affected by the technology. NA NA "Requires expert design and construction" (Compendium) To build up the technology a skilled labour with technical knowledge is necessary. "Requires expert design and construction" (Compendium) The composting chamber is well designed, the users will not have to handle the material during the first year. Awell-functioning composting chamber should not produce odours." (Compendium) To ensure that the system is well planned and runs	yes NA NA NA yes
drinking_water_exposure 0 0 construction_skills design_skills	Performance, Categorical 0 0 0 Performance, Categorical	TRUE FALSE FALSE TRUE TRUE	Close Not close 0 Ladder: unskilled skilled professional Ladder: unskilled skilled professional	(close = 1, not close = 1) NA NA (unskilled = 0, skilled = 1, professional = 1) (unskilled = 0, skilled = 0.5, professional = 1)	The compost in the chamber is not lying directly on the ground and exiting liquids leave the system by a drainage. (Compendium) The technology doesn't rely on soil absorbtion and no content of the chamber should reach the ground. That means that the groundwater is not affected by the technology. NA NA "Requires expert design and construction" (Compendium) To build up the technology a skilled labour with technical knowledge is necessary. "Requires expert design and construction" (Compendium) "If the composting chamber is well designed, the users will not have to handle the material during the first year. A well-functioning composting chamber should not produce odours." (Compendium) To ensure that the system is well planned and runs properly it should be designed by an expert planner or an engineer.	yes NA NA NA yes
drinking_water_exposure 0 construction_skills	Performance, Categorical 0 0 Performance, Categorical	TRUE FALSE FALSE TRUE TRUE	Close Not close O Ladder: Unskilled skilled professional Ladder: unskilled professional Ladder: Ladder:	(close = 1, not close = 1) NA NA NA (unskilled = 0, skilled = 1, professional = 1) (unskilled = 0, skilled = 0.5, professional = 1) (unskilled = 0, skilled = 1, professional = 1)	The compost in the chamber is not lying directly on the ground and exiting liquids leave the system by a drainage. (Compendium) The technology doesnt rely on soil absorbtion and no content of the chamber should reach the ground. That means that the groundwater is not affected by the technology. NA NA "Requires expert design and construction" (Compendium) To build up the technology a skilled labour with technical knowledge is necessary. Requires expert design and construction" (Compendium) "Requires expert design and construction" (Compendium) "If the composting chamber is well designed, the users will not have to handle the material during the first year. A well-functioning composting chamber should not produce odours." (Compendium) To ensure that the system is well planned and runs properly it should be designed by an expert planner or an engineer. "Requires well-trained user or service personnel for	yes NA NA NA yes
drinking_water_exposure 0 0 construction_skills design_skills	Performance, Categorical 0 0 0 Performance, Categorical	TRUE FALSE FALSE TRUE TRUE	Close Not close 0 Ladder: unskilled skilled professional Ladder: unskilled skilled professional	(close = 1, not close = 1) NA NA (unskilled = 0, skilled = 1, professional = 1) (unskilled = 0, skilled = 0.5, professional = 1)	The compost in the chamber is not lying directly on the ground and exiting liquids leave the system by a drainage. (Compendium) The technology doesn't rely on soil absorbtion and no content of the chamber should reach the ground. That means that the groundwater is not affected by the technology. NA NA "Requires expert design and construction" (Compendium) To build up the technology a skilled labour with technical knowledge is necessary. "Requires expert design and construction" (Compendium) "If the composting chamber is well designed, the users will not have to handle the material during the first year. A well-functioning composting chamber should not produce odours." (Compendium) To ensure that the system is well planned and runs properly it should be designed by an expert planner or an engineer.	NA NA NA yes
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drinking_water_exposure 0 0 construction_skills design_skills	Performance, Categorical 0 0 0 Performance, Categorical	TRUE FALSE FALSE TRUE TRUE	Close Not close O Ladder: unskilled skilled professional Ladder: unskilled skilled professional Ladder: Unskilled Skilled	(close = 1, not close = 1) NA NA NA (unskilled = 0, skilled = 1, professional = 1) (unskilled = 0, skilled = 0.5, professional = 1) (unskilled = 0.5, skilled = 1, professional = 1)	The compost in the chamber is not lying directly on the ground and exiting liquids leave the system by a drainage. (Compendium) The technology doesnt rely on soil absorbtion and no content of the chamber should reach the ground. That means that the groundwater is not affected by the technology. NA NA "Requires expert design and construction" (Compendium) To build up the technology a skilled labour with technical knowledge is necessary. "Requires expert design and construction" (Compendium) Ti the composting chamber is well designed, the users will not have to handle the material during the first year. A well-functioning composting chamber should not produce odours." (Compendium) To ensure that the system is well planned and runs properly it should be designed by an expert planner or an engineer. "Requires well-trained user or service personnel for monitoring and maintenance" (Compendium) "Although simple in theory, composting chambers are not that easy to operate. The moisture must be controlled, the C.N ratio must be well balanced and the	NA NA NA yes
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drinking_water_exposure	Performance, Categorical 0 0 0 Performance, Categorical Performance, Categorical Performance, Categorical 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	FALSE FALSE TRUE TRUE TRUE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE	Close Not close O Ladder: unskilled skilled professional Ladder: unskilled skilled professional Ladder: Unskilled Skilled Professional O O O O O O O O O O O O O O O O O O O	(close = 1, not close = 1) NA NA NA (unskilled = 0, skilled = 1, professional = 1) (unskilled = 0, skilled = 0.5, professional = 1) (unskilled = 0, skilled = 1, professional = 1) (unskilled = 0.5, skilled = 1, professional = 1) NA NA NA NA NA NA NA NA NA N	The compost in the chamber is not lying directly on the ground and exiting liquids leave the system by a drainage. (Compendium) The technology doesnt rely on soil absorbtion and no content of the chamber should reach the ground. That means that the groundwater is not affected by the technology. NA NA "Requires expert design and construction" (Compendium) To build up the technology a skilled labour with technical knowledge is necessary. "Requires sepert design and construction" (Compendium) To build up the technology a skilled labour with technical knowledge is necessary. "Requires expert design and construction" (Compendium) The though the system is well designed, the users will not have to handle the material during the first year. A well-functioning composting chamber should not produce odours." (Compendium) To ensure that the system is well planned and runs properly it should be designed by an expert planner or an engineer. "Requires well-trained user or service personnel for monitoring and maintenance" (Compendium) This plant is the system is well planned and runs properly it should be designed by an expert planner or an engineer. "Requires well-trained user or service personnel for monitoring and maintenance" (Compendium) The system is the system is well planned and runs properly it should be designed by an expert planner or an engineer. "Requires well-trained user or service personnel for monitoring and maintenance" (Compendium) in the compost plant is a special plant in the compost plant is added to absorbed excess liquid, improve the aeration of the pile and balance the carbon availability. Turning the material from time to time will boost the oxygen supply. A squeeze test can be made to check the moisture level within the chamber. When squeezing a handful of compost, it should not crumble or feel dry, nor should if feel like a wet syonger. Rather, the compost should leave only a few drops of water in one's hand. If the material in the chamber becomes to compact and humid, additional bulking material s	yes NA NA yes yes yes NA NA NA NA NA NA NA NA NA NA NA NA NA
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drinking_water_exposure	Performance, Categorical 0 0 0 Performance, Categorical Performance, Categorical Performance, Categorical 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	FALSE FALSE TRUE TRUE TRUE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE	Close Not close O Ladder: unskilled skilled professional Ladder: unskilled skilled professional Ladder: Unskilled Skilled Professional O O O O O O O O O O O O O O O O O O O	(close = 1, not close = 1) NA NA NA (unskilled = 0, skilled = 1, professional = 1) (unskilled = 0, skilled = 0.5, professional = 1) (unskilled = 0, skilled = 1, professional = 1) (unskilled = 0.5, skilled = 1, professional = 1) NA NA NA NA NA NA NA NA NA N	The compost in the chamber is not lying directly on the ground and exiting liquids leave the system by a drainage. (Compendium) The technology doesn't rely on soil absorbtion and no content of the chamber should reach the ground. That means that the groundwater is not affected by the technology. NA NA "Requires expert design and construction" (Compendium) To build up the technology a skilled labour with technical knowledge is necessary. "Requires expert design and construction" (Compendium) To build up the technology a skilled labour with technical knowledge is necessary. "Requires expert design and construction" (Compendium) "If the composting chamber is well designed, the users will not have to handle the material during the first year. A well-functioning composting chamber should not produce odours." (Compendium) To ensure that the system is well planned and runs properly it should be designed by an expert planner or an engineer. "Requires well-trained user or service personnel for monitoring and maintenance" (Compendium) "Although simple in theory, composting chambers are not that easy to operate. The moisture must be controlled, the C.N ratio must be well balanced and the volume of the unit must be such that the temperature of the compost plie remains high to achieve pathogen reduction. After each defectation, a small amount of building material is added to absorb excess liquid, improve the aeration of the pile and balance the carbon availability. Turning the material from time to time will boost the oxygen supply. A squeeze test can be made to check the moisture level within the chamber. When squeezing a handful of compost, it should not crumble or feel dry, nor should it feel like a wet sponge. Rather, the compost should it seel like a wet sponge. Rather, the compost should is a developed on the chamber when squeezing a handful of compost in the chamber when squeezing a handful of compost in the chamber when squeezing a handful of compost in the chamber when squeezing a handful of compost in the chamber	yes NA NA yes yes yes NA NA NA NA NA NA NA NA NA NA NA NA NA

speed_implement_toilet	PDF, Categorical	TRUE	rapid (< 3 days) moderate (3 days to 2 weeks) slow (> 2 weeks)	(rapid = 0, moderate = 0.2, slow = 0.8)	"This technology usually requires four main parts: (1) a reactor (storage chamber); (2) a ventilation unit to provide oxygen and allow gases (CO2, water vapour) to escape; (3) a leachate collection system; and (4) an access door to remove the mature product." Compendium The above goes to show that design and construction requires special attention and efforts to achieve good quality (technical complexity is higher). This points towards slower speeds of implementation (largely expected to be > 2 weeks)	yes		
speed_implement_treatment	PDF, Categorical	FALSE	rapid (few days to a week) moderate (few weeks up to three months)	NA	NA	NA		
scalability	Performance, Categorical	TRUE	slow (- 3 months) easy difficult	(easy = 1, difficult = 0.5)	"A design value of 300 I/person/year can be used to calculate the required chamber volume." (Compendium) "Although simple in theory, composting chambers are not that easy to operate. The moisture must be controlled, the C.N ratio must be well balanced and the volume of the unit must be such that the temperature of the compost pile remains high to achieve pathogen reduction. After each defectation, a small amount of bulking material is added to absorb excess liquid, improve the peration of the pile and balance the carbon availability. The immediate coverage of the fresh faeces with an additive material also lowers nuisances caused by odour of files. Turning the material from time to time will boost the oxygen supply." (Compendium) in general, a composting chamber has a designed specific volume per person and it is complex to construct afurther units othat scaling up the technology is difficult. However, if composting chambers are designed large enough and the abovementioned conditions can be fulfilled, it is possible to increase the amount of input material into a composting chamber. This requires the availability of further bulking material, additive material and material with sufficient carbon content to be added to the system. (Rukka limanen, Eawag 2021)			
construction_parts	PDF, Categorical		simple technical special	(simple = 0, technical = 0.5, special = 0.5)	"This technology usually requires four main parts: (1) a reactor (storage chamber); (2) a ventilation unit to provide oxygen and allow gases (CO2, water vapour) to escape; (3) a leachate collection system; and (4) an access door to remove the mature product. [] A composting chamber can be designed in various configurations. [] Ventilation channels (air ducts) under the heap can be beneficial for aeration. More complex designs can include a small ventilation fan, a mechanical mixer, or multiple compartments to allow for increased storage and degradation time. [] A drainage system is important to ensure the removal of leachate. [] May require some specialized parts and electricity." (Compendium) The technology can be designed in various configurations. Some of them require some claidly-manufactured parts, while any system requires some kind of technical parts for mixine and ventilation.	yes		
	Compost 0.95	Range	Effluent 0.05	Airloss	Soilloss		Comments * as P	Reference Stintzing et al.
	1	-	0	0		0 0	* see	(2004) Yadav et al.
	0.00		0.04				11.2.1	(2012)
med (R)	0.99		0.01			0 0	* as P	Meinzinger (2010)
k	100	[0.05]	-					PA Stintzing et al.
TN	0.7		0	0.3			* as N * see	(2004) Yadav et al.
	0.07			0.33				(2012)
	0.65	-	0	0.35		0	* as N	Meinzinger (2010)
	0.3	-	0	0.7			* max N losses through	Heinonen-Tanski and van Wijk-
-		-	0.05					Sijbesma (2005) PA
med (R) bal.	0.66 0.63			0.34		0 0		-
k H2O	2 0.65	(0.6) 0.59 - 0.7	- 0	0.35		0	* moisture	PA Winblad, U. et
							content should be 50- 60%, compare with calculations in 11.2.2	al. (2004)
	0.54		0	0.46			Spuhler et al. (2021)	Yadav et al. (2012)
	0.7	-	0	0.3			*moisture content should be 60%, see	Zavala and Funamizu (2005)
							calculation in 11.2.2	
med (R)	0.65	0.54-0.8	0.05			0 0		PA
bal.	0.63		0.05			0 0		PA
k				0.62			*reduction is achieved by	Zavala and Funamizu (2005)
TS	0.33	0.1-0.6	0.05				organic matter consumption by bacteria	
**	0.33 0.33 2			0.62			organic matter consumption	PA
TS		3 0.1-0.6		0.62			organic matter consumption	- PA
med (R) // R Additional Information 2.2.3		3 0.1-0.6		0.62			organic matter consumption	PA
med (R) // R Additional Information 2.2.3	0.33 2 (Data from Yadav et al. (2012))	8 0.1-0.6 (0.5) 8 (0.5) 8 Bulking Material*	0.05 Compost				organic matter consumption	PA
med (R) & Additional Information 2.2.3	0.33 2 (Data from Yadav et al. (2012)) Faecal Slurry	8 0.1-0.6 9 [0.5] Bulking Material* 2 43 5 (0.26)	Compost 50			0 0	organic matter consumption by bacteria *reduction is achieved by	- PA
med (R) & Additional Information 2.2.3 Moisture %	0.33 2 (Data from Yadav et al. (2012)) Faecal Sturry 92 5	8 0.1-0.6 9 [0.5] Bulking Material* 2 43 5 (0.26)	Compost 50				organic matter consumption by bacteria *reduction is achieved by organic matter consumption	PA
med (R) & Additional Information 2.2.3 Moisture %	0.33 2 (Data from Yadav et al. (2012)) Faecal Sturry 92 5	0.1-0.6 (0.5) Bulking Material* 2 (0.2c) 0.1-0.6	Compost 5.0	0.62			organic matter consumption by bacteria *reduction is achieved by organic matter	PA
med (R) Moisture % Moisture % med (R) med (R)	0.33 2 (Data from Yadav et al. (2012)) Faecal Sturry 92 5 0.33	Bulking Material* 2	Compost 5.0	0.62		0 0	organic matter consumption by bacteria *reduction is achieved by organic matter consumption	PA
med (R) Moisture % med (R) Additional Information 2.2.3 Moisture % R TS med (R) Additional Information 2.2.3	0.33 2 (Data from Yadav et al. (2012)) Faecal Slurry 22 5 0.33 0.33 2 (Data from Yadav et al. (2012))	0.1-0.6 (0.5)	Compost 5.0	0.62		0 0	organic matter consumption by bacteria *reduction is achieved by organic matter consumption	- PA
med (R) Moisture % med (R) Additional Information 2.2.3 Moisture % R TS med (R) Additional Information 2.2.3	0.33 2 (Data from Yadav et al. (2012)) Faecal Sturry 92 5 0.33	Bulking Material* 45 [0.5] Bulking Material* 45 [0.46] 0.1-0.6	Compost 50 0.05	0.62		0 0	organic matter consumption by bacteria *reduction is achieved by organic matter consumption	PA

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Fossa Alterna						
General Information FUNCTIONAL GROUP	Values S	Data Source				
UNIQUE IDENTIFIER (ID)		-				
INPUT PRODUCT	Matthias van Sloten faeces, excreta, organics	- Tilley, E. et al. (2014)				
OUTPUT PRODUCT RELATIONS		Tilley, E. et al. (2014) Tilley, E. et al. (2014)				
	Output: NA					
COMMENTS re-Filter Criteria	Values	Data Source				
applicability_level	(household = 1, neighbourhood = 0.5,	Tilley, E. et al. (2014)				
management_level	city = 0) (household = 1, shared = 1, public =	Tilley, E. et al. (2014)				
capex_req_level	0.5)	Spuhler, D. et al. (2021)				
opex_req_level	3	Spuhler, D. et al. (2021)				
technical_maturity development_phase	(acute = 0, stabilisation = 1,	Tilley, E. et al. (2014) Gensch, R. et al. (2018)				
	development/recovery = 1)					
creening Criteria water_supply	Type and Function Performance, Categorical	Applicable for this Functional Group? FALSE	house [Unit]	Technology Values (Data) NA		Internal Review Done? NA
water_volume	Performance, Trapez		[L/cap/day]	(a = 0, b = 0, c = 999, d = 999)	"Waterless double pit technology" (Compendium).	Yes
					"The Fossa Alterna should be used for urine, but water should not be added" (Compendium).	
					"It is especially suitable to water-scarce environments" (Compendium).	
					Maximum values (c & d) are assumed to remain 999	
					L/cap/day since the disruption of this tech due to high water volumes, i.e., due to either flooding or	
					high groundwater tables is considered with two	
					separate criteria "Flooding" and "Groundwater Depth". Additionally, the FG U technology that will	
					be connected with this tech according Santiago	
					algorithm, based on input-output products will never be a technology that leads to high water	
					volumes entering fossa alterna (because blackwater	
					is not a defined input product). For e.g. Cistern flush sytems will never be the recommended FG U tech	
					for fossa alterna. (Akanksha Jain)	
electricity_supply	Performance, Categorical	TRUE	electricity	(electricity = 1, intermittent = 1, no	No electricity needed.	yes
			intermittent no electricity	electricity = 1)		
fuel_supply	Performance, Categorical	FALSE	fuel	NA	NA	NA
frequency_of_om	PDF, Categorical	TRUE	no fuel irregular	(irregular = 0.3, regular = 0.7,	"When the first pit is put into use, a layer of leaves	yes
,	,		regular	continous = 0)	should be put onto the bottom of the pit.	
			continuous		Periodically, more leaves should be added to increase the porosity and oxygen availability.	
					Following the addition of faeces to the pit, a small	
					amount of soil, ash, and/or leaves should be added. Occasionally, the mounded material beneath the	
					toilet hole should be pushed to the sides of the pit in order to optimise the use of space. [] Depending	
					on the dimensions of the pits, the contents should	
					not be emptied more often than once a year." (Compendium)	
					Rather regular than irregular maintenance is	
pipe_supply	Performance, Categorical	TRUE	no pipes	(no pipes = 1, difficultly available = 1,	No pipes needed.	yes
			difficultly available pipes	pipes = 1)		
pump_supply	Performance, Categorical	TRUE	no pumps	(no pumps = 1, difficultly available =		yes
			difficultly available pumps	1, pumps = 1)	Alterna (it is dug out, not pumped out); thus, vacuum truck access to the pits is not necessary."	
					(Compendium)	
concrete_supply	Performance, Categorical	TRUE	no concrete	(no concrete = 1, difficultly available =	No pumps needed. "Can be built and repaired with locally available	yes
	,		difficultly available	1, concrete = 1)	materials" (Compendium)	
			concrete		"Pit lining materials can include brick, rotresistant timber, bamboo, concrete, stones, or mortar	
					plastered onto the soil." (EmersanCompendium) But concrete is not specifically needed.	
spare_parts	PDF, Categorical	TRUE	simple technical	(simple = 1, technical = 0, special = 0)	"Can be built and repaired with locally available materials" (Compendium)	yes
			special			
0	0	FALSE FALSE	0	NA NA	NA NA	NA NA
0		FALSE		NA NA		NA NA
temperature	Performance, Categorical	TRUE	very cold cold	(very cold = 0.5, cold = 0.7, temperate = 1, warm = 1, hot = 1)	A single pit can be built in colder climates but there has to be taken in account that leachate respectively	yes
			temperate	, 2, 100 - 27	soil absorbtion performance can be lower if the	
			warm hot		bottom of the pit is frozen.	
flooding	Performance, Categorical	TRUE	flooding	(flooding = 0.5, no flooding = 1)		Yes
			no flooding		compacted soils (that are difficult to dig) or for areas that flood frequently, except if the pits are	
					raised." (Compendium)	
					Raised configurations of fossa alterna are also possible for flood prone areas (Borges Pedro et al.,	
					2020)	
					All technologies where raised configurations are possible get a 50% performance for category	
					"flooding". (Akanksha Jain)	
vehicular_acces	Performance, Categorical	TRUE	no access	(no access = 0.8, difficult = 0.8, full =		yes
			difficult full	1)	Alterna (it is dug out, not pumped out); thus, vacuum truck access to the pits is not necessary."	
					(Compendium)	
					The emptying and transport is slightly improved by motorized transport as the dug-out material can be	
slope	Performance, Categorical	FALSE	flat	NA .	transported more efficiently.	NA .
siope soil_type	Performance, Categorical Performance, Categorical	TRUE	clay	(clay = 0.25, silt = 0.5, sand = 1, gravel	"The Fossa Alterna is not suited for rocky or	yes
			silt sand	= 0.5, rock = 0.25)	compacted soils (that are difficult to dig) or for	
			gravel		areas that flood frequently, except if the pits are raised." (Compendium)	
			rock		Soil percolation and filtration is desired resulting in lower desludging rates.	
groundwater_depth	Performance, Trapez	TRUE	water depth [m]	(a = 6, b = 9, c = 999, d = 999)	"In flood-prone areas and where the groundwater	yes
					table is too high, the Fossa Alterna could be raised or built entirely above ground to avoid water	
					intrusion and groundwater pollution." (Compendium)	
					If the technology is constructed in areas with a high groundwater table the risk for contamination is	
					higher and some further design and effort is needed.	
					It is assumed that a pit is at least 3 m deep and optimally 6 m deep. A vertical safety distance of 3	
					meters is applied.	
excavation	Performance, Categorical	TRUE	easy	(easy = 1, hard = 0.5)		yes
	-		hard		compacted soils (that are difficult to dig) or for areas that flood frequently, except if the pits are	
					raised." (Compendium)	

	_	T	T	T	T	
surface_area_onsite	Performance, Trapez	TRUE	[m2/plot]	(a = 2, b = 2, c = 999, d = 999)	Based on a comparison of different technologies, we derive the space requirements of a fossa alterna to be (at least) twice the space of the space requirements of a single pit. This is based on the assumption that the excrete ands up in two alternating chambers below the user, instead of just one chamber. There are no further significant differences in terms of space requirements between a single pit and a fossa alterna and therefore, using twice the space (ZmZ/pilot) is justified [Cawag, 2021). Note that this does not involve any visual protection. A superstructure could require more space.	
surface_area_offsite	Performance, Trapez		m2/pers	NA	NA	NA
0		FALSE FALSE		NA NA	NA NA	NA NA
0	0	FALSE		NA	NA .	NA
drinking_water_exposure	Performance, Categorical	TRUE	Close Not close	(close = 0, not close = 1)	"In flood-prone areas and where the groundwater table is too high, the Fossa Alterna could be raised or built entirely above ground to avoid water intrusion and groundwater pollution." (Compendium) if the technology is constructed close to a drinking water source the risk for contamination is higher and some further design and effort is needed.	yes
0	0	FALSE		NA	NA	NA
0 construction_skills	Performance, Categorical	FALSE TRUE	Ladder:	NA (unskilled = 0, skilled = 1, professional	NA "Can be built and repaired with locally available	NA yes
construction_skills	Performance, Categorical		unskilled	(unskilled = 0, skilled = 1, professional = 1)	materials" (Compendium)	y
			skilled		Moderate construction skills are recommended, low	
			professional		construction skills could be sufficient.	
design_skills	Performance, Categorical Performance, Categorical		Ladder: unskilled skilled professional	(unskilled = 0, skilled = 1, professional = 1) (unskilled = 0.5, skilled = 1, professional = 1)	"The Fossa Alterna technology will only work properly if the two pits are used sequentially and not concurrently. Therefore, an adequate cover for the out of service pit is required. A UDDT (U.2) can be used with the Fossa Alterna, but only in circumstances when the soil cannot sufficiently absorb the urine or when the urine is highly valued for application. To reduce the smeller even further, a ventilation pipe can be added. If space is abundant and emptying not desired, the Arbordoo (D.1) can be an alternative Disposal option. Pits should not be lined if used as an Arbordoo." (Compendium) Several things to take in account and different configurations possible depending on the circumstances. Since the design requires little lower design skills than a double VIP, moderate design skills are sufficient. "When the first pit is put into use, a layer of leaves."	yes
			Unskilled Stilled Professional	professional = 1)	should be put onto the bottom of the pit. Periodically, more leaves should be added increase the porostly and oxygen availability. Following the addition of faces to the pit, a small amount of soil, ash, and/or leaves should be added. Occasionally, the mounded material beneath the total to possible the should be pushed to the sides of the pit in order to optimise the use of space. Unlike a Single or Ventilated Pit (S.C. S.3) which will be covered or emptied, the material in the Fossa Alterna is meant to be used as a soil conditioner. Herefore, it is extremely important that no garbage is put into the pit. Emptying the Fossa Alterna is easier than emptying other pits; the pits are shallower and the addition of soil, ash, and/or leaves means that the contents are less compact. The material that is removed is not offensive and presents a reduced threat of contamination. Depending on the dimensions of the pits, the contents should not be emptied more often than once a year." (Compendium) Moderate OM skills can ensure propper operation	
0	0	FALSE		NA	NA	NA
0	0	FALSE		NA NA	NA NA	NA NA
0	0	FALSE FALSE		NA NA	NA NA	NA NA
cleansing_method	Performance, Categorical		Washers	NA NA	NA NA	NA .
			Soft wipers			
0	n	FALSE	Hard wipers 0	NA .	NA .	NA .
0	0	FALSE		NA NA	NA NA	NA
lifetime	Performance, Categorical PDF, Categorical	TRUE	short (< 1 year) medium (1-5 years) long (>5 years) rapid (< 3 days)	(short = 1, medium = 1, long = 1)	"Because double pits are used alternately, their life is virtually unlinted" (Compedium) "May require a year or more of maturation before being safe to use." (Pit Humus SLU Compendium) The fact that a storage time of less than one year is unsuitable is not considered in the criterion 'Lifetime', (Kuka Ilmane, Eawag 2021)	yes
argument (FE) _ LVIEL	r Ur, Lategorical		rapin (< 2 days) to 2 weeks) slow (> 2 weeks)	, vinue ave = V.4, suw = U	A slightly lower value is allotted to the category "Rapdf" (80%) than a Single VIP as the complexity of construction is slightly higher, owing to the implementation of verilation system – double pits (double the efforts and consequently time). (Akansha Jain, Eawag 2021) "Twin pit systems include double Ventilated Improved Pits (VIP), and the fossa alterna (FA)." (Twin pit systems: Emersan Compendium) Same values are allotted to both Fossa Alterna and Double VIPs because of the text above. Other important text from Emersan Compendium that bear some relevance for this technology and criteria: "The slab can be fabricated on-site with a mould and cement. In the acute emergency phase, pre-fabricated plastic slabs may be used." "As the second pit only comes into operation when the first pit is full, which may take between 6 to 24 months, Twin PIP LDY systems are recommended as longer- term solutions in prolonged emergency situations."	,
speed_implement_treatment	PDF, Categorical		rapid (few days to a week) moderate (few weeks up to three months) slow (> 3 months)	NA (easy = 1 difficult = 0.8)	NA "Facior excavation than single nit systems. [hut]	NA Nes
scalability	Performance, Categorical	INVE	easy difficult	(easy = 1, difficult = 0.8)	"Easier excavation than single pit systems, [but] double the space and materials required" (Twin Pit Dry System - Emersan) Technology is complete and it's not easy to extend the pit size, however it is possible to build new units. This depends on the availability of material and space. (Rukka limanen. Eaware 2021)	yes
construction_parts	PDF, Categorical	TRUE	simple	(simple = 1, technical = 0, special = 0)	"Can be built and repaired with locally available	yes
	,		technical		materials" (Compendium)	

Transfer Coefficients	(copied from "Sanitation_Technologies_TC_database_20210	622.xlsm*)					
	Pit Humus	Range	Airloss	Soilloss	Waterloss	Comments	Reference
TP	0.29	0,18 - 0,4	0	0.71	0	* as P	Montangero and Belevi (2007)
med (R)	0.29	(0.18 - 0.4)	0	0.71	0	_	-
	5						PA
TN	0.18	0,09-0,27	0	0.82	0	* as N	Montangero and Belevi (2007)
	0.18	0.15 - 0.2	0.55	0.27			Jacks et al. (1999)
	0.2	-	0.6	0.2	0	* TC Soilloss: N reaching the groundwater	Nyenje et al. (2013)
med (R)	0.18	0,09-0,27	0.55	0.27	0		-
k	5	[0.18]					PA
H2O	0.15	0.05 - 0.3	0.15	0.7			PA
						permeability	
med (R)	0.15		0.15	0.70	0		-
	5	[0.25]					PA
TS	0.6	0.5 - 0.7	0	0.4			Montangero and Belevi (2007)
						(Assumption for TS: 0.5 - 0.7)	
med (R)	0.60	0.5 - 0.7	0	0.40	0		-
	5	[0.2]					PA
							Spuhler et al. (2021)

Additional Information

Copied from "single pit" because the treatment is assumed to be similar. The k-factors were decreased if not already at minimum value.

References

Gensch, R., Jennings, A., Renggli, S., & Reymond, P. (2018). Compendium of Sanitation Technologies in Emergencies . German WASH Network (GWN), Swiss Federal Institute of Aquatic Science and Technology (Eawag), Global WASH Cluster (GWC) and Sustainable Sanitation Alliance (SuSanA).

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Deep Trench Latrine							
	Values	Data Source					
UNIQUE IDENTIFIER (ID)		-					
	Matthias van Sloten faeces, excreta, blackwater	- Gensch, R. et al. (2018)					
OUTPUT PRODUCT	sludge	Gensch, R. et al. (2018)					
RELATIONS	Input: OR Output: NA	Gensch, R. et al. (2018)					
COMMENTS							
	Values (household = 0, neighbourhood = 1,	Data Source Gensch, R. et al. (2018)					
	city = 0)						
management_level	(household = 0, shared = 0.5, public = 1)	Gensch, R. et al. (2018)					
capex_req_level		Spuhler, D. et al. (2021)					
opex_req_level technical_maturity		Spuhler, D. et al. (2021) "A Deep Trench Latrine is a widely-					
	_	used communal latrine option for					
		emergencies" (Gensch, R. et al. (2018)).					
	(acute = 1, stabilisation = 0.5, development/recovery = 0)	Gensch, R. et al. (2018)					
		Applicable for this Functional Group?	Categories [Unit]	Technology Values (Data)	Data Source / Assumptions	Internal Review Done?	
water_supply	Performance, Categorical		house	NA	NA	NA	
			yard public				
water_volume	Performance, Trapez	TRUE	none [L/cap/day]	(a = 0, b = 0, c = 8, d = 33)	"No water needed for operation"	yes	
water_volume	renomance, maper	11102	[2] Cap/ Gay]	(4 - 0, 5 - 0, 5 - 0, 4 - 55)	(Emersan).	,	
					No additional water required. This is a technology that is negatively		
					impacted if very high water-volumes		
					enter it (performance is reduced). Since		
					blackwater is an input to this technology, Santiago algorithm CAN pair these		
					technologies with FG U techs that		
					introduce high volumes of water into the system (e.g., Cistern flush). Thus, our		
					criterion (WATER REQ) should bring down the performance of this tech and		
					hence its appropriateness when a user		
					defines a case attribute with high water inputs. Or in other words, if user defines		
					water requirements that allow the FG U		
					tech "Cistern flush toilets" to be selected, then any system which Santiago		
					recommends that combines cistern flush		
					toilets with any of the above four techs— SHOULD have a reduced appropriateness		
					(this reduced appropriateness will be by		
					means of our criterion (WATER REQ). Therefore, an optimal and maximum		
					upper limit of water volume the		
electricity_supply	Performance, Categorical	TRUE	electricity	(electricity = 1, intermittent = 1, no	No need for electricity.	yes	
			intermittent no electricity	electricity = 1)			
fuel_supply	Performance, Categorical	FALSE	fuel no fuel	NA	NA	NA	
frequency_of_om	PDF, Categorical	TRUE	irregular	(irregular = 0, regular = 0.6, continous	"The general operation and maintenance	yes	
			regular continuous	= 0.4)	(O & M) measures therefore include regular cleaning, routine operational		
			Continuous		tasks such as checking availability of		
					water, hygiene items, soap and dry cleansing materials, providing advice on		
					proper use, conducting minor repairs and		
					monitoring of trench filling level. O & M also includes daily covering of excreta		
					with a 10 cm layer of soil to minimise		
					odour and prevent fly breeding." (Emersan)		
					Very labour intensive technology with		
					need for regular or maybe even coninous OM.		
atas accepto	Bufuman Catanadal	TOUE		(an alone A differential and light a			
pipe_supply	Performance, Categorical	INVE	no pipes difficultly available	(no pipes = 1, difficultly available = 1, pipes = 1)	No need for pipes.	yes	
pump_supply	Performance, Categorical	TRUF	no pumps	(no pumps = 1, difficultly available = 1,	No need for numps	yes	
			difficultly available	pumps = 1)	p - copper		
concrete_supply	Performance, Categorical	TRUE	no concrete	(no concrete = 1, difficultly available =	"If possible, locally available construction	yes	
			difficultly available	1, concrete = 1)	materials should be used. The latrine superstructure can be made from local		
			concrete		materials, such as bamboo, wood, plastic		
					or metal sheeting (though this often		
					heats up the interior). The trench lining can be made from bricks, timber, sand		
					bags or temporary lining materials such		
					as bamboo poles or matting." (Emersan) No need for concrete.		
spare_parts	PDF, Categorical	TRUE	simple	(simple = 1, technical = 0, special = 0)	"If possible, locally available construction	yes	
spare_parts	rur, categorical		technical	Simple = 1, technical = 0, special = 0)	materials should be used. The latrine	,	
			special		superstructure can be made from local materials, such as bamboo, wood, plastic		
					or metal sheeting (though this often		
					heats up the interior). The trench lining		
					can be made from bricks, timber, sand bags or temporary lining materials such		
					as bamboo poles or matting. Some relief		
					agencies have rapid response kits for slabs and superstructure which can be		
					used where there are few resources locally." (Emersan)		
	i e				The technology is supposed to be		
					constructed with locally available material, so a need for technical or		
				1	special parts should not occure.		
0		FALSE) NA	NA	NA	
0	0	FALSE	(NA NA	NA	NA	
0 0 0 temperature	0	FALSE FALSE	very cold	NA NA (very cold = 0.5, cold = 0.7, temperate	NA NA A deep trench latrine can be built in		
0 0 0 temperature	0	FALSE FALSE	very cold cold	NA NA	NA NA A deep trench latrine can be built in colder climates but there has to be taken	NA NA	
0 0 0 temperature	0	FALSE FALSE	very cold	NA NA (very cold = 0.5, cold = 0.7, temperate	NA NA A deep trench latrine can be built in	NA NA	
0 0 0 temperature	0	FALSE FALSE	very cold cold temperate	NA NA (very cold = 0.5, cold = 0.7, temperate	NA NA A deep trench latrine can be built in colder climates but there has to be taken in account that leachate respectively soil	NA NA	
0 0 0 temperature	0	FALSE FALSE TRUE	very cold cold temperate warm hot	NA NA (very cold = 0.5, cold = 0.7, temperate	NA A deep trench latrine can be built in colder climates but there has to be taken in account that leachate respectively soil absorbtion performance can be lower if the bottom of the pit is frozen. "Unsuitable for areas with high water-	NA NA	
	0 0 Performance, Categorical	FALSE FALSE TRUE	very cold cold temperate warm hot	NA (very cold = 0.5, cold = 0.7, temperate = 1, warm = 1, hot = 1)	NA A deep trench latrine can be built in colder climates but there has to be taken in account that leachate respectively soil absorbtion performance can be lower if the bottom of the pit is frozen. "Unsuitable for areas with high water-table, unstable soil, rocky ground or	NA NA yes	
	0 0 Performance, Categorical	FALSE FALSE TRUE	very cold cold temperate warm hot	NA (very cold = 0.5, cold = 0.7, temperate = 1, warm = 1, hot = 1)	NA A deep trench latrine can be built in colder climates but there has to be taken in account that leachate respectively soil absorbtion performance can be lower if the bottom of the pit is frozen. "Unsuitable for areas with high watertable, unstable soil, rocky ground or prone to flooding" (Emersan) A low performance of 10% is allotted to	NA NA yes	
	0 0 Performance, Categorical	FALSE FALSE TRUE	very cold cold temperate warm hot	NA (very cold = 0.5, cold = 0.7, temperate = 1, warm = 1, hot = 1)	NA A deep trench latrine can be built in colder climates but there has to be taken in account that leachate respectively soil absorbtion performance can be lower if the bottom of the pit is frozen. "Unsuitable for areas with high water-table, unstable soil, rocky ground or prone to flooding" (Emersan) A low performance of 10% is allotted to the category "Hooding" given that there	NA NA yes	
	0 0 Performance, Categorical	FALSE FALSE TRUE	very cold cold temperate warm hot	NA (very cold = 0.5, cold = 0.7, temperate = 1, warm = 1, hot = 1)	NA A deep trench latrine can be built in colder climates but there has to be taken in account that leachate respectively soil absorbtion performance can be lower if the bottom of the pit is frozen. "Unsuitable for areas with high water-table, unstable soil, rocky ground or prone to flooding" (Emersan) A low performance of 10% is allotted to the category "flooding" given that there exists the possibility that deep trench latrines could be built at leevated/ non-	NA NA yes	
	0 0 Performance, Categorical	FALSE FALSE TRUE	very cold cold temperate warm hot	NA (very cold = 0.5, cold = 0.7, temperate = 1, warm = 1, hot = 1)	NA A deep trench latrine can be built in Colder climates but there has to be taken in account that leachate respectively soil absorbtion performance can be lower if the bottom of the pit is frozen. "Unsuitable for areas with high water- table, unstable soil, rocky ground or prone to flooding" (Emersan) A low performance of 10% is allotted to the category "flooding" given that there exists the possibility that deep trench	NA NA yes	

vehicular_acces	Performance, Categorical	TRUE	no access	(no access = 0.3, difficult =0.6, full = 1)	"Accessibility for desludging vehicles C.2	yes
			difficult full		should be considered. If desludging is not an option the latrines should be	
					decommissioned X.6 when the trench is filled up to 0.5 m below the top of the	
					trench." (Emersan) Vehicular access is not necessary needed	
					but gives more options for decommission of the products especially as regular emptying is required.	
slope	Performance, Categorical	FALSE	flat not flat	NA	NA	NA
soil_type	Performance, Categorical	TRUE	clay	(clay = 0.25, silt = 0.5, sand = 1, gravel = 0.5, rock = 0.25)	"Unsuitable for areas with high water- table, unstable soil, rocky ground or	yes
			sand gravel	,	prone to flooding" (Emersan) "Special attention should be paid to []	
			rock		ground conditions and soil permeability. Poorly permeable soil will increase the	
					rate at which the pit fills." (Emersan) Soil percolation and filtration is desired.	
groundwater_depth	Performance, Trapez	TRUE	water depth [m]	(a = 4.5, b = 6, c = 999, d = 999)	"Unsuitable for areas with high water- table, unstable soil, rocky ground or	yes
					prone to flooding" (Emersan) "The depth (usually between 1.5 to 3 m)	
					may vary depending on local soil conditions and required speed of	
					implementation. A maximum trench length of 6 m is recommended, providing	
excavation	Performance, Categorical	TRUE	easy	(easy = 1, hard =0.75)	for six cubicles." (Emersan) "The depth (usually between 1.5 to 3 m)	yes
			hard		may vary depending on local soil conditions and required speed of	
					implementation. A maximum trench length of 6 m is recommended, providing	
					for six cubicles." (Emersan) Volume of excavation is not that big. In	
					areas where excavation is hard the construction is still possible but therefore	
surface_area_onsite	Performance, Trapez	TRUE	[m2/plot]	(a = 1, b = 1, c = 999, d = 999)	it gets more labour intensive. Deep trench latrines can also be constructed on a small footprint	
					("Trenches should be around 0.8– 0.9 m wide" (Emersan)). Based on a comparison	
					of different technologies, we derive the space requirements of a deep trench to	
					be similar to a single pit and use the same minimum space requirement of 1m2/plot	
					(Eawag, 2021). Note that this does not involve any visual protection. A	
					superstructure could require more space.	
surface_area_offsite 0		FALSE		NA NA	NA NA	NA NA
0	0	FALSE FALSE	0	NA NA	NA NA	NA NA
drinking_water_exposure	Performance, Categorical	TRUE	Close Not close	(close = 0, not close = 1)	"As with all pit-based systems, groundwater contamination can be an	yes
					issue and soil properties such as the permeability of the soil and groundwater	
					level should be properly assessed X.3 to identify the minimum distance to the	
					next water source and limit exposure to microbial contamination." (Emersan)	
0	0					
0		FALSE FALSE		NA NA	NA NA	NA NA
0 construction_skills		FALSE	Ladder:	NA (unskilled = 1, skilled = 1, professional	NA "Inexpensive and quick to construct"	NA NA yes
construction_skills	O Performance, Categorical	FALSE TRUE	0	NA (unskilled = 1, skilled = 1, professional = 1)	NA "Inexpensive and quick to construct" (Emersan) Simple construction that does not need moderate or high construction skills.	NA
	0	FALSE TRUE	0 Ladder: unskilled skilled professional Ladder: unskilled	NA (unskilled = 1, skilled = 1, professional	NA "inexpensive and quick to construct" (Emersan) Simple construction that does not need moderate or high construction skills. "Proper drainage should be provided for around the trench to ensure runoff and	NA
construction_skills	O Performance, Categorical	FALSE TRUE	Ladder: unskilled skilled professional Ladder:	NA (unskilled = 1, skilled = 1, professional = 1) (unskilled = 0, skilled = 0.5,	NA "Inexpensive and quick to construct" (Emersan) Simple construction that does not need moderate or high construction skills. "Proper drainage should be provided for around the trench to ensure rundf and prevent flooding. When the trench is complete, salsa are placed over it.	NA yes
construction_skills	O Performance, Categorical	FALSE TRUE	Dadder: unskilled skilled skilled skilled Ladder: unskilled skilled	NA (unskilled = 1, skilled = 1, professional = 1) (unskilled = 0, skilled = 0.5,	NA "Inexpensive and quick to construct" (Emersan) Simple construction that does not need moderate or high construction skills. "Proper drainage should be provided for around the trench to ensure runoff and prevent flooding. When the trench is complete, slabs are placed over it. Prefabricated self-supporting plastic slabs can increase the speed of construction, if	NA yes
construction_skills	O Performance, Categorical	FALSE TRUE	Dadder: unskilled skilled skilled skilled Ladder: unskilled skilled	NA (unskilled = 1, skilled = 1, professional = 1) (unskilled = 0, skilled = 0.5,	NA "Inexpensive and quick to construct" (Emersan) Simple construction that does not need moderate or high construction skills. "Proper drainage should be provided for around the trench to ensure runoff and prevent flooding. When the trench is complete, slabs are placed over it. Prefabricated self-supporting plastic slabs can increase the speed of construction, if available. Alternatively, wooden planks can be secured across the trench (leaving	NA yes
construction_skills	O Performance, Categorical	FALSE TRUE	Dadder: unskilled skilled skilled skilled Ladder: unskilled skilled	NA (unskilled = 1, skilled = 1, professional = 1) (unskilled = 0, skilled = 0.5,	NA "Inexpensive and quick to construct" (Emersan) Simple construction that does not need moderate or high construction skills. "Proper drainage should be provided for around the trench to ensure runoff and prevent flooding. When the trench is complete, slabs are placed over it. Prefabricated self-supporting plastic slabs can increase the speed of construction, if available. Alternatively, wooden planks can be secured across the trench (leaving out every third or fourth plank for defecation) nutl wooden or concrete	NA yes
construction_skills	O Performance, Categorical	FALSE TRUE	Dadder: unskilled skilled skilled skilled Ladder: unskilled skilled	NA (unskilled = 1, skilled = 1, professional = 1) (unskilled = 0, skilled = 0.5,	NA. "Inexpensive and quick to construct" (Emersan) Simple construction that does not need moderate or high construction skills. "Proper drainage should be provided for around the trench to ensure runoff and prevent flooding. When the trench is complete, slabs are placed over it. Prefabricated self-supporting plastic slabs can increase the speed of construction, if available. Alternatively, wooden planks can be secured across the trench (leaving out every third or fourth plank for defecation) until wooden or concrete slabs can be produced locally. The slabs can be fitted with pedestal toilets where	NA yes
construction_skills	O Performance, Categorical	FALSE TRUE	Dadder: unskilled skilled skilled skilled Ladder: unskilled skilled	NA (unskilled = 1, skilled = 1, professional = 1) (unskilled = 0, skilled = 0.5,	NA. "Inexpensive and quick to construct" (Emersan) Simple construction that does not need moderate or high construction skills. "Proper drainage should be provided for around the trench to ensure runoff and prevent flooding. When the trench is complete, slabs are placed over it. Perfabricated self-supporting plastic slabs can increase the speed of construction, if available. Alternatively, wooden planks can be secured across the trench (leaving out every third or fourth plank for of the flash of the construction) until wooden or concrete slabs can be produced locally. The slabs can be fitted with pedestal toilets where users do not squat. Separate trench latrines for men and women should be	NA yes
construction_skills	O Performance, Categorical	FALSE TRUE	Dadder: unskilled skilled skilled skilled Ladder: unskilled skilled	NA (unskilled = 1, skilled = 1, professional = 1) (unskilled = 0, skilled = 0.5,	IAA. "Inexpensive and quick to construct" (Emersan) Simple construction that does not need moderate or high construction skills. "Proper drainage should be provided for around the trench to ensure runoff and prevent flooding. When the trench is complete, slabs are placed over it. Perfabricated self-supporting plastic slabs can increase the speed of construction, if available. Alternatively, wooden planks can be secured across the trench (leaving out every third or fourth plank for defectation) until wooden or concrete slabs can be firted with pedestal toilets where users do not squat. Separate trench latrines for men and women should be considered. The trench lifespan (the time required to fill it to within half a metre of	NA yes
construction_skills	O Performance, Categorical	FALSE TRUE	Dadder: unskilled skilled skilled skilled Ladder: unskilled	NA (unskilled = 1, skilled = 1, professional = 1) (unskilled = 0, skilled = 0.5,	INA. "Inexpensive and quick to construct" (Emersan) Simple construction that does not need moderate or high construction skills. "Proper drainage should be provided for around the trench to ensure runoff and prevent flooding. When the trench is complete, slabs are placed over it. Prefabricated self-supporting plastic slabs can increase the speed of construction, if available. Alternatively, wooden plants can be secured across the trench (leaving out every third or fourth plank for foreign the secured across the trench (leaving out every third or fourth plank for foreign the stabs can be fitted with pedestal toilets where users do not squard. Separate trench latrines for men and women should be considered. The trench life to within half a metre of the top) is a function of the trench volume, divided by the number of users	NA yes
construction_skills	O Performance, Categorical	FALSE TRUE	Dadder: unskilled skilled skilled skilled Ladder: unskilled	NA (unskilled = 1, skilled = 1, professional = 1) (unskilled = 0, skilled = 0.5,	NA "Inexpensive and quick to construct" [Emersan] Simple construction that does not need moderate or high construction skills. "Proper drainage should be provided for around the trench to ensure runoff and prevent flooding. When the trench is complete, salsa are placed over to complete, salsa are placed over to complete, salsa are placed over to available. Alternatively, wooden plants can be secured across the trench (leaving out every third or fourth plank for defecation) until wooden or concrete slabs can be fitted with woeden or concrete slabs can be fitted with pedestat toilets where users do not squat. Separate trench latrines for men and women should be considered. The trench lifespan (the time required to fill it to within half a metre of the top) is a function of the trench	NA yes
construction_skills	O Performance, Categorical	FALSE TRUE	Dadder: unskilled skilled skilled skilled Ladder: unskilled	NA (unskilled = 1, skilled = 1, professional = 1) (unskilled = 0, skilled = 0.5,	INA "Inexpensive and quick to construct" (Emersan) Simple construction that does not need moderate or high construction skills. "Proper drainage should be provided for around the trench to ensure runoff and prevent flooding. When the trench is complete, slabs are placed over it. Prefabricated self-supporting plastic slabs can increase the speed of construction, if available. Alternatively, wooden plants can be secured across the trench (leaving out every third or fourth plank for defecation) until wooden or concrete slabs can be produced locally. The slabs can be fitted with pedestal toilets where users do not squat. Separate trench latrines for men and women should be considered. The trench lifespan (the time required to fill it to within half a metre of the top) is a function of the trench volume, divided by the number of osers and estimated excreta volume generated per person. On average, solids	NA yes
construction_skills	O Performance, Categorical	FALSE TRUE	Dadder: unskilled skilled skilled skilled Ladder: unskilled	NA (unskilled = 1, skilled = 1, professional = 1) (unskilled = 0, skilled = 0.5,	INA. "Inexpensive and quick to construct" (Emersan) Simple construction that does not need moderate or high construction skills. "Proper drainage should be provided for around the trench to ensure runoff and prevent flooding. When the trench is complete, slabs are placed over it. Prefabricated self-supporting plastic slabs can increase the speed of construction, if available. Alternatively, wooden planks can be secured across the trench (leaving out every third or fourth plank if the stabs can be produced locally. The slabs can be fitted with pedestal toilets where users do not squat. Separate trench latrines for men and women should be considered. The trench lifespan (the time required to fall it to within half a metre of the tople, is a function of the trench volume, dividended by the number of users and estimated excreta volume generated per person. On average, solids accumulate at a rate of 3–5. L/person/month and up to 5–7.5. L/person/expensions plants are used. (Emersan) Even though several of things have to be	NA yes
construction_skills design_skills	Performance, Categorical Performance, Categorical	FALSE TRUE	Ladder: unskilled skilled professional Ladder: unskilled skilled professional	NA (unskilled = 1, skilled = 1, professional = 1) (unskilled = 0, skilled = 0.5, professional = 1)	NA "Inexpensive and quick to construct" (Emersan) Simple construction that does not need moderate or high construction skills. "Proper drainage should be provided for around the trench to ensure runoff and prevent flooding. When the trench is complete, slabs are placed over the complete, slabs are placed over the plastic slabs can be secured across the trench (leaving out every third or fourth plank for defecation) until wooden or concrete slabs can be produced locally. The slabs can be fitted with pedestal toilets where users do not square. Support the plank for the considered. The trench lifespan (the time required to fill it to within half a metre of the top) is a function of the trench volume, divided by the number of users and estimated excreta volume penerated per person. On average, solids accumulate at a rate of 3–5 (Uperson/month if dry cleansing materials are used." (Emersan)	NA Yes
construction_skills	O Performance, Categorical	FALSE TRUE	Dadder: unskilled skilled skilled skilled Ladder: unskilled	NA (unskilled = 1, skilled = 1, professional = 1) (unskilled = 0, skilled = 0.5,	INA. 'Inexpensive and quick to construct" [Emersan] Simple construction that does not need moderate or high construction skills. 'Proper drainage should be provided for around the trench to ensure runoff and prevent flooding. When the trench is complete, slabs are placed over it. Prefabricated self-supporting plastic slabs can increase the speed of construction, if available. Alternatively, wooden planks can be secured across the trench (leaving out every third or fourth plank / The slabs can be produced locally. The slabs can be fitted with pedestal toilets where users do not squat. Separate trench latirines for men and women should be considered. The trench lifespan (the time required to fill it to within half a metre of the top) is a function of the trench volume, dividend by the number of users and estimated excreta volume generated per person. On average, solids accumulate at a rate of 3-5 Li/person/month and up to 5-7.5 Li/person/month and up to 5-7.5 Li/person/month if dry cleansing materials are used. ('Emersan) Eventh. "General" is pretty simple. 'Deep Trench Latrines are usually built as communal latrine blocks. The general	NA Yes
construction_skills design_skills	Performance, Categorical Performance, Categorical	FALSE TRUE	Ladder: unskilled skilled professional Ladder: unskilled professional Ladder: Unskilled Ladder: Unskilled	NA (unskilled = 1, skilled = 1, professional = 1) (unskilled = 0, skilled = 0.5, professional = 1) (unskilled = 0.5, skilled = 1, (unskilled = 0.5, professional = 1)	INA. "Inexpensive and quick to construct" (Emersan) Simple construction that does not need moderate or high construction skills. "Proper drainage should be provided for around the trench to ensure runoff and prevent flooding. When the trench is complete, slabs are placed over it. Prefabricated self-supporting plastic slabs can increase the speed of construction, if available. Alternatively, wooden plants can be secured across the trench (leaving out every third or fourth plank first plants of the secured across the trench (leaving out every third or fourth plank first plants and the secured across the trench (leaving out every third for fourth plank first plants and the secured across the trench leaving out every third the trench leaving the stabs can be fitted with pedestal toilets where users do not square. Separate trench latrines for men and women should be considered. The trench lifespan (the time required to fill it to within half a metre of the top) is a function of the trench volume, divided by the number of users and estimated excreta volume generated per person. On average, solids accumulate at a rate of 3–5 L/person/month if dry cleansing materials are used." (Bersan) Even though several of things have to be considered the design is pretty simple. "Deep Trench Latrines are usually built as	NA Yes
construction_skills design_skills	Performance, Categorical Performance, Categorical	FALSE TRUE	Ladder: unskilled skilled professional Ladder: unskilled skilled professional Ladder: Unskilled Skilled Unskilled	NA (unskilled = 1, skilled = 1, professional = 1) (unskilled = 0, skilled = 0.5, professional = 1) (unskilled = 0.5, skilled = 1, (unskilled = 0.5, professional = 1)	INA. "Inexpensive and quick to construct" (Emersan) Simple construction that does not need moderate or high construction skills. "Proper drainage should be provided for around the trench to ensure runoff and prevent flooding. When the trench is complete, slabs are placed over it. Prefabricated self-supporting plastic slabs can increase the speed of construction, if available. Alternatively, wooden planks can be secured across the trench (leaving out every third or fourth plank for of defecation) until wooden or concrete slabs can be fitted with pedestal toilets where users do not squat. Separate trench latrines for men and women should be considered. The trench lifespan (the time required to fill it to within half a metre of the top), is a function of the trench volume, divided by the number of users and estimated excreta volume generated per person. On average, solids accumulate at a rate of 3–5. L/person/month and up to 5–7.5. L/person/month if dry cleansing materials are used. (Emersan) The proper prench Latrines are usually built as communal latrine blocks. The general operation and maintenance (O & M) measures therefore include regular	NA Yes
construction_skills design_skills	Performance, Categorical Performance, Categorical	FALSE TRUE	Ladder: unskilled skilled professional Ladder: unskilled skilled professional Ladder: Unskilled Skilled Unskilled	NA (unskilled = 1, skilled = 1, professional = 1) (unskilled = 0, skilled = 0.5, professional = 1) (unskilled = 0.5, skilled = 1, (unskilled = 0.5, professional = 1)	INA "Inexpensive and quick to construct" [Emersan] Simple construction that does not need moderate or high construction skills. "Proper drainage should be provided for around the trench to ensure runoff and prevent flooding. When the trench is complete, slabs are placed over the special complete, slabs are placed over the special construction, if available. Alternatively, wooden planks can be secured across the trench (leaving out every third or fourth plank for defecation) until wooden or concrete slabs can be produced locally. The slabs can be fitted with pedestal toilets where users do not square. Separate trench latrines for men and women should be considered. The trench lifespan (the time required to fill it to within half a metre of the top) is a function of the trench volume, divided by the number of users and estimated excreta volume generated per person. On average, solids accumulate at a rate of 3-5 L/person/month ind cycleansing materials are used." (Emersan) Even though several of things have to be considered. The several poperation and maintenance (O & M) measures therefore include regular coloning, routine blocks. The general operation and maintenance (O & M) measures therefore include regular extens, soap and dry cleansing materials, providing advice on proper use, conducting minor repairs and monitoring	NA Yes
construction_skills design_skills	Performance, Categorical Performance, Categorical	FALSE TRUE	Ladder: unskilled skilled professional Ladder: unskilled skilled professional Ladder: Unskilled Skilled Unskilled	NA (unskilled = 1, skilled = 1, professional = 1) (unskilled = 0, skilled = 0.5, professional = 1) (unskilled = 0.5, skilled = 1, (unskilled = 0.5, professional = 1)	NA 'Inexpensive and quick to construct" [Emersain] Simple construction that does not need moderate or high construction skills. 'Proper drainage should be provided for around the trench to ensure runoff and prevent flooding. When the trench is complete, slabs are placed over the complete, slabs are placed over the complete, slabs are placed over the speed of construction, if available. Alternatively, wooden planks can be secured across the trench (leaving out every third or fourth plank for defecation) until wooden or concrete slabs can be produced locally. The slabs can be fitted with pedestal toilets where users do not squart. Separate trench latrines for men and women should be considered. The trench lifespan (the time required to fill it to within half a metre of the top) is a function of the trench volume, divided by the number of users and estimated excreta volume generated per person. On average, solids accumulate at a rate of 3–5 L/person/month and up to 5–7.5 L/person/month if dry cleansing materials are used." (Emersan) Even though several of things have to be considered the design is pretty simple. "Deep Trench Latrines are usually built as communal latrine blocks. The general operation and maintenance (O & M) measures therefore include regular cleaning, routine operational tasks such as checking availability of water, hygiene items, soap and dry cleansing materials, providing advice on proper use, conducting minor repairs and monitoring of trench filling level. O & M also includes dally covering of excreta with a 10 cm	NA Yes
construction_skills design_skills	Performance, Categorical Performance, Categorical	FALSE TRUE	Ladder: unskilled skilled professional Ladder: unskilled skilled professional Ladder: Unskilled Skilled Unskilled	NA (unskilled = 1, skilled = 1, professional = 1) (unskilled = 0, skilled = 0.5, professional = 1) (unskilled = 0.5, skilled = 1, (unskilled = 0.5, professional = 1)	NA "Inexpensive and quick to construct" [Emersan] Simple construction that does not need moderate or high construction skills. "Proper drainage should be provided for around the trench to ensure runoff and prevent flooding. When the trench is complete, slabs are placed over the complete, slabs are placed over to complete, slabs are placed over to available. Alternatively, wooden planks can he secured across the trench (leaving out every third or fourth plank for defecation) until wooden or concrete slabs can be produced locally. The slabs can be fitted with pedestal toilets where users do not squat. Separate trench latrines for men and women should be considered. The trench lifespan (the time required to fill it to within half a metre of the top) is a function of the trench volume, divided by the number of users and estimated excreta volume generated per person. On average, solids accumulate at a rate of 3–5 Uperson/month and up to 5–7.5 Uperson/month if dry cleansing materials are used." (Emersan) "Deep Trench Latrines are usually built as communal latrine blocks. The general operation and maintenance (O & M) measures therefore include regular cleaning, routine operational tasks such as checking availability of water, hygiene letems, soap and dry cleansing materials, providing advice on proper use, conducting miner repairs and monitoring of trench filling level. O & M also indured layer of soil to minimise odour and prevent fly breeding. As trenches are	NA Yes
construction_skills design_skills	Performance, Categorical Performance, Categorical	FALSE TRUE	Ladder: unskilled skilled professional Ladder: unskilled skilled professional Ladder: Unskilled Skilled Unskilled	NA (unskilled = 1, skilled = 1, professional = 1) (unskilled = 0, skilled = 0.5, professional = 1) (unskilled = 0.5, skilled = 1, (unskilled = 0.5, professional = 1)	INA. "Inexpensive and quick to construct" (Emersan) Simple construction that does not need moderate or high construction skills. "Proper drainage should be provided for around the trench to ensure runoff and prevent flooding. When the trench is complete, slabs are placed over it. Prefabricated self-supporting plastic slabs can increase the speed of construction, if available. Alternatively, wooden plants can be secured across the trench (leaving out every third or fourth plank for of defecation) until wooden or concrete slabs can be produced locally. The slabs can be fitted with pedestal toilets where users do not squared. Separate trench latrines for men and women should be considered. The trench flespan (the time required to fill it to within half a metre of the top) is a function of the trench volume, divided by the number of users and estimated excreta volume generated per person. On average, solids accumulate at a rate of 3–5. Lyperson/month if dry cleansing materials are used." (Emersan) Even though several of things have to be considered the design is pretty simple. "Deep Trench tartines are usually built as communal latrine blocks. The general operation and maintenance (0 & M) measures therefore include regular cleaning, routine operational tasks such as checking availability of water, hygiene items, soap and dry cleansing materials, providing advice on proper use, conducting filing revent by breeding. As trenches are often misused for solid waste disposal, which can complicate later emptying,	NA Yes
construction_skills design_skills	Performance, Categorical Performance, Categorical	FALSE TRUE	Ladder: unskilled skilled professional Ladder: unskilled skilled professional Ladder: Unskilled Skilled Unskilled	NA (unskilled = 1, skilled = 1, professional = 1) (unskilled = 0, skilled = 0.5, professional = 1) (unskilled = 0.5, skilled = 1, (unskilled = 0.5, professional = 1)	INA. "Inexpensive and quick to construct" (Emersan) Simple construction that does not need moderate or high construction skills. "Proper drainage should be provided for around the trench to ensure runoff and prevent flooding. When the trench is complete, salsa are placed over it. Prefabricated self-supporting plastic salso can increase the speed of construction, if available. Alternatively, wooden plants can be secured across the trench (leaving out every third or fourth plants). The salsa can be reduced locally. The salsa can be reduced or fourth plants, the salsa can be produced locally. The salsa can be fitted with pedestal toilets where users do not squal. Separate trench latrines for men and women should be considered. The trench lifespan (the time required to fill it to within half a metre of the top) is a function of the trench volume, divided by the number of users and estimated excreta volume generated per person. On average, solids accumulate at a rate of 3–5. L/person/month and up to 5–7.5. L/person/month if dry cleansing materials are used." (Emersan) Even though several of things have to be considered the design is pretty simple. "Deep Trench tartines are usually built as communal latrine blocks. The general operation and maintenance (O & M) measures therefore include regular cleaning, routine operational tasks such as checking availability of water, hygiene items, soap and dry cleansing materials, providing advice on proper use, conducting minor even it is a formation of the considered the design is pretty simple. Which can complicate later emptying, awareness raising measures X.12 should be a part of installation programmes. If	NA Yes
construction_skills design_skills	Performance, Categorical Performance, Categorical	FALSE TRUE	Ladder: unskilled skilled professional Ladder: unskilled skilled professional Ladder: Unskilled Skilled Unskilled	NA (unskilled = 1, skilled = 1, professional = 1) (unskilled = 0, skilled = 0.5, professional = 1) (unskilled = 0.5, skilled = 1, (unskilled = 0.5, professional = 1)	INA. "Inexpensive and quick to construct" (Emersan) Simple construction that does not need moderate or high construction skills. "Proper drainage should be provided for around the trench to ensure runoff and prevent flooding. When the trench is complete, slabs are placed over it. Prefabricated self-supporting plastic slabs can increase the speed of construction, if available. Alternatively, wooden plants can be secured across the trench (leaving out every third or fourth plank for fordefecation) until wooden or concrete slabs can be produced locally. The slabs can be fitted with pedestal toilets where users 60 not squared. Separate trench latrines for men and women should be considered. The trench lifespan (the time required to fill it to within half a metre of the top) is a function of the trench volume, divided by the number of users and estimated excreta volume generated per person. On avarage, solids accumulate at a rate of 3–5 L/person/month if dry (elansing materials are used." (Emersan) Even though several of things have to be considered the design is pretty simple. "Deep Trench Latrines are usually built as communal latrine blocks. The general operation and maintenance (O & M) measures therefore include regular cleaning, routing maintenance (O & M) measures therefore include regular cleaning, routing maintenance (O & M) measures therefore of sucreta with a 10 cm layer of soil to minimise dodour and prevent fly breeding. As trenches are often misused for soild waste disposal, which can complicate later emptying, awareness raising measures X.12 should be a part of installation programmes. If desiudging is not an option the latrines should be decommissioned X.6 when the	NA Yes
construction_skills design_skills	Performance, Categorical Performance, Categorical	FALSE TRUE	Ladder: unskilled skilled professional Ladder: unskilled skilled professional Ladder: Unskilled Skilled Unskilled	NA (unskilled = 1, skilled = 1, professional = 1) (unskilled = 0, skilled = 0.5, professional = 1) (unskilled = 0.5, skilled = 1, (unskilled = 0.5, professional = 1)	INA "Inexpensive and quick to construct" [Emersain] Simple construction that does not need moderate or high construction skills. "Proper drainage should be provided for around the trench to ensure runoff and prevent flooding. When the trench is complete, slabs are placed over it. Prefabricated self-supporting plastic slabs can be respect of construction, if available. Alternatively, wooden planks can be secured across the trench (leaving out every third or fourth plank for defecation) until wooden or concrete slabs can be produced locally. The slabs can be fitted with pedestal toilets where users do not square. Support of the slabs can be fitted with pedestal toilets where users do not square. Support of the considered. The trench lifespan (the time required to fill it to within half a metre of the top) is a function of the trench considered. The trench lifespan destinated excreta volume generated per person. On average, solids accumulate at a rate of 3–5. Li/person/month and up to 5–7.5. Li/person/month if dry cleansing materials are used." (Emersar) Even though several of things have to be considered. The several per several conducting miner person and maintenance (O & M) measures therefore include regular cleaning, routine operational materials, providing advice on proper use, conducting minor repairs and monitoring of trench filling level. O & M also includes ally covering of excreta with a 10 cm layer of soil to mainteins odour and prevent fly breeding. As trenches are often misused for solid waste disposal, which can complicate later emptying of trench trained and prevent fly breeding. As trenches are often misused for solid waste disposal, which can complicate later emptying of trench trained and prevent fly breeding. As trenches are often misused for solid waste disposal, which can complicate later emptying of trench trained and trained and trained and trained and trained and trained and trained and trained and trained and trained and trained and trained and trained and trained and trained and t	NA Yes
construction_skills design_skills	Performance, Categorical Performance, Categorical	FALSE TRUE	Ladder: unskilled skilled professional Ladder: unskilled skilled professional Ladder: Unskilled Skilled Unskilled	NA (unskilled = 1, skilled = 1, professional = 1) (unskilled = 0, skilled = 0.5, professional = 1) (unskilled = 0.5, skilled = 1, (unskilled = 0.5, professional = 1)	INA "Inexpensive and quick to construct" (Emersain) Simple construction that does not need moderate or high construction skills. "Proper drainage should be provided for around the trench to ensure runoff and prevent flooding. When the trench is complete, slabs are placed over it. Prefabricated self-supporting plastic slabs can be greated self-supporting plastic slabs can be research (leaving out every third or fourth plank for of defecation) until wooden or concrete slabs can be freded or fourth plank. The slabs can be fitted with pedestal toilets where users do not square. Self-support for defecation) until wooden or concrete slabs can be fitted with pedestal toilets where users do not square. Self-support for the trench lifespan (the time required to fill it to within half a metre of text of the top) is a function of the trench volume, divided by the number of users and estimated excreta volume generated per person. On everage, solids accumulate at a rate of 3–5 L/person/month and up to 5–7.5 L/person/month if dry cleansing materials are used." (femersan) Even though several of things have to be considered the design is pretty simple. "Deep Trench Latrines are usually built as communal latrine blocks. The general operation and maintenance (O & M) measures therefore include regular cleaning, routing minor repairs and monitoring of trench filling level. O & M also includes daily covering of excreta with a 10 cm layer of soil to minimise odour and prevent fly breeding. As trenches are orden misused for soil wasset disposal, which can complicate later emptying, awareness raising measures X.12 should be a part of installation programmes. If deskudging is not an option the latrines should be decommissioned X.6 when the trench is filled up to 0.5 m below the top of the trench." (Emersan) The only crucial thing is determining	NA Yes
construction_skills design_skills om_skills	Performance, Categorical Performance, Categorical	TRUE TRUE	Ladder: unskilled skilled professional Ladder: unskilled skilled professional Ladder: Unskilled Skilled Professional	NA (unskilled = 1, skilled = 1, professional = 1) (unskilled = 0, skilled = 0.5, professional = 1) (unskilled = 0.5, skilled = 1, professional = 1)	INA. "Inexpensive and quick to construct" (Emersain) Simple construction that does not need moderate or high construction skills. "Proper drainage should be provided for around the trench to ensure runoff and prevent flooding. When the trench is complete, slabs are placed over it. Prefabricated self-supporting plastic slabs can be greated self-supporting plastic slabs can be secured across the trench (leaving out every third or fourth plank for defecation) until wooden or concrete slabs can be fitted with pedestal toilets where users do not square. It is shabs can be fitted with pedestal toilets where users do not square. Separate trench latrines for men and women should be considered. The trench lifespan (the time required to fill it to within half a metre of the top) is a function of the trench volume, divided by the number of users and estimated excreta volume generated per person. On average, solids accumulate at a rate of 3–5 L/person/month and up to 5–7.5 L/person/month and up to 5–7.5 L/person/month if dry cleansing materials are used." (Emersan) Even though several of things have to be considered the design is pretty simple. "Deep Trench Latrines are usually built as communal latrine blocks. The general operation and maintenance (O & M) measures therefore include regular cleaning, routine operation and mretenals, providing advice on proper use, conducting minor repairs and monitoring of trench filling level. O & M also includes daily covering of excreta with a 10 cm layer of soil to not anyton the latrines should be decommissioned X.6 when the trench is fillied up to 0.5 m below the top of the trench." (Emersan) The only crucial thing is determining when to decommission the latrine.	yes yes
construction_skills design_skills om_skills	Performance, Categorical Performance, Categorical Performance, Categorical	TRUE TRUE TRUE FALSE FALSE FALSE	Ladder: unskilled skilled professional Ladder: unskilled skilled professional Ladder: Unskilled Skilled Professional	NA (unskilled = 1, skilled = 1, professional = 1) (unskilled = 0, skilled = 0.5, professional = 1) (unskilled = 0.5, skilled = 1, professional = 1)	INA. "Inexpensive and quick to construct" (Emersain) Simple construction that does not need moderate or high construction skills. "Proper drainage should be provided for around the trench to ensure runoff and prevent flooding. When the trench is complete, slabs are placed over it. Prefabricated self-supporting plastic slabs can be respect of construction, if available. Alternatively, wooden planks can be secured across the trench (leaving out every third or fourth plank for defecation) until wooden or concrete slabs can be fitted with pedestal toilets where users do not square. It is a subject to the stable scan be fitted with pedestal toilets where users do not square. Separate trench latrines for men and women should be considered. The trench lifespan (the time required to fill it to within half a metre of the top) is a function of the trench cholume, divided by the number of users and estimated excreta volume generated per person. On average, solids accumulate at a rate of 3–3 Liperson/month and up to 5–7.5 Liperson/month if dry leansing materials providing advice on proper use, considered. The design is pretty simple. "Deep Trench Latrines are usually built as communal latrine blocks. The general operation and maintenance (O & M) measures therefore include regular cleaning, routing advice on proper use, conducting minor repairs and monitoring of trench filling level. O & M also includes daily covering of excreta with a 10 cm often misused for solid waste disposal, which can complicate later emptyling of trench filling level. O & M also includes daily covering of excreta with a 10 cm often misused for solid waste disposal, which can complicate later emptyling of trench filling level. O & M also includes daily covering of excreta with a 10 cm tench is filled up to 0.5 m below the top of the trench." (Emersan) The only crucial thing is determining when to decommission the latrine.	yes yes
construction_skills design_skills om_skills om_skills	Performance, Categorical Performance, Categorical Performance, Categorical	FALSE TRUE TRUE TRUE TRUE FALSE FALSE FALSE FALSE	Ladder: unskilled skilled professional Ladder: unskilled skilled professional Ladder: Unskilled skilled Professional	NA (unskilled = 1, skilled = 1, professional = 1) (unskilled = 0, skilled = 0.5, professional = 1) (unskilled = 0.5, skilled = 1, professional = 1) NA NA NA NA NA NA NA NA NA NA	INA Tinexpensive and quick to construct" [Emersian] Simple construction that does not need moderate or high construction skills. "Proper drainage should be provided for around the trench to ensure runoff and prevent flooding. When the trench is complete, slabs are placed over it. Prefabricated self-supporting plastic slabs can be research speed of construction, if available. Alternatively, wooden planks can be secured across the trench (leaving out every third or fourth plank for defecation) until wooden or concrete slabs can be fitted with pedestal toilets where users do not square. The slabs can be fitted with pedestal toilets where users do not square. Separate trench latrines for men and women should be considered. The trench lifespan (the time required to fill it to within half a metre of the top) is a function of the trench considered. The trench lifespan desired and estimated exercted volume, divided by the number of users and estimated exercted volume generated per person. On average, solving acreased on average, solving acreased are used." (Emersian) Even though several of things have to be considered. The design is pretty simple. Deep Trench Latrines are usually built as communal latrine blocks. The general prevainment of the considered the design is pretty simple. Deep Trench Latrines are usually built as communal latrine operation and maintenance (Og & M) measures therefore include regular cleaning, routine operation and maintenance (Og & M) measures therefore include regular cleaning, routing repairs and monitoring of trench filling level. Og & M also includes them, soap and monitoring of trench filling level. Og & M as included the condition of the subject of soil to minimise odour and prevent fly breeding. As trenches are often misused for soil dwaste disposal, which can complicate later emptying, awareness raising measures X; a bould be a part of installation programmes. If deskudging is not an option the latrines should be decommission the latrines should be decommission the latrine. N	yes yes yes NA NA NA NA
construction_skills design_skills om_skills	Performance, Categorical Performance, Categorical Performance, Categorical	FALSE TRUE TRUE TRUE TRUE FALSE FALSE FALSE FALSE	Ladder: unskilled skilled professional Ladder: unskilled skilled professional Ladder: Unskilled skilled Professional	NA (unskilled = 1, skilled = 1, professional = 1) (unskilled = 0, skilled = 0.5, professional = 1) (unskilled = 0.5, skilled = 1, professional = 1) (unskilled = 0.5, skilled = 1, professional = 1)	NA 'Inexpensive and quick to construct' [Emersan] Simple construction that does not need moderate or high construction stills. 'Proper drainage should be provided for around the trench to ensure runoff and prevent flooding. When the trench is complete, slabs are placed over the complete, slabs are placed over the complete, slabs are placed over the complete, slabs are placed over the complete, slabs are placed over the complete, slabs are placed over defected in the speed of construction, if available. Alternatively, wooden planks can be secured across the trench (leaving out every third or fourth plank for defecation) until wooden or concrete slabs can be produced locally. The slabs can be fitted with pedestal toilets where users do not squat. Separate trench latrines for men and women should be considered. The trench lifespan (the time required to fill it to within half a metre of the top) is a function of the trench volume, divided by the number of users and estimated excreta volume generated per person. On average, solids accumulate at a rate of 3–5 L/person/month and up to 5–7.5 L/person/month if dry cleansing materials are used. (Emersan) Even though several of things have to be considered the design is pretty simple. 'Deep Trench Latrines are usually built as communal latrine blocks. The general operation and maintenance (O & M) measures therefore include regular cleaning, routine operational tasks such as checking availability of water, hygiene items, soap and dry cleansing materials, providing advice on proper use, conducting minor repairs and monitoring of trench filling level. O & M also includes a part of installation programmes. If desludging is not an option the latrines are often misused for solid waste disposal, which can complicate later emptying, awareness raising measures X.12 should be a part of installation programmes. If desludging is not an option the latrines which can complicate later emptying, awareness raising measures X.12 should be a part of installation programmes. If desludgi	yes yes NA NA NA
construction_skills design_skills om_skills om_skills	Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical O 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	FALSE TRUE TRUE TRUE TRUE FALSE FALSE FALSE FALSE	Ladder: unskilled skilled professional Ladder: unskilled skilled professional Ladder: Unskilled skilled Professional	NA (unskilled = 1, skilled = 1, professional = 1) (unskilled = 0, skilled = 0.5, professional = 1) (unskilled = 0.5, skilled = 1, professional = 1) NA NA NA NA NA NA NA NA NA NA	INA Tinexpensive and quick to construct" [Emersain] Simple construction that does not need moderate or high construction skills. "Proper drainage should be provided for around the trench to ensure runoff and prevent flooding. When the trench is complete, slabs are placed over it. Prefabricated self-supporting plastic slabs can increase the speed of construction, if available. Alternatively, wooden planks can be secured across the trench (leaving out every third or fourth plank for defecation) until wooden or concrete slabs can be produced locally. The slabs can be fitted with pedestal toilets where users do not squared. Separate trench latrines for men and women should be considered. The trench lifespan (the time required to fill it to within half a metre of the top) is a function of the trench considered. The trench lifespan destinated excreta volume generated per person. On average, solids accumulate at a rate of 3–5. L/person/month and up to 5–7.5. L/person/month and up to 5–7.5. L/person/month if dry cleansing materials are used. (Temersar) Even though several of things have to be considered. The support of the considered the several volume, deviced and person and maintenance (0 & M) measures therefore include regular cleaning, routine operational tasks such as checking availability of water, hygiene tems, soap and dry cleansing materials, providing advice on proper use, conducting minor repairs and monitoring of trench filling level. O & M also includes as checking availability of water, hygiene tems, soap and dry cleansing materials, providing advice on proper use, conducting minor repairs and monitoring of trench filling level. O & M also includes and provent by breeding. Ast renches are often misused for solid waste disposal, which can complicate later emptying of trench filling level. O & M also includes the special providing advice on proper use, conducting minor repairs and monitoring of trench filling level. O & M also includes the special providing advice on proper use, conducting minor re	yes yes yes NA NA NA NA

W					Tra	1	ı i
lifetime	Performance, Categorical	IKUE	short (< 1 year)	(short = 1, medium = 0.5, long = 0)	"Deep Trench Latrines can be a viable	yes	
			medium (1-5 years)		solution in the acute phase of an		
			long (>5 years)		emergency provided that the technology		
					is acceptable to the users" (Emersan)		
					A deep trench latrine can be used in the		
					short-term. It is often also in use for more		
					than a year. (Kukka Ilmanen, Eawag 2021)		
speed_implement_toilet	PDF, Categorical	TRUE	rapid (< 3 days)	(rapid = 1, moderate = 0, slow = 0)	"It can be quickly implemented(within	yes	
			moderate (3 days to 2 weeks)		1-2 days)" (Emersan Compendium)		
			slow (> 2 weeks)				
speed_implement_treatment	PDF, Categorical	FALSE	rapid (few days to a week)	NA	NA	NA	
	,		moderate (few weeks up to three				
			months)				
			slow (> 3 months)				
scalability	Performance, Categorical	TRUE	easy	(easy = 1, difficult = 1)	"Deep Trench Latrines can be replicated	yes	
Scalability	i criorinance, categoricai		difficult	(000, 2, 0111cont - 2)	fast and implemented at scale given that	/	
			acare		enough space is available." (Emersan)		
construction parts	PDF, Categorical	TRUE	simple	(simple = 1, technical = 0, special = 0)	"If possible, locally available construction	yes	
construction_parts	r Di , Categoricai		technical	(Simple - 1, technical = 0, special = 0)	materials should be used. The latrine	1	
			special		superstructure can be made from local		
			Special				
					materials, such as bamboo, wood, plastic		
					or metal sheeting (though this often		
					heats up the interior). The trench lining		
					can be made from bricks, timber, sand		
					bags or temporary lining materials such		
					as bamboo poles or matting. Some relief		
					agencies have rapid response kits for		
					slabs and superstructure which can be		
					used where there are few resources		
					locally." (Emersan)		
					Can be constructed from locally available		
					material.		
Transfer Coefficients	(copied from "Sanitation_Technologies_TC_database_202	10622.xism*)					
	Sludge	Range	Airloss	Soilloss	Waterloss		Reference
TP	0.29			0.71		* as P	Montangero and Belevi (2007)
med (R)	0.29			0.71			-
k	5	[0.22]					PA
TN	0.18		0	0.82			Montangero and Belevi (2007)
	0.18						Jacks et al. (1999)
	0.2		0.6			* TC Soilloss: N reaching the groundwater	Nyenje et al. (2013)
med (R)	0.18		0.55	0.27	C		a contract of
k	25	[0.18]					PA
H2O	0.15	0.05 - 0.3	0.15	0.7			PA
						permeability	
med (R)	0.15		0.15	0.70	0		
k	5	[0.25]					PA
TS	0.6	0.5 - 0.7	0	0.4			Montangero and Belevi (2007)
						(Assumption for TS: 0.5 - 0.7)	
med (R)	0.60			0.40	0		-
k	5	[0.2]					PA
·	·	·	·	·	·	·	Spuhler et al. (2021)
Additional Information							

Additional Information
Copied from "single pit". Some of the k-factors were decreased if they weren't already the minimum possible value.

References

References

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Jacks, G., et al. (1999). "Tensitive nitrogen budget for pit latrines - sestem Botswana." Environmental Geology 38(3): 1999-203.

Nyenje, P. M., et al. (2013). "Nutrient pollution in shallow aquifers underlying pit latrines and domestic solid waste dumps in urban slums." Journal of Environmental Management 122: 15–24.

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Onsite Vermi-Composting							
FUNCTIONAL GROUP		Data Source					
DATA COMPILER	onsite_vermi_composting Matthias van Sloten	-	1				
OUTPUT PRODUCT OUTPUT PRODUCT RELATIONS	faeces, excreta, organics, blackwater effluent, compost	Gensch, R. et al. (2018) Gensch, R. et al. (2018) Gensch, R. et al. (2018)	1				
RELATIONS	Output: AND	Gensch, R. et al. (2018)					
COMMENTS Pre-Filter Criteria	Values	Data Source	1				
applicability_level	(household = 1, neighbourhood = 0.5, city = 0)	Gensch, R. et al. (2018)					
management level capex_req_level	(household = 1, shared = 1, public = 0)	Gensch, R. et al. (2018) Spuhler, D. et al. (2021)					
opex req level technical_maturity		Spuhler, D. et al. (2021) "The Worm-Based Toilet is an	-				
		emerging technology that has been used successfully in rural, peri-urban					
development_phase		and camp settings" (Emersan). Gensch, R. et al. (2018)	_				
Screening Criteria	development/recovery = 1) Type and Function	Applicable for this Functional Group?		Technology Values (Data)	Data Source / Assumptions	Internal Review Done?	
water_supply	Performance, Categorica	FALSE	house yard public	NA	NA .	NA .	
water_volume	Performance, Trape:	TRUE	none [L/cap/day]	(a = 0, b = 8, c = 33, d = 60)	"Water-based Technology" (Emersan). "They are	Yes	
water_voidine	renominee, maper	TRUE	(L/CSP/SSP)	(4 - 0, 5 - 0, 5 - 33, 4 - 30)	particularly appropriate in contexts where water is available and used for flushing. The toilets should		
					only be cleaned with water and a brush, and should be flushed (min. 200 mL) after every use		
					including urination" (Emersan) Absolute mimimal volume: can be used without		
					flushing water, e.g cacarousel (a=0) - Typical minimal and maximal volume: can be		
					used with pour-flush toilet (1-3 l/use) and anal cleansing water (0.3-3 l/use) assuming 6 visits per		
					persons per day - Maximal volume: can be used with cistern flush		
					toilet (10 l/use) assuming 6 visits per persons per day. Even though onsite vermicompost can handle more water, big amount of flushing water		
					handle more water, big amount of flushing water should be avoided to keep the moisture content satisfactory for the worms.		
electricity_supply	Performance, Categorica	TRUE	electricity intermittent	(electricity = 1, intermittent = 1, no elec	No need for electricity.	yes	
fuel_supply	Performance, Categorica	FALSE	no electricity fuel	NA .	NA .	NA .	
frequency_of_om	PDF, Categorica		no fuel irregular	(irregular = 0.2, regular = 0.8,	"The system thus needs emptying less frequently	yes	
			regular continuous	continous = 0)	than traditional pit systems." (Emersan) "General operation and maintenance (O & M)		
					measures include regular cleaning of toilets, advice on proper use, minor repairs, regular		
					checking of the well-being of the worms and the monitoring of the filling of the tank. These toilets require emptying approximately every 5 years."		
pipe_supply	Performance, Categorica	TRUE	no pipes	(no pipes = 0.5. difficultly available = 0	require emptying approximately every 5 years." (Emersan) Inlet pipe to connect flush toilet with composting	yes	
р,рс_заррту			difficultly available pipes		pit required (Emersan)		
pump_supply	Performance, Categorica	TRUE	no pumps difficultly available	(no pumps = 1, difficultly available = 1,	No need for pumps.	yes	
concrete_supply	Performance, Categorica	TRUE	pumps no concrete		"Worm-Based Toilets can be constructed from	yes	
			difficultly available concrete	= 0.75, concrete = 1)	locally available materials. The offset tank can be made from various materials including concrete		
					rings, masonry and brickwork." (Emersan) Concrete may be helpful but it is definitely		
spare_parts	PDF, Categorica	TRUE	simple technical	(simple = 1, technical = 0, special = 0)	feasible without concrete. "Worm-Based Toilets can be constructed from locally available materials. The superstructure	yes	
			special		should contain a roof and a door for privacy. A pour flush pan is also required. The offset tank		
					can be made from various materials including		
i .					concrete rings, masonry and brickwork. The most		
					concrete rings, masonry and brickwork. The most important material is the worms." (Emersan) The worms can be found locally and are not		
0		FALSE		D NA	concrete rings, masonry and brickwork. The most important material is the worms." (Emersan) The worms can be found locally and are not considered as special. NA	NA NA	
0 0		FALSE FALSE	(D NA	concrete rings, masonry and brickwork. The most important material is the worms." (Emersan) The worms can be found locally and are not considered as special. NA NA NA NA	NA NA	
0 0 0 temperature	(FALSE FALSE	very cold cold	D NA	concrete rings, masonny and brickwork. The most important materials the worms. (femesan) The worms can be found locally and are not considered as special. NA NA NA NA NA NA NA NA NA N	NA	
0 0 temperature		FALSE FALSE	very cold	D NA	concrete rings, masonny and brickwork. The most important materials is the worms. "General? The worms can be found locally and are not considered as special. NA NA NA NA NA NA NA NA NA N	NA NA	
	Performance, Categorica	FALSE FALSE TRUE	very cold cold temperate warm hot	D NA NA (very cold = 0.2, cold = 0.5, temperate =	concrete rings, masonry and brickwork. The most important materials is the worms. "General? The worms can be found locally and are not considered as special. NA NA NA NA NA NA NA NA NA N	NA NA yes	
0 0 0 0 temperature		FALSE FALSE TRUE	very cold cold temperate warm	D NA	concrete rings, masonny and brickwork. The most important materials is the worms. "General? The worms can be found locally and are not considered as special. NA NA NA NA NA NA NA NA NA N	NA NA	
	Performance, Categorica	FALSE FALSE TRUE	very cold cold temperate warm hot	D NA NA (very cold = 0.2, cold = 0.5, temperate =	concrete rings, masonny and brickwork. The most important materials the worms. "Generaln" The worms can be found locally and are not considered as special. NA NA NA NA NA NA NA NA NA N	NA NA yes	
	Performance, Categorica	FALSE FALSE TRUE	very cold cold temperate warm hot	D NA NA (very cold = 0.2, cold = 0.5, temperate =	concrete rings, masonry and brickwork. The most important materials is the worms. "General? The worms can be found locally and are not considered as special. MA. NA. As the effluent enters the soil, a certain institution, and institution and institution and institution. The companism of the soil and	NA NA yes	
	Performance, Categorica	FALSE FALSE TRUE	very cold cold temperate warm hot	D NA NA (very cold = 0.2, cold = 0.5, temperate =	concrete rings, masonry and brickwork. The most important materials is the worms. "General? The worms can be found locally and are not considered as special. NA NA NA NA NA NA NA NA NA N	NA NA yes	
	Performance, Categorica	FALSE FALSE TRUE	cod cold cold temperate werm hot flooding no flooding flooding flooding flooding flooding flooding flooding flooding flooding flooding flooding flooding flooding flooding flooding flooding flooding flooding flooding flo	D NA NA (very cold = 0.2, cold = 0.5, temperate =	concrete rings, masonry and brickwork. The most important materials is the worms. "General? The worms can be found locally and are not considered as special. NA NA NA NA NA NA NA NA NA N	NA NA yes	
flooding	Performance, Categorica Performance, Categorica Performance, Categorica	FALSE FALSE TRUE	every cold cold temperate warm hot flooding no flooding	NA NA (very cold = 0.2, cold = 0.5, temperate = 0.2, cold = 0.5, temperate = 0.5, no flooding = 0.5, no flooding = 1)	concrete rings, masonry and brickwork. The most important materials the worms." (Inemeran) The worms can be found locally and are not considered as special. NA NA NA NA NA NA NA NA NA N	NA NA yes	
flooding	Performance, Categorica Performance, Categorica Performance, Categorica	FALSE FALSE TRUE TRUE	revy cold cold temperate warm hot flooding no flooding no access difficult fluid	NA NA (very cold = 0.2, cold = 0.5, temperate = 0.2, cold = 0.5, temperate = 0.5, no flooding = 0.5, no flooding = 1)	concrete rings, masonry and brickwork. The most important materials is the worms. (Temeran) The worms can be found locally and are not considered as special. NA. NA. NA. NA. NA. NA. NA. NA.	NA NA yes	
flooding vehicular_acces	Performance, Categorica Performance, Categorica Performance, Categorica	FALSE TRUE TRUE TRUE TRUE	revy cold cold temperate warm hot flooding no flooding no access difficult fluid flooding flooding flooding no flooding	NA NA NA (very cold = 0.2, cold = 0.5, temperate = (flooding = 0.5, no flooding = 1) (no access = 1, difficult = 1, full = 1) NA	concrete rings, masonry and brickwork. The most important materials is the worms. "General? The worms can be found locally and are not considered as special. MA NA NA NA NA NA NA NA NA NA	NA NA yes Yes	
flooding vehicular_acces	Performance, Categorica Performance, Categorica Performance, Categorica Performance, Categorica	FALSE TRUE TRUE TRUE TRUE	revy cold cold temperate warm hot flooding no flooding no flooding	NA NA NA (very cold = 0.2, cold = 0.5, temperate = (flooding = 0.5, no flooding = 1) (no access = 1, difficult = 1, full = 1) NA	concrete rings, masonry and brickwork. The most important materials is the worms." (Imensarian) The worms can be found locally and are not considered as special. NA. NA. NA. NA. NA. NA. NA. N	NA. NA. yes Yes	
flooding vehicular_acces stope soil_type	Performance, Categorica Performance, Categorica Performance, Categorica Performance, Categorica Performance, Categorica	FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRU	revy cold cold temperate warm hot flooding no flooding no flooding	NA NA NA (very cold = 0.2, cold = 0.5, temperate = (flooding = 0.5, no flooding = 1) (no access = 1, difficult = 1, full = 1) NA (clay = 0, silt = 0.25, sand = 1, gravel = 0	concrete rings, masonry and brickwork. The most important materials is the worms. (Temeran) The worms can be found locally and are not considered as special. NA. NA. NA. NA. NA. NA. NA. NA.	NA NA Yes Yes NA Yes	
flooding vehicular_acces	Performance, Categorica Performance, Categorica Performance, Categorica Performance, Categorica	FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRU	revy cold cold temperate weirm hot flooding no flooding f	NA NA NA (very cold = 0.2, cold = 0.5, temperate = (flooding = 0.5, no flooding = 1) (no access = 1, difficult = 1, full = 1) NA	concrete rings, masonry and brickwork. The most important materials is the worms. "General? The worms can be found locally and are not considered as special. MA. As the effluent enters the soil, a certain insulfiration capacity is required. "Compendium) As the leachate might not percolate into the soil, lower temperatures might be less appropriate. Moreover, the worms will also decrease in performance or eventually even die if the ambient temperature is too low. "Recent research tottles suggest that the effluent from worm based systems can be considered when the soil of the	NA. NA. yes Yes	
flooding vehicular_acces slope soil_type groundwater_depth	Performance, Categorica Performance, Categorica Performance, Categorica Performance, Categorica Performance, Categorica Performance, Categorica Performance, Trapes	FALSE TRUE TRUE TRUE TRUE TRUE TRUE	cod codd codd temperate warm hot flooding no flooding flooding flooding flooding flooding flooding flooding flooding flooding flooding flooding flooding flooding flooding flooding flooding flooding flooding flooding flo	NA NA (very cold = 0.2, cold = 0.5, temperate = (flooding = 0.5, no flooding = 1) (no access = 1, difficult = 1, full = 1) NA (clay = 0, silt = 0.25, sand = 1, gravel = 0 (a = 1, b = 1, c = 999, d = 999)	concrete rings, masonry and brickwork. The most important materials is the worms. "General? The worms can be found locally and are not considered as special. MA. NA. NA. NA. NA. NA. NA. NA	NA NA Yes Yes NA Yes	
flooding vehicular_acces stope soil_type	Performance, Categorica Performance, Categorica Performance, Categorica Performance, Categorica Performance, Categorica	FALSE TRUE TRUE TRUE TRUE TRUE TRUE	revy cold cold temperate warm hot flooding no flooding no flooding	NA NA NA (very cold = 0.2, cold = 0.5, temperate = (flooding = 0.5, no flooding = 1) (no access = 1, difficult = 1, full = 1) NA (clay = 0, silt = 0.25, sand = 1, gravel = 0	concrete rings, masonry and brickwork. The most important materials is the worms. "General? The worms can be found locally and are not considered as special. NA. NA. NA. NA. NA. NA. NA. N	NA NA Yes Yes NA Yes	
flooding vehicular_acces slope soil_type groundwater_depth	Performance, Categorica Performance, Categorica Performance, Categorica Performance, Categorica Performance, Categorica Performance, Categorica Performance, Trapes	FALSE TRUE TRUE TRUE TRUE TRUE TRUE	revy cold cold temperate warm hot flooding no flooding no flooding	NA NA (very cold = 0.2, cold = 0.5, temperate = (flooding = 0.5, no flooding = 1) (no access = 1, difficult = 1, full = 1) NA (clay = 0, silt = 0.25, sand = 1, gravel = 0 (a = 1, b = 1, c = 999, d = 999)	concrete rings, masonny and brickwork. The most important materials is the worms." (Imensarian) The worms can be found locally and are not considered as special. NA. NA. NA. NA. NA. NA. NA. N	NA NA Yes Yes NA Yes	
flooding vehicular_acces slope soil_type groundwater_depth excavation	Performance, Categorica Performance, Categorica Performance, Categorica Performance, Categorica Performance, Categorica Performance, Trape:	FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRU	revy cold cold temperate warm hot flooding no flooding no access difficult full flat not flat city silt sand gravel rock water depth [m]	NA NA (tvery cold = 0.2, cold = 0.5, temperate = (flooding = 0.5, no flooding = 1) (no access = 1, difficult = 1, full = 1) NA (clay = 0, silt = 0.25, sand = 1, gravel = 0 (a = 1, b = 1, c = 999, d = 999) (easy = 1, hard = 0.5)	concrete rings, masonry and brickwork. The most important materials is the worms." (Imensarian) The worms can be found locally and are not considered as special. NA. NA. NA. NA. NA. NA. NA. N	NA NA Yes Yes NA Yes	
flooding vehicular_acces slope soil_type groundwater_depth	Performance, Categorica Performance, Categorica Performance, Categorica Performance, Categorica Performance, Categorica Performance, Categorica Performance, Trapes	FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRU	revy cold cold temperate warm hot flooding no flooding no flooding	NA NA (very cold = 0.2, cold = 0.5, temperate = (flooding = 0.5, no flooding = 1) (no access = 1, difficult = 1, full = 1) NA (clay = 0, silt = 0.25, sand = 1, gravel = 0 (a = 1, b = 1, c = 999, d = 999)	concrete rings, masonny and brickwork. The most important materials is the worms." (Imensarian) The worms can be found locally and are not considered as special. NA. NA. NA. NA. NA. NA. NA. N	NA NA Yes Yes NA Yes	
flooding vehicular_acces slope soil_type groundwater_depth excavation	Performance, Categorica Performance, Categorica Performance, Categorica Performance, Categorica Performance, Categorica Performance, Trape:	FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRU	revy cold cold temperate warm hot flooding no flooding no access difficult full flat not flat city silt sand gravel rock water depth [m]	NA NA (tvery cold = 0.2, cold = 0.5, temperate = (flooding = 0.5, no flooding = 1) (no access = 1, difficult = 1, full = 1) NA (clay = 0, silt = 0.25, sand = 1, gravel = 0 (a = 1, b = 1, c = 999, d = 999) (easy = 1, hard = 0.5)	concrete rings, masonny and brickwork. The most important materials is the worms." (Inverse and The worms can be found locally and are not considered as special. NA. NA. NA. NA. NA. NA. NA. N	NA NA Yes Yes NA Yes	
flooding vehicular_acces slope soil_type groundwater_depth excavation	Performance, Categorica Performance, Categorica Performance, Categorica Performance, Categorica Performance, Categorica Performance, Trape:	FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRU	revy cold cold temperate warm hot flooding no flooding no access difficult full flat not flat city silt sand gravel rock water depth [m]	NA NA (tvery cold = 0.2, cold = 0.5, temperate = (flooding = 0.5, no flooding = 1) (no access = 1, difficult = 1, full = 1) NA (clay = 0, silt = 0.25, sand = 1, gravel = 0 (a = 1, b = 1, c = 999, d = 999) (easy = 1, hard = 0.5)	concrete rings, masonny and brickwork. The most important materials is the worms." (Imensarian) The worms can be found locally and are not considered as special. NA. NA. NA. NA. NA. NA. NA. N	NA NA Yes Yes NA Yes	
flooding vehicular_acces slope soil_type groundwater_depth excavation	Performance, Categorica Performance, Categorica Performance, Categorica Performance, Categorica Performance, Categorica Performance, Trape:	FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRU	revy cold cold temperate warm hot flooding no flooding no access difficult full flat not flat city silt sand gravel rock water depth [m]	NA NA (tvery cold = 0.2, cold = 0.5, temperate = (flooding = 0.5, no flooding = 1) (no access = 1, difficult = 1, full = 1) NA (clay = 0, silt = 0.25, sand = 1, gravel = 0 (a = 1, b = 1, c = 999, d = 999) (easy = 1, hard = 0.5)	concrete rings, masonny and brickwork. The most important materials is the worms." (Imensarian) The worms can be found locally and are not considered as special. NA. NA. NA. NA. NA. NA. NA. N	NA NA Yes Yes NA Yes	
flooding vehicular_acces slope soil_type groundwater_depth excavation	Performance, Categorica Performance, Categorica Performance, Categorica Performance, Categorica Performance, Categorica Performance, Trape:	FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRU	revy cold cold temperate warm hot flooding no flooding no access difficult full flat not flat city silt sand gravel rock water depth [m]	NA NA (tvery cold = 0.2, cold = 0.5, temperate = (flooding = 0.5, no flooding = 1) (no access = 1, difficult = 1, full = 1) NA (clay = 0, silt = 0.25, sand = 1, gravel = 0 (a = 1, b = 1, c = 999, d = 999) (easy = 1, hard = 0.5)	concrete rings, masonny and brickwork. The most important materials is the worms." (Imemeran) The worms can be found locally and are not considered as special. NA. NA. NA. NA. NA. NA. NA. N	NA NA Yes Yes NA Yes	
flooding vehicular_acces slope soil_type groundwater_depth excavation	Performance, Categorica Performance, Categorica Performance, Categorica Performance, Categorica Performance, Categorica Performance, Trape:	FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRU	revy cold cold temperate warm hot flooding no flooding no access difficult full flat not flat city silt sand gravel rock water depth [m]	NA NA (tvery cold = 0.2, cold = 0.5, temperate = (flooding = 0.5, no flooding = 1) (no access = 1, difficult = 1, full = 1) NA (clay = 0, silt = 0.25, sand = 1, gravel = 0 (a = 1, b = 1, c = 999, d = 999) (easy = 1, hard = 0.5)	concrete rings, masonny and brickwork. The most important materials is the worms. "General? The worms can be found locally and are not considered as special. NA. NA. NA. NA. NA. NA. NA. NA.	NA NA Yes Yes NA Yes	
flooding vehicular_acces slope soil_type groundwater_depth excavation	Performance, Categorica Performance, Categorica Performance, Categorica Performance, Categorica Performance, Categorica Performance, Trape:	FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRU	revy cold cold temperate warm hot flooding no flooding no access difficult full flat not flat city silt sand gravel rock water depth [m]	NA NA (tvery cold = 0.2, cold = 0.5, temperate = (flooding = 0.5, no flooding = 1) (no access = 1, difficult = 1, full = 1) NA (clay = 0, silt = 0.25, sand = 1, gravel = 0 (a = 1, b = 1, c = 999, d = 999) (easy = 1, hard = 0.5)	concrete rings, masonny and brickwork. The most important materials is the worms. "General? The worms can be found locally and are not considered as special. NA. NA. NA. NA. NA. NA. NA. NA.	NA NA Yes Yes NA Yes	
vehicular_acces slope soil_type groundwater_depth excavation surface_area_onsite	Performance, Categorica Performance, Categorica Performance, Categorica Performance, Categorica Performance, Categorica Performance, Trape: Performance, Trape:	FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRU	revy cold cold temperate warm hot flooding no flooding fl	NA NA (very cold = 0.2, cold = 0.5, temperate = 0.5, no flooding = 1) (flooding = 0.5, no flooding = 1) (no access = 1, difficult = 1, full = 1) NA (clay = 0, slilt = 0.25, sand = 1, gravel = 0 (a = 1, b = 1, c = 999, d = 999) (easy = 1, hard = 0.5) (a = 2, b = 2, c = 999, d = 999)	concrete rings, masonny and brickwork. The most important materials is the worms. "General? The worms can be found locally and are not considered as special. NA. NA. NA. NA. NA. NA. NA. NA.	NA NA Yes Yes Yes Yes Yes	
flooding vehicular_acces slope soil_type groundwater_depth excavation	Performance, Categorica Performance, Categorica Performance, Categorica Performance, Categorica Performance, Categorica Performance, Trape: Performance, Trape: Performance, Trape:	FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRU	revy cold cold temperate warm hot flooding no flooding no flooding	NA NA (tvery cold = 0.2, cold = 0.5, temperate = (flooding = 0.5, no flooding = 1) (no access = 1, difficult = 1, full = 1) NA (clay = 0, silt = 0.25, sand = 1, gravel = 0 (a = 1, b = 1, c = 999, d = 999) (easy = 1, hard = 0.5)	concrete rings, masonny and brickwork. The most important materials is the worms." (Imemeran) The worms can be found locally and are not considered as special. NA. NA. NA. NA. NA. NA. NA. N	NA NA Yes Yes NA Yes	
vehicular_acces slope soil_type groundwater_depth excavation surface_area_onste	Performance, Categorica Performance, Categorica Performance, Categorica Performance, Categorica Performance, Categorica Performance, Trapes Performance, Trapes	FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRU	revy cold cold temperate warm hot flooding no access difficult fall falt not flat clay silt sand gravel rock water depth [m] easy hard [m2/plot]	NA NA (Recy cold = 0.2, cold = 0.5, temperate = 0.5, no flooding = 1) (Rooding = 0.5, no flooding = 1) (Roo access = 1, difficult = 1, full = 1) NA (clay = 0, silt = 0.25, sand = 1, gravel = 0 (clay = 0	concrete rings, masonny and brickwork. The most unportant materials is the worms. "General? The worms can be found locally and are not considered as special." NA. NA. NA. NA. NA. NA. NA. N	NA NA Yes Yes NA NA NA NA NA NA NA	
vehicular_acces slope soil_type groundwater_depth excavation surface_area_onsite	Performance, Categorica Performance, Categorica Performance, Categorica Performance, Categorica Performance, Categorica Performance, Categorica Performance, Trape: Performance, Trape:	FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRU	cold cold cold temperate warm hot flooding no flooding no flooding	NA NA (very cold = 0.2, cold = 0.5, temperate = (flooding = 0.5, no flooding = 1) (no access = 1, difficult = 1, full = 1) NA (clay = 0, silt = 0.25, sand = 1, gravel = 0 (a = 1, b = 1, c = 999, d = 999) (easy = 1, hard = 0.5) (a = 2, b = 2, c = 999, d = 999)	concrete rings, masonny and brickwork. The most important materials is the worms. "General? The worms can be found locally and are not considered as special. NA. NA. NA. NA. NA. NA. NA. NA.	NA NA Yes Yes NA NA NA NA NA NA NA	
vehicular_acces slope soil_type groundwater_depth excavation surface_area_onste	Performance, Categorica Performance, Categorica Performance, Categorica Performance, Categorica Performance, Categorica Performance, Trapes Performance, Trapes	FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRU	revy cold cold temperate warm hot flooding no access difficult fall falt not flat clay silt sand gravel rock water depth [m] easy hard [m2/plot]	NA NA (Recy cold = 0.2, cold = 0.5, temperate = 0.5, no flooding = 1) (Rooding = 0.5, no flooding = 1) (Roo access = 1, difficult = 1, full = 1) NA (clay = 0, silt = 0.25, sand = 1, gravel = 0 (clay = 0	concrete rings, masonny and brickwork. The most important materials is the worms. "General? The worms can be found locally and are not considered as special. NA. NA. NA. NA. NA. NA. NA. NA.	NA NA Yes Yes NA NA NA NA NA NA NA	
vehicular_acces slope soil_type groundwater_depth excavation surface_area_onste	Performance, Categorica Performance, Categorica Performance, Categorica Performance, Categorica Performance, Categorica Performance, Trapes Performance, Trapes	FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRU	revy cold cold temperate warm hot flooding no access difficult fall falt not flat clay silt sand gravel rock water depth [m] easy hard [m2/plot]	NA NA (Recy cold = 0.2, cold = 0.5, temperate = 0.5, no flooding = 1) (Rooding = 0.5, no flooding = 1) (Roo access = 1, difficult = 1, full = 1) NA (clay = 0, silt = 0.25, sand = 1, gravel = 0 (clay = 0	concrete rings, masonny and brickwork. The most important materials is the worms. "General? The worms can be found locally and are not considered as special. NA. NA. NA. NA. NA. NA. NA. NA.	NA NA Yes Yes NA NA NA NA NA NA NA	
vehicular_acces slope soil_type groundwater_depth excavation surface_area_onste	Performance, Categorica Performance, Categorica Performance, Categorica Performance, Categorica Performance, Categorica Performance, Trapes Performance, Trapes	FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRU	revy cold cold temperate warm hot flooding no access difficult fall falt not flat clay silt sand gravel rock water depth [m] easy hard [m2/plot]	NA NA (Recy cold = 0.2, cold = 0.5, temperate = 0.5, no flooding = 1) (Rooding = 0.5, no flooding = 1) (No access = 1, difficult = 1, full = 1) NA (clay = 0, silt = 0.25, sand = 1, gravel = 0 (easy = 1, hard = 0.5) (easy = 1, hard = 0.5) (a = 2, b = 2, c = 999, d = 999)	concrete rings, masonny and brickwork. The most unportant materials is the worms." (Imensarian) The worms can be found locally and are not considered as special. MA MA MA MA MA MA MA MA MA M	NA NA Yes Yes NA NA NA NA NA NA NA	
vehicular_acces slope soil_type groundwater_depth excavation surface_area_onste	Performance, Categorica Performance, Categorica Performance, Categorica Performance, Categorica Performance, Categorica Performance, Categorica Performance, Trape: Performance, Trape:	FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRU	cold cold cold temperate warm hot flooding no flooding no flooding flooding flooding flooding flooding flooding flooding full flat not flat clay sit surface flooding	NA NA (Recy cold = 0.2, cold = 0.5, temperate = 0.5, no flooding = 1) (Rooding = 0.5, no flooding = 1) (No access = 1, difficult = 1, full = 1) NA (clay = 0, silt = 0.25, sand = 1, gravel = 0 (easy = 1, hard = 0.5) (easy = 1, hard = 0.5) (a = 2, b = 2, c = 999, d = 999)	concrete rings, masonny and brickwork. The most important materials is the worms." (Imemeran) The worms can be found locally and are not considered as special. MA NA NA NA NA NA NA NA NA NA	NA NA Yes Yes NA NA NA NA NA NA NA	

March Marc	construction_skills		FALSE	0	NA	NA .	NA.		
March Marc		Performance, Categorical	TRUE	Ladder:	(unskilled = 0, skilled = 1, professional		yes		
### ADM 1				unskilled	= 1)	locally available materials. The superstructure			
Married Marr						should contain a roof and a door for privacy. A			
Column C				professional		pour flush pan is also required. The offset tank			
An interview of the content of the									
### And And And And And And And And And And						concrete rings, masonry and brickwork. (Emersan)			
### And And And And And And And And And And						Basic technical knowledge to build it.			
### Water Wa									
Part Part	design_skills	Performance, Categorical	TRUE	Ladder:	(unskilled = 0, skilled = 0.5,	"Ideally the toilets are emptied by the household	yes		
March Marc					professional = 1)	after they have been un-used for one week,			
March Marc				skilled					
## And the second secon				proressional		removed from the edges of the tank with a small			
## A Company of the C									
March Marc									
Manual Process Manu						bedding later. The harvested vermi compost can			
March Marc						be buried on-site. When sensitising the users, it			
Part						should be highlighted that only water, faeces,			
Marked M						urine and possibly toilet paper should go into			
Part Part						with water and a brush, and should be flushed			
## 1									
## A CANDON STATE OF THE PROPERTY OF THE PROPE						the households is not an option (due to			
10 10 10 10 10 10 10 10						acceptabilityissues or other reasons) other			
Part Part						options involving local service providers need to			
## A Part of the Company of Table						"The hottom of the tank is exposed to the soil			
Part Part						The tank contains 40 cm of drainage material			
Company Comp									
Part Part									
Column						then connected to the pour flush system."			
March Marc						(Emersan)			
March Marc	om_skills	Performance, Categorical	TRUE		(unskilled = 0.5, skilled = 1,		yes		
Product Prod				Unskilled	professional = 1)				
The control of the									
Company Comp				· · · · · · · · · · · · · · · · · · ·		"O & M is still a grey area as the systems which			
100 100						have been built have not been emptied yet."			
1					A1A	(Emersan)	***		
Manual Control Manu	-	0	FALSE FALSE						
Company Comp	0	0	FAISE	0	NA NA	NA .	NA NA		
Company Comp	0	0	FALSE	0	NA				
March Marc	cleansing_method	Performance, Categorical	FALSE	Washers					
Part Peter no. Company Dist. Peter no. Company Dist. Peter no. Company Dist. D				Soft wipers					
Company Comp	1	-	EAI SE	naru wipers -	NA .	NΔ	NΔ		
Married Married Congress Married Married Congress Married Co	0								
Marked State Mark	lifatima	Performance Categorical	TRUE	short (< 1 year)					
Marked M	metime	r criomonice, categorical	• •	medium (1-5 years)		(Emersan)			
West Agency West	1					Meant for long-term service life, if the emptying			
Control of the cont	1					happens every 5 years or even less frequent.			
Part Part									
March Agency March March Agency March March Agency Mar									
### 12-100 Part of Company Tild Tild Part of Company Tild Part of Company Tild Part of Company Tild Part of Company Tild Part of Company Tild Part of Company Tild Part of Company Tild Part of Company Tild Part of Company Tild Part of Company Tild Part of Company Tild Part of Company Tild Part of Company Tild Part of Company Tild Part of Company Tild Tild Part of Company Tild Tild Part of Company Tild Tild Part of Company Tild Tild Part of Company Tild						is unsuitable is not considered in the criterion			
March Approximate Approx									
### CONTROL OF THE PROPERTY OF		<u> </u>					<u> </u>		
March Part	speed_implement_toilet	PDF, Categorical	TRUE	rapid (< 3 days)	(rapid = 0, moderate = 0.2, slow = 0.8)	Technical complexity is on the higher side (based	yes		
March Marc				moderate (3 days to 2 weeks)		on Emersan Compendium). "Worm-Based Toilets			
March Control Process Process Marc				slow (> 2 weeks)					
Process of the control of the cont									
March Marc						various materials including concrete rings,			
March canaba, the part of the control of the cont						material is the worms (100 g per person). They can			
United Section Continued						be found locally, bought from vermicomposting or			
Control Accordance Control						vermiculture businesses, or imported."			
West Control of an anticology Control of a						Given that concrete could be used for			
## 100 March March									
Part Company									
Management of the coverage per training Management of the coverage p									
Separate Separate						digging required). Additionally, worms may have			
March or consequences on a digital personal processes of the personal per						to imported. All these elements point towards			
March Care Control						that this technology be implemented in <3 days			
### Committee Part									
Separate Professor Company Total Compa						,,,,			
Marie Participation Participation Companies	speed_implement_treatment	PDF, Categorical	FALSE		NA	NA	NA		
Antimiting Caligner Part									
Profession Profession Companies Co									
Marie Carlifornia Mari	ccalability	Borformanco Catoroxical	TRUE		(open = 1 difficult = 0.9)	"The curface area of the household tank for the	une		
Proc. Continue Proc	scalability	Performance, Categorical	IRUE	difficult	(easy = 1, difficult = 0.8)	vermifilter varies from 0.7 m2 to 1 m2 depending	yes		
Section Sect				unneun					
Marie Continue Marie M									
Second Configuration Proc. Configuration						are a viable solution if long-term household			
Desire conditions Desire continues Desire con						are a viable solution if long-term household sanitation is required [] and in camp			
Simple Coefficient Simple						are a viable solution if long-term household sanitation is required [] and in camp communities that have a strategy of implementing			
Author Control Contr						are a viable solution if long-term household sanitation is required [] and in camp communities that have a strategy of implementing household systems" (Emersan)			
Value Valu						are a viable solution if long-term household sanitation is required [] and in camp communities that have a strategy of implementing household systems" (Emersan) Onsite worm based toilets are often implemented			
Madd A. Source Protection for Notice of Commission from Notice of Co						are a viable solution if long-term household sanitation is required [] and in camp communities that have a strategy of implementing household systems" (Emersan) Onsite worm based toilets are often implemented at a household scale and designed for a specific			
Specific Confidence Specific Confidence						are a viable solution if long-term household sanitation is required [] and in camp communities that have a strategy of implementing household systems" [Emersan] Onsite worm based toilets are often implemented at a household scale and designed for a specific number of users in these households. Therefore,			
Contraction Find Contraction Find Contraction Find Contraction Find Contraction Find Contraction Find Contraction Find Contraction Find Contraction Find Contraction Find Contraction Find Contraction Find Contraction Find Contraction Find Contraction Find Contraction Find						are a viable solution if long-term household sanitation is required [] and in camp communities that have a strategy of implementing household systems" [Emersan] Onsite worm based tollets are often implemented at a household scale and designed for a specific number of users in these households. Therefore, scaling up by increasing the size of one unit is not lead.			
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No. No.	Transfer Coefficients 11 med [f] ba	Compost 1 1 23 35 0.55 0.66 0.66 0.55 1 1 0.05 0.100 0.100 0.100 0.100 0.100 0.100 0.100 0.100 0.100 0.100 0.100 0.100 0.100	(0.23-1)	######################################	(simple = 1, technical = 0, special = 0) Arrioss 0 0 0 0 00 000 022 036 05	are a viable solution if long-term household sanitation is required. —J and in camp communities that have a strategy of implementing household systems ("Imersan) Onsite worm based toilets are often implemented at a household systems ("Imersan) Onsite worm based toilets are often implemented at a household systems ("Imersan) Onsite worm based toilets are often implemented at a household scale and designed for a specific reasonable to the state of the state of one unit is not estable. However, the technology can be scaled up by building new units for other households. "Worm-Based Toilets can be constructed from locally available materials. (Worms) can be found locally, bought from vermicinopostic proversion of the properties of the state	Westerfoss 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	*see calculations in 12.2.2 *includes prior composting see caticulations in 12.2.1 *increase of P content removael efficiency for PO4-P, with sand and growel dividing layer *see calculations in 12.2.2 *a. Th *caticulations in 12.2.2 *a. Th *increase of T increase *increase *increase of T increase *increase	Vador et al. (2010) Vador et al. (2011) Hait and Tare (2011) Hait and Tare (2011) Hait and Tare (2011) Hait and Tare (2011) Hait and Tare (2011) Software (2011) Hait and Tare (2011) Software (2011) Vador et al. (2010) Benitze et al. (2010) Graph and Graph (2011) Vador et al. (2012) Vador et al. (2012) Vador et al. (2012) Vador et al. (2012) Software (2012) Softwar
No. No.	Transfer Coefficients Ti med (i) but	Impact from "Sentration," Technologies, T., Galabase, 221 Compost	(0.23-1)	### Itechnical special ####################################	(simple = 1, technical = 0, special = 0) Airtoss 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	are a viable solution if long-term household sanitation is required. —J and in camp communities that have a strategy of implementing household systems ("Imersan) Onsite worm based toilets are often implemented at a household systems ("Imersan) Onsite worm based toilets are often implemented at a household systems ("Imersan) Onsite worm based toilets are often implemented at a household scale and designed for a specific reasonable to the state of the state of one unit is not estable. However, the technology can be scaled up by building new units for other households. "Worm-Based Toilets can be constructed from locally available materials. (Worms) can be found locally, bought from vermicinopostic proversion of the properties of the state	Westerfoss 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	*see calculations in 12.2.2 *includes prior composting see caticulations in 12.2.1 *increase of P content removael efficiency for PO4-P, with sand and growel dividing layer *see calculations in 12.2.2 *a. Th *caticulations in 12.2.2 *a. Th *increase of T increase *increase *increase of T increase *increase	Vador et al. (2010) Vador et al. (2011) Hait and Tare (2011) Hait and Tare (2011) Hait and Tare (2011) Hait and Tare (2011) Hait and Tare (2011) Software (2011) Hait and Tare (2011) Software (2011) Vador et al. (2010) Benitze et al. (2010) Graph and Graph (2011) Vador et al. (2012) Vador et al. (2012) Vador et al. (2012) Vador et al. (2012) Software (2012) Softwar
Calculations in 12.21 Calculations in 12.21 Calculations in 12.21 Calculations in 12.21 Calculations in 12.21 Calculations in 12.21 Calculations in 12.21 Calculations in 12.21 Calculations in 12.21 Calculations in 12.21 Calculations in 12.22 Calculations in 12.22 Calculations in 12.23 Calculations in 12.24 Calculations in 12.24 Calculations in 12.22 Calculations in 12.22 Calculations in 12.22 Calculations in 12.22 Calculations in 12.22 Calculations in 12.22 Calculations in 12.22 Calculations in 12.22 Calculations in 12.22 Calculations in 12.22 Calculations in 12.22 Calculations in 12.22 Calculations in 12.22 Calculations in 12.22 Calculations in 12.22 Calculations in 12.22 Calculations in 12.22 Calculations in 12.23 Calculations in 12.24 Calculations in 12.25 Calc	Transfer Coefficients 11 med [f] but med [e] med [e]	Compost 1 1 23 0.55 0.55 0.68 0.64 0.55 1 0.055 0.198 0.498	(0.23-1)	### Itechnical special ####################################	(simple = 1, technical = 0, special = 0) Airtoss 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	are a viable solution if long-term household sanitation is required. —J and in camp communities that have a strategy of implementing household systems ("Imersan) Onsite worm based toilets are often implemented at a household systems ("Imersan) Onsite worm based toilets are often implemented at a household systems ("Imersan) Onsite worm based toilets are often implemented at a household scale and designed for a specific reasonable to the state of the state of one unit is not estable. However, the technology can be scaled up by building new units for other households. "Worm-Based Toilets can be constructed from locally available materials. (Worms) can be found locally, bought from vermicinopostic proversion of the properties of the state	Westerfoss 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	*see calculations in 12.2.2 *includes prior composting see caticulations in 12.2.1 *increase of P content removael efficiency for PO4-P, with sand and growel dividing layer *see calculations in 12.2.2 *a. Th *caticulations in 12.2.2 *a. Th *increase of T increase *increase *increase of T increase *increase	Vador et al. (2010) Vador et al. (2011) Hait and Tare (2011) Hait and Tare (2011) Hait and Tare (2011) Hait and Tare (2011) Hait and Tare (2011) Software (2011) Hait and Tare (2011) Software (2011) Vador et al. (2010) Benitze et al. (2010) Graph and Graph (2011) Vador et al. (2012) Vador et al. (2012) Vador et al. (2012) Vador et al. (2012) Software (2012) Softwar
0.53	Transfer Coefficients T1 med (R bal		(0.23-1) (0.77)	### (### ### ### ### ### ### ### ### ##	(simple = 1, technical = 0, special = 0) Alrioss 0 0 0 0 00 032 033 036 0 0 0 0 0 0 0 0 0 0 0	are a viable solution if long-term household sanitation is required. J. and in camp communities that have a strategy of implementing communities that have a strategy of implementing household systems ("Imersan) Onsite worm based toilets are often implemented at a household scale and designed for a specific number of users in these households. Therefore, a strategy of the specific number of users in these households. Therefore, desirable, incover, the technology can be caused up by building new units for other households. "Worm-Based Toilets can be constructed from locally available materials. [Worms] can be found locally, bought from vermicomposting or vermiculture businesses, or imported." (Emersan) Since they can be set up with locally available material and do not require special parts, building new units should not be difficult. "Worm-Based Toilets can be constructed from locally available materials." The worm of the strategy of the strate	Waterloss	*see calculations in 12.2.2 *Includes prior compositing see calculations in 12.2.1 *Increase of IP content removael efficiency for POA-P, with sand and graved findings layer *see calculations in 12.2.2 *sa TN *includes prior compositing, see calculations in 12.2.2 *lax TN *includes prior compositing, see calculations in 12.2.2 *lax TN *includes prior compositing, see calculations in 12.2.2 *lax TN *includes prior compositing, see calculations in 12.2.3 *lax TN *includes prior compositing, see calculations in 12.2.4 *lax TN *includes prior compositing, see calculations in 12.2.5 *lax TN *includes prior compositing, see calculations in 12.2.5 *lax TN *includes prior compositing, see calculations in 12.2.5 *lax TN *includes prior compositing, see calculations in 12.2.5 *lax TN *includes prior compositing, see calculations in 12.2.5 *lax TN *includes prior compositing, see calculations in 12.2.5 *lax TN *includes prior compositing, see calculations in 12.2.5 *lax TN *includes prior compositing, see calculations in 12.2.5 *lax TN *includes prior compositing, see calculations in 12.2.5 *lax TN *includes prior compositing, see calculations in 12.2.5 *lax TN *includes prior compositing, see calculations in 12.2.5 *lax TN *includes prior compositing, see calculations in 12.2.5 *lax TN *includes prior compositing, see calculations in 12.2.5 *lax TN *includes prior compositing, see calculations in 12.2.5 *lax TN *includes prior compositing, see calculations in 12.2.5 *lax TN *includes prior compositing, see calculations in 12.2.5 *lax TN *includes prior compositing, see calculations in 12.2.5 *lax TN *includes prior compositing, see calculations in 12.2.5 *lax TN *includes prior compositing, see calculations in 12.2.5 *lax TN *includes prior compositing, see calculations in 12.2.5 *lax TN *includes prior compositing, see calculations in 12.2.5 *lax TN *includes prior compositing, see calculations in 12.2.5 *lax TN *includes prior compositing, see calculations in	Vador et al. (2010) Vador et al. (2011) Hait and Tare (2011) Hait and Tare (2011) Hait and Tare (2011) Hait and Tare (2011) Hait and Tare (2011) Softweengest, A. 2016. Koderlegs, Konste and Karamber (2010), Vador et al. (2010) Beneise et al. (2010) Hait and Tare (2011) Gugts and Gare (2010) Arosol, P., Gesensley Nartey, E. and Schreecongol, A. 2016. Hay, E. and Schreecongol, A. 2016.
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0.1	Transfer Coefficients T1 med (R bal	Compost 1 1 2 2233 0.233 0.253 0.055 0.056 0.05	(0.23-1) (0.27)	Effluent Effluent 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	(simple = 1, technical = 0, special = 0) Airloss 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	are a viable solution if long-term household sanitation is required. J. and in camp communities that have a strategy of implementing communities that have a strategy of implementing household systems ("Imersan) Onsite worm based toilets are often implemented at a household scale and designed for a specific number of users in these households. Therefore, and the strategy of the strategy of the special control of the strategy of	Waterloss	**see calculations in 12.2.2 *Includes prior composting, see calculations in 12.2.1 *Includes prior composting, see calculations in 12.2.1 *Includes prior composting, see calculations in 12.2.2 *a TM *Includes prior composting, see calculations in 12.2.2 *Includes prior composting, see calculations in 12.2.2 *Includes prior composting, see calculations in 12.2.1 *Includes prior composting, see calculations in 12.2.1 *Includes prior composting, see calculations in 12.2.1	Vador et al. (2010) Vador et al. (2011) Hait and Tare (2011) Hait and Tare (2011) Hait and Tare (2011) Hait and Tare (2011) Hait and Tare (2011) Hait and Tare (2011) W Vador et al. (2010) Bombie et al. (2010) Bombie et al. (2010) Gupta and Garantier (2011) Gupta a
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0.05 assumption that almost no evaporation occur (closed tank) med (R) 0.2 (0.1-0.53) 0.655 0.05 0 0 bal. 0.3 0.65 0.05 k 2 (0.43) 75 0.5 0.5 *see calculations in 12.2.2 Yadwet at. (2010) **See calculations in 12.2.2 Amoubt P, Cleanatery Nartey, E, and **See calculations in 12.2.2 Amoubt P, Cleanatery Nartey, E, and **See calculations in 12.2.2 Amoubt P, Cleanatery Nartey, E, and	Transfer Coefficients T1 med (R bal	Compost Comp	(0.23-1) (0.27)	Effluent Effluent 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	(simple = 1, technical = 0, special = 0) Airloss 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	are a viable solution if long-term household sanitation is required. J. and in camp communities that have a strategy of implementing communities that have a strategy of implementing household systems ("Imersan) Onsite worm based toilets are often implemented at a household scale and designed for a specific number of users in these households. Therefore, and the strategy of the strategy of the special control of the strategy of	Waterloss	*see calculations in 12.2.2 *Includes prior composting see calculations in 12.2.1 *Includes prior composting see calculations in 12.2.1 *Increase of TP combent *removal efficiency for PO4-P, with sand and graved drainage layer *see calculations in 122.2.2 *see calculations in 122.2.2 *see calculations in 122.2.2 *see calculations in 122.2.2 *Increase of TW content *Includes prior composting, see calculations in 12.3.2.1 *Includes prior composting see calculations in 12.3.2.1 *Includes prior composting see calculations in 12.3.2.1 *Includes prior composting see calculations in 12.3.2.1 *Includes prior composting, see calculations in 12.3.2.1 *Includes prior composting, see calculations in 12.3.2.1 *Includes prior composting, see calculations in 12.3.2.2.2 *Includes prior composting, see calculations in 12.3.2.2.2 *Includes prior composting see calculations in 12.3.2.2.2.2 *Includes prior composting see calculations in 12.3.2.2.2.2 *Includes prior composting see calculations in 12.3.2.2.2.2.2 *Includes prior composting see calculations in 12.3.2.2.2.2.2.2.2.2.2.2.2.2.2.2.2.2.2.2	Vador et al. (2010) Vador et al. (2011) Hait and Tare (2011) Hait and Tare (2011) Hait and Tare (2011) Hait and Tare (2011) Hait and Tare (2011) Hait and Tare (2011) Hait and Tare (2011) Softweengest, A. (2016) Vador et al. (2010) Bennite et al. (2010) Hait and Tare (2011) Vador et al. (2012) Vador et al. (2012) Vador et al. (2012) Vador et al. (2012) Vador et al. (2012) Vador et al. (2012) Vador et al. (2012) Vador et al. (2012) Vador et al. (2012) Vador et al. (2012) Vador et al. (2012) Vador et al. (2012) Vador et al. (2012) Vador et al. (2012) Vador et al. (2012) Vador et al. (2012) Vador et al. (2012) Vador et al. (2012)
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med (R) 0.2 (0.1-0.53) 0.655 0.05 0 0 bal. 0.3 0.65 0.05 0 0 4 0	Transfer Coefficients T1 med (R bal		(0.23-1) (0.27-1) (0.	######################################	(simple = 1, technical = 0, special = 0) Autous 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	are a viable solution if long-term household sanitation is required. J. and in camp communities that have a strategy of implementing communities that have a strategy of implementing household systems ("Imersan) Onsite worm based toilets are often implemented at a household scale and designed for a specific number of users in these households. Therefore, and the strategy of the strategy of the special control of the strategy of	Waterloss	**see calculations in 12.2.2 **Incides prior composting see calculations in 12.2.1 **increase of TP content **removael efficiency for PO+P with sand and gravel drainage layer **see calculations in 12.2.2 **see calculations in 12.2.2 **see calculations in 12.2.2 **see calculations in 12.2.2 **see calculations in 12.2.2 **see calculations in 12.2.2 **see calculations in 12.2.2 **see calculations in 12.2.2 **see calculations in 12.2.1 **increase of TN content **Includes prior composting, see calculations in 12.2.1 **see calculations in 12.2.2 **see calculations in in 12.2.1 **see calculations in in 12.2.2 **see calculations in in 12.2.2 **see calculations in in 12.2.2 **see calculations in in the total was of faces conversion ratio ICI du Sept mass of	Vador et al. (2010) Vador et al. (2011) Hatt and Tare (2011) Hatt and Tare (2011) Hatt and Tare (2011) Hatt and Tare (2011) Hatt and Tare (2011) Softweengest, A. 2016. Softweengest, A. 2016. Softweengest, A. 2016. Softweengest, Call (2010) Bennice et al. (2010) Hatt and Tare (2011) Gugtt and Gorg (2010) Hatt and Tare (2011) Softweengest, A. 2016. Softweengest, A. 2016. Annual, P., General Waster, E. and Schrecongest, A. 2016 Annual, P., General Vaster, E. and Schrecongest, A. 2016. Annual, P., General Vaster, E. and Schrecongest, A. 2016. Full of et al. (2012) Vador et al. (2012) Full of et al. (2012) Full of et al. (2012) Full of et al. (2012) Full of et al. (2012) Full of et al. (2012) Full of et al. (2012) Full of et al. (2012) Full of et al. (2012) Full of et al. (2015) Full of
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75 0.5 **see calculations in 12.2.2 Yadov et al. (2010)	Transfer Coefficients TI med (fi ba) med (fi type (Composit 1 1 1 2.333 2.535 2.55 2.75 2.66 2.66 2.64 2.65 2.66 2.66 2.66 2.66 2.66 2.66 2.66	(0.23-1) (0.27-1) (0.	Effluent 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	(simple = 1, technical = 0, special = 0) Airloss 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	are a viable solution if long-term household sanitation is required. —J and in camp communities that have a strategy of implementing household systems ("Imersan) Onsite worm based toilets are often implemented at a household systems ("Imersan) Onsite worm based toilets are often implemented at a household stade and designed for a specific residence of the special systems of the state of one unit is not existed by the state of the state of one unit is not existed up by building new units for other households. "Worm-Based Toilets can be constructed from locally available materials. (Worms) can be found locally, bought from vermicinopostic great parts of the state of one units and the state of the sta	Waterloss	**see calculations in 12.2.2 **includes prior composting, see calculations in 12.2.1 **increase of TP content **encrease of TP content **see calculations in 12.2.1 **a TN **see calculations in 12.2.2 **a TN **see calculations in 12.2.2 **a TN **see calculations in 12.2.1 **increase of TN content **increase of TN cont	Vador et al. (2010) Vador et al. (2011) Hatt and Tare (2011) Hatt and Tare (2011) Hatt and Tare (2011) Hatt and Tare (2011) Hatt and Tare (2011) Softweengest, A. 2016. Softweengest, A. 2016. Softweengest, A. 2016. Softweengest, Call (2010) Bennice et al. (2010) Hatt and Tare (2011) Gugtt and Gorg (2010) Hatt and Tare (2011) Softweengest, A. 2016. Softweengest, A. 2016. Annual, P., General Waster, E. and Schrecongest, A. 2016 Annual, P., General Vaster, E. and Schrecongest, A. 2016. Annual, P., General Vaster, E. and Schrecongest, A. 2016. Full of et al. (2012) Vador et al. (2012) Full of et al. (2012) Full of et al. (2012) Full of et al. (2012) Full of et al. (2012) Full of et al. (2012) Full of et al. (2012) Full of et al. (2012) Full of et al. (2012) Full of et al. (2015) Full of
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	Transfer Coefficients Ti med (fi ba) 13 med (fi coefficients) med (fi ba) ba)	Comport	(0.23-1) (0.23-1) (0.23-1) (0.21) (0.	Effluent 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	(simple = 1, technical = 0, special = 0) Airloss 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	are a viable solution if long-term household sanitation is required. J-and in camp communities that have a strategy of implementing household systems ("Imensan) Onsite worm based toilets are often implemented at a household start ("Imensan) Onsite worm based toilets are often implemented at a household start of the	Waterloss	**see calculations in 12.2.2 **includes prior composting, see calculations in 12.2.1 **increase of TP content removaed efficiency for PO4-P **increase of TP content removaed efficiency for PO4-P **see calculations in 12.2.2 **a TM **see calculations in 12.2.2 **a TM **increase of TP content **in	Yador et al. (2010) Yador et al. (2011) Hait and Ture (2011) Hait and Ture (2011) Hait and Ture (2011) Hait and Ture (2011) Hait and Ture (2011) Hait and Ture (2011) But (2011) Hait and Ture (2011) Hait and Ture (2011) Hait and Ture (2011) Gupta and Gurg (2002) Yador et al. (2012) Hait and Ture (2011) Gupta and Gurg (2002) Annoale P., Chematry Nartey, E. and Schrecongost, A. 2016. Yador et al. (2012) Yador et al. (2012) Yador et al. (2012) Yador et al. (2012) Yador et al. (2012) Yador et al. (2012) Yador et al. (2012) Yador et al. (2012) Yador et al. (2012) Yador et al. (2012) Yador et al. (2012) Yador et al. (2012) Yador et al. (2012)
0.2 0.8 estimated based on drawing Zhao et al. (2010)	Transfer Coefficients Ti med (fi ba) 13 med (fi coefficients) med (fi ba) ba)	Description Section Technology To distance 201 Compost 1 1 1 0.33 0.5 0.66 0.66 0.66 0.69 0.49 0.49 0.49 0.49 0.49 0.49 0.49 0.49 0.50 0.49 0.49 0.50 0.49 0.50	(0.23-1) (0.23-1) (0.23-1) (0.21) (0.	Effluent Cffluent Cffluent Cffluent Comparison Co	Simple = 1, technical = 0, special = 0) Airloss 0 0 0 0 0 0 0 0 0 0 0 0	are a viable solution if long-term household sanitation is required. J-and in camp communities that have a strategy of implementing household systems ("Imensan) Onsite worm based toilets are often implemented at a household start ("Imensan) Onsite worm based toilets are often implemented at a household start of the	Waterloss	* see calculations in 12.2.2 * Includes prior compositing see calculations in 12.2.1 * Increase of TP content * removaed efficiency for PO4-P with sand and graved drainage layer * see calculations in 12.2.2 * see calculations in 12.2.2 * see calculations in 12.2.2 * linear of TR content * includes prior compositing, see calculations of TR content effluent removal efficiency for NH3-N Sputher et al. (2021) * Includes prior compositing see calculations in 12.2.2 * includes prior compositing see calculations in 12.2.2 * includes prior compositing see calculations in 12.2.2 * includes prior compositing see calculations in 12.2.2 * see calculations in 12.2.2 * see calculations in 12.2.2 * see calculations in 12.2.2 * see calculations in 12.2.2	Vador et al. (2010) Vador et al. (2011) Hait and Tare (2011) Hait and Tare (2011) Hait and Tare (2011) Hait and Tare (2011) Hait and Tare (2011) Hait and Tare (2011) Hait and Tare (2011) Some (2011) Wallow et al. (2010) Particle et al. (2010) Gupta and Garantier (2011) Gupta and Garantier (2011) Gupta and Garantier (2011) Gupta and Garantier (2011) Gupta and Garantier (2011) Gupta and Garantier (2011) Gupta and Garantier (2011) Gupta and Garantier (2011) Gupta and Garantier (2011) Gupta and Garantier (2011) Gupta and Garantier (2011) Gupta and Garantier (2011) Gupta and Garantier (2011) Gupta and Garantier (2011) Gupta and Garantier (2011) Gupta and Garantier (2011) Gupta and Garantier (2011) Vador et al. (2012) Vador et al. (2012) Vador et al. (2012) Vador et al. (2012) Vador et al. (2010) Spublier et al. (2010) Vador et al. (2010) Vador et al. (2010) Vador et al. (2010)
	Transfer Coefficients Ti med (fi ba) 13 med (fi coefficients) med (fi ba) ba)	Compost	(0.2-3-1) (0.2-3-1) (0.2-1) (0.2-1) (0.2-1) (0.2-1) (0.2-1) (0.2-1) (0.3-1) (0.4-0.53)	### CERT CERT	(simple = 1, technical = 0, special = 0) Airfors 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	are a viable solution if long-term household sanitation is required. J-and in camp communities that have a strategy of implementing household systems ("Imensan) Onsite worm based toilets are often implemented at a household start ("Imensan) Onsite worm based toilets are often implemented at a household start of the	Waterloss	* see calculations in 12.2.2 * Includes prior compositing see calculations in 12.2.1 * Increase of IP content * removael efficiency for POR-P with sand and gravel drainage layer * see calculations in 12.2.2 * see calculations in 12.2.2 * see calculations in 12.2.2 * linear of IR Content * Includes prior compositing, see calculations of IR Content * linear	Vador et al. (2010) Vador et al. (2011) Hait and Tare (2011) Hait and Tare (2011) Hait and Tare (2011) Hait and Tare (2011) Hait and Tare (2011) Hait and Tare (2011) Hait and Tare (2011) Some (2011) Wallow et al. (2010) Particle et al. (2010) Gupta and Garantier (2011) Gupta and Garantier (2011) Gupta and Garantier (2011) Gupta and Garantier (2011) Gupta and Garantier (2011) Gupta and Garantier (2011) Gupta and Garantier (2011) Gupta and Garantier (2011) Gupta and Garantier (2011) Gupta and Garantier (2011) Gupta and Garantier (2011) Gupta and Garantier (2011) Gupta and Garantier (2011) Gupta and Garantier (2011) Gupta and Garantier (2011) Gupta and Garantier (2011) Gupta and Garantier (2011) Vador et al. (2012) Vador et al. (2012) Vador et al. (2012) Vador et al. (2012) Vador et al. (2010) Spublier et al. (2010) Vador et al. (2010) Vador et al. (2010) Vador et al. (2010)
	Transfer Coefficients Ti med (fi ba) 13 med (fi coefficients) med (fi ba) ba)	Compost	(0.2-3-1) (0.2-3-1) (0.2-1) (0.2-1) (0.2-1) (0.2-1) (0.2-1) (0.2-1) (0.3-1) (0.4-0.53)	### CERT CERT	(simple = 1, technical = 0, special = 0) Airfors 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	are a viable solution if long-term household sanitation is required. J-and in camp communities that have a strategy of implementing household systems ("Imensan) Onsite worm based toilets are often implemented at a household start ("Imensan) Onsite worm based toilets are often implemented at a household start of the	Waterloss	* see calculations in 12.2.2 * Includes prior compositing see calculations in 12.2.1 * Increase of IP content * removael efficiency for POR-P with sand and gravel drainage layer * see calculations in 12.2.2 * see calculations in 12.2.2 * see calculations in 12.2.2 * linear of IR Content * Includes prior compositing, see calculations of IR Content * linear	Vador et al. (2010) Vador et al. (2011) Hait and Tare (2011) Hait and Tare (2011) Hait and Tare (2011) Hait and Tare (2011) Hait and Tare (2011) Hait and Tare (2011) Hait and Tare (2011) Some (2011) Wallow et al. (2010) Particle et al. (2010) Gupta and Garantier (2011) Gupta and Garantier (2011) Gupta and Garantier (2011) Gupta and Garantier (2011) Gupta and Garantier (2011) Gupta and Garantier (2011) Gupta and Garantier (2011) Gupta and Garantier (2011) Gupta and Garantier (2011) Gupta and Garantier (2011) Gupta and Garantier (2011) Gupta and Garantier (2011) Gupta and Garantier (2011) Gupta and Garantier (2011) Gupta and Garantier (2011) Gupta and Garantier (2011) Gupta and Garantier (2011) Vador et al. (2012) Vador et al. (2012) Vador et al. (2012) Vador et al. (2012) Vador et al. (2010) Spublier et al. (2010) Vador et al. (2010) Vador et al. (2010) Vador et al. (2010)

	0.1	0,02-0,2				Reduction in the total wet mass of faeces	Koslengar, Konate and Karambiri (2020)
	0.1925	0,17-0,21	0.8075			conversion ratio (1:0.55) * moisure (35%)	
				0.05		assumption that almost no evaporation	
						occur (closed tank)	
med (R)	0.2	(0.1-0.53)	0.655	0.05	0	0	
bal.	0.3		0.65	0.05			
k		[0.43]					
TS	0.5			0.5		* see calculations in 12.2.2	
	·			·	·	·	

Tederences:

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Sopulier, D., de Morstin Lim, P. Fritzsche, F., Jamenne, K., Jam, A., van Solativa Marcha Countries (Sandeed, Saviss Federal institute of Aquatic Science and Technology (Eawag), Dibendorf, Switzerland.
Sopuler, D., de Morstin Lim, P. Fritzsche, F. Lamenne, K., Jam, A., van Solativa Marcha Marcha Solativa Marcha Solativa Marcha Solativa Marcha Solativa Marcha Solativa Marcha Solativa Marcha Solativa Marcha Solativa Marcha Solativa Marcha Solativa Marcha

Septic Tank						
General Information	Values	Data Source	I			
FUNCTIONAL GROUP UNIQUE IDENTIFIER (ID)	septic_tank	-				
	Matthias van Sloten blackwater, greywater	- Spuhler, D. & Roller, L. (2020)				
OUTPUT PRODUCT	sludge, effluent	Spuhler, D. & Roller, L. (2020)				
	Input: OR Output: AND	Spuhler, D. & Roller, L. (2020)				
COMMENTS Pre-Filter Criteria	Values	Data Source				
applicability_level		Tilley, E. et al. (2014)				
	(household = 1, shared = 1, public = 1)	Tilley, E. et al. (2014)				
capex_req_level opex_req_level	3	Spuhler, D. et al. (2021) Spuhler, D. et al. (2021)				
technical_maturity development phase	(acute = 0.5, stabilisation = 1,	Tilley, E. et al. (2014) Gensch, R. et al. (2018)				
	development/recovery = 1)	Applicable for this Functional Group?	Catagories [Unit]	Technology Values (Data)	Data Source / Assumptions	Internal Revie
water_supply	Performance, Categorical	FALSE	house	NA NA	NA NA	NA
			yard public			
water_volume	Performance, Trapez	TRUE	none [L/cap/day]	(a = 8, b = 33, c = 60, d = 120)	"There is sufficient water available	Yes
			[4,444,441]	(- 5, 5 55, 5	(water consumption of at least	
					30L/person/day)." (Monvois et al. (2012))	
					The performance of the technology is depending on a minimum but not on a	
					maximum of water consumption.	
					 mimimal volumes with pour flush toilet flushing water (1-3 l/use) and anal 	
					cleansing water (0.3-3 l/use) assuming 6 visits per persons per day	
					- Maximal volume: can be used with	
					cistern flush toilet (10-20 l/use) assuming 6 visits per persons per day.	
electricity_supply	Performance, Categorical	TRUE	electricity intermittent	(electricity = 1, intermittent = 1, no electr	"No electrical energy is required"	yes
			no electricity		(Compendium)	
fuel_supply	Performance, Categorical	FALSE	fuel no fuel	NA	NA	NA
frequency_of_om	PDF, Categorical	TRUE	irregular	(irregular = 0, regular = 1, continous = 0)	"Desludging is required for Septic Tanks	yes
			regular continuous		and frequency will depend on the volume of the tank relative to the input	
					of solids, the amount of indigestible solids, and the ambient temperature, as	
					well as usage, system characteristics and the requirements of the relevant	
					authority. Well-functioning systems will	
					require emptying every two to five years. [] The most common cause of	
					failure of Septic Tanks is the failure of the in filtration system. Tanks connected	
					to under-designed disposal systems will	
					require emptying more frequently." (Emersan)	
					"Scum and sludge levels need to be monitored to ensure that the tank is	
					functioning well. [] Septic tanks should	
					be checked from time to time to ensure that they are watertight." (Compendium)	
pipe_supply	Performance, Categorical	TRUE	no pipes	(no pipes = 1, difficultly available = 0.75, p		yes
			difficultly available pipes		recommended to reduce scums and solids that are discharged.	
pump_supply	Performance, Categorical	TRUE	no pumps	(no pumps = 1, difficultly available = 1, pu	(Compendium)	yes
panip_supply	r enormance, categorical		difficultly available	, pomps - 1, unneutry available - 1, pu	(Compendium)	,
			pumps		There is no need for pumps to buildup the technology. (Compendium)	
concrete_supply	Performance, Categorical	TRUE	no concrete difficultly available	(no concrete = 0.5, difficultly available = 0.75, concrete = 1)		yes
			concrete	and a construction of the	plastic []." (Compendium)	
					"A Septic Tank can be made of local bricks, cement blocks or stone and thus	
					can be constructed on site using local materials. Prefabricated tanks are	
					available in fibreglass, PVC or plastic."	
					(Emersan) Concrete can be replaced by alternative	
					options, but these might perform worse due to lifetime, import of pre-fabrication	
					options or more local experience with	
					concrete construction.	
spare_parts	PDF, Categorical	TRUE	simple technical	(simple = 0.8, technical = 0.2, special = 0)	"Simple and robust technology" (Compendium)	yes
			special		"A Septic Tank can be made of local	
					bricks, cement blocks or stone and thus can be constructed on site using local	
					materials. [] The most common cause of failure of Septic Tanks is the failure of	
					the in filtration system. " (Emersan)	
0	0	FALSE	0	NA	NA	NA
0	0	FALSE FALSE	0	NA	NA	NA
temperature	Performance, Categorical		very cold	NA (very cold = 0.7, cold = 0.8, temperate = 1	"They can be implemented in every type	yes yes
			cold temperate		of climate, although the efficiency will be lower in colder climates (as	
			warm		an aerobic digestion occurs more	
			hot		efficiently at higher temperatures)." (Emersan)	
					Performance in colder temperatures decreased.	
flooding	Performance, Categorical	TRUE	flooding	(flooding = 0.6, no flooding = 1)	"Even though septic tanks are	Yes
			no flooding		watertight, it is not recommended to construct them in areas with high	
					groundwater tables or where there is	
					frequent flooding." (Compendium) Raised configurations of septic tank are	
					also possible for flood prone areas (Borges Pedro et al., 2020)	
İ					All technologies where raised	
			i e	İ	configurations are possible get a 50%	1
					performance for category "flooding".	
					performance for category "flooding". Septic tank also gets a slightly higher performance, i.e, 60% since it is built to	

Marchane Marchane Company Dist							
Patient and Company Patient and Company	vehicular_acces	Performance, Categorical	TRUE	difficult	(no access = 0, difficult = 0, full = 1)	there is a way of dispersing or transporting the effluent. [] Instead, the septic tanks should be connected to some type of Conveyance technology, through which the effluent is transported to a subsequent Treatment or Disposal site. [] Because the septic tank must be regularly desludged, a vacuum truck should be able to access	yes
Patient and Company Patient and Company	slope	Performance, Categorical	FALSE	flat	NA	NA	NA
Secondarity depth Performance, Toping State Secondarity depth Secondarity dept				not flat clay silt sand		Technology does not rely on soil absorbtion. No difference between soil	
Next				water depth [m]		watertight, it is not recommended to construct them in areas with high groundwater tables or where there is frequent flooding." (Compendium) However, even though there is remaining risk of groundwater contamination, a septic tank should be built watertight and therefore should not affect the groundwater.	
Septimization of the process of the						If built underground, excavation can be necessary.	
Bodies B	surface_area_onsite	Performance, Trapez	TRUE	[m2/plot]	(a = 5, b = 5 , c = 999 , d = 999)	septic tanks (Monvois et al. 2012). The value of 5m2/plot is used here, making septic tank a technology with a larger footprint on the plot compared to	
March Marc	surface_area_offsite	Performance, Trapez					
Professionary Composed Part Prof		0					
O O ALEX O O O O O O O O O	0	0	FALSE	Close	NA	NA "Even though septic tanks are watertight, it is not recommended to construct them in areas with high groundwater tables or where there is frequent flooding." (Compendium)	NA
Loader professional Performance, Categorical TAUE Loader professional 2 1 2 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	0	0	FALSE	0	NA		NA
continued cont	0	0	FALSE	0	NA	NA	NA
unalited shifted professional p				unskilled skilled professional	1)	(Compendium) There are no technical parts to be installed and the design is pretty simple. There are prefabricated tanks are available in fibreglass, PVC or plastic. (Emersan)	
Unskled Skilled Professional Skilled Professional Skilled Professional Skilled Professional Skilled Professional Skilled Professional Skilled Professional Skilled Ski				unskilled skilled professional	1)	considerations must be done and the design is depending on several parameter that have to be noted. (Compendium) Therefore at least moderate design skills are needed.	
O O FALSE O NA NA NA NA NA O O FALSE O NA NA NA NA NA O O FALSE O NA NA NA NA NA O O Ferformance, Categorical FALSE Numbers Soft wipers O O ALSE NA NA NA NA NA O O FALSE NA NA NA NA NA NA NA NA NA NA NA NA NA NA NA NA NA NA N	om_skills	Performance, Categorical	TRUE	Unskilled Skilled		Septic Tanks is the failure of the in filtration system." (Emersan) "Scum and sludge levels need to be monitored to ensure that the tank is functioning well. [] Septic tanks should be checked from time to time to ensure	yes
O O FALSE O NA NA NA NA NA O O FALSE O NA NA NA NA NA O O FALSE O NA NA NA NA NA O O Ferformance, Categorical FALSE Numbers Soft wipers O O ALSE NA NA NA NA NA O O FALSE NA NA NA NA NA NA NA NA NA NA NA NA NA NA NA NA NA NA N	0	0	FALSE	0	NA	NA	NA
O O ALSE Washers O NA NA NA NA NA NA NA							
cleaning_method Performance, Categorical ALSE Washers Soft wipers Hard wipers O NA NA NA NA NA NA NA NA NA NA	0	0	FALSE	0	NA	NA	NA
Soft wipers Mart M							
Performance, Categorical TRUE Short (< 1 year) Moderant () systems will require emptying every two for five years () long (>5 years) Moderant () systems will require emptying every two for five years () long (>5 years) Moderant () systems will require emptying every two for five years () long (>5 years) Moderant () systems will require emptying every two for five years () length () status () systems will require emptying every two for five years () length () systems will require emptying every two for five years () length () systems will require emptying every two for five years () length () systems will require emptying every two for five years () length () systems will require emptying every two for five years () length () systems will require emptying every two for five years () length () systems will require emptying every two for five years () length () systems will require emptying every two for five years () length () systems will require emptying every two for five years () length () systems will require emptying every two for five years () length () systems will require emptying every two for five years () length () systems will require emptying every two for five years () length () systems will require emptying every two for five years () length () systems will require emptying every two for five expends on the systems will require emptying every two for five expends on the systems will require emptying every two for five emptying every for systems will require emptying every two for five emptying every for systems will require emptying every two for five emptying expents () systems will require emptying every for five emptying expents () systems will require emptying every for five emptying expents () systems will require emptying every for the emptying expents () systems will require emptying every for the emptying empty () systems will require emptying expents () systems will require emptying expents () systems will require emptying expents () systems will require emptying expents ()				Soft wipers Hard wipers			
## speed_implement_toilet ## speed_implement_treatment ## PDF, Categorical FALSE ## speed_implement_treatment ## speed_implement_treatment ## speed_implement_treatment ## speed							
moderate (3 days to 2 weeks) slow (> 2 weeks) wricks, cement blocks or stone and thus can be constructed on site using local materials. Prefabricated tanks are available in fibreglass, PVC or plastic." ((Emersan Compendium) Design and construction requires attention to ensure water tightness and proper functioning of septic tank (i.e., too high solids are not discharged into effluent). Since there is transport of effluent required (Either soil infiltration or conevyance technology- a subsequent pipe network or infiltration or conevyance technology- a subsequent pipe network or infiltration or conevyance technology- a subsequent pipe network or infiltration or conevyance technology- a subsequent pipe network or infiltration or components could lead to slower speeds of implementation. (Akanksha Jain, Eawag 2021) speed_implement_treatment PDF, Categorical FALSE rapid (few days to a week) moderate (few weeks up to three months) NA NA NA NA NA NA NA NA NA N	lifetime	Performance, Categorical	TRUE	short (-1 year) medium (1-5 years) iong (>5 years)	(short = 1, medium = 1, long = 1)	"long service life", "Well-functioning systems will require emptying every two to five years." (Emersan) Meant for long-term service life, if the emptying itself happens every 2-5 years. "For the civil works a life expectancy of 25 years is assumed. Pipework and the manhole cover are expected to last for 15 years." (Septic Tank Griesauer, C. (2014)) In a study by Berg on the CLARA planning tool the expected lifetimes for septic tanks were larger than 5 years.	
speed_implement_treatment	speed_implement_toilet	PDF, Categorical	TRUE	moderate (3 days to 2 weeks)	(rapid = 0, moderate = 0.5, slow = 0.5)	bricks, cement blocks or stone and thus can be constructed on site using local materials. Prefabricated tanks are available in fibreglass, PVC or plastic." (Emersan Compendium) Design and construction requires attention to ensure water tightness and proper functioning of septic tank (i.e., too high solids are not discharged into effluent). Since there is transport of effluent required (Either soil infiltration or conevyance technology: a subsequent pipe network or infiltration system needs to exist. All these components could lead to slower speeds	yes
	speed_implement_treatment	PDF, Categorical	FALSE	moderate (few weeks up to three months)	NA .	Eawag 2021)	NA

	Desferment Catanadas	TOUE		(4 difficulty 0.5)	Triangle design of a south took design design design.		Ī	1
scalability	Performance, Categorical	IRUE	easy difficult	(easy = 1, difficult = 0.5)	"The design of a septic tank depends on the expected number of users, the water	yes		
					used per capita, average annual temperature, desludging frequency and			
					wastewater characteristics." (Emersan)			
					"Construction costs of septic tanks are			
					relatively low compared to other water based systems. However, they are much			
					more expensive than for dry or composting toilets and unlikely to be			
					affordable for poorer people in society.			
					" (Septic Tank SSWM Toolbox)			
					Technology is designed for a specific number of users and not easy to extend.			
					However, new septic tanks can be built to extend the system. These new ones			
					are more complicated and costly to			
					build than dry pit latrines and therefore more difficult to scale-up. (Kukka			
					Ilmanen, Eawag 2021)			
construction_parts	PDF, Categorical	TRUE	simple	(simple = 0.8, technical = 0.2, special = 0)		yes		
			technical special		(Compendium) "A Septic Tank can be made of local			
					bricks, cement blocks or stone and thus			
					can be constructed on site using local materials. Prefabricated tanks are			
					available in fibreglass, PVC or plastic.", "The most common cause of failure of			
					Septic Tanks is the failure of the in			
Transfer Coefficients	copied from "Sanitation_Technologies_TC_database_202106	22.xlsm")			filtration system. " (Emersan)			'
	Sludge 0.19	Range 11 - 27 %	Effluent 0.81	Airloss	Soilloss	Waterloss	* general P pathways	Reference Montangero and
IP IP		11 - 27 %		U	· ·			Belevi (2007)
	0.23	-	0.77	d	C	0	* general TP removal	Hamader and Javorszky (2014)
	0.4		0.6	0	(0	* general TP removal	Polprasert and
	0.1	-	0.9			0	* P removal at HRT 24 - 48h	Rajput (1982) Siegrist (2017)
	0.256	-	0.7444			0	* P removal at HRT 24h	Nasr and Mikhaeil (2013)
	0.3	-	0.7				* PO4 at HRT 20h	Rahman et al. (1999)
	0.6 0.269	-	0.4 0.731		C		* TP removal at HRT 48h * P removal at HRT 48h	Wanasen (2003) Nasr and Mikhaeil
								(2013)
	0.33 0.47		0.67 0.53				* PO4 at HRT 46h * TP removal at HRT 24h	Rahman et al. (1999) Wanasen (2003)
	0.293	-	0.707	0		0	* P removal at HRT 72h	Nasr and Mikhaeil
	0.33		0.67	0			* PO4 at HRT 73h	(2013) Rahman et al. (1999)
med (R)	0.65 0.30		0.35			0	* PO4 at HRT 114h	Rahman et al. (1999)
med (K)	0.30	(0,1 - 0,65)	0.70	U.			Spuhler et al. (2021)	PA
TN	0.095	5 - 14 %	0.905	O.	C	0	* general N pathways	Montangero and Belevi (2007)
1	0.08		0.92	l O			* general TN removal	Polprasert and
	0		1	o o) (* N removal at HRT 24 - 48h	Rajput (1982) Siegrist (2017)
	0.177		0.823				* TKN removal at HRT 24h,	Nasr and Mikhaeil
							increase of ammonia concentration	(2013)
	0.16 0.24		0.84 0.76				* NO3 removal at HRT 20h * TKN removal at HRT 24h	Rahman et al. (1999) Wanasen (2003)
	0.208		0.792				* TKN removal at HRT 48h,	Nasr and Mikhaeil
	0.2		0.8	Q) 0	increase of ammonia * NO3 removal at HRT 46h	(2013) Rahman et al. (1999)
	0.44		0.56	O.) (* TKN removal at HRT 48h	Wanasen (2003)
	0.268	-	0.732	0		0	* TKN removal at HRT 72h, increase of ammonia	Nasr and Mikhaeil (2013)
	0.35		0.65	q			concentration * NO3 removal at HRT 67h	Rahman et al. (1999)
	0.48		0.52				* general TN pathways	Hamader and
	0.46		0.54	Q) (* NO3 removal at HRT 114h	Javorszky (2014) Rahman et al. (1999)
	0.16		0.84				* NO3 removal at HRT 20h	-
	0.24	-	0.76			0	* TKN removal at HRT 24h	-
	0.208	-	0.792	O	C	0	* TKN removal at HRT 48h, increase of ammonia	PA
	0.2		0.8	a) 0	* NO3 removal at HRT 46h	Howard (2007)
	0.44		0.56	O) 0	* TKN removal at HRT 48h	-
	0.268	-	0.732	O.	C) 0	* TKN removal at HRT 72h, increase of ammonia	PA
	0.35		0.65	Q	ı Ö	, ,	* NO3 removal at HRT 67h	Álvarez et al. (2008)
	0.48		0.65	0			* general TN pathways	Seabloom et al.
	0.46		0.54	n			* NO3 removal at HRT 114h	(2005)
	0.46	30 - 40%	0.54				* at HRT 24 - 48h; TSS removal	Polprasert and Siegrist (2017)
							60-80% (TS removal 30-40%, estimated using 13.2.1.).	
	0.33	-	0.68	O.	C) 0	* single baffle septic tank; TSS removal at HRT 24h: 65% (~TS	Nasr and Mikhaeil (2014)
	0.25		0.75	Q	ı c) 1	37 5% actimated using 13 7 1 \ * TS removal at HRT 24h	Nasr and Mikhaeil
								(2013)
	0.25	-	0.75	O			* TSS removal at HRT 20h: 50% (~TS 25%, estimated using	Rahman et al. (1999)
	0.24		0.76	Q	ı		13.2.1.)	Wanasen (2003)
	0.24		5.70		·		septic tank at HRT 24h: 47%	
	0.34	-	0.66	O	ı c) 0	* single baffle septic tank; TSS	Nasr and Mikhaeil
							removal: 69% (~TS 34%, estimated using 13 7 1)	(2014)
	0.27	-	0.73	0			* TS removal at HRT 48h	Nasr and Mikhaeil (2013)
	0.18	-	0.82	O	C) 0	* TSS removal at 46h: 36% (~TS 18%, estimated using	Rahman et al. (1999)
				a			12 7 1 1	Wanasa (2002)
	0.38	-	0.62	d	0	, 0	* TSS removal of conventional septic tank at HRT 48h: 76%	Wanasen (2003)
	0.37	-	0.63	d) 0	I~TS 38% estimated using * single baffle septic tank; TSS	Nasr and Mikhaeil
							removal: 73% (~TS 0,37, estimated using 13.2.1.)	(2014)
	0.38	-	0.62	O	C) 0	* TS removal at HRT 72h	Nasr and Mikhaeil (2013)
				a			* TCC romoved et UPT 771	
	0.35	-	0.65	O	0	, C	* TSS removal at HRT 73h: 70% (~TS 35%, estimated using	nanman et al. (1999)
	0.20	-	0.80	Q) a	* TSS removal at HRT 114h:	Rahman et al. (1999)
							40% (~TS 20%, estimated using 13.2.1.)	
med (R)	0.33	(0,18 - 0,51)	0.67	0		0		PA PA
		[0.33]						
Additional Information 13.2.1	Relationship TS:TSS removal in septic tanks							
								,

TS removal	38%	27% 24.60%		46%	
TSS removal 65.30%	58.30%		55%	70%	
Ratio TS:TSS removal 58.19%	46.31%	44.73%	65.71%	AVERAGE:	53.74%
Reference Nasr and Mikhaeil (2013)	Nasr and Mikhaeil (2013)	Nasr and Mikhaeil (2013)	Polprasert and Rajput (1982)		

Raised Latrine General Information	Values	Data Source					
FUNCTIONAL GROUP	s						
UNIQUE IDENTIFIER (ID) DATA COMPILER	SaniChoice Project Team	-					
INPUT PRODUCT OUTPUT PRODUCT	faeces, excreta	Gensch, R. et al. (2018) Gensch, R. et al. (2018)					
RELATIONS	Input: OR	Gensch, R. et al. (2018)					
COMMENTS	Output: NA						
Pre-Filter Criteria	Values (household = 1, neighbourhood = 1,	Data Source Gensch, R. et al. (2018)		·			
	city = 0)						
	(household = 1, shared = 1, public = 1)						
capex_req_level opex_req_level		Spuhler, D. et al. (2021) Spuhler, D. et al. (2021)					
technical_maturity	(acute = 1, stabilisation = 0.5,	Gensch, R. et al. (2018) Gensch, R. et al. (2018)					
	development/recovery = 0.5)						
Screening Criteria water_supply	Type and Function Performance, Categorical	Applicable for this Functional Group? FALSE	house	Technology Values (Data) NA	Data Source / Assumptions NA	Internal Review Done? NA	
			yard public				
water_volume	Performance, Trapez	TRUE	none	(a = 0, b = 0, c = 999, d = 999)	"As no water is needed for operation	Yes	
water_volume	Performance, fragez	INCE	[L/cap/uay]	(a - 0, 0 - 0, C - 333, u - 333)	As no water is needed no operation it is also a solution for water scarce areas" (Emersan). This technology is not impacted by flooding and/or high groundwater tables. The only possible way high	res	
					water volumes could enter this technology would be by means of a FG U technology that introduces high amount of water into the system (i.e.,		
					due to anal cleansing or flush water). Maximum values (c & d) are assumed to remain 999 L/cap/day since the FG		
					U technology that will be connected with this tech according to santiago algorithm, based on input-output products, will never be a technology		
					that leads to high water volumes entering raised latrines (because blackwater is not a defined input). For e.g. Cistern flush sytems will never be		
					the recommended FG U tech for raised latrines. (Akanksha Jain)		
electricity_supply	Performance, Categorical Performance, Categorical		intermittent no electricity	(electricity = 1, intermittent = 1, no electricity = 1)	No need for electricity. NA	yes	
	_		no fuel				
frequency_of_om	PDF, Categorical	TRUE	irregular regular continuous	(irregular = 0.5, regular = 0.5, continuous = 0)	"Operation and maintenance (O & M) requirements depend on which latrine design is used. Raised Latrines with a sealed containment facility fill up	yes	
					quickly and need regular emptying or replacement of storage facility and subsequent management of collected studge. O & M tasks also include regular cleaning, conducting routine operational tasks (e.g. checking of availability of water, hygiene items, soap), providing advice on proper use, conducting minor repairs and monitoring the fill level." (Emersan) Maintenance is between regular and irregular.		
pipe_supply	Performance, Categorical	TRUE	no pipes difficultly available pipes	(no pipes = 1, difficultly available = 1, pipes = 1)	Only ventilation pipes require (Emersan) Ventilation pipes can be produced from local material	yes	
pump_supply	Performance, Categorical	TRUE	pumps	(no pumps = 1, difficultly available = 1, pumps = 1)	Raised latrine is aboveground and does not require emptying with a pump.	yes	
concrete_supply	Performance, Categorical		no concrete difficultly available concrete	(no concrete = 1, difficultly available = 1, concrete = 1)	"If possible, materials should be used that are readily available and that can be sourced rapidly. The superstructure can be made from materials including bamboo, grass matting, wood, plastic or metal sheeting (though this often heats up the interior). The lining can be of concrete rings, bricks, stones, timber or sand bags. Several companies have developed variations of prefabricated Raised Latrines that can be delivered and assembled quickly." (Emersan) No concrete specifically needed	yes	
spare_parts	PDF, Categorical	INUE	simple technical special	(simple = 1, technical = 0, special = 0)	"If possible, materials should be used that are readily available and that can be sourced rapidly. The superstructure can be made from materials including bamboo, grass matting, wood, plastic or metal sheeting (though this often heats up the interior). The lining can be of concrete rings, bricks, stones, timber or sand bags. Several companies have developed variations.	yes	
		ENCE		MA.	of prefabricated Raised Latrines that can be delivered and assembled quickly." (Emersan) Material should be locally available and be sourced rapidly when it needs to be replaced, so it cannot be too complicated.	NA.	
0	0	FALSE FALSE	0	NA NA	NA NA	NA NA	
0 temperature	0 Performance, Categorical	FALSE TRUE		NA (very cold = 1, cold = 1, temperate = 1,	NA Raised latrines do not rely on	NA yes	
	,		cold temperate warm hot	warm = 1, hot = 1)	percolation and are therefore suitable for all climates (Emersan).		
flooding	Performance, Categorical	TRUE	flooding	(flooding = 1, no flooding = 1)	"Raised Latrines are particularly	Yes	
			no flooding		suitable for flood prone areas" (Emersan)		

vehicular_acces	Performance, Categorical	TRUE	no access difficult	(no access = 0, difficult = 0.5, full = 1)	"Raised Latrines with a sealed containment facility fill up quickly and	yes
			full		need regular emptying or replacement of storage facility and subsequent	
					management of collected sludge. [] Public Raised Latrines tend to have a	
					high sludge accumulation rate and will	
					require frequent emptying. If regular desludging is needed, availability of	
					and accessibility for desludging	
					vehicles must be considered " (Emersan)	
					Vehicular Access of at least smaller	
					desludging vehicles is required and due to the frequency of emptying full	
					access allowing pumping trucks	
					perform the best	
slope	Performance, Categorical	FALSE	flat not flat	NA	NA	NA
soil_type	Performance, Categorical	TRUE	clay	(clay = 0.7, silt = 0.9, sand = 1, gravel =	"For Raised Latrines partly below	yes
			silt sand	0.9, rock = 0.7)	ground, groundwater contamination can be an issue and soil properties and	
			gravel		the groundwater level should be	
			rock		assessed (X.3) to identify the minimum distance to the next water	
					source and limit exposure to microbial	
					contamination." (Emersan) The technology can be built to rely on	
					soil percolation and filtration, but	
groundwater_depth	Performance, Trapez	TRUE	water depth [m]	(a = 0, b = 3, c = 999, d = 999)	does not necessarily have to. "Raised Latrines are particularly	yes
					suitable for areas where the water table is high","For Raised Latrines	
					partly below ground, groundwater	
					contamination can be an issue and soil properties and the groundwater level	
					should be assessed (X.3) to identify	
					the minimum distance to the next water source and limit exposure to	
					microbial contamination." (Emersan)	
					Could affect the groundwater if built underground.	
excavation	Performance, Categorical	TRUE	eacy	(easy = 1, hard = 1)	"Raised Latrines are particularly	ves
excavation	renormance, Categorica	THOE .	easy hard	(CCJy = 1, Hard = 1)	suitable for flood prone areas, areas	yes
					where pit digging is difficult" (Emersan)	
surface_area_onsite	Performance, Trapez	TRUE	[m2/plot]	(a = 2, b = 2, c = 999, d = 999)	The space area requirements of the	
					raised latrine are derived based on a comparable approach with other	
					technologies. Its space requirements	
					are certainly similar to a single pit (1m2/plot), as it also requires just one	
					chamber below the user where the	
					excreta ends up. However, due to elevated structure, additional space is	
					required (e.g. to construct stairs). It is	
					assumed that the space requirements of the toilet itself are similar to a	
					single pit (1m2/plot), but at least an	
					additional space of 1m2/plot are required due to the elevated	
					structure. It is therefore assumed that	
					the raised latrine requires at least 2m2/plot (Eawag, 2021). The space	
					requirements are therefore similar to toilets with alternating chambers.	
					Note that this does not involve any	
					visual protection. A superstructure could require more space.	
surface_area_offsite 0	Performance, Trapez	FALSE FALSE	m2/pers	NA NA	NA NA	NA NA
0	0	FALSE	0	NA	NA	NA
0 drinking_water_exposure	Performance, Categorical	FALSE TRUE	Close	NA (close = 0.5, not close = 1)	"For Raised Latrines partly below	yes yes
			Not close	,	ground, groundwater contamination	
					can be an issue and soil properties and the groundwater level should be	
					assessed (X.3) to identify the minimum distance to the next water	
					source and limit exposure to microbial	
					contamination." (Emersan) Two different configurations partly	
					below and above ground. Could	
0		FALSE		NA	contaminate groundwater. NA	NA
0 construction_skills	Performance, Categorical	FALSE TRUE	Ladder:	NA (unskilled = 0, skilled = 1, professional	NA "Raised Latrines must be equipped	NA yes
construction_skills	remormance, categorical		unskilled	= 1)	with stairs or a ramp and	,
			skilled professional		corresponding handrails and, if necessary, structural support at the	
					back" (Emersan).	
					Requires more construction skills than facilities not raised.	
design_skills	Performance, Categorical	TRUE	Ladder:	(unskilled = 0, skilled = 0.5,	"Raised Latrines with pits partially	yes
			unskilled skilled	professional = 1)	below ground need pit lining (> 0.5 m) to ensure that the pit remains stable.	
			professional		To reduce odours and flies the latrine	
					should be equipped with a ventilation pipe. Drainage should be considered	
					around the latrine so that rainwater	
	l .				does not enter the pit" (Emersan). Some considerations necessary.	
1		1	Ladder:	(unskilled = 0.5, skilled = 1,	"O&M tasks also include regular	yes
om skills	Performance Categorical	TRUE		professional = 1)	cleaning, conducting routine	7
om_skills	Performance, Categorical	TRUE	Unskilled		Language and south of the standard of	ĺ
om_skills	Performance, Categorical	TRUE	Unskilled Skilled	,	operational tasks (e.g. checking of availability of water, hygiene items.	
om_skills	Performance, Categorical	TRUE	Unskilled	,	availability of water, hygiene items, soap), providing advice on proper use,	
om_skills	Performance, Categorical	TRUE	Unskilled Skilled		availability of water, hygiene items, soap), providing advice on proper use, conducting minor repairs and	
om_skills	Performance, Categorical	TRUE	Unskilled Skilled		availability of water, hygiene items, soap), providing advice on proper use, conducting minor repairs and monitoring the fill level" (Emersan). Simple O&M. Monitoring fill level is	
om_skills			Unskilled Skilled Professional		availability of water, hygiene items, soap), providing advice on proper use, conducting minor repairs and monitoring the fill level" (Emersan). Simple O&M. Monitoring fill level is the most crucial aspect.	NA NA
0 0	000	FALSE FALSE	Unskilled Skilled Professional	NA NA	availability of water, hygiene items, soap), providing advice on proper use, conducting minor repairs and monitoring the fill level" (Emersan). Simple O&M. Monitoring fill level is the most crucial aspect. NA NA	NA NA
0 0 0	000000000000000000000000000000000000000	FALSE FALSE FALSE FALSE FALSE	Unskilled Skilled Professional 0 0 0	NA NA NA NA	availability of water, hyglene items, soap), providing advice on proper us, conducting minor repairs and monitoring the fill level '(Emersan). Simple O&M. Monitoring fill level is the most crucial aspect. NA NA NA NA	NA NA
0 0	0	FALSE FALSE FALSE FALSE FALSE	Unskilled Skilled Professional 0 0 0 Washers	NA NA NA	availability of water, hyglene items, soap), providing advice on proper use, conducting minor repairs and monitoring the fill level" (Emersan). Simple O.M. Monitoring fill level is the most crucial aspect. NA NA	NA NA
0 0 0 cleansing_method	0 0 0 0 Performance, Categorical	FALSE FALSE FALSE FALSE FALSE	Unskilled Skilled Professional 0 0 0 Washers Soft wipers Hard wipers	NA NA NA NA NA	availability of water, hyglene items, soap), providing advice on proper use, conducting minor repairs and monitoring the fill level (Emersan). Simple O&M. Monitoring fill level is the most crucial aspect. NA NA NA NA NA	NA NA NA NA
0 0 0	0 0 0 0 Performance, Categorical	FALSE FALSE FALSE FALSE FALSE	Unskilled Skilled Professional 0 0 0 0 0 Washers Soft wipers Hard wipers	NA NA NA NA	availability of water, hyglene items, soap), providing advice on proper us, conducting minor repairs and monitoring the fill level '(Emersan). Simple O&M. Monitoring fill level is the most crucial aspect. NA NA NA NA	NA NA

**Pop Categorical Table **Pop Categorical Table **pop Categorica	lifetime	Performance, Categorical		short (< 1 year) medium (1-5 years) long (>5 years)	(short = 1, medium = 1, long = 1)	"They can be considered a viable solution in all stages of an emergency provided the technology is acceptable to the users" (Emersan) The lifetime of a raised latrine depends on the pit volume and accumulation rate. If regular emptying is possible the latrine can be used for a long time similarly to a pit latrine. (Kukka Ilmanen, Eawag 2021)		
moderate (few weeks up to three months) months mont	speed_implement_toilet	PDF, Categorical		moderate (3 days to 2 weeks)	(rapid = 0.8, moderate = 0.2, slow = 0)	solution in all stages of an emergency provided the technology is acceptable to the users." They can be replicated quickly and implemented at scale if enough space is available. "(Inersan Compendium) A slightly lower value is allotted to the category "Rapid" (80%) than a Single VIP as the complexity of construction is slightly higher, owing to the implementation of vertilation system +rabed structure (more efforts for constructing stairs, holding tanks, etc. and consequently more time).	yes	
Construction_parts	speed_implement_treatment	PDF, Categorical		moderate (few weeks up to three months)	NA	NA	NA	
technical special	scalability	Performance, Categorical	TRUE	easy difficult	(easy = 1, difficult = 1)		yes	
Sudge				technical		that are readily available and that can be sourced rapidly. The superstructure can be made from materials including bamboo, grass matting, wood, plastic or metal sheeting (though this offen heats up the interior). The lining can be of concrete rings, brides, stones, timber or sand bags. Several companies have developed variations of prefabricated Raised Latrines that can be delivered and assembled quickly." (Emergian) Can be constructed from locally available material or prefabricated		
TP				Airlore	Soillage	Waterloss	Commonte/Specifications	Poforonco
Med (R)				0	0			
TN		1.00		0	0	()	-
Med (R)	k							PA (1000)
Med (R)	TN							
H20	med (R)		0,16-0,7			C)	-
£ 5 (0.25) - - PA TS 1 0 0 0 No TSS losses assumed. PA med (R) 1.00 0.5 · 0.7 0 0 0 - -		0.85	0.75 - 1			C	high variability depending on soil permeability	
TS 1 0 0 No TSS losses assumed. PA med (R) 1.00 0.5-0.7 0 0 0 -	med (R)	0.85		0.15	0	C		-
med (R) 1.00 0.5-0.7 0 0 0 -	k	5					homisse sessal 22T old	***
) 135 1033E3 833UITEU.	-
· [0.2]	k	1	[0.2]					PA

Additional Information

Spuhler et al. [2021]

Copied from "single pit" and adapted. Some of the literature used to calculate the transfer coefficients for "single pit" dealt with blackwater as an input solely. Since the raised latrine does not have blackwater as an input, we removed the literature values (Montangero and Belevi (2007)) that dealt with blackwater as an input product. We assume raised latrines are sealed against the ground and therefore have no soil losses. The soil losses are allocated to sludge.

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allow Trench Latrine eneral Information	Values	Data Source					
FUNCTIONAL GROUP	S	-					
UNIQUE IDENTIFIER (ID) DATA COMPILER	shallow_trench_latrine Akanksha Jain, Kukka Ilmanen	-					
INPUT PRODUCT	faeces, excreta	Spuhler, D. & Roller, L. (2020)					
OUTPUT PRODUCT RELATIONS		Spuhler, D. & Roller, L. (2020) Spuhler, D. & Roller, L. (2020)					
	Output: NA						
COMMENTS							
re-Filter Criteria	Values (household = 0, neighbourhood = 1,	Data Source Gensch, R. et al. (2018)					
applicability_level	(nousenoid = 0, neignbournood = 1, city = 0.5)	Genson, R. et al. (2018)					
management_level	(household = 0, shared = 0, public = 1)	Gensch, R. et al. (2018)					
capex_req_level		Spuhler, D. et al. (2021)					
opex_req_level technical_maturity		Spuhler, D. et al. (2021) Gensch, R. et al. (2018)					
development_phase	(acute = 1, stabilisation = 0,	Gensch, R. et al. (2018)					
	development/recovery = 0) Type and Function	Applicable for this Functional Group?	Categories [Unit]	Technology Values (Data)	Data Source / Assumptions	Internal Review Done?	
water_supply	Performance, Categorical	FALSE	house yard	NA	NA	NA	
			public				
water_volume	Performance, Trapez	TRUE	none [L/cap/day]	(a = 0, b = 0, c = 999, d = 999)	According to (Emersan) it belongs into	Yes	
_					the 'Dry' technologies. Water is only		
					required for handwashing, which is neglected here.		
					Maximum values (c & d) are assumed		
					to remain 999 L/cap/day since the disruption of this tech due to high		
					water volumes, i.e., due to either		
					flooding or high groundwater tables is considered with two separate criteria		
					"Flooding" and "Groundwater Depth".		
					Additionally, the FG U technology that will be connected with this tech		
					according to Santiago algorithm based		
					on input-output products, will never be a technology that leads to high		
					water volumes entering shallow		
					trench latrines (because blackwater is not a defined input). For e.g. Cistern		
					flush sytems will never be the		
					recommended FG U tech for shallow		
					trench latrines (due to input-output mismatch). (Akanksha Jain)		
electricity_supply	Performance, Categorical	IKUE	electricity intermittent	(electricity = 1, intermittent = 1, no electricity = 1)	No electricity required	yes	
fuel_supply	Performance, Categorical	FALSE	no electricity fuel	NA	NA .	NA .	
			no fuel				
frequency_of_om	PDF, Categorical	TRUE	irregular regular	(irregular = 0, regular = 0.3, continous = 0.7)	"In order to ensure security, proper use and the opening and closing of		
			continuous	- 0.77	defecation trenches there should be		
					an attendant at all times." (Emersan) Very labour intensive technology with		
					need for (regular or) continous OM.		
nino cumbu	Performance, Categorical	TRUE	no pipes	(no pipes = 1, difficutly available = 1,	No pipes required.	yes	
pipe_supply	Performance, Categorical	IKUE	difficultly available	pipes = 1, difficulty available = 1,	No pipes required.	yes	
numa cun-t-	Performance, Categorical	TRUE	pipes		No pumps required.	yes	
pump_supply	r en ormance, categorical		no pumps difficultly available	pumps = 1, difficulty available = 1,	no pampa required.	,	
concrete_supply	Performance, Categorical	TRUE	pumps no concrete	(no concrete = 1, difficultly available =	"Simple digging tools are needed for	yes	
22.10гене_заррту			difficultly available	1, concrete = 1)	Shallow Trench Latrines, such as		
			concrete		shovels and picks. In order to assure privacy screening should be provided.		
					This can be done with plastic canvas		
					or materials such as bamboo, fabrics and others. Shovels for users can be		
					provided to allow each user to cover		
					their excreta with soil." (Emersan) No need for concrete.		
spare_parts	PDF, Categorical	TRUE	simple technical	(simple = 1, technical = 0, special = 0)	"Simple digging tools are needed for Shallow Trench Latrines, such as	yes	
			special		shovels and picks. In order to assure		
					privacy screening should be provided. This can be done with plastic canyas		
					This can be done with plastic canvas or materials such as bamboo, fabrics		
					and others. Shovels for users can be provided to allow each user to cover		
					their excreta with soil." (Emersan)		
					The required materials should all be		
					locally available and not require technical or special spare parts.		
0		FALSE		0 NA	NA .	NA .	
0	0	FALSE		0 NA	NA	NA	
0 temperature		FALSE TRUE	very cold	0 NA (very cold = 0.5, cold = 0.7, temperate	NA "There is no doubt that land	NA yes	
temperature	r en ormance, categorical		cold	= 1, warm = 1, hot = 1)	application of manure to frozen or	,	
			temperate		cold and wet ground has potential to		
			warm hot		exacerbate nutrient loss in runoff. []." (Liu et al. (2018))		
					A shallow trench latrine can be built in		
					colder climates but there has to be taken in account that leachate		
					respectively soil absorbtion		
					performance can be lower if the bottom of the pit is frozen.		
flooding	Performance, Categorical	TRUE	flooding	(flooding = 0.1, no flooding = 1)	The hygiene risk if a defecation	Yes	
J			no flooding		field/trench latrine is flooded is		
					considered as unacceptable. A low performance of 10% is allotted to the		
					category "flooding" given that there		
l		ĺ	İ	I .	exists the possibility that shallow	İ	
					trench latrines could be built at		
					trench latrines could be built at elevated/ non-flooded plot areas of		

vehicular_acces	Porformanco Catogorical		no access	(no access = 1, difficult = 1, full = 1)	"After each defecation, faeces should	was	
	Performance, Categorical	IRUE	difficult	(no access = 1, difficult = 1, full = 1)	be covered with soil. After one trench	yes	
			full		section is full, the soil with excreta		
					should be treated with on-site		
					disinfection such as lime treatment or		
					should be taken away to a treatment		
					facility. When closing one defecation		
					trench section, privacy screens and simple slabs (if applicable) need to be		
					moved to the next trench section."		
					(Emersan)		
					Vehicular access is not necessary, as		
					trenches are decommissioned.		
slope	Performance, Categorical	FALSE	flat	NA	NA	NA	
and there	Desferred Coherenter	TOUE	not flat	(day 0.25 alls 0.5 and 1 amount	IID to b letele b letele		-
soil_type	Performance, Categorical	IRUE	clay silt	(clay = 0.25, silt = 0.5, sand = 1, gravel = 0.5, rock = 0.25)	"Deep trench latrines are unsuitable for areas with high water-table,	yes	
			sand	- 0.5, rock - 0.25)	unstable soil, rocky ground or prone		
			gravel		to flooding" (Emersan)		
			rock		"Special attention should be paid to		
					[] ground conditions and soil		
					permeability. Poorly permeable soil		
					will increase the rate at which the pit fills." (Emersan)		
					It is assumed that shallow trench		
					latrines requires similar soil		
					absorption capacities as deep trench		
					latrines. Soil percolation and filtration		
					is desired.		
groundwater_depth	Performance, Trapez	IRUE	water depth [m]	(a = 3.2, b = 3.2, c = 999, d = 999)	"Shallow trenches should be around 20–30 cm wide and 15 cm deep"	yes	
					(Emersan)		
					3m difference between latrine depth		
					and GW table are added for safety		
excavation	Performance, Categorical	TRUE	easy	(easy = 1, hard = 0.75)	No deep excavation required. (only	yes	
		TO LEE	hard	/ as I as	upto 15cm)		
surface_area_onsite	Performance, Trapez	TRUE	[m2/plot]	(a = 35, b = 35, c = 999, d = 999)	As the space requirements of shallow		
					trench latrines strongly depend on the		
					number of users, some assumptions are required here. In general, "the		
					area needed is approximately 0.25		
					m2/person/day" (Emersan). Assuming		
					that at least 10 people need to be able		
					to use the shallow trench latrine for a		
					mininum of two weeks, we estimate		
					the minimum space requirements for shallow trench latrines to be 35		
					m2/plot (Eawag, 2021) and thus a lot		
					larger than other technologies of this		
					functional group.		
surface_area_offsite	Performance, Trapez			NA	NA	NA	
0		FALSE		NA	NA	NA	
0		FALSE FALSE		NA NA	NA NA	NA NA	-
drinking_water_exposure	Performance, Categorical		Close	(close = 0, not close = 1)	"Shallow Trench Latrines should be	yes	
			Not close	(4.000 0, 1.000 0,	located where they are less likely to	,	
					be public health hazards" (Emersan)		
0		FALSE		NA	NA	NA	
0		FALSE		NA	NA	NA	
construction_skills	Performance, Categorical	IRUE	Ladder: unskilled	(unskilled = 1, skilled = 1, professional = 1)	No specific skills needed.	yes	
			skilled	- 1)			
			professional				
design_skills	Performance, Categorical	TRUE	Ladder:	(unskilled = 0, skilled = 0.5,	Design requires expert identification	yes	
uesigii_skiiis	remonnance, categorical	mor					
design_skiiis	renormance, categorican	THOSE .	unskilled	professional = 1)	of an appropriate location,	,	
design_skiiis	renormance, categorical		unskilled skilled			,	
design_skiis	renonnance, Categorica		unskilled		of an appropriate location, considering the following aspects:		
uesign_skiis	renormance, caregorica		unskilled skilled		of an appropriate location, considering the following aspects: "The area chosen should be at least 50		
design_skiis	renormance, categorica		unskilled skilled		of an appropriate location, considering the following aspects: "The area chosen should be at least 50 m from food production, storage and		
design_skiis	Periormance, Categorica		unskilled skilled		of an appropriate location, considering the following aspects: "The area chosen should be at least 50 m from food production, storage and preparation areas (e.g. kitchens,		
uesgr_smis	Periormance, Categorica		unskilled skilled		of an appropriate location, considering the following aspects: "The area chosen should be at least 50 m from food production, storage and		
uesgr_sms	renormance, categorica		unskilled skilled		of an appropriate location, considering the following aspects: "The area chosen should be at least 50 m from food production, storage and preparation areas (e.g., kitchens, markets), water sources, water storage and treatment facilities but close enough to ensure safety of and		
ueagrijania	renormance, categorica		unskilled skilled		of an appropriate location, considering the following aspects: "The area chosen should be at least 50 m from food production, storage and preparation areas (e.g. kitchens, markets), water sources, water storage and treatment facilities but close enough to ensure safety of and accessibility for users. Defecation		
Georgi Jania	renormance, categorica		unskilled skilled		of an appropriate location, considering the following aspects: "The area chosen should be at least 50 m from food production, storage and preparation areas (e.g. kitchens, markets), water sources, water storage and treatment facilities but close enough to ensure safety of and accessibility for users. Defecation fields should be downhill of		
Georgi Jania	renormance, categorica		unskilled skilled		of an appropriate location, considering the following aspects: The area chosen should be at least 50 m from food production, storage and preparation areas (e.g. kitchens, markets), water sources, water storage and treatment facilities but close enough to ensure safety of and accessibility for users. Defecation fields should be downhild or settlements, camps and water sources settlements, camps and water sources settlements, camps and water sources		
Geaga Jania	renormance, categorica		unskilled skilled		of an appropriate location, considering the following aspects: "The area chosen should be at least 50 m from food production, storage and preparation areas (e.g. kitchens, markets), water sources, water storage and treatment facilities but close enough to ensure safety of and accessibility for users. Defecation fields should be downhill of		
Geaga Jania	renormance, categorica		unskilled skilled		of an appropriate location, considering the following aspects: "The area chosen should be at least 50 m from food production, storage and preparation areas (e.g. kitchens, markets), water sources, water storage and treatment facilities but close enough to ensure safety of and accessibility for users. Defecation fields should be downhill of settlements, camps and water sources to avoid contamination" (Emersan).		
Georgi Jania	renormance, categorica		unskilled skilled		of an appropriate location, considering the following aspects: The area chosen should be at least 50 m from food production, storage and preparation areas (e.g. kitchens, markets), water sources, water storage and treatment facilities but close enough to ensure safety of and accessibility for users. Defecation fields should be downhild or settlements, camps and water sources settlements, camps and water sources settlements, camps and water sources		
om_skills	Performance, Categorical		unskilled skilled professional	professional = 1) (unskilled = 1, skilled = 1, professional	of an appropriate location, considering the following aspects: "The area chosen should be at least 50 m from food production, storage and preparation areas (e.g., kitchens, markets), water sources, water storage and treatment facilities but close enough to ensure safety of and accessibility for users. Defectation fields should be downhill of settlements, camps and water sources to avoid contamination" (Emersan). No other design skills necessary.		
			unskilled skilled professional Ladder: Unskilled	professional = 1)	of an appropriate location, considering the following aspects: "The area chosen should be at least 50 m from food production, storage and preparation areas (e.g., kitchens, markets), water sources, water storage and treatment facilities but close enough to ensure safety of and accessibility for users. Defectation fields should be downhill of settlements, camps and water sources to avoid contamination" (Emersan). No other design skills necessary.		
			unskilled skilled professional Ladder: Unskilled Skilled	professional = 1) (unskilled = 1, skilled = 1, professional	of an appropriate location, considering the following aspects: "The area chosen should be at least 50 m from food production, storage and preparation areas (e.g., kitchens, markets), water sources, water storage and treatment facilities but close enough to ensure safety of and accessibility for users. Defectation fields should be downhill of settlements, camps and water sources to avoid contamination" (Emersan). No other design skills necessary.		
om_skills	Performance, Categorical	TRUE	unskilled skilled professional Ladder: Unskilled Skilled Professional	professional = 1) (unskilled = 1, skilled = 1, professional = 1)	of an appropriate location, considering the following aspects: "The area chosen should be at least 50 m from food production, storage and preparation areas (e.g. kitchens, markets), water sources, water storage and treatment facilities but close enough to ensure safety of and accessibility for users. Defecation fields should be downhill of settlements, camps and water sources to avoid contamination" (Emersan). No other design skills necessary.	yes	
	Performance, Categorical	TRUE	unskilled skilled professional Ladder: Unskilled Skilled Professional	professional = 1) (unskilled = 1, skilled = 1, professional = 1) NA	of an appropriate location, considering the following aspects: The area chosen should be at least 50 m from food production, storage and preparation areas (e.g. kitchens, markets), water sources, water storage and treatment facilities but close enough to ensure safety of and accessibility for users. Defecation fields should be downhill of estimate the control of	yes	
om_skills 0 0	Performance, Categorical 0 0	TRUE FALSE FALSE FALSE	unskilled skilled professional Ladder: Unskilled Skilled Professional	professional = 1) (unskilled = 1, skilled = 1, professional = 1) NA NA	of an appropriate location, considering the following aspects: The area chosen should be at least 50 m from food production, storage and preparation areas (e.g. kitchens, markets), water sources, water storage and treatment facilities but close enough to ensure safety of and accessibility for users. Defecation fields should be downhill of settlements, camps and water sources to avoid contamination' (Emersan). No other design skills necessary. No specific skills needed.	yes NA NA NA	
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om_skills 0 0 0 0 cleansing_method 0 ilfetime speed_implement_toilet speed_implement_treatment scalability construction_parts transfer Coefficients TP med (R) R TN	Performance, Categorical 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	FALSE FALSE FALSE FALSE FALSE FALSE FALSE TRUE TRUE TRUE TRUE 10022.36m1 Range 0.18-0.40 (0.16-0.4) (0.22) 0.09-0.27 0.15-0.2	unskilled skilled professional Ladder: Unskilled Skilled Professional (Compared to the skilled Skilled Skilled Skilled Skilled (Compared to the skilled Skilled (Compared to the skilled	(unskilled = 1, skilled = 1, professional = 1) NA	of an appropriate location, considering the following aspects: "The area chosen should be at least SO m from food production, storage and preparation areas (e.g. kitchens, markets), water sources, water storage and treatment facilities but close enough to ensure safety of and accessibility for users. Defecation fields should be downhill of settlements, camps and water sources to avoid contamination' (Emersan). No other design skills necessary. No specific skills needed. NA NA NA NA NA NA NA NA NA NA NA NA NA	yes NA NA NA NA NA NA NA NA NA Ves Comments * as P * as N	Montangero and Belevi (2007) PA Montangero and Belevi (2007) Jacks et al. (1999)
om_skills 0 0 0 0 cleansing_method iffetime speed_implement_toilet speed_implement_treatment scalability construction_parts Iransfer Coefficients TP med (R)	Performance, Categorical 0 0 0 0 Performance, Categorical PDF, Categorical PDF, Categorical PDF, Categorical PF, Categorical PF, Categorical PF, Categorical POF, Categorical POF, Categorical POF, Categorical ORDER TO CATEGORICA POF, Categorical ORDER TO CATEGORICA ORD	FALSE FALSE FALSE FALSE FALSE FALSE FALSE TRUE TRUE TRUE TRUE 10022.36m1 Range 0.18-0.40 (0.16-0.4) (0.22) 0.09-0.27 0.15-0.2	unskilled skilled professional Ladder: Unskilled Skilled Professional (Compared to the skilled Skille	(unskilled = 1, skilled = 1, professional = 1) NA	of an appropriate location, considering the following aspects: "The area chosen should be at least SO m from food production, storage and preparation areas (e.g. kitchens, markets), water sources, water storage and treatment facilities but close enough to ensure safety of and accessibility for users. Defecation fields should be downhill of settlements, camps and water sources to avoid contamination' (Emersan). No other design skills necessary. No specific skills needed. NA NA NA NA NA NA NA NA NA NA NA NA NA	yes NA NA NA NA NA NA NA NA NA Ves Comments * as P * as N	Montangero and Belevi (2007) PA Montangero and Belevi (2007) Jacks et al. (1999)
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om_skills 0 0 0 0 0 cleansing_method iffetime speed_implement_toilet speed_implement_treatment scalability construction_parts Transfer Coefficients TP med (R) R med (R)	Performance, Categorical 0 0 0 0 Performance, Categorical 0 Performance, Categorical PDF, Categorical PDF, Categorical PDF, Categorical PDF, Categorical POF, Categorical POF, Categorical POF, Categorical ORDINATION Technologies TC Grabase 203 Sludge 0.29 0.29 0.28 0.18 0.18 0.2	FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE TRUE TRUE TRUE 17 (0.18 - 0.4) (0.18 - 0.4) (0.19 - 0.7) (0.20 - 0.7)	unskilled skilled professional Ladder: Unskilled Skilled Professional (C Skilled Professional (C Washers Soft wipers Hard wipers (C short (< 1 year) medium (1-5 years) long (>5 years) rapid (< 3 days) moderate (3 days to 2 weeks) slow (>2 weeks) rapid few days to a week) moderate (few weeks up to three months) slow (> 3 months) easy difficult simple technical special Airloss (C C C C C C C C C C C C C C C C C C	(unskilled = 1, skilled = 1, professional = 1)	of an appropriate location, considering the following aspects: "The area chosen should be at least SO m from food production, storage and preparation areas (e.g. kitchens, markets), water sources, water storage and treatment facilities but close enough to ensure safety of and accessibility for users. Defecation fields should be downhill of settlements, camps and water sources to avoid contamination" (Emersan). No other design skills necessary. No specific skills needed. NA NA NA NA NA NA NA NA NA NA NA NA NA	yes NA NA NA NA NA NA NA NA NA Ves Comments * as P * as N * as N * T C Soilloss: N reaching the groundwater	Montangero and Belevi (2007) - PA Montangero and Belevi (2007) Jacks et al. (1999) Nyenje et al. (2013) - PA

med (R)	0.15	(0.05 - 0.3)	0.15	0.70	C		-
k	5	[0.25]					PA
TS	0.6	0.5 - 0.7	0	0.4		*TSS retainment range: 0.7-0.9	Montangero and Belevi (2007)
						(Assumption for TS: 0.5 - 0.7)	
med (R)	0.60	0.5 - 0.7	0	0.40	C		-
k	5	[0.2]					PA
	•					*	Snuhler et al. (2021)

Additional Information
Copied from "single pit". Some of the k-factors were decreased if they weren't already the minimum possible value.

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DATA COMM NEMPT PROC OUTPUT PROC OUTPUT PROC REAT COMM Criteria spoilcability management capes rea get-chical mat development_p technical mat development_p pump_ss concrete_ss spare_j tempers tempers	(ID) chemical toilet	Genech, R. et al. (2018) Spuller, D. et al. (2021) Spuller, D. et al. (2021) Spuller, D. et al. (2021) Genech, R. et al. (2021) Genech, R. et al. (2025) Genech, R. et al. (2026) Genech, R. et al. (2026) TRUE TRUE TRUE TRUE	Categories (Unit) house public none [L/cap/day] electricity interentiatent no electricity fuel non fuel irregular regular continuous	NA (a = 0, b = 0, c = 999, d = 999)	NA "A small amount of water and chemicals are mixed to make the flush water" (Emersan). As the technology does not handle blackwater, the entire possible range of water volume is considered to some technology being discarded (Sputher et al. 2021). No need for electricity.	Internal Review Done? NA Yes yes
UNIQUE DESTRIBE DATA COMM NPUT PROC OUTPUT PROC RELAT COMM Citeria applicability management caper rea oper. reg. technical mat development_E technical mat development_E concrete_ss frequency_ol pump_ss concrete_ss spare_j tempera	(Di) chemical toilet	Genoch, R. et al. (2018) Genoch, R. et al. (2018) Genoch, R. et al. (2018) Genoch, R. et al. (2013) Genoch, R. et al. (2013) Genoch, R. et al. (2013) Spuller, D. et al. (2013) Genoch, R. et al. (2013) Genoch, R. et al. (2018) Genoch, R. et al. (2018) Genoch, R. et al. (2018) TRUE TRUE TRUE TRUE	house yard public none (Li-cap/day) electricity intermittent none electricity none electricity none electricity none electricity none fuel regular regular continuous	NA (a = 0, b = 0, c = 999, d = 999) (electricity = 1, intermittent = 1, no electricity = 1) NA	NA "A small amount of water and chemicals are mixed to make the flush water" (Emersan). As the technology does not handle blackwater, the entire possible range of water volume is considered to some technology being discarded (Sputher et al. 2021). No need for electricity.	Yes yes
NPLIT PROC OUTPUT PROC RELAT RELAT COMM Criteria applicability management caper red oper red oper red technical mat development, p technical mat development, p technical mat development, p technical mat development, p technical mat development, p technical mat development, p technical mat development, p technical mat frequency, of technical mat pump_sx concrete_sx spare_j tempera tempera	UCIT flaces, exceta UCIT f	Genoch, R. et al. (2018) Genoch, R. et al. (2018) Genoch, R. et al. (2018) Genoch, R. et al. (2013) Genoch, R. et al. (2013) Genoch, R. et al. (2013) Spuller, D. et al. (2013) Genoch, R. et al. (2013) Genoch, R. et al. (2018) Genoch, R. et al. (2018) Genoch, R. et al. (2018) TRUE TRUE TRUE TRUE	house yard public none (Li-cap/day) electricity intermittent none electricity none electricity none electricity none electricity none fuel regular regular continuous	NA (a = 0, b = 0, c = 999, d = 999) (electricity = 1, intermittent = 1, no electricity = 1) NA	NA "A small amount of water and chemicals are mixed to make the flush water" (Emersan). As the technology does not handle blackwater, the entire possible range of water volume is considered to some technology being discarded (Sputher et al. 2021). No need for electricity.	Yes yes
Criteria applicability management caper red oper. reg oper. reg technical mat development_E technical mat development_E technical mat development_E technical mat development_E technical mat development_E technical mat development_E technical mat technica	Values	Genech, R. et al. (2018) Genech, R. et al. (2018) Sputher, D. et al. (2013) Sputher, D. et al. (2021) Genech, R. et al. (2021) Genech, R. et al. (2018) Genech, R. et al. (2018) Applicable for this Functional Group? FRASE TRUE TRUE TRUE TRUE	house yard public none (Li-cap/day) electricity intermittent none electricity none electricity none electricity none electricity none fuel regular regular continuous	NA (a = 0, b = 0, c = 999, d = 999) (electricity = 1, intermittent = 1, no electricity = 1) NA	NA "A small amount of water and chemicals are mixed to make the flush water" (Emersan). As the technology does not handle blackwater, the entire possible range of water volume is considered to some technology being discarded (Sputher et al. 2021). No need for electricity.	Yes yes
management capex_rea copex_rea copex_rea copex_rea copex_rea technical mat development_p mater_so water_so electricity_so fuel_so frequency_ol pipe_so pump_so concrete_so spare_j tempera	well (household = 0, shared = 0, public = 1) vel vel vel vel vel poly see (scote = 1, stabilisation = 0, stabilisation =	Genech, R. et al. (2018) Spuller, D. et al. (2021) Spuller, D. et al. (2021) Spuller, D. et al. (2021) Genech, R. et al. (2021) Genech, R. et al. (2025) Genech, R. et al. (2026) Genech, R. et al. (2026) TRUE TRUE TRUE TRUE	house yard public none (Li-cap/day) electricity intermittent none electricity none electricity none electricity none electricity none fuel regular regular continuous	NA (a = 0, b = 0, c = 999, d = 999) (electricity = 1, intermittent = 1, no electricity = 1) NA	NA "A small amount of water and chemicals are mixed to make the flush water" (Emersan). As the technology does not handle blackwater, the entire possible range of water volume is considered to some technology being discarded (Sputher et al. 2021). No need for electricity.	Yes yes
opes reg technical mat development_p Cotteria water_so water_so electricity_ss fuel_ss frequency_of pipe_ss pump_ss concrete_ss concrete_ss vehicular_s floc	vet vet vet vet vet vet vet vet	Spuller, D. et al. (2021) Gensch, R. et al. (2018) Gensch, R. et al. (2018) Gensch, R. et al. (2018) Gensch, R. et al. (2018) FALSE TRUE FALSE TRUE	house yard public none (Li-cap/day) electricity intermittent none electricity none electricity none electricity none electricity none fuel regular regular continuous	NA (a = 0, b = 0, c = 999, d = 999) (electricity = 1, intermittent = 1, no electricity = 1) NA	NA "A small amount of water and chemicals are mixed to make the flush water" (Emersan). As the technology does not handle blackwater, the entire possible range of water volume is considered to some technology being discarded (Sputher et al. 2021). No need for electricity.	Yes yes
development_p water_si water_si water_vol electricity_ss fuel_si frequency_of pipe_ss pump_ss concrete_si spare_l tempera	ase (acute = 1, stabilisation = 0, development = 1, stabilisation = 0, development/covery = 0) Type and Function Performance, Categorica Performance, Categorica Performance, Categorica PDF	Genech, R. et al. (2018) Applicable for this Functional Group? FALSE TRUE FALSE TRUE TRUE TRUE TRUE	house yard public none (Li-cap/day) electricity intermittent none electricity none electricity none electricity none electricity none fuel regular regular continuous	NA (a = 0, b = 0, c = 999, d = 999) (electricity = 1, intermittent = 1, no electricity = 1) NA	NA "A small amount of water and chemicals are mixed to make the flush water" (Emersan). As the technology does not handle blackwater, the entire possible range of water volume is considered to some technology being discarded (Sputher et al. 2021). No need for electricity.	Yes yes
water_so water_vol electricity_so fixet_so frequency_ol pipe_so pump_so concrete_so spare_j tempera	Type and Function Performance, Categorica me Performance, Trape Performance, Trape Performance, Categorica ply Performance, Categorica POF, Categorica POF, Categorica Popy Performance, Categorica ply Performance, Categorica Popy Performance, Categorica Popy Performance, Categorica Popy Performance, Categorica Popy Performance, Categorica	TRUE FALSE TRUE FALSE TRUE TRUE	house yard public none (Li-cap/day) electricity intermittent none electricity none electricity none electricity none electricity none fuel regular regular continuous	NA (a = 0, b = 0, c = 999, d = 999) (electricity = 1, intermittent = 1, no electricity = 1) NA	NA "A small amount of water and chemicals are mixed to make the flush water" (Emersan). As the technology does not handle blackwater, the entire possible range of water volume is considered to some technology being discarded (Sputher et al. 2021). No need for electricity.	Yes yes
water_vol electricity_sc fuel_sc frequency_of pipe_sc pump_sc concrete_sc spare_j tempera	ply Performance, Categorica me Performance, Categorica ply Performance, Categorica ply Performance, Categorica ply Performance, Categorica ply Performance, Categorica ply Performance, Categorica	TRUE FALSE TRUE TRUE TRUE	yard public none [L/cap/day] electricity intermittent no electricity fuel most public intermittent nor electricity regular continuous	(electricity = 1, intermittent = 1, no electricity = 1) NA	to make the flush water" (Emersan). As the technology does not handle blackwater, the entire possible range of water volume is considered to avoid the technology being discarded (Spuhler et al. 2021) No need for electricity.	yes
electricity_ss fivel_ss fivel_ss frequency_of pipe_ss pump_ss concrete_ss spare_j tempers	ply Performance, Categorica ply Performance, Categorica proprior PFG, Categorica proprior Performance, Categorica ply Performance, Categorica ply Performance, Categorica	TRUE FALSE TRUE TRUE	electricity intermittent no electricity fuel no fuel irregular regular continuous	(electricity = 1, intermittent = 1, no electricity = 1) NA	to make the flush water" (Emersan). As the technology does not handle blackwater, the entire possible range of water volume is considered to avoid the technology being discarded (Spuhler et al. 2021) No need for electricity.	yes
fuel_ss frequency_d frequency_d frequency_d pipe_ss pump_ss concrete_ss spare_l tempera	ply Performance, Categorica PDF, Categorica PDF, Categorica PDF Categorica PDF Performance, Categorica PPFormance, Categorica PPFormance, Categorica	TRUE TRUE	intermittent no elettridity fuel no fuel irregular regular continuous	= 1) NA	No need for electricity.	
frequency_ol frequency_ol pipe_sx pump_sx concrete_sx spare_j tempers floc	om PDF, Categorica PDF, Categorica pply Performance, Categorica pply Performance, Categorica pply Performance, Categorica	TRUE TRUE	no electricity fuel no fuel irregular regular continuous	NA	NA .	NΔ
frequency_of frequency_of frequency_of frequency_of pump_ss pump_ss pump_ss concrete_ss spare_j	om PDF, Categorica PDF, Categorica pply Performance, Categorica pply Performance, Categorica pply Performance, Categorica	TRUE TRUE	irregular regular continuous no pipes			
pump_ss concrete_ss spare_j tempera tempera	ply Performance, Categorica ply Performance, Categorica	TRUE	no pipes		"The toilets require regular cleaning and checking of water for handwashing and anal cleansing, hygiene items, soap and dry cleaning materials. Where there is a high number of users it is advised to have an attendant to guarantee maintenance and cleaning. It is recommended to have one attendant	yes
concrete_ss spare spare tempera floc vehicular_d	Performance, Categorica		conscuring available	(no pipes = 1, difficultIty available = 1, pipes = 1)	for every 10 cubicles." (Emersan) No need for pipes (only ventilation pipe, which can be made from local material or is part of	yes
spare	Performance, Categorica		no pumps	(no pumps = 1, difficultly available = 1, pumps	prefabricated cubicle)	yes
spare			difficultly available pumps	= 1)		
tempera floc vehicular z	arts PDF, Categorica	TRUE	no concrete difficultly available	(no concrete = 1, difficultly available = 1, concrete = 1)	"The Chemical Toilet is designed as a complete prefabricated cubicle []." (Emersan)	yes
floc vehicular_s		TRUE	concrete simple technical special	(simple = 0, technical = 0.5, special = 0.5)	No concrete needed. "The Chemical Toilet comes as complete prefabricated plastic unit either available in-country from existing suppliers or can be flown in." (Emersan) Assumed that spare parts for these units need to be accessed from the producer and mostly cannot be replaced with locally produced parts.	yes
floc vehicular_s		FALSE FALSE		NA NA		NA NA
vehicular_i		FALSE TRUE	very cold cold temperate warm hot	NA (very cold = 0.5, cold = 0.75, temperate = 1, warm = 1, hot = 1)		NA yes
	ing Performance, Categorica	TRUE	flooding no flooding	(flooding = 1, no flooding = 1)	"Chemical Toilets are appropriate for the acute response phase of an emergency and are particularly suitable for flood prone affected areas, where pit digging is difficult, within urban areas and where low water and non-permanent solutions are required." (Emersan)	Yes
5	ces Performance, Categorica	TRUE	no access difficult full	(no access = 0, difficult = 0.5, full = 1)	"if 75–100 people are using one toilet per day then they should be emptied daily using a Motorised Emptying and Transport." (Emersan) Vehicular access for some type of motorized vehicles is necessary. Smaller vehicles (e.g. Gulper) are an option and can navigate difficult terrain but	yes
	ope Performance, Categorica	FALSE	flat not flat	NA	are less efficient. NA	NA
soil_	Performance, Categorica	TRUE	clay silt sand gravel	(clay = 1, silt = 1, sand = 1, gravel = 1, rock = 1)	Not relying on soil absorbtion and therefore not affected by soil type.	yes
groundwater_d	pth Performance, Trape	TRUE	rock water depth [m]	(a = 0, b = 0, c = 999, d = 999)	"Chemical Toilets are appropriate for the acute response phase of an emergency and are particularly suitable for flood prone affected areas, where pit digging is difficult, within urban areas and where low water and non-permanent solutions are required." (Emersan) Low risk for contamination and therefore suitable	yes
excava	ion Performance, Categorica	TRUE	easy hard	(easy = 1, hard = 1)	for areas with a high groundwater table. "Chemical Toilets are appropriate [] where pit digging is difficult, []." (Emersan)	yes
surface_area_o			[mz/plot]	(a = 1, b = 1, c = 999, d = 999)	Not affected by excavation. This tollet can also be constructed on a small footprint. Based on a comparison of different technologies, we derive the space requirements of a chemical tollet to be similar to a single pit and use the same minimum space requirement of 1m2/plot (Eaway, 2021). Note that this does not involve any visual protection. A superstructure could require more space.	yes
surface area of	0 (FALSE FALSE FALSE	0	NA	NA	NA NA NA
drinking_water_expc	0 (Categorica Performance, Categorica Catego	FALSE	Close Not close		"Chemical Toilets are appropriate for the acute response phase of an emergency and are particularly suitable for flood prone affected areas, where pit digging is difficult, within urban areas and where low water and non-permanent solutions are required. As excreta is well contained and well solated with minimal risk of containnation, it is a good solution where there is a risk of cholera." (Emersain)	NA yes
construction	0 (FALSE		NA	NA	NA
construction_ design_			Ladder: unskilled skilled skilled skilled skilled skilled skilled skilled Ladder: unskilled skilled skilled = 1, skilled = 1, professional = 1) (unskilled = 0, skilled = 0.5, professional = 1)	"The Chemical Toilet comes as complete prehability of the Chemical Toilet comes as complete prehability of the Chemical Toilet Chemical Ch	yes .	

om skills	Performance, Categorica	TOUR	Ladder:	(unskilled = 0.5, skilled = 1, professional = 1)	"Chemical Toilets come with a basic pump flush	yes	i i
Om_skiis	Performance, Categorica	TRUE		(unskilled = 0.5, skilled = 1, professional = 1)		yes	
			Unskilled		that operates using the hand or foot or as dry		
			Skilled		systems without flush. If 75–100 people are using		
			Professional		one toilet per day then they should be emptied		
					daily Using a Motorised Emptying and Transport.		
					The toilets require regular cleaning and checking of		
					water for handwashing and anal cleansing, hygiene		
					items, soap and dry cleansing materials. Some		
					chemicals in the sludge can harm the biological		
					activity in certain treatment facilities such as an		
					aerobic Baffled Reactors or Biogas Reactors."		
					(Emersan)		
0		FALSE	0	NA		NA	
0		FALSE				NA	
0		FALSE	0	NA .	NA .	NA	
0		FALSE	0	NA	NA .	NA	
cleansing_method	Performance, Categorica	EALSE	Washers	NA .	NA .	NA .	
CCUISING_INCLINE	i ciromance, categorica	I ALSE	Soft wipers	na			
I		I	Hard wipers				
<u> </u>		FALSE		NA .	NA .	NA .	l l
- 0							l l
		FALSE				NA	l l
lifetime	Performance, Categorica	TRUE	short (< 1 year)	(short = 1, medium = 0, long = 0)	"meant for short term" (Emersan)	yes	
I		I	medium (1-5 years)				
		I	long (>5 years)		1		l l
speed implement toilet	PDF, Categorica	TRUE	rapid (< 3 days)	(rapid = 1, moderate = 0, slow = 0)	"The Chemical Toilet, commonly referred to as a	yes	l l
4,000_00,0000_0000	,		moderate (3 days to 2 weeks)	('portaloo', can be used as an immediate solution in	,	
			slow (> 2 weeks)		the acute response phase of an emergency."		
			slow (> 2 weeks)				
					"immediate solution" (Emersan)		
					"in Dominican republic inside 2days arrival"		
					(Harvey, 2007)		
					The implementation time could be slightly slower, if		
					chemical toilets are not locally available and need		
					to be transported there. This is neglected here.		
					(Kukka Ilmanen, Eawag 2021)		
speed implement treatment	PDF, Categorica	EALSE	rapid (few days to a week)	NA .	NA	NA	
speed_imperient_deadment	1 bi , categorica	I ALSE	moderate (few weeks up to three months)	na			
			slow (> 3 months)				
scalability	Performance, Categorica	TRUE	easy	(easy = 1, difficult = 1)	"Can be mobilised rapidly" (Emersan)	yes	
			difficult		The chemical toilets can be up- and downscaled		
					rapidly by changing the number of available		
					cubicles. It should be mentioned that this depends		
					on the local availability of further chemical toilets.		
					(Kukka Ilmanen, Eawag 2021)		
construction_parts	PDF, Categorica	TRUE	simple	(simple = 0, technical = 0, special = 1)	"The Chemical Toilet comes as complete	yes	
construction_parts	PDF, Categorica	TRUE	technical	(simple - 0, tecinical - 0, special - 1)	prefabricated plastic unit either available in-country	yes	
		I					
	i e	1	special		from existing suppliers or can be flown in."		
1				l .	(Emersan)		
1							
					Assumed that these units need to be accessed from		
Transfer Coefficients	(copied from "Savitation_Technologies_TC_database_20230622.alom")				Assumed that these units need to be accessed from the oroducer.		
Transfer Coefficients	Sludge	Range		Soilloss	Assumed that these units need to be accessed from the oroducer.	Comments	Reference
Transfer Coefficients		Range	Airloss 0.01		Assumed that these units need to be accessed from the oroducer.	Comments	Reference PA
TP	Sludge 0.99	Range	0.01	0	Assumed that these units need to be accessed from the oroducer.	Comments	
	Sludge 0.99 0.99	Range		0	Assumed that these units need to be accessed from the oroducer.	Comments	
TP med (R) &	Sludge 0.99 0.99 0.99	Range	0.01	0	Assumed that these units need to be accessed from the oroducer.	Comments	PA - PA
TP med (R) k	Studge 0.95 0.95 2.25 0.5	Range	0.01 0.01	0	Assumed that these units need to be accessed from the oroducer. Waterloss 0 0	Comments	PA -
TP med (R) &	Studge 0.96 0.96 0.99 22 0.50 0.50	Range	0.01	0	Assumed that these units need to be accessed from the oroducer. Waterloss 0 0	Comments	PA - PA - PA
TP med (R) TN med (R)	Studge 0.95 0.95 22 0.96 0.96	Range	0.01 0.01 0.1 0.05	0	Assumed that these units need to be accessed from the oroducer. Waterloss 0 0 0		PA
TP med (R)	Studge 0.95 0.95 22 0.05 0.05 0.05 0.05 0.05 0.05	Range	0.01 0.01	0	Assumed that these units need to be accessed from the oroducer. Waterloss 0 0 0	Comments sealed tank with chemical tollet fluid	PA - PA - PA
TP med (R) TN med (R)	Studge 0.950	Range	0.01 0.01 0.1 0.05	0	Assumed that these units need to be accessed from the oroducer. Waterloss 0 0 0		PA
TP med (R)	Studge 0.95 0.95 22 0.05 0.05 0.05 0.05 0.05 0.05	Range	0.01 0.01 0.1 0.05	0	Assumed that these units need to be accessed from the oroducer. Waterloss 0 0 0		PA
TP med (R) **TY med (R) **TY med (R) **Med (R) **Med (R) **Med (R)	Studge 0.95 0.95 22 0.95 25 0.95 1.95 1.95 1.95 1.95 1.95 1.95 1.95 1	Range	0.01 0.01 0.05 0.05	0 0 0 0	Assumed that these units need to be accessed from the oroducer. Waterloss 0 0 0		PA
TF med (8 (8)	Sludge 0.956 0.950 2.50 0.950 0.950 0.950 0.950 0.950 0.950 0.950 0.950 0.950 0.950	Range	0.011 0.010 0.050 0.050 0.050 0.050	0 0 0 0 0	Assumed that these units need to be accessed from the oroducer. Waterloss 0 0 0		PA
17 med (R 17 med	Shadge 0.95 (0.95	Range	0.01 0.01 0.05 0.05	0 0 0 0 0	Assumed that these units need to be accessed from the oroducer. Waterloss 0 0 0		PA
TF med (8 (8)	Sludge 0.956 0.950 2.50 0.950 0.950 0.950 0.950 0.950 0.950 0.950 0.950 0.950 0.950	Range	0.011 0.010 0.050 0.050 0.050 0.050	0 0 0 0 0	Assumed that these units need to be accessed from the oroducer. Waterloss 0 0 0		PA
17 med (R 17 med	Shadge 0.95 (0.95	Range	0.011 0.010 0.050 0.050 0.050 0.050	0 0 0 0 0	Assumed that these units need to be accessed from the oroducer. Waterloss 0 0 0		PA

References

Genosth, P., Innnings, A., Renggli, S., & Reymond, P. (2018). Compendium of Sonitation Pst-chnology is in Emergencies. German WASH Network (GWN), Swiss Federal Institute of Aquatic Science and Technology (Eawag), Global WASH Custor (GWC) and Sozitalnable Sanitation Alliance (SuSanA). Leacther, T., & Relien, J. (2002). A decision support system for selecting sanitation systems in developing countries. Sozio-Economir Planning Sciences, 36 (4), 267–290. https://doi.org/10.1016/S0038-00121(0))0000071

Squifes, D., & Morais Linas, P., Hirstche, J., Imanere, K., Jan, A., van Stoten, M. & Willimann, C. (2011). Sanithose Project Team Departments Sanitation, Waste for Development Countries (Sanited, Swiss Federal Institute of Aquatic Science and Technology (Eawag), Dibendorf, Switzerland Squifes, D. (2016). Experiment Countries (Sanited, Swiss Federal Institute of Aquatic Science and Technology (Eawag), Dibendorf, Switzerland Squifes, D. (2016). Experiment Countries (Sanited, Swiss Federal Institute of Aquatic Science and Technology (Eawag), Dibendorf, Switzerland Squifes, D. (2016). Experiment Countries (Sanited, Swiss Federal Institute of Aquatic Science and Technology (Eawag), Dibendorf, Switzerland Squifes, D. (2016). Experiment Countries (Sanited, Swiss Federal Institute of Aquatic Science and Technology (Eawag), Dibendorf, Switzerland Squifes, D. (2016). Experiment Countries (Sanited, Swiss Federal Institute of Aquatic Science and Technology (Eawag), Dibendorf, Switzerland Squifes, D. (2016). Experiment Countries (Sanited Institute of Aquatic Science and Technology (Eawag).

	Values	Data Source					
FUNCTIONAL GROUP S UNIQUE IDENTIFIER (ID) s	S	-					
	Akanksha Jain, Kukka Ilmanen	- Spuhler, D. et al. (2021)					
OUTPUT PRODUCT s	sludge	Gensch, R. et al. (2018)					
RELATIONS II	Input: NA Output: NA	Spuhler, D. et al. (2021)					
COMMENTS	Welling	Data Carres					
applicability_level (Values (household = 0, neighbourhood = 1,	Gensch, R. et al. (2018)					
	city = 0.5) (household = 0, shared = 0, public = 1)	Gensch, R. et al. (2018)					
capex_req_level opex_req_level	5	Spuhler, D. et al. (2021) Spuhler, D. et al. (2021)					
technical_maturity	(acute = 1, stabilisation = 0,	Gensch, R. et al. (2018) Gensch, R. et al. (2018)					
c	development/recovery = 0)						
icreening Criteria T water_supply	Type and Function Performance, Categorical	Applicable for this Functional Group? FALSE		Technology Values (Data) NA	Data Source / Assumptions NA	Internal Review Done? NA	
			yard public				
			none				
water_volume	Performance, Trapez	TRUE	[L/cap/day]	(a = 0, b = 0, c = 999, d = 999)	According to (Emersan) it belongs into the 'Dry' technologies. Water is only	Yes	
					required for handwashing, which is neglected here.		
					Maximum values (c & d) are assumed		
					to remain 999 L/person/day, firstly since the aspect of high water		
					volumes disrupting this technology is considered with a separate		
					criterion"Flooding", and secondly		
					since this technology could be mobilized to a non-flooded plot area,		
					the upper limit on incoming water is a		
electricity_supply	Performance, Categorica	TRUE	electricity	(electricity = 1, intermittent = 1, no	non-issue (Akanksha Jain). No electricity required	yes	
,			intermittent no electricity	electricity = 1)			
fuel_supply	Performance, Categorica		fuel	NA	NA	NA	
frequency_of_om	PDF, Categorical		no fuel irregular	(irregular = 0, regular = 0, continuous	"An attendant should be on site at all		
			regular continuous	= 1)	times in order to ensure security, continuous user orientation, proper		
			condituous		use and the opening and closing of		
pipe_supply	Performance, Categorical	TRUE	no pipes	(no pipes = 1, difficutly available = 1,	defecation strips." (Emersan) No pipes required.	yes	
E-Sc_subbit			difficultly available	pipes = 1, difficulty available = 1,	and the second second		
pump_supply	Performance, Categorical	TRUE	pipes no pumps		No pumps required.	yes	
	-		difficultly available pumps	pumps = 1)			
concrete_supply	Performance, Categorical	TRUE	no concrete	(no concrete = 1, difficultly available =	"Materials are needed for proper	yes	
			difficultly available concrete	1, concrete = 1)	screening and demarcation of the area. This can be done with plastic		
					canvas or materials such as bamboo or fabrics. Wooden or metal posts are		
					required as well as shovels and picks		
					to set up the posts." (Emersan) No concrete required		
spare_parts	PDF, Categorical	TRUE	simple technical	(simple = 1, technical = 0, special = 0)	"Materials are needed for proper screening and demarcation of the	yes	
			special		area. This can be done with plastic		
					canvas or materials such as bamboo or fabrics. Wooden or metal posts are		
					required as well as shovels and picks		
					to set up the posts.", "Can be built and repaired with locally available		
					materials" (Emersan) No special materials required		
0		FALSE		NA NA	NA	NA NA	
0	0	FALSE	0	NA NA	NA NA	NA NA	
temperature	Performance, Categorical	TRUE	very cold cold	(very cold = 0.5, cold = 0.7, temperate = 1, warm = 1, hot = 1)	"There is no doubt that land application of manure to frozen or	yes	
			temperate		cold and wet ground has potential to		
			warm hot		exacerbate nutrient loss in runoff. []." (Liu et al. (2018))		
					A defecation field can be set up in any climate, but there has to be taken in		
					account that leachate respectively soil		
					absorbtion performance can be lower if the bottom of the pit is frozen.		
flooding	Performance, Categorical	TRUE	flooding	(flooding = 0.1, no flooding = 1)	The hygiene risk if a defecation field is	Yes	
ghiboon	. enormance, categorical		no flooding		flooded is considered as unacceptable.		
					A low performance of 10% is allotted to the category "flooding" given that		
					there exists the possibility that open defecation fields could be built at		
					elevated/ non-flooded plot areas of		
					the flood-prone region. (Akanksha Jain)		
vehicular_acces	Performance, Categorical		no access	(no access = 0.3, difficult = 0.6, full = 1)	"O & M also includes regular	yes	
			difficult full		treatment of faeces with lime, their removal and burial or transport to a		
					disposal site." (Emersan) Vehicular access is not necessary, as		
					manual transport is possible.		
					However, motorized vehicles can strongly improve the operation		
					efficiency (e.g. as they can handle very large loads of sludge that require		
		544.05			frequent emptying).		
slope	Performance, Categorical	FALSE	flat not flat	NA	NA	NA	
soil_type	Performance, Categorical		clay	(clay = 0, silt = 0.5, sand = 1, gravel = 0.5, rock = 0)	If the soil does not allow the liquid to infiltrate, ponding of contaminated	yes	
			sand	5.5, 10CK = 0)	material would pose a serious health		
			gravel rock		risk. Soil percolation and filtration therefore should be guaranteed.		
graphic district.	Destar **			(2-2 h-2 c 000 d 000)		was	
groundwater_depth	Performance, Trapez	IKUE	water depth [m]	(a = 3, b = 3, c = 999, d = 999)	No flushwater and no excavation therefore limited infiltration of	yes	
					effluent, so that groundwater depth should not be a limiting factor.		
					However, there is a risk of		
					However, there is a risk of contamination of groundwater if the groundwater table is high. A safety		
excavation	Performance, Categorica	TRUE	easy	(easy = 1, hard = 1)	However, there is a risk of contamination of groundwater if the	yes	

surface_area_onsite	Performance, Trapez	TRUE	[m2/plot]	(a = 35, b = 35, c = 999, d = 999)	As the space requirements of open defectation fields strongly depend on the number of users, some assumptions are required here. The assumptions are based on the space requirements of shallow trench latrines: "the area needed is approximately 0.25 m2/person/day" (Emersan). This is justified due to the similar nature of the two technologies. Assuming that at least 10 people need to be able to use the open defecation field for a minimum of two weeks, we estimate the minimum space requirements for open defecation fields to be 35 m2/plot (Eawag, 2021) and thus a lot larger than other technologies of this functional group.	yes	
surface_area_offsite	Performance, Trapez	FALSE	m2/pers	NA	NA	NA	
0		FALSE			NA	NA	
0		FALSE		NA NA	NA	NA	
0		FALSE	Close	NA .	NA	NA	
drinking_water_exposure	renormance, categorical	INDE	Not close	(close = 0, not close = 1)	"The area chosen should be at least 50 m from [] water sources" (Emersan)	yes	
		54105					
0	0	FALSE FALSE		NA NA	NA NA	NA NA	
construction_skills			Ladder:		No specific skills needed.	yes	
			unskilled skilled	= 1)			
design_skills	Performance, Categorical	TRUE	portessional Ladder: unskilled skilled professional	(unskilled = 0, skilled = 0.5, professional = 1)	Design requires expert identification of an appropriate location, considering the following aspects: "The area chosen should be at least 50 m from food production, storage and preparation areas (e.g. kitchens, markets), water sources, water storage and treatment facilities but close enough to ensure safety of and accessibility for users. Defecation fields should be downhill of settlements, camps and water source to avoid contamination" (Emersan). No other design skills necessary.	yes	
om_skills	Performance, Categorical	TRUE	Ladder: Unskilled Skilled	(unskilled = 1, skilled = 1, professional = 1)	No specific training needed for maintaining. But they can be "Difficult to manage" (Emersan)	yes	
0		FALSE	Professional	NA NA	NA	NA	
0		FALSE			NA NA	NA NA	
0	0	FALSE	0	NA NA	NA	NA	
0	0	FALSE			NA	NA	
cleansing_method			Washers Soft wipers Hard wipers	NA	NA	NA	
0		FALSE FALSE			NA NA	NA NA	
lifetime			short (< 1 year)	(short = 1, medium = 0, long = 0)	"Controlled Open Defecation is not	yes	
			medium (1-5 years) long (>5 years)	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	considered an improved sanitation technology and should be used only as an extreme short-term measure before other sanitation options are ready to use." (Emersan)	,	
speed_implement_toilet	PDF, Categorical	TRUE	rapid (< 3 days) moderate (3 days to 2 weeks) slow (> 2 weeks)	(rapid = 1, moderate = 0, slow = 0)	"Rapid implementation" (Emersan)	yes	
speed_implement_treatment	PDF, Categorical		rapid (few days to a week) moderate (few weeks up to three months) slow (> 3 months)	NA	NA	NA	
scalability	Performance, Categorical	IKUE	easy difficult	(easy = 1, difficult = 1)	The defecation field can be increased by demarking new areas. (Kukka Ilmanen, Eawag 2021)	yes	
construction_parts			simple technical special	(simple = 1, technical = 0, special = 0)	"Can be built and repaired with locally available materials" (Emersan)	yes	
Transfer Coefficients	(copied from "Sanitation_Technologies_TC_database_202			,	,		
TP	Sludge 0.29	Range 0,18 - 0,4	Airloss		Waterloss		Reference Montangero and Belevi (2007)
med (R)							- evioritarigero anu berevi (2007)
k	5	[0.22]					PA
TN		0,09-0,27	(* as N	Montangero and Belevi (2007)
	0.18		0.55			* as N * TC Soilloss: N reaching the groundwater	Jacks et al. (1999) Nyenie et al. (2013)
med (R)						re soliloss, is reaching the groundwater	- (2015)
k	25	[0.18]					PA
H2O	0.15	0.05 - 0.3	0.15	0.7	(PA
med (R)	0.15	(0.05 - 0.3)	0.15	0.70		permeability	
k	5	[0.25]					PA
TS	0.6		(0.4		*TSS retainment range: 0.7-0.9	Montangero and Belevi (2007)
med (R)	0.60	0.5 - 0.7	(0.40		(Assumption for TS: 0.5 - 0.7)	
k	5	[0.2]		0.40			PA
	·			•		·	Spuhler et al. (2021)
Additional Information							

Additional Information

Copied from "single pit". Some of the k-factors were decreased if they weren't already the minimum possible value.

References
Gensch, R., Jennings, A., Renggil, S., & Reymond, P. (2018). Compendium of Sonitation Technologies in Emergencies . German WASH Network (GWN), Swiss Federal Institute of Aquatic Science and Technology (Eawag), Global WASH Cluster (GWC) and Sustainable Sanitation Alliance (SuSanA). Loetscher, T., & Keller, J. (2002). A decision support system for selecting sanitation systems in developing countries. Socie-Cenomic Planning Sciences, 36 (4), 267–290. https://doi.org/10.1016/50038-0121(02)00007-1. Sphiler, D., & Roller, L. (2002). Sonitation settings, L., Jain, A., van Slotton, M., & Williaman, C. (2021). Sanitation settings, L., Jain, A., van Slotton, M. & Williaman, C. (2021). Sanitation settings, L., Jain, A., van Slotton, M. & Williaman, C. (2021). Sanitation settings, L., Jain, A., van Slotton, M. & Williaman, C. (2021). Sanitation settings, L., Jain, A., van Slotton, M. & Williaman, C. (2021). Sanitation settings, L., Jain, A., van Slotton, M. & Williaman, C. (2021). Sanitation settings, L., Jain, A., van Slotton, M. & Williaman, C. (2021). Sanitation settings, L., Jain, A., van Slotton, M. & Williaman, C. (2021). Sanitation settings, L., Jain, A., van Slotton, M. & Williaman, C. (2021). Sanitation settings, L., Jain, A., van Slotton, M. & Williaman, C. (2021). Sanitation settings, L., Jain, A., van Slotton, M. & Williaman, C. (2021). Sanitation settings, L., Jain, A., van Slotton, M. & Williaman, M. &

nsfer Station and Storage						
	Values	Data Source				
FUNCTIONAL GROUP	s	-				
UNIQUE IDENTIFIER (ID) DATA COMPILER	transfer_station Matthias van Sloten	-				
INPUT PRODUCT	sludge	Tilley, E. et al. (2014)				
OUTPUT PRODUCT RELATIONS	transterred_sludge Input: NA	Tilley, E. et al. (2014) Tilley, E. et al. (2014)				
	Output: NA					
COMMENTS -Filter Criteria	Values	Data Source				
applicability_level	(household = 0, neighbourhood = 1,	Tilley, E. et al. (2014)				
	city = 1) (household = 0, shared = 0.5, public = 1)	Tilley, E. et al. (2014)				
capex_req_level opex_req_level	4	Spuhler, D. et al. (2021) Spuhler, D. et al. (2021)				
technical_maturity development phase	(acute = 0.5, stabilisation = 0.5,	Tilley, E. et al. (2014) Gensch, R. et al. (2018)				
	development/recovery = 1)		A	- 1 1 11 15 15 15	2.0 (0.0)	
ening Criteria water_supply	Type and Function Performance, Categorical	Applicable for this Functional Group? FALSE	house [Unit]	Technology Values (Data) NA	Data Source / Assumptions NA	Internal Review Done? NA
2.777			yard			
			public none			
water_volume	Performance, Trapez	TRUE	[L/cap/day]	(a = 0, b = 0, c = 999, d = 999)	Can be used for all types of water	Yes
electricity_supply	Performance, Categorical	TRUE	electricity	(electricity = 1, intermittent = 1, no	consumption. Assumed that there is no electricity	
			intermittent	electricity = 1)	needed.	
fuel_supply	Performance, Categorical	FALSE	no electricity fuel	NA	NA	NA
			no fuel			
frequency_of_om	PDF, Categorical	TRUE	irregular regular	(irregular = 0, regular = 1, continuous = 0)	"Screens must be frequently cleaned to ensure a constant flow and prevent	yes
			continuous		back-ups. Sand, grit and on solidated sludge must also be periodically removed from the holding tank. There should be a well-organized system to empty the transfer station; if the holding tank fills up and overflows, it is no better than an overflowing pit. The pad and loading area should be regularly cleaned to minimize odours, filles and other vectors from becoming nuisances." (Compendium) Regular maintenance required.	
pipe_supply	Performance, Categorical	TRUE	no pipes difficultly available	(no pipes = 1, difficultly available = 1, pipes = 1)	No pipes are required.	yes
pump_supply	Performance, Categorical	TRUE	no pumps difficultly available	(no pumps = 1, difficultly available = 1, pumps = 1)	No pumps required (pumping trucks required)	yes
concrete_supply	Performance, Categorical	TRUE	pumps no concrete difficultly available concrete	(no concrete = 0.5, difficultly available = 0.75, no concrete = 1)	No data found. It is assumed, that underground holding tanks are mostly constructed with concrete, because	yes
spare_parts	PDF, Categorical	TOLE	simple	(simple = 0.7, technical = 0.3, special =	they should be watertight (Compendium). However, other materials are also possible, but these tanks are mostly bought from a specialized dealer in prefabricated HDPE holding tanks and have therefore a lower performance. "Transfer stations can be equipped	Yes
зµа ∈ _µа г з	T.J., Garegorian		septial special	0)	with digital data recording devices to track quantity, input type and origin, as well as collect data about the individuals who dump there. In this way, the operator can collect detailed information and more accurately plan and adapt to differing loads." (Compendium) No technical spare parts are usually required. However, the use of technical equipment might improve the performance of the technology.	
0			0	NA	NA	NA
		FALSE				
0	0	FALSE FALSE FALSE	0	NA NA	NA	NA NA
	0	FALSE FALSE	0 0 very cold cold temperate warm	NA NA (very cold = 0, cold = 0.25, temperate = 0.75, warm = 1, hot = 1)	NA	NA
0	0	FALSE FALSE TRUE	0 very cold cold temperate warm hot flooding	NA (very cold = 0, cold = 0.25, temperate	NA NA Assumed to be similar to a biogas	NA NA
0 temperature flooding	0 0 Performance, Categorical Performance, Categorical	FALSE FALSE TRUE	0 very cold cold temperate warm hot flooding no flooding	NA (very cold = 0, cold = 0.25, temperate = 0.75, warm = 1, hot = 1) (flooding = 0.9, no flooding = 1)	NA NA Assumed to be similar to a biogas reactor. Assumed to be similar to a biogas reactor.	NA NA Yes
0 temperature	0 0 Performance, Categorical	FALSE FALSE TRUE	0 very cold cold temperate warm hot flooding no flooding no no access difficult	NA (very cold = 0, cold = 0.25, temperate = 0.75, warm = 1, hot = 1)	NA Assumed to be similar to a biogas reactor. Assumed to be similar to a biogas reactor. Assumed to be similar to a biogas reactor. "A vacuum truck is required to empty transfer stations when they	NA NA Yes
0 temperature flooding vehicular_acces	Performance, Categorical Performance, Categorical Performance, Categorical	FALSE FALSE TRUE TRUE	very cold cold temperate warm hot flooding no flooding no access difficult full little	NA (very cold = 0, cold = 0.25, temperate = 0.75, warm = 1, hot = 1) (flooding = 0.9, no flooding = 1) (no access = 0, difficult = 1, full = 1)	NA Assumed to be similar to a biogas reactor. Assumed to be similar to a biogas reactor. "A vacuum truck is required to empty transfer stations when they are full." (Compendium)	NA NA Yes Yes
0 temperature	0 0 Performance, Categorical Performance, Categorical	FALSE FALSE TRUE TRUE	0 very cold cold temperate warm hot flooding no flooding no no access difficult	NA (very cold = 0, cold = 0.25, temperate = 0.75, warm = 1, hot = 1) (flooding = 0.9, no flooding = 1)	NA Assumed to be similar to a biogas reactor. Assumed to be similar to a biogas reactor. Assumed to be similar to a biogas reactor. "A vacuum truck is required to empty transfer stations when they	NA NA Yes
0 temperature flooding vehicular_acces	Performance, Categorical Performance, Categorical Performance, Categorical	FALSE TRUE TRUE TRUE FALSE	overy cold cold temperate warm hot flooding no flooding no access difficult full flat	NA (very cold = 0, cold = 0.25, temperate = 0.75, warm = 1, hot = 1) (flooding = 0.9, no flooding = 1) (no access = 0, difficult = 1, full = 1) NA	NA Assumed to be similar to a biogas reactor. Assumed to be similar to a biogas reactor. "A vacuum truck is required to empty transfer stations when they are full." (Compendium)	NA NA Yes Yes
0 temperature flooding vehicular_acces	Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical	FALSE FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE	very cold cold temperate warm hot flooding no flooding no flooding no flooding no access difficult full flat not flat clay slit sand	NA (very cold = 0, cold = 0.25, temperate = 0.75, warm = 1, hot = 1) (flooding = 0.9, no flooding = 1) (no access = 0, difficult = 1, full = 1) NA (clay = 1, silt = 1, sand = 1, gravel = 1,	NA Assumed to be similar to a biogas reactor. Assumed to be similar to a biogas reactor. Assumed to be similar to a biogas reactor. Assumed to be similar to a biogas reactor. "A vacuum truck is required to empty transfer stations when they are full." (Compendium) NA Not relying on soil absorbtion and therefore not affected by soil type. "The holding tank must be well	NA NA Yes Yes
0 temperature flooding vehicular_acces slope soil_type	Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical	FALSE FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE	very cold cold temperate warm hot flooding no access difficult full flat noct flat clay silt sand gravel rock	NA (very cold = 0, cold = 0.25, temperate = 0.75, warm = 1, hot = 1) (flooding = 0.9, no flooding = 1) (no access = 0, difficult = 1, full = 1) NA (clay = 1, silt = 1, sand = 1, gravel = 1, rock = 1)	NA Assumed to be similar to a biogas reactor. Assumed to be similar to a biogas reactor. "A vacuum truck is required to empty transfer stations when they are full." (Compendium) NA Not relying on soil absorbtion and therefore not affected by soil type.	NA NA Yes Yes Yes yes NA yes
0 temperature flooding vehicular_acces slope soil_type	Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical	FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRU	very cold cold temperate warm hot flooding no access difficult full flat noct flat clay silt sand gravel rock	NA (very cold = 0, cold = 0.25, temperate = 0.75, warm = 1, hot = 1) (flooding = 0.9, no flooding = 1) (no access = 0, difficult = 1, full = 1) NA (clay = 1, silt = 1, sand = 1, gravel = 1, rock = 1)	NA Assumed to be similar to a biogas reactor. Assumed to be similar to a biogas reactor. Assumed to be similar to a biogas reactor. Assumed to be similar to a biogas reactor. Assumed to be similar to a biogas reactor. Assumed to be similar to a biogas reactor. Assumed to be similar to a biogas reactor. Assumed to be similar to empty transfer stations when they are full." (Compendium) NA Not relying on soil absorbtion and therefore not affected by soil type. The holding tank must be well constructed to prevent leaching and/or surface water infliration." (Compendium) If it is propper built there should not be any problem at a place with a high groundwater table. But since there is still a remaining risk of contamination, one must be very careful in areas with a high groundwater table. But since there is still a remaining risk of contamination, one must be very careful in areas with a high groundwater table. But since there is still a remaining this of contamination, one must be very careful in areas with a high groundwater table. But since there is careful a remaining the summary of the su	NA NA Yes Yes Yes yes NA yes
flooding vehicular_acces slope soil_type groundwater_depth	Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Trapez	FALSE FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRU	very cold cold temperate warm hot flooding no access difficult full flat nont flat clay silt sand gravel vater depth [m]	NA (very cold = 0, cold = 0.25, temperate = 0.75, warm = 1, hot = 1) (flooding = 0.9, no flooding = 1) (no access = 0, difficult = 1, full = 1) NA (clay = 1, silt = 1, sand = 1, gravel = 1, rock = 1) (a = 0, b = 3, c = 999, d = 999)	NA Assumed to be similar to a biogas reactor. Assumed to be similar to a biogas reactor. Assumed to be similar to a biogas reactor. Assumed to be similar to a biogas reactor. Assumed to be similar to a biogas reactor. Assumed to be similar to a biogas reactor. Assumed to be similar to a biogas reactor. Assumed to be empt y tander stations when they are full." (Compendium) NA Not relying on soil absorbtion and therefore not affected by soil type. The holding tank must be well constructed to prevent leaching and/or surface water infiltration." (Compendium) If it is propper built there should not be any problem at a place with a high groundwater table. But since there is sill a remaining risk of contamination, one must be very careful in areas with a high groundwater table. The dumping point six for contamination, one must be very careful in areas with a high groundwater table. But since there is some there is a proposed to the six of the six o	NA NA Yes Yes Yes yes NA yes
groundwater_depth excavation surface_area_onsite	Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Trapez Performance, Trapez	FALSE FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE	very cold cold temperate warm hot flooding no access difficult full flat not flat clay silt sand gravel rock water depth [m]	NA (very cold = 0, cold = 0.25, temperate = 0.75, warm = 1, hot = 1) (flooding = 0.9, no flooding = 1) (no access = 0, difficult = 1, full = 1) NA (clay = 1, silt = 1, sand = 1, gravel = 1, rock = 1) (a = 0, b = 3, c = 999, d = 999) (easy = 1, hard = 0.5)	NA Assumed to be similar to a biogas reactor. Assumed to be similar to a biogas reactor. A sumed to be similar to a biogas reactor. A vacuum truck is required to empty transfer stations when they are full." (Compendium) NA Not relying on soil absorbtion and therefore not affected by soil type. "The holding tank must be well constructed to prevent leaching and/or surface water infiltration." (Compendium) If it is propper built there should not be any problem at a place with a high groundwater table. "The dumping point should be built low enough to inimize spills when labourers manually empty their sludge carts." (Compendium) Underground holding tanks are (mostly) built underground and therefore require excavation. However, the excavation is not as big as for a sewer, comparable to the excavation of a soak pit. Depending on the transfer time. Can be as small as a normal pit.	NA NA Yes Yes Yes Yes NA yes yes
groundwater_depth	Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Trapez	FALSE FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE	very cold cold tetmperate warm hot flooding no access difficult full flat noof flat clay silt sand gravel rock water depth [m] easy hard	NA (very cold = 0, cold = 0.25, temperate = 0.75, warm = 1, hot = 1) (flooding = 0.9, no flooding = 1) (no access = 0, difficult = 1, full = 1) NA (clay = 1, silt = 1, sand = 1, gravel = 1, rock = 1) (a = 0, b = 3, c = 999, d = 999) (easy = 1, hard = 0.5)	NA Assumed to be similar to a biogas reactor. Assumed to be similar to a biogas reactor. Assumed to be similar to a biogas reactor. A sacuum truck is required to empty transfer stations when they are full." (Compendium) NA Not relying on soil absorbtion and therefore not affected by soil type. "The holding tank must be well constructed to prevent leaching and/or surface water infiltration." (Compendium) If it is propper built there should not be any problem at a place with a high groundwater table. But since there is still a remainig risk of contamination, one must be very careful in areas with a high groundwater table. But since there is still a remainig risk of contamination, one must be very careful in areas with a high groundwater table. Underground holding tanks are (mostly) built underground holding tanks are (mostly) built underground and therefore require excavation. However, the excavation is not as big as for a sewer, comparable to the excavation of a soak pit. Depending on the transfer time. Can be as small as a normal pit. NA	NA NA Yes Yes Yes Yes Yes Yes NA yes yes

drinking_water_exposure							
	Performance, Categorical	TRUE	Close Not close	(close = 0.5, not close = 1)	"The holding tank must be well constructed to prevent leaching and/or surface water infiltration." (Compendium) If it is propper built there should not be any problem at a place close to a drinking water source. But since there	yes	
					is still a remainig risk of contamination, one must still be very careful in areas close to drinking water.		
0		FALSE FALSE		NA NA	NA NA	NA NA	
construction_skills	Performance, Categorical		Ladder:	(unskilled = 0, skilled = 0.1,	"Requires expert design and	yes	
			unskilled skilled professional	professional = 1)	construction" (Compendium) Assumed to be comparable with the skills for a solids-free/simplified sewer.	,	
design_skills	Performance, Categorical	TRUE	Ladder: unskilled skilled professional	(unskilled = 0, skilled = 0.1, professional = 1)	"Requires expert design and construction" (Compendium) Assumed to be comparable with the skills for a solids-free/simplified sewer.	yes	
om_skills	Performance, Categorical	TRUE	Ladder: Unskilled Skilled Professional	(unskilled = 1, skilled = 1, professional = 1)	"Screens must be frequently cleaned to ensure a constant flow and prevent back-ups. Sand, grit and consolidated sludge must also be periodically removed from the holding tank." (Compendium) The required operation and	yes	
0	0	FALSE		NA	maintenance skills are low-level.	NA	
0	0	FALSE	C	NA NA	NA	NA	
0	0	FALSE	C	NA	NA	NA	
0		FALSE				NA	
cleansing_method	Performance, Categorical		Washers Soft wipers Hard wipers	NA	NA	NA	
0		FALSE	C	NA	NA	NA	
0 lifetime	Performance, Categorical	FALSE		NA (short = 1, medium = 1, long = 1)	NA Construction can last long	NA yes	
			short (< 1 year) medium (1-5 years) long (>5 years)			yes	
speed_implement_toilet							
7	PDF, Categorical	TRUE	rapid (< 3 days) moderate (3 days to 2 weeks) slow (> 2 weeks)	(rapid = 0.3, moderate = 0.5, slow = 0.2)	"Requires expert design and construction" (Compendium) Since expert design and construction skills are required a rather moderate implementation time is assumed. The location also has to be chosen carefully (PA)	Yes	
speed_implement_treatment	PDF, Categorical		moderate (3 days to 2 weeks) slow (> 2 weeks) rapid (few days to a week) moderate (few weeks up to three months)	(rapid = 0.3, moderate = 0.5, slow = 0.2) NA	construction" (Compendium) Since expert design and construction skills are required a rather moderate implementation time is assumed. The location also has to be chosen	NA NA	
		FALSE	moderate (3 days to 2 weeks) slow (> 2 weeks) rapid (few days to a week) moderate (few weeks up to three	0.2)	construction" (Compendium) Since expert design and construction skills are required a rather moderate implementation time is assumed. The location also has to be chosen carefully (PA)		
speed_implement_treatment scalability construction_parts	PDF, Categorical Performance, Categorical PDF, Categorical	FALSE	moderate (3 days to 2 weeks) slow (> 2 weeks) rapid (few days to a week) moderate (few weeks up to three months) slow (> 3 months) easy	0.2) NA	construction" (Compendium) Since expert design and construction skills are required a rather moderate implementation time is assumed. The location also has to be chosen carefully (PA) NA The scalability of a transfer station is limited. Other transfer stations could be built to enhance the capacity (PA).	NA .	
speed_implement_treatment scalability construction_parts	PDF, Categorical Performance, Categorical PDF, Categorical PDF, Categorical	TRUE TRUE	moderate (3 days to 2 weeks) slow (> 2 weeks) rapid (few days to a week) moderate (few weeks up to three months) slow (> 3 months) easy difficult simple technical special	NA (easy = 0.5, difficiult = 1) (simple = 0.7, technical = 0.3, special = 0)	construction" (Compendium) Since expert design and construction skills are required a rather moderate implementation time is assumed. The location also has to be chosen carefully (PA) The scalability of a transfer station is limited. Other transfer stations could be built to enhance the capacity (PA). "Transfer stations can be equipped with digital data recording devices to track quantity, input type and origin, as well as collect data about the individuals who dump there. In this way, the operator can collect detailed information and more accurately plan and adapt to differing loads." (Compendium) No technical spare parts are usually required. However, the use of technical equipment might improve the performance of the technology.	NA Yes	Parlamen
speed_implement_treatment scalability construction_parts	PDF, Categorical Performance, Categorical PDF, Categorical PDF, Categorical	FALSE	moderate (3 days to 2 weeks) slow (> 2 weeks) rapid (few days to a week) moderate (few weeks up to three months) slow (> 3 months) easy difficult simple technical special	NA (easy = 0.5, difficult = 1) (simple = 0.7, technical = 0.3, special = 0)	construction" (Compendium) Since expert design and construction skills are required a rather moderate implementation time is assumed. The location also has to be chosen carefully (PA) The scalability of a transfer station is limited. Other transfer stations could be built to enhance the capacity (PA). Transfer stations can be equipped with digital data recording devices to track quantity, input type and origin, as well as collect data about the individuals who dump there. In this way, the operator can collect detailed information and more accurately plan and adapt to differing loads." (Compendium) No technical spare parts are usually required. However, the use of technical equipment might improve	NA .	Reference PA
speed_implement_treatment scalability construction_parts ransfer Coefficients	PDF, Categorical Performance, Categorical PDF, Categorical PDF, Categorical	TRUE TRUE TRUE Range	moderate (3 days to 2 weeks) slow (> 2 weeks) rapid (few days to a week) moderate (few weeks up to three months) slow (> 3 months) easy difficult simple technical special	NA (easy = 0.5, difficiult = 1) (simple = 0.7, technical = 0.3, special = 0)	construction" (Compendium) Since expert design and construction skills are required a rather moderate implementation time is assumed. The location also has to be chosen carefully (PA) NA The scalability of a transfer station is limited. Other transfer stations could be built to enhance the capacity (PA). "Transfer stations can be equipped with digital data recording devices to rack quantity, input type and origin, as well as collect data about the individuals who dump there. In this way, the operator can collect detailed information and more accurately plan and adapt to differing loads." (Compendium) No technical spare parts are usually required. However, the use of technical equipment might improve the performance of the technology.	NA Yes	PA -
speed_implement_treatment scalability construction_parts ransfer Coefficients ransfer Coefficients	PDF, Categorical Performance, Categorical PDF, Categorical PDF, Categorical PDF, Categorical Copped from Sentation Technologies TC database 202 Transferred Sludge 0.99 0.99	TRUE TRUE TRUE TRUE TRUE	moderate (3 days to 2 weeks) slow (> 2 weeks) rapid (few days to a week) moderate (few weeks up to three months) easy difficult simple technical special Airloss 0.01	NA (easy = 0.5, difficiult = 1) (simple = 0.7, technical = 0.3, special = 0)	construction" (Compendium) Since expert design and construction skills are required a rather moderate implementation time is assumed. The location also has to be chosen carefully (PA) NA The scalability of a transfer station is limited. Other transfer stations could be built to enhance the capacity (PA). "Transfer stations can be equipped with digital data recording devices to rack quantity, input type and origin, as well as collect data about the individuals who dump there. In this way, the operator can collect detailed information and more accurately plan and adapt to differing loads." (Compendium) No technical spare parts are usually required. However, the use of technical equipment might improve the performance of the technology.	NA Yes	PA - PA
peed_implement_treatment scalability construction_parts construction_parts ransfer Coefficients remed (R) med (R) f N	PDF, Categorical Performance, Categorical PDF, Categorical PDF, Categorical PDF, Categorical PDF, Categorical Open from "Santation, Technologies, TC database, 202 Transferred Sludge 0.99 0.99 0.99	TRUE TRUE TRUE TRUE TRUE	moderate (3 days to 2 weeks) slow (> 2 weeks) rapid (few days to a week) moderate (few weeks up to three months) slow (> 3 months) easy difficult simple technical special	NA (easy = 0.5, difficiult = 1) (simple = 0.7, technical = 0.3, special = 0) Soilloss	construction" (Compendium) Since expert design and construction skills are required a rather moderate implementation time is assumed. The location also has to be chosen carefully (PA) The scalability of a transfer station is limited. Other transfer stations could be built to enhance the capacity (PA). "Transfer stations can be equipped with digital data recording devices to track quantity, input type and origin, as well as collect data about the individuals who dump there. In this way, the operator can collect detailed information and more accurately plan and adapt to differing loads." (Compendium) No technical spare parts are usually required. However, the use of technical equipment might improve the performance of the technology. Waterloss	NA Yes	PA -
peed_implement_treatment scalability construction_parts ransfer Coefficients remains 1	PDF, Categorical Performance, Categorical PDF, Categorical PDF, Categorical PDF, Categorical Copped from Sentation Technologies TC database 202 Transferred Sludge 0.99 0.99	TRUE TRUE TRUE TRUE TRUE	moderate (3 days to 2 weeks) slow (> 2 weeks) rapid (few days to a week) moderate (few weeks up to three months) easy difficult simple technical special	NA (easy = 0.5, difficiult = 1) (simple = 0.7, technical = 0.3, special = 0) Soilloss	construction" (Compendium) Since expert design and construction skills are required a rather moderate implementation time is assumed. The location also has to be chosen carefully (PA) The scalability of a transfer station is limited. Other transfer stations could be built to enhance the capacity (PA). "Transfer stations can be equipped with digital data recording devices to track quantity, input type and origin, as well as collect data about the individuals who dump there. In this way, the operator can collect detailed information and more accurately plan and adapt to differing loads." (Compendium) No technical spare parts are usually required. However, the use of technical equipment might improve the performance of the technology. Waterloss	NA Yes	PA - PA
speed_implement_treatment scalability construction_parts construction_parts ransfer Coefficients rp med (R) x med (R)	PDF, Categorical Performance, Categorical PDF, Categorical PDF, Categorical PDF, Categorical PDF, Categorical Opportunities of the Categorical of the Categoric	TRUE TRUE TRUE TRUE	moderate (3 days to 2 weeks) slow (> 2 weeks) rapid (few days to a week) moderate (few weeks up to three months) slow (> 3 months) easy difficult simple technical special	NA (easy = 0.5, difficiult = 1) (simple = 0.7, technical = 0.3, special = 0) Soilloss	construction" (Compendium) Since expert design and construction skills are required a rather moderate implementation time is assumed. The location also has to be chosen carefully (PA) The scalability of a transfer station is limited. Other transfer stations could be built to enhance the capacity (PA). "Transfer stations can be equipped with digital data recording devices to track quantity, input type and origin, as well as collect data about the individuals who dump there. In this way, the operator can collect detailed information and more accurately and and adapt to differing loads." (Compendium) No technical spare parts are usually required. However, the use of technical equipment might improve the performance of the technology. Waterloss	NA Yes	PA - PA - PA - PA
speed_implement_treatment scalability construction_parts construction_parts fransfer Coefficients rp med (R) k	PDF, Categorical Performance, Categorical PDF, Categorical PDF, Categorical PDF, Categorical PDF, Categorical Open from "Santation, Technologies, TC database, 202 Transferred Sludge 0.99 0.99 0.99	FALSE TRUE TRUE TRUE AGENTALISMOST	moderate (3 days to 2 weeks) slow (> 2 weeks) rapid (few days to a week) moderate (few weeks up to three months) slow (> 3 months) easy difficult simple technical special	NA (easy = 0.5, difficiult = 1) (simple = 0.7, technical = 0.3, special = 0) Soilloss	construction" (Compendium) Since expert design and construction skills are required a rather moderate implementation time is assumed. The location also has to be chosen carefully (PA) NA The scalability of a transfer station is limited. Other transfer stations could be built to enhance the capacity (PA). "Transfer stations can be equipped with digital data recording devices to rack quantity, input type and origin, as well as collect data about the individuals who dump there. In this way, the operator can collect detailed information and more accurately plan and adapt to differing loads." (Compendium) No technical spare parts are usually required. However, the use of technical equipment might improve the performance of the technology. Waterloss	NA Yes	PA - PA
speed_implement_treatment scalability construction_parts construction_parts Framsfer Coefficients T TP med (R) k H2O med (R)	PDF, Categorical Performance, Categorical PDF, Categorical PDF, Categorical PDF, Categorical PDF, Categorical Opportunities Technologies TC distribute 200 Transferred Sludge 0.99 9 9 9 9 9 9 9 9 9 9 9 9	FALSE TRUE TRUE TRUE ORGENIUM Range	moderate (3 days to 2 weeks) slow (> 2 weeks) rapid (few days to a week) moderate (few weeks up to three months) slow (> 3 months) easy difficult simple technical special Airloss 0.00 0.00 0.00	NA (easy = 0.5, difficult = 1) (simple = 0.7, technical = 0.3, special = 0) Soilloss	construction" (Compendium) Since expert design and construction skills are required a rather moderate implementation time is assumed. The location also has to be chosen carefully (PA) NA The scalability of a transfer station is limited. Other transfer stations could be built to enhance the capacity (PA). "Transfer stations can be equipped with digital data recording devices to track quantity, input type and origin, as well as collect data about the individuals who dump there. In this way, the operator can collect detailed information and more accurately plan and adapt to differing loads." (Compendium) No technical spare parts are usually required. However, the use of technical equipment might improve the performance of the technology. Waterloss	NA Yes Comments	PA
speed_implement_treatment scalability construction_parts Transfer Coefficients TP med (R) TR med (R) 120 med (R)	PDF, Categorical Performance, Categorical PDF, Categorical PDF, Categorical PDF, Categorical Copied from "Santation, Technologies, TC, database, 202 Transferred Sludge 0.99 9.99 9.99 9.05 0.55 0.55	TRUE TRUE TRUE TRUE	moderate (3 days to 2 weeks) slow (> 2 weeks) rapid (few days to a week) moderate (few weeks up to three months) slow (> 3 months) easy difficult simple technical special Airloss 0.01 0.05	0.2) NA (easy = 0.5, difficiult = 1) (simple = 0.7, technical = 0.3, special = 0) Soilloss	construction" (Compendium) Since expert design and construction skills are required a rather moderate implementation time is assumed. The location also has to be chosen carefully (PA) The scalability of a transfer station is limited. Other transfer stations could be built to enhance the capacity (PA). "Transfer stations can be equipped with digital data recording devices to track quantity, input type and origin, as well as collect data about the individuals who dump there. In this dinformation and more accurately plan and adapt to differing loads." (Compendium) No technical spare parts are usually required. Holwever, the use of technical equipment might improve the performance of the technology. Waterloss	NA Yes Comments	PA - PA - PA - PA - PA - PA - PA - PA -

References

Gensch, R., Jennings, A., Benggli, S., & Reymond, P. (2018). Compendium of Sonitation Technologies in Emergencies. German WASH Network (GWN), Swiss Federal Institute of Aquatic Science and Technology (Eawag), Global WASH Cluster (GWC) and Sustainable Sanitation Alliance (SuSanA). Loetscher, T., & Keller, J. (2002). A decision support system for selecting sanitation systems in developing countries. Socio-Economic Planning Sciences, 36(4), 267–290. https://doi.org/10.1016/S0038-0121(02)00007-1

Spuhler, D., & Workisi Lima, P., Fritzsche, J., Ilmanen, K., Jain, A., van Sloten, M., & Willimann, C. (2021). Sanitchoice Project Team. Department Sanitation, Water and Solid Waste for Development Countries (Sandec), Swiss Federal Institute of Aquatic Science and Technology (Eawag), Dibendorf, Switzerland. Spuhler, D., & Roller, L. (2020). Sonitation technology library. Details and data sources for appropriateness profiles and transfer coefficients. Eawag - Swiss Federal Institute of Aquatic Science and Technology.

Tilley, E., Ulrich, L., Lüthi, C., Reymond, P., & Zurbrügg, C. (2014). Compendium of Sonitation Systems and Technologies—2nd revised edition. Swiss Federal Institute of Aquatic Science and Technology (EAWAG).

Motorized Emptying and Tran	sport of Urine Values	Data Source	T			
	C motorized_emptying_urine	-				
DATA COMPILER		- Spuhler, D. & Roller, L. (2020)				
OUTPUT PRODUCT RELATIONS	struvite NA [Ifor SaniChoice, use x]	Spuhler, D. & Roller, L. (2020) Spuhler, D. & Roller, L. (2020)				
COMMENTS	stabilized_urine > concentrated_urine > dried_urine > struvite					
Pre-Filter Criteria applicability_level	Values (household = 1, neighbourhood = 1, city = 0.5)	Data Source Tilley, E. et al. (2014)				
management_level	(household = 0, shared = 0.5, public = 1)	Tilley, E. et al. (2014) Spuhler, D. et al. (2021)				
capex_req_level opex_req_level technical_maturity	8	Spunier, D. et al. (2021) Spuhler, D. et al. (2021) Tilley, E. et al. (2014)				
development_phase	(acute = 1, stabilisation = 1,	Gensch, R. et al. (2018)				
Screening Criteria	development/recovery = 1) Type and Function	Applicable for this Functional Group?	Categories [Unit]	Technology Values (Data)	Data Source / Assumptions	Internal Review Done?
water_supply	Performance, Categorical	FALSE	house	NA	NA	NA
			yard public none			
water_volume	Performance, Trapez	TRUE	[L/cap/day]	(a = 0, b = 0, c = 999, d = 999)	Motorised emptying and transport of urine involves transport of urine alone, from technologies that store it separately. The general problems associated with conveyance technologies, especially those that use pumps such as this one, is that the sludge is too thick and difficult to transport. This is not an issue here and there the full range of continuous function (0-999 L/cap/day) is considered (i.e., full range has 100%	Yes
electricity_supply	Performance, Categorical	FALSE	electricity intermittent	NA	performance) (Akanksha Jain) NA	NA
fuel_supply	Performance, Categorical	TRUE	no electricity fuel	(fuel = 1, no fuel = 0.1)	Pumping trucks rely on fuel for operation, however they	yes
			no fuel		might also be run with electricity or a manual option could be possible though with a lot lower performance. To avoid discarding technologies based on their need for fuel, 10% is awarded for 'no fuel'.	
frequency_of_om	PDF, Categorical	TRUE	irregular regular continuous	(irregular = 0, regular = 0.5, continuous = 0.5)	Those to was awared on in truer. "Most pump trucks are manufactured in North America, Asia or Europe. Thus, in some regions it is difficult to locate spare parts and a mechanic to repair broken pumps or trucks. New trucks are very expensive and sometimes difficult to obtain. Therefore, older trucks are often used, but the savings are offset by the resulting high maintenance and fuel costs that can account for more than two thirds of the total costs incurred by a truck operator. Truck owners must be conscientious to save money for the purchase of expensive replacement parts, tires and equipment. The lack of preventive maintenance is often the cause for major repairs." (Compendium)	yes
pipe_supply	Performance, Categorical	TRUE	no pipes	(no pipes = 1, difficultly available = 1,	guite time-consuming, almost continuous. No water pipes necessary for this technology.	yes
hibc_adhhi	r ciromunec, estegories	THOSE STATE OF THE	difficultly available	pipes = 1)	water pipes necessary for this technology.	, co
pump_supply	Performance, Categorical	TRUE	pipes no pumps difficultly available pumps	(no pumps = 1, difficultly available = 1, pumps = 1)	The motorized pumping trucks contain an installed pump and are independent of the pumps covered by pump supply. They usually cannot be replaced by a normal pump, but need special equipment for the trucks.	yes
concrete_supply	Performance, Categorical	TRUE	no concrete difficultly available	(no concrete = 1, difficultly available = 1, concrete = 1)	No concrete necessary for this technology.	yes
spare_parts	PDF, Categorical	TRUE	concrete simple technical special	(simple = 0, technical = 0.5, special = 0.5)	"Most pump trucks are manufactured in North America, Asia or Europe. Thus, in some regions it is difficult to locate spare parts and a mechanic to repair broken pumps or trucks. New trucks are very expensive and sometimes difficult to obtain." (Compendium) if something breaks, technical as well as possibly specially manufactured spare parts that are produced by the manufactureres, are necessary for this technology. NA	yes
0	0	FALSE	C	NA NA	NA	NA
0 temperature	0 Performance, Categorical	FALSE FALSE	very cold	NA NA	NA NA	NA NA
flooding flooding vehicular_acces	Performance, Categorical Performance, Categorical	TRUE	cold temperate warm hot flooding no flooding no no access	(flooding=0.1, no flooding=1)	There is significant hazard associated with walking or driving a vehicle through a flood. Given so, the performance of this technology is surely reduced for the category of "Flooding" in Aperformance of 10% is allotted to the category "Flooding" is when the possibility that the desludging time can be adjusted, and the service is performed after the flooding event is over and waters have receded. (Akanisha Jain) It is assumed that it is equally risky for human-powered transport and motorized transport to operate during flooding and therefore, all technologies related to the two are allotted same performance values. (Akanisha Jain)	Yes
			difficult full			
slope	Performance, Categorical		flat not flat	(flat = 1, not flat = 1)	Pumping trucks do not rely on a hydraulic gradient for conveyance - Maximum performance on every slope, however: "A very steep gradient can pose problems for vacuum trucks." (Monvois et al. 2012)	yes
soil_type	Performance, Categorical	FALSE	clay silt sand gravel rock	NA	NA .	NA
groundwater_depth excavation	Performance, Trapez Performance, Categorical	FALSE TRUE	water depth [m] easy	NA (easy = 1, hard = 1)	NA Pumping trucks do not need any kind of excavation	NA yes
surface_area_onsite	Performance, Trapez	FALSE	hard [m2/plot]	NA	digging - Maximum performance for every type NA	NA NA
surface_area_offsite 0		FALSE		NA NA	NA NA	NA NA
0	0	FALSE FALSE	C	NA NA	NA NA	NA NA
drinking_water_exposure	Performance, Categorical		Close Not close	NA	NA	NA
0		FALSE FALSE		NA NA	NA NA	NA NA
		-	-			

		I	I		lu.	1	1
construction_skills	Performance, Categorical	TRUE	Ladder:	(unskilled = 0, skilled = 1, professional	"Most pump trucks are	yes	
			unskilled	= 1)	manufactured in North America, Asia or Europe. Thus,		
			skilled		in some regions it is difficult to locate spare parts and a		
			professional		mechanic to repair broken pumps or trucks. New trucks		
					are very expensive and sometimes difficult to obtain.		
					Therefore, older trucks are often used, but the savings		
					are offset by the resulting high maintenance and fuel		
					costs that can account for more than two thirds of the		
					total costs incurred by a truck operator. Truck owners		
					must be conscientious to save money for the purchase		
					of expensive replacement parts, tires and equipment.		
					The lack of preventive maintenance is often the cause		
					for major repairs."		
					Even though pumping trucks probably aren't		
					constructed onsite, a skilled technician is necessary to		
					maintain the truck.		
					maintain the truck.		
design_skills	Performance, Categorical	TRUE	Ladder:	(unchilled = 0 skilled = 1 professional	Construction and design skills are equivalent		
uesign_skiils	renormance, categorical	INOL			construction and design skills are equivalent	yes	
			unskilled	= 1)			
			skilled				
			professional				1
om_skills	Performance, Categorical	TRUE	Ladder:	(unskilled = 0, skilled = 1, professional		yes	
			Unskilled	= 1)	the purchase of expensive replacement parts, tires and	1	
			Skilled		equipment. The lack of preventive maintenance is often	1	
			Professional		the cause for major repairs." (Compendium)	1	
					Mechanic skills are required		
0	0	FALSE) NA	NA	NA	1
0		FALSE) NA	NA NA	NA NA	1
							1
0		FALSE		NA	NA	NA	1
0		FALSE		NA NA	NA	NA	1
cleansing_method	Performance, Categorical	FALSE	Washers	NA	NA	NA	
Į.			Soft wipers			1	
			Hard wipers				
0	0	FALSE		NA NA	NA .	NA]
0		FALSE		NA NA	NA	NA	1
lifetime	Performance, Categorical	FALSE	short (< 1 year)	NA NA	NA NA	NA NA	1
meante	r en ormance, categorical	· · · · · · ·	medium (1-5 years)	I			
						1	
			long (>5 years)			l	4
speed_implement_toilet	PDF, Categorical	FALSE	rapid (< 3 days)	NA	NA	NA	
			moderate (3 days to 2 weeks)			1	
			slow (> 2 weeks)	1		<u> </u>]
eed_implement_treatment	PDF, Categorical	FALSE	rapid (few days to a week)	NA	NA	NA	
_			moderate (few weeks up to three			1	
			months)				
			slow (> 3 months)				
scalability	Performance, Categorical	TRUE		(ans 1 difficult - 1)	The empty ing can be espled up by buring more trucks or		1
Scalability	Performance, Categorical	INDE	easy	(easy = 1, difficult = 1)	The emptying can be scaled-up by buying more trucks or	yes	
			difficult		using the existing ones more frequently. (Kukka	1	
					Ilmanen, Eawag 2021)	1	4
construction_parts	PDF, Categorical	TRUE	simple	(simple = 0, technical = 0.3, special =	"Most pump trucks are manufactured in North America,	yes	[
_			technical	0.7)	Asia or Europe. Thus, in some regions it is difficult to	1	
			special		locate spare parts and a mechanic to repair broken	1	
						1	
					pumps or trucks. New trucks are very expensive and	1	
					sometimes difficult to obtain." (Compendium)	1	
					"The required materials – a vehicle, a tank and a pump –		
Į.					are usually available locally. Second-hand trucks are	1	
					often used, which can reduce costs but often also	1	
Į.					reduce efficiency.", "Not all parts and materials may be	1	
					locally available" (Emersan)	1	
					To get pump trucks one can either add pumps to a truck		
					or buy specially-manufactured pumping tracks. The	1	
						1	
					latter are used more often, so that specially-		
					manufactured parts are more likely to be required.	1	
	opied from "Sanitation_Technologies_TC_database_2021	1622 vism"1	l	1	I	1	l
nsfer Coefficients (∞		Range	Airloss	Soilloss	Waterloss	Comments	Reference
	0.98		AITIOSS		waterioss 0.02		PA
	0.98				0.02		
TP	0.98		-		0.02		
TP med (R)				-			PA
TP med (R)	100		0.0			* Ammonia volatilization	Udert et al. (2006)
TP med (R) k TN	100 0.96	-		· · · · · · · · · · · · · · · · · · ·	0.02	2	-
TP med (R)	100 0.96 0.96		0.0	2			
TP med (R) k TN	100 0.96		0.03	-			PA
TP med (R) k TN med (R)	100 0.96 0.96			-	0.02	2	
TP med (R) k TN med (R) k H2O	100 0.96 0.96 100		0.0	1 (0.02		PA PA
TP med (R) L TN med (R) L H2O med (R)	100 0.96 0.96 100 0.97 0.97		0.0	1 (PA -
TP med (R) k TN med (R) k 4 4 4 4 4 4 4 4 4 6 6 6 7 7 8 8 8 8 8 8 8 8 8 8 8 8 8 8 8	100 0.956 0.950 100 0.97 0.97		0.0	- 1 (0.02	-	PA - PA
TP med (R)	100 0.96 0.96 100 0.97 0.97 100		0.0		0.02		PA -
TP med (R) k TN med (R) k 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 6 6 6 6	100 0.956 0.950 100 0.97 0.97		0.0	- 1 (0.02		PA - PA

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Application Continues Co							
March Marc		Values	Data Source				
March 1987 Mar	FUNCTIONAL GROUP	С	-	-			·
Company Comp	DATA COMPILER	Julian Fritzsche		1			
			Spuhler, D. & Roller, L. (2020)				
Content			Soubler D & Roller I (2020)	=			
Marchest Marchest		Input: OR		=			
March Marc	COMMENTS			=			
Process	e-Filter Criteria	Values					
AND COLOR	applicability_level		Tilley, E. et al. (2014)				
March Marc	management_level		Tilley, E. et al. (2014)	-			
March Marc	capex reg level	3	Soubler, D. et al. (2021)	=			
Montange Montange	opex_req_level	5	Spuhler, D. et al. (2021)				
Professional Cultural Professional Decision Professional Cultural Professional Cultu		development/recovery = 1)					
WATER WATE							
Auto-Continued Auto				yard			
Part Part							
Section Process Proc	water_volume	Performance, Trapez	TRUE	[L/cap/day]	(a = 0, b = 0, c = 999, d = 999)		Yes
Martinestand Martinestand Categoria Dist.							
Machine Mach							
Approx.com/						technologies, especially those that use	
### CONTROL OF THE CO							
## A Part Company Performance, Companion Part Part Company						transport. This is not an issue here and	
### descripting apply Performance, Categorical (PASE) Advanced						there the full range of continuous	
Performance Congress Table						considered (i.e., full range has 100%	
Montanger Marchanes Marc							
Bell_Loops	electricity_supply	Performance, Categorical	FALSE		NA	NA	NA
Following Commence Collegerial DULE Following C				intermittent			
forgoning of one of POC Categories (BUE) register 10	fuel_supply	Performance, Categorical	TRUE	fuel	(fuel = 1, no fuel = 1)	No fuel is required.	yes
register of the processor of the process	frequency of om	PDF. Categorical	TRUE		(irregular = 0, regular = 1, continuous	"Manually operated sludge numps	yes
ppc_uppr Performance_Categorical RolE		,		regular		require daily maintenance (cleaning,	
Paper				continuous			
Performance, Categorical Riule of proper control of proper in the design * Compression of proper control of proper in the						clean and maintain their protective	
PRE_popular Preformance, Categorical TRUE page _ popular _ preformance, Categorical TRUE page _ popular _ preformance, Categorical TRUE page _ popular _ preformance, Categorical TRUE page _ popular _ preformance, Categorical TRUE page _ popular _ preformance, Categorical TRUE page _ popular _ preformance, Categorical TRUE page _ popular _ preformance, Categorical TRUE page _ popular _ preformance, Categorical TRUE page _ popular _ preformance, Categorical TRUE page _ popular _ preformance, Categorical TRUE page _ popular _ preformance, Categorical TRUE page _ popular _ preformance, Categorical TRUE page _ popular _ pop							
pgs_uspt Performance_Categorical TRUE Performance_Categori						Regular maintenance is necessary to	
pump, pump, pump Performance, Categorical TRUE Performance, Teoporical TRUE Performance,	nine sunnly	Performance Categorical	TRUE	no nines	(no nines = 1 difficultly available = 1		ves
Performance, Categorial TULE	pipe_sappiy	r criormance, categorica		difficultly available		no pipes are required.	,0
Befficulty available pumps 1 pumps	numn sunnly	Performance, Categorical	TRUF		(no numps = 1, difficultly available = 1.	Can be done by shoveling or with	VPS
Concrete_supply Performance, Categorical PRUE occurrence of discussive probable concrete in Concrete i	раттр_заррту	r criormance, categorica	11102	difficultly available		manual hand-held pumps. These latter	,
Concrete_soppy Performance, Categorical PULE pare_parts PPC, Categorical PULE pare_parts PPC, Categorical PULE pare_parts PPC, Categorical PULE pare parts PPC, Categorical PULE pare parts PPC, Categorical PULE pare parts PPC, Categorical PULE pare parts PPC, Categorical PULE pare parts PPC, Categorical PULE pare parts PPC, Categorical PULE pare parts PPC, Categorical PULE parts PPC, Categorical PULE				pumps			
officulty switched by Control 19 Control 1						large volumes.	
Spaine_parts POF, Categorical PULE simple control and simple control	concrete_supply	Performance, Categorical	TRUE			No concrete necessary	yes
technical special and experience with iscoally available in special and experience with iscoally available in special and experience of period with color of control and properly in special period with iscoally available in special and period with the color of period with the color of period with iscoally accepted with the color of period with iscoally accepted with the color of period with iscoally accepted with the color of period with iscoally accepted with the color of period with iscoally accepted with the color of period with iscoally accepted with the color of period with the color o				concrete			
Special Spec	spare_parts	PDF, Categorical	TRUE				yes
Compendum Comp				special		materials", " Some devices may	
Most devices on the built and repaired with lower-tent practices, some require with flower-tent practices, some require with flower-tent work flowers and repairs work with flower-tent with some services and repairs work working. MA							
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temperature Performance, Categorical MASE ever cold cold temperature processing and the cold temperature process and temperatu							
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with walking or driving a vehicle through a flood, Given so, the performance of this technology of survey reached for the category of Tiboding". A performance of 10% is allotted to the category of Tiboding". A performance of 10% is allotted to the category flooding of th		Parties and a control	TRUE	hot	(flooding=0.1 flooding	Thora is significant beautiful	Voc
through a flood. Given so, the performance of this technology is survely reduced for the category of "Flooding", Aperformance of 10% is allotted to the category "Flooding" given the possibility that the decluding time can be adjusted, and the service is performed after it is experimed after the decluding time can be adjusted, and the service is performed after it is experimed after it is experimed after it is experimed after it is experimed after it is experimed after it is experimed after it is experimed after it is experimed after it is experimed after it is experimed after it is experimed after it is experimed after it is experimed after it is experimed after it is experimed after it is experimed after it is experimed after it is experimed after it is experiment. When the control is experiment is experiment in the experiment in the experiment is experiment. When the control is experiment is experiment in the experiment in the experiment is experiment. When the control is experiment is experiment in the experiment in the experiment is experiment. When the control is experiment is experiment in the experiment is experiment. When the control is experiment is experiment. When the control is experiment is experiment. When the control is experiment is experiment. When the control is experiment is experiment. When the control is experiment is experiment. When the control is experiment. W	Tlooding	reriormance, Categorical	INUE		(1100ding=0.1, no 1100ding=1)	with walking or driving a vehicle	res
Surface Performance, Categorical FALSE And a continue FALSE						through a flood. Given so, the	
Flooding-A performance of 10% is allotted to the category "Flooding" given the possibility that the decluding time can be adjusted, and the service is performed after the flooding event is one and waters have receded, (Alanskha Jain) It is assumed that it is equally risky for human-powered transport and motorized transport and motorized transport and motorized transport and motorized transport and motorized transport and motorized transport and motorized transport and motorized transport and motorized transport and motorized transport and motorized transport and motorized transport and motorized transport and motorized transport and motorized transport and motorized transport and motorized transport and motorized transport and motorized transport to operate during flooding and therefore, all technologies related to the two are allotted same performance values. (Akanskha Jain) Vehicular_acces							
Bername Bern						"Flooding". A performance of 10% is	
desludging time can be adjusted, and the service is performed after the flooding event is over and waters have receded, (Ashisha ain) It is assumed that it is equally risky for human-powered transport and motorized transport to perate during flooding and therefore, all technologies related to the two are allotted same performance, called the two are allotted same performance values. Vericular_acces							
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Performance Congress TALE				skilled		or be constructed by a skilled		
Performance Congress TALE				professional		craftsman)"(Monyois et al. (2012))		
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						specialized dealer.		
	design_skills	Performance, Categorica	TRUE	Ladder:	(unskilled = 0.5, skilled = 1,	"Medium-level skills (a gulper can be	yes	
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printstood				skilled	ľ.			
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Performance, Categorical Titos Unable Unab						Requires moderate construction and		
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Projectional Professional Prof					/	et al. (2012))		
Control of Control o								
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O	0	C	FALSE	0	NA NA	NA	NA	
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				long (>5 years)				
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13 using buckets and showels, or 2 2) using a portable, manually				special		two ways:		
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torized Emptying and Trans							
		Data Source					
FUNCTIONAL GROUP	С						
UNIQUE IDENTIFIER (ID) I	motorized_emptying_solids		-				
	sludge, transferred_sludge,	Spuhler, D. & Roller, L. (2020)	-				
t	processed_sludge, pithumus,						
	dried_faeces, stabilized_sludge, stored_faeces, organics, compost,						
F	pellets, briquettes, biochar, ash]				
OUTPUT PRODUCT !	NA [Ifor SaniChoice, use x]	Spuhler, D. & Roller, L. (2020)					
RELATIONS I	Input: OR	Spuhler, D. & Roller, L. (2020)					
COMMENTS	Output: sludge > transferred_sludge >		-				
	Values	Data Source					
		Tilley, E. et al. (2014)					
	city = 0.5)						
management_level ((household = 0, shared = 0.5, public =	Tilley, E. et al. (2014)					
capex_req_level	1) 5	Spuhler, D. et al. (2021)	-				
opex_req_level	8	Spuhler, D. et al. (2021)	1				
technical_maturity		Tilley, E. et al. (2014)	-				
	(acute = 1, stabilisation = 1, development/recovery = 1)	Gensch, R. et al. (2018)					
		Applicable for this Functional Group?	Categories [Unit]	Technology Values (Data)	Data Source / Assumptions	Internal Review Done?	
water_supply	Performance, Categorical		house	NA	NA	NA	
			yard				
			public				
water_volume	Performance, Trapez	TRUE	none [L/cap/day]	(a = 0, b = 7, c = 999, d = 999)	"Depending on the Collection and	Yes	
water_volume	renormance, riapez		[2/20]/00/]	(4 - 5, 5 - 7, 5 - 333, 4 - 333)	Storage technology, the sludge can be		
					so dense that it cannot be easily		
					pumped. In these situations it is		
					necessary to thin the solids with water		
					so that they flow more easily, but this may be inefficient and costly."		
					(Compendium)		
					Given the above source, the optimal		
					minimum water requirement for this		
					technology was set by assuming that atleast pour-flush sytems should		
					ideally be present to generate a sludge		
					fluid enough to be pumped. A value of		
					"b"=7L/cap/day was calculated based		
					on the following assumptions: 7 toilet visits/person/day and 1L/flush for		
					pour flush tech (Compendium)		
					The minimum water requirement is		
					still kept at OL/cap/day assuming that		
					the water required to thin out the "too-solid" sludge can be found		
					locally, however, given the unit of		
					"L/capita/day" it may be too less to be		
					accountable.		
					Handling too high water volumes		
electricity_supply	Performance, Categorical	FALSE	electricity	NA	NA	NA	
			intermittent no electricity				
fuel_supply	Performance, Categorical	TRUE	fuel	(fuel = 1, no fuel = 0.1)	Pumping trucks rely on fuel for	yes	
	,		no fuel		operation, however they might also		
					be run with electricity or a manual		
					option could be possible though with a lot lower performance. To avoid		
					discarding technologies based on their		
					need for fuel, 10% is awarded for 'no		
£., .	AF	TOUT	 	(Investigation O. 1. C.)	fuel'.		
frequency_of_om	PDF, Categorical	IKUE	irregular regular	(irregular = 0, regular = 0.5, continuous = 0.5)	"Most pump trucks are manufactured in North America, Asia or Europe.	yes	
			continuous		Thus, in some regions it is difficult to		
					locate spare parts and a mechanic to		
					repair broken pumps or trucks. New		
					trucks are very expensive and sometimes difficult to obtain.		
					Therefore, older trucks are often used,		
					but the savings are offset by the		
			I.		resulting high maintenance and fuel		
				ii.		1	
					costs that can account for more than		
					two thirds of the total costs incurred		
					two thirds of the total costs incurred by a truck operator. Truck owners must be conscientious to save money for the purchase of expensive		
					two thirds of the total costs incurred by a truck operator. Truck owners must be conscientious to save money for the purchase of expensive replacement parts, tires and		
					two thirds of the total costs incurred by a truck operator. Truck owners must be conscientious to save money for the purchase of expensive replacement parts, tires and equipment. The lack of preventive		
					two thirds of the total costs incurred by a truck operator. Truck owners but to conscientious to save money for the purchase of expensive replacement parts, tires and equipment. The lack of preventive maintenance is often the cause for major repairs, ("Compendium)		
					two thirds of the total costs incurred by a truck operator. Truck owners must be conscientious to save money for the purchase of expensive replacement parts, tires and equipment. The lack of preventive maintenance is often the cause for major repairs." (Compendium) Pumping trucks require regular		
					two thirds of the total costs incurred by a truck operator. Truck owners must be conscientious to save money for the purchase of expensive replacement parts, tires and equipment. The lack of preventive maintenance is often the cause for major repairs." (Compendium) Pumping trucks require regular maintenance that can be quite time-individual control of the control		
					two thirds of the total costs incurred by a truck operator. Truck owners must be conscientious to save money for the purchase of expensive replacement parts, tires and equipment. The lack of preventive maintenance is often the cause for major repairs." (Compendium) Pumping trucks require regular		
pipe_supply	Performance, Categorical	TRUE	no pipes		wo thirds of the total costs incurred by a truck operator. Truck owners must be conscientious to save money for the purchase of expensive replacement parts, tires and equipment. The lack of preventive maintenance is often the cause for major repairs." (Compendium) Pumping trucks require regular maintenance that can be quite timeconsuming, almost continuous. No water pipes necessary for this	yes	
plpe_supply	Performance, Categorical	TRUE	difficultly available	(no pipes = 1, difficultly available = 1, pipes = 1)	two thirds of the total costs incurred by a truck operator. Truck owners must be conscientious to save money for the purchase of expensive replacement parts, tires and equipment. The lack of preventive maintenance is often the cause for major repairs." (Compendium) Pumping trucks require regular maintenance that can be quite time-consuming, almost continuous.	yes	
			difficultly available pipes	pipes = 1)	two thirds of the total costs incurred by a truck operator. Truck owners must be conscientious to save money for the purchase of expensive replacement parts, tires and equipment. The lack of preventive maintenance is often the cause for major repairs." (Compendium) Pumping trucks require regular maintenance that can be quite time-consuming, almost continuous. No water pipes necessary for this technology.		
pipe_supply pump_supply	Performance, Categorical Performance, Categorical		difficultly available pipes no pumps difficultly available		two thirds of the total costs incurred by a truck operator. Truck owners must be conscientious to save money for the purchase of expensive replacement parts, tires and equipment. The lack of preventive maintenance is often the cause for major repairs." (Compendium) Pumping trucks require regular maintenance that can be quite time-consuming, almost continuous. No water pipes necessary for this technology.	yes yes	
			difficultly available pipes no pumps	pipes = 1) (no pumps = 1, difficultly available = 1,	two thirds of the total costs incurred by a truck operator. Truck owners must be conscientious to save money for the purchase of expensive replacement parts, tires and equipment. The lack of preventive maintenance is often the cause for major repairs," (Compendium) Pumping trucks require regular maintenance that can be quite time-consuming, almost continuous. No water pipes necessary for this technology. The motorized pumping trucks contain an installed pump and are independent of the pumps covered by		
			difficultly available pipes no pumps difficultly available	pipes = 1) (no pumps = 1, difficultly available = 1,	two thirds of the total costs incurred by a truck operator. Truck owners must be conscientious to save money for the purchase of expensive replacement parts, tires and equipment. The lack of preventive maintenance is often the cause for major repairs." (Compendium) Pumping trucks require regular maintenance that can be quite time-consuming, almost continuous. No water pipes necessary for this technology. The motorized pumping trucks contain an installed pump and are independent of the pumps covered by pump supply. They usually cannot be		
			difficultly available pipes no pumps difficultly available	pipes = 1) (no pumps = 1, difficultly available = 1,	wo thirds of the total costs incurred by a truck operator. Truck owners must be conscientious to save money for the purchase of expensive replacement parts, tires and equipment. The lack of preventive maintenance is often the cause for major repairs." (Compendium) Pumping trucks require regular maintenance that can be quite time-consuming, almost continuous. No water pipes necessary for this technology. The motorized pumping trucks contain an installed pump and are independent of the pumps covered by pump supply. They usually cannot be replaced by a normal pump, but need		
pump_supply	Performance, Categorical	TRUE	difficultly available pipes no pumps difficultly available pumps	pipes = 1) (no pumps = 1, difficultly available = 1, pumps = 1)	two thirds of the total costs incurred by a truck operator. Truck owners must be conscientious to save money for the purchase of expensive replacement parts, tires and equipment. The lack of preventive maintenance is often the cause for major repairs." (Compendium) Pumping trucks require regular maintenance that can be quite time-consuming, almost continuous. No water pipes necessary for this technology. The motorized pumping trucks contain an installed pump and are independent of the pumps covered by pump supply. They usually cannot be replaced by a normal pump, but need special equipment for the trucks.	yes	
		TRUE	difficulty available pipes no pumps difficulty available pumps no concrete	pipes = 1) (no pumps = 1, difficultly available = 1, pumps = 1) (no concrete = 1, difficultly available =	two thirds of the total costs incurred by a truck operator. Truck owners must be conscientious to save money for the purchase of expensive replacement parts, tires and equipment. The lack of preventive maintenance is often the cause for major repairs." (Compendium) Pumping trucks require regular maintenance that can be quite time-consuming, almost continuous. No water pipes necessary for this technology. The motorized pumping trucks contain an installed pump and are independent of the pumps, covered by pump supply. They usually cannot be replaced by a normal pump, but need special equipment for the trucks. No concrete necessary for this		
pump_supply	Performance, Categorical	TRUE	difficulty available pipes no pumps difficulty available pumps no concrete difficulty available	pipes = 1) (no pumps = 1, difficultly available = 1, pumps = 1)	two thirds of the total costs incurred by a truck operator. Truck owners must be conscientious to save money for the purchase of expensive replacement parts, tires and equipment. The lack of preventive maintenance is often the cause for major repairs." (Compendium) Pumping trucks require regular maintenance that can be quite time-consuming, almost continuous. No water pipes necessary for this technology. The motorized pumping trucks contain an installed pump and are independent of the pumps covered by pump supply. They usually cannot be replaced by a normal pump, but need special equipment for the trucks.	yes	
pump_supply concrete_supply	Performance, Categorical Performance, Categorical	TRUE	difficulty available pipes no pumps difficulty available pumps no concrete difficulty available concrete	pipes = 1) (no pumps = 1, difficultly available = 1, pumps = 1) (no concrete = 1, difficultly available = 1, concrete = 1)	two thirds of the total costs incurred by a truck operator. Truck owners must be conscientious to save money for the purchase of expensive replacement parts, tires and equipment. The lack of preventive maintenance is often the cause for major repairs." (Compendium) Pumping trucks require regular maintenance that can be quite time-consuming, almost continuous. No water pipes necessary for this technology. The motorized pumping trucks contain an installed pump and are independent of the pumps covered by pump supply. They usually cannot be replaced by a normal pump, but need special equipment for the trucks. No concrete necessary for this technology.	yes	
pump_supply	Performance, Categorical	TRUE	difficulty available pipes no pumps difficulty available pumps no concrete difficulty available	pipes = 1) (no pumps = 1, difficultly available = 1, pumps = 1) (no concrete = 1, difficultly available =	two thirds of the total costs incurred by a truck operator. Truck owners must be conscientious to save money for the purchase of expensive replacement parts, tires and equipment. The lack of preventive maintenance is often the cause for major repairs." (Compendium) Pumping trucks require regular maintenance that can be quite time-consuming, almost continuous. No water pipes necessary for this technology. The motorized pumping trucks contain an installed pump and are independent of the pumps, covered by pump supply. They usually cannot be replaced by a normal pump, but need special equipment for the trucks. No concrete necessary for this	yes	
pump_supply concrete_supply	Performance, Categorical Performance, Categorical	TRUE	difficulty available pipes no pumps difficulty available pumps no concrete difficulty available concrete simple	pipes = 1) (no pumps = 1, difficultly available = 1, pumps = 1) (no concrete = 1, difficultly available = 1, concrete = 1) (simple = 0, technical = 0.5, special =	two thirds of the total costs incurred by a truck operator. Truck owners must be conscientious to save money for the purchase of expensive replacement parts, tires and equipment. The lack of preventive maintenance is often the cause for major repairs." (Compendium) Pumping trucks require regular maintenance that can be quite time-consuming, almost continuous. No water pipes necessary for this technology. The motorized pumping trucks contain an installed pump and are independent of the pumps covered by pump supply. They usually cannot be replaced by a normal pump, but need special equipment for the trucks. No concrete necessary for this technology. "Most pump trucks are manufactured in North America, Asia or Europe."	yes	
pump_supply concrete_supply	Performance, Categorical Performance, Categorical	TRUE	difficulty available pipes no pumps difficulty available pumps no concrete difficulty available concrete simple technical	pipes = 1) (no pumps = 1, difficultly available = 1, pumps = 1) (no concrete = 1, difficultly available = 1, concrete = 1) (simple = 0, technical = 0.5, special =	wo thirds of the total costs incurred by a truck operator. Truck owners must be conscientious to save money for the purchase of expensive replacement parts, tires and equipment. The lack of preventive maintenance is often the cause for major repairs." (Compendium) Pumping trucks require regular maintenance that can be quite time-consuming, almost continuous. No water pipes necessary for this technology. The motorized pumping trucks contain an installed pump and are independent of the pumps covered by pump supply. They usually cannot be replaced by a normal pump, but need special equipment for the trucks. No concrete necessary for this technology. "Most pump trucks are manufactured in North America, Asia or Europe. Thus, in some regions it is difficult to locate space parts and a mechanic to	yes	
pump_supply concrete_supply	Performance, Categorical Performance, Categorical	TRUE	difficulty available pipes no pumps difficulty available pumps no concrete difficulty available concrete simple technical	pipes = 1) (no pumps = 1, difficultly available = 1, pumps = 1) (no concrete = 1, difficultly available = 1, concrete = 1) (simple = 0, technical = 0.5, special =	two thirds of the total costs incurred by a truck operator. Truck owners must be conscientious to save money for the purchase of expensive replacement parts, tires and equipment. The lack of preventive maintenance is often the cause for major repairs." (Compendium) Pumping trucks require regular maintenance that can be quite time-consuming, almost continuous. No water pipes necessary for this technology. The motorized pumping trucks contain an installed pump and are independent of the pumps covered by pump supply. They usually cannot be replaced by a normal pump, but need special equipment for the trucks. No concrete necessary for this technology. "Most pump trucks are manufactured in North America, Asia or Europe. Thus, in some regions it is difficult to locate spare parts and a mechanic to locate spare parts and a mechanic to locate spare parts and a mechanic to repair broken pumps or trucks. Nee	yes	
pump_supply concrete_supply	Performance, Categorical Performance, Categorical	TRUE	difficulty available pipes no pumps difficulty available pumps no concrete difficulty available concrete simple technical	pipes = 1) (no pumps = 1, difficultly available = 1, pumps = 1) (no concrete = 1, difficultly available = 1, concrete = 1) (simple = 0, technical = 0.5, special =	wo thirds of the total costs incurred by a truck operator. Truck owners must be conscientious to save money for the purchase of expensive replacement parts, tires and equipment. The lack of preventive maintenance is often the cause for major repairs." (Compendium) Pumping trucks require regular maintenance that can be quite time-consuming, almost continuous. No water pipes necessary for this technology. The motorized pumping trucks contain an installed pump and are independent of the pumps covered by pump supply. They usually cannot be replaced by a normal pump, but need special equipment for the trucks. No concrete necessary for this technology. "Most pump trucks are manufactured in North America, Asia or Europe. Thus, in some regions it is difficult to locate spare parts and a mechanic to repair broken pumps or trucks. New trucks are very expensive and	yes	
pump_supply concrete_supply	Performance, Categorical Performance, Categorical	TRUE	difficulty available pipes no pumps difficulty available pumps no concrete difficulty available concrete simple technical	pipes = 1) (no pumps = 1, difficultly available = 1, pumps = 1) (no concrete = 1, difficultly available = 1, concrete = 1) (simple = 0, technical = 0.5, special =	wo thirds of the total costs incurred by a truck operator. Truck owners must be conscientious to save money for the purchase of expensive replacement parts, tires and equipment. The lack of preventive maintenance is often the cause for major repairs." (Compendium) Pumping trucks require regular maintenance that can be quite time-consuming, almost continuous. No water pipes necessary for this technology. The motorized pumping trucks contain an installed pump and are independent of the pumps covered by pump supply. They usually cannot be replaced by a normal pump, but need special equipment for the trucks. No concrete necessary for this technology. "Most pump trucks are manufactured in North America, Asis or Europe. Thus, in some regions it is difficult to locate spare parts and a mechanic to repair broken pumps or trucks. New trucks are very expensive and sometimes difficult to obtain."	yes	
pump_supply concrete_supply	Performance, Categorical Performance, Categorical	TRUE	difficulty available pipes no pumps difficulty available pumps no concrete difficulty available concrete simple technical	pipes = 1) (no pumps = 1, difficultly available = 1, pumps = 1) (no concrete = 1, difficultly available = 1, concrete = 1) (simple = 0, technical = 0.5, special =	wo thirds of the total costs incurred by a truck operator. Truck owners must be conscientious to save money for the purchase of expensive replacement parts, tires and equipment. The lack of preventive maintenance is often the cause for major repairs." (Compendium) Pumping trucks require regular maintenance to store the cause for major repairs." (Compendium) No water pipes necessary for this technology. The motorized pumping trucks contain an installed pump and are independent of the pumps covered by pump supply. They usually cannot be replaced by a normal pump, but need special equipment for the trucks. No concrete necessary for this technology. "Most pump trucks are manufactured in North America, Asis or Europe. Thus, in some regions it is difficult to locate spare parts and a mechanic to repair broken pumps or trucks. New trucks are very expensive and sometimes difficult to obtain." (Compendium)	yes	
pump_supply concrete_supply	Performance, Categorical Performance, Categorical	TRUE	difficulty available pipes no pumps difficulty available pumps no concrete difficulty available concrete simple technical	pipes = 1) (no pumps = 1, difficultly available = 1, pumps = 1) (no concrete = 1, difficultly available = 1, concrete = 1) (simple = 0, technical = 0.5, special =	wo thirds of the total costs incurred by a truck operator. Truck owners must be conscientious to save money for the purchase of expensive replacement parts, tires and equipment. The lack of preventive maintenance is often the cause for major repairs." (Compendium) Pumping trucks require regular maintenance that can be quite time-consuming, almost continuous. No water pipes necessary for this technology. The motorized pumping trucks contain an installed pump and are independent of the pumps covered by pump supply. They usually cannot be replaced by a normal pump, but need special equipment for the trucks. No concrete necessary for this technology. "Most pump trucks are manufactured in North America, Asia or Europe. Thus, in some regions it is difficult to locate spare parts and a mechanic to repair broken pumps or trucks. New trucks are very expensive and sometimes difficult to obtain." (Compendium) If something breaks, technical as well as possibly specially manufactured	yes	
pump_supply concrete_supply	Performance, Categorical Performance, Categorical	TRUE	difficulty available pipes no pumps difficulty available pumps no concrete difficulty available concrete simple technical	pipes = 1) (no pumps = 1, difficultly available = 1, pumps = 1) (no concrete = 1, difficultly available = 1, concrete = 1) (simple = 0, technical = 0.5, special =	wo thirds of the total costs incurred by a truck operator. Truck owners must be conscientious to save money for the purchase of expensive replacement parts, tires and equipment. The lack of preventive maintenance is often the cause for major repairs." (Compendium) Pumping trucks require regular maintenance that can be quite time-consuming, almost continuous. No water pipes necessary for this technology. The motorized pumping trucks contain an installed pump and are independent of the pumps covered by pump supply. They usually cannot be epicaced by a normal pump, but need special equipment for the trucks. No concrete necessary for this technology. "Most pump trucks are manufactured in North America, Asis or Europe. Thus, in some regions it is difficult to locate spare parts and a mechanic to repair broken pumps or trucks. New trucks are very expensive and sometimes difficult to obtain." (Compendium) It something breaks, technical as well as possibly specially manufactured as pare parts that are produced by the	yes	
pump_supply concrete_supply	Performance, Categorical Performance, Categorical	TRUE	difficulty available pipes no pumps difficulty available pumps no concrete difficulty available concrete simple technical	pipes = 1) (no pumps = 1, difficultly available = 1, pumps = 1) (no concrete = 1, difficultly available = 1, concrete = 1) (simple = 0, technical = 0.5, special =	wo thirds of the total costs incurred by a truck operator. Truck owners must be conscientious to save money for the purchase of expensive replacement parts, tires and equipment. The lack of preventive maintenance is often the cause for major repairs." (Compendium) Pumping trucks require regular maintenance that can be quite time-consuming, almost continuous. No water pipes necessary for this technology. The motorized pumping trucks contain an installed pump and are independent of the pumps covered by pump supply. They usually cannot be replaced by a normal pump, but need special equipment for the trucks. No concrete necessary for this technology. "Most pump trucks are manufactured in North America, Asia or Europe. Thus, in some regions it is difficult to locate spare parts and a mechanic to repair broken pumps or trucks. No smellines difficult to obtain." (Compendium) If something breaks, technical as well as possibly specially manufactured spare parts that are produced by the manufactured spare parts that are produced by the manufactured spare parts that are produced by the manufactured spare parts that are produced by the manufactured spare parts that are produced by the manufactured spare parts that are produced by the manufactured spare parts that are produced by the manufacturers, are necessary for this	yes	
pump_supply concrete_supply spare_parts	Performance, Categorical Performance, Categorical PDF, Categorical	TRUE TRUE	difficulty available pipes no pumps difficulty available pumps difficulty available pumps no concrete difficulty available concrete simple technical special	pipes = 1) (no pumps = 1, difficultly available = 1, pumps = 1) (no concrete = 1, difficultly available = 1, concrete = 1) (simple = 0, technical = 0.5, special = 0.5)	wo thirds of the total costs incurred by a truck operator. Truck owners must be conscientious to save money for the purchase of expensive replacement parts, tires and equipment. The lack of preventive maintenance is often the cause for major repairs." (Compendium) Pumping trucks require regular maintenance that can be quite time-consuming, almost continuous. No water pipes necessary for this technology. The motorized pumping trucks contain an installed pump and are independent of the pumps covered by pump supply. They usually cannot be replaced by a normal pump, but need special equipment for the trucks. No concrete necessary for this technology. "Most pump trucks are manufactured in North America, Asia or Europe. Thus, in some regions it is difficult to locate spare parts and a mechanic to locate spare parts and a mechanic to repair broken pumps or trucks. New trucks are very expensive and sometimes difficult to obtain." (Compendium) if something breaks, technical as well as possibly specially manufactured spare parts that are produced by the technology. NA	yes yes	
pump_supply concrete_supply spare_parts 0	Performance, Categorical Performance, Categorical PDF, Categorical	TRUE TRUE TRUE FALSE FALSE	difficulty available pipes no pumps difficulty available pumps no concrete difficulty available concrete simple technical special	pipes = 1) (no pumps = 1, difficultly available = 1, pumps = 1) (no concrete = 1, difficultly available = 1, concrete = 1), concrete = 1) (simple = 0, technical = 0.5, special = 0.5)	wo thirds of the total costs incurred by a truck operator. Truck owners must be conscientious to save money for the purchase of expensive replacement parts, tires and equipment. The lack of preventive maintenance is often the cause for major repairs." (Compendium) Pumping trucks require regular maintenance that can be quite time-consuming, almost continuous. No water pipes necessary for this technology. The motorized pumping trucks contain an installed pump and are independent of the pumps covered by pump supply. They usually cannot be replaced by a normal pump, but need special equipment for the trucks. No concrete necessary for this technology. "Most pump trucks are manufactured in North America, Asia or Europe. Thus, in some regions it is difficult to locate spare parts and a mechanic to repair broken pumps or trucks. New trucks are very expensive and sometimes difficult to obtain." (Compendium) if something breaks, technical as well as possibly specially manufactured spare parts that are produced by the manufacturerers, are necessary for this technology.	yes yes	
pump_supply concrete_supply spare_parts 0 0 0	Performance, Categorical Performance, Categorical PDF, Categorical 0 0	TRUE TRUE TRUE FALSE FALSE FALSE FALSE	difficulty available pipes no pumps difficulty available pumps difficulty available pumps no concrete difficulty available concrete simple technical special	pipes = 1) (no pumps = 1, difficultly available = 1, pumps = 1) (no concrete = 1, difficultly available = 1, concrete = 1), concrete = 1) (simple = 0, technical = 0.5, special = 0.5)	wo thirds of the total costs incurred by a truck operator. Truck owners must be conscientious to save money for the purchase of expensive replacement parts, tires and equipment. The lack of preventive maintenance is often the cause for major repairs." (Compendium) Pumping trucks require regular maintenance that can be quite time-consuming, almost continuous. No water pipes necessary for this technology. The motorized pumping trucks contain an installed pump and are independent of the pumps covered by pump supply. They usually cannot be replaced by a normal pump, but need special equipment for the trucks. No concrete necessary for this technology. "Most pump trucks are manufactured in North America, Asia or Europe. Thus, in some regions it is difficult to locate spare parts and a mechanic to locate spare parts and a mechanic to repair broken pumps or trucks. New trucks are very expensive and sometimes difficult to obtain." (Compendium) if something breaks, technical as well as possibly specially manufactured spare parts that are produced by the technology. NA	yes yes	
pump_supply concrete_supply spare_parts 0	Performance, Categorical Performance, Categorical PDF, Categorical	TRUE TRUE TRUE FALSE FALSE FALSE FALSE	difficulty available pipes no pumps difficulty available pumps difficulty available pumps no concrete difficulty available concrete simple technical special	pipes = 1) (no pumps = 1, difficultly available = 1, pumps = 1) (no concrete = 1, difficultly available = 1, concrete = 1) (simple = 0, technical = 0.5, special = 0.5)	wo thirds of the total costs incurred by a truck operator. Truck owners must be conscientious to save money for the purchase of expensive replacement parts, tires and equipment. The lack of preventive maintenance is often the cause for major repairs." (Compendium) Pumping trucks require regular maintenance to store the cause for major repairs." (Compendium) No water pipes necessary for this technology. The motorized pumping trucks contain an installed pump and are independent of the pumps covered by pump supply. They usually cannot be replaced by a normal pump, but need special equipment for the trucks. No concrete necessary for this technology. "Most pump trucks are manufactured in North America, Asis or Europe. Thus, in some regions it is difficult to locate spare parts and a mechanic to repair broken pumps or trucks. New trucks are very expensive and sometimes difficult to obtain." (Compendium) If something breaks, technical as well as possibly special my normal currers, are necessary for this technology. NA NA NA NA	yes yes yes NA	
pump_supply concrete_supply spare_parts 0 0 0	Performance, Categorical Performance, Categorical PDF, Categorical 0 0	TRUE TRUE TRUE FALSE FALSE FALSE FALSE	difficulty available pipes no pumps difficulty available pumps no concrete difficulty available concrete simple technical special	pipes = 1) (no pumps = 1, difficultly available = 1, pumps = 1) (no concrete = 1, difficultly available = 1, concrete = 1) (simple = 0, technical = 0.5, special = 0.5)	wo thirds of the total costs incurred by a truck operator. Truck owners must be conscientious to save money for the purchase of expensive replacement parts, tires and equipment. The lack of preventive maintenance is often the cause for major repairs." (Compendium) Pumping trucks require regular maintenance to store the cause for major repairs." (Compendium) No water pipes necessary for this technology. The motorized pumping trucks contain an installed pump and are independent of the pumps covered by pump supply. They usually cannot be replaced by a normal pump, but need special equipment for the trucks. No concrete necessary for this technology. "Most pump trucks are manufactured in North America, Asis or Europe. Thus, in some regions it is difficult to locate spare parts and a mechanic to repair broken pumps or trucks. New trucks are very expensive and sometimes difficult to obtain." (Compendium) If something breaks, technical as well as possibly special my normal currers, are necessary for this technology. NA NA NA NA	yes yes yes NA	

flooding flooding vehicular_acces	Performance, Categorical Performance, Categorical		Rooding no flooding	(flooding=0.1, no flooding=1)	with walking or driving a vehicle through a flood, Given so, the performance of this technology is surely reduced for the category of "Flooding". A performance of 10% is allotted to the category flooding given the possibility that the desludging time can be adjusted, and the service is performed after the flooding event is over and waters have receded. (Akanskha Jain) It is assumed that it is equally risky for human-powered transport and motorized transport to operate during flooding and therefore, all technologies related to the two are allotted same performance values. (Akanskha Jain)	Yes
_			difficult			
slope	Performance, Categorical	TRUE	full flat not flat	(flat = 1, not flat = 1)	Pumping trucks do not rely on a hydraulic gradient for conveyance - Maximum performance on every slope, however: "A very steep gradient can pose problems for vacuum trucks." (Monvois et al. 2012)	yes
soil_type	Performance, Categorical		clay	NA		NA
groundwater_depth	Performance, Trapez		silt sand gravel rock water depth [m]	NA .	NA	NA .
excavation	Performance, Categorical		easy	(easy = 1, hard = 1)	Pumping trucks do not need any kind	yes
surface_area_onsite	Performance, Trapez		[m2/plot]	NA Ty	of excavation digging - Maximum performance for every type	NA
curfofr '	pf=	ENICE	m2/nors	NA	NA	NA
surface_area_offsite 0	Performance, Trapez 0	FALSE	m2/pers 0	NA NA		NA NA
0	0	FALSE	0	NA	NA	NA
0	0	FALSE	0	NA	NA	NA
drinking_water_exposure	Performance, Categorical	FALSE	Close Not close	NA	NA	NA
0	0	FALSE		NA	NA	NA
0		FALSE		NA (unskilled = 0, skilled = 1, professional	NA	NA
design_skills	Performance, Categorical	TOLIS	professional Ladder:	(unskilled = 0, skilled = 1, professional	locate spare parts and a mechanic to regaler broken pumps or trucks. New trucks are very expensive and sometimes difficult to obtain. Therefore, older trucks are often used, but the savings are offset by the resulting high maintenance and fuel costs that can account for more than two thirds of the total costs incurred by a truck operator. Truck owners must be conscientious to save money for the purchase of expensive replacement parts, tires and equipment. The lack of preventive maintenance is often the cause for major repairs. (Compendium) Even though pumping trucks probably aren't constructed onsite, a skilled technician is necessary to maintain the truck. Construction and design skills are	yes
			unskilled skilled professional	= 1)	equivalent	
om_skills	Performance, Categorical		Ladder: Unskilled Skilled Professional	(unskilled = 0, skilled = 1, professional = 1)	"Truck owners must be conscientious to save money for the purchase of expensive replacement parts, tires and equipment. The lack of preventive maintenance is often the cause for major repairs." (Compendium) Mechanic skills are required	
0	0	FALSE		NA		NA
0		FALSE		NA NA		NA NA
0		FALSE FALSE		NA NA		NA NA
cleansing_method	Performance, Categorical	FALSE	Washers Soft wipers Hard wipers	NA	NA	NA
0		FALSE		NA		NA
0 lifetime	Performance, Categorical		short (< 1 year) medium (1-5 years) long (>5 years)	NA NA	NA	NA NA
speed_implement_toilet	PDF, Categorical		rapid (< 3 days) moderate (3 days to 2 weeks) slow (> 2 weeks)	NA		NA
speed_implement_treatment	PDF, Categorical		rapid (few days to a week) moderate (few weeks up to three months) slow (> 3 months)	NA		NA
scalability	Performance, Categorical	IKUE	easy difficult	(easy = 1, difficult = 1)	The emptying can be scaled-up by buying more trucks or using the existing ones more frequently. (Kukka Ilmanen, Eawag 2021)	yes

construction_parts	PDF, Categorical	TRUE	simple	(simple = 0, technical = 0.3, special =	"Most pump trucks are manufactured	yes	
			technical	0.7)	in North America, Asia or Europe.		
			special		Thus, in some regions it is difficult to		
					locate spare parts and a mechanic to		
					repair broken pumps or trucks. New		
					trucks are very expensive and		
					sometimes difficult to obtain."		
					(Compendium)		
					"The required materials – a vehicle, a		
					tank and a pump – are usually		
					available locally. Second-hand trucks		
					are often used, which can reduce		
					costs but often also reduce		
					efficiency.", "Not all parts and		
					materials may be locally available"		
					(Emersan)		
					To get pump trucks one can either add		
					pumps to a truck or buy specially-		
					manufactured pumping tracks. The		
					latter are used more often, so that		
					specially-manufactured parts are		
					more likely to be required.		
Transfer Coefficients	(copied from "Sanitation_Technologies_TC_database_202	210622.xlsm")					
Transfer coefficients	x	Range	Airloss		more likely to be required. Waterloss		Reference
TP	X 0.98	Range -	Airloss 0		more likely to be required. Waterloss 0.02		Reference PA
Transfer coefficients	X 0.98 0.98	Range -	Airloss 0		more likely to be required. Waterloss	-	PA -
TP med (R)	X 0.98 0.98 100	Range -	0	Soilloss 0	more likely to be required. Waterloss 0.02 0.02		PA - PA
TP med (R)	X 0.98 0.98 100 0.96	Range -	0 0 - 0.02	Soilloss 0 0	more likely to be required. Waterloss 0.02 0.02	-	PA -
TP med (R)	X 0.98 0.98 100 0.96	Range -	0	Soilloss 0 0	more likely to be required. Waterloss 0.02 0.02	* Ammonia volatilization	PA - PA Udert et al. (2006) - PA - PA - PA - PA - PA - PA - PA - P
TP med (R) k TN med (R) k	X 0.98 0.98 100 0.99 0.96	Range	0.02 0.02	Soilloss 0 0 0 0 0	more likely to be required. Waterloss 0.02 0.02 0.02	* Ammonia volatilization	PA - PA Udert et al. (2006) - PA
TP med (R) k TN med (R) k + H2O	X 0.98 0.98 100 0.96 100 0.96 100 0.97 0.97 0.97 0.97 0.97 0.97 0.97 0.	Range	0 0 0.02 0.02	Soilloss	more likely to be required. Waterloss 0.02 0.02 0.02 0.02 0.02	* Ammonia volatilization	PA - PA Udert et al. (2006) - PA - PA - PA - PA - PA - PA - PA - P
TP med (R) k TN med (R) k	X 0.98 0.98 100 0.96 100 0.96 100 0.97 0.97 0.97 0.97 0.97	Range	0.02 0.02	Soilloss	more likely to be required. Waterloss 0.02 0.02 0.02	* Ammonia volatilization	PA
TP med (R) k TN med (R) (R) (R) (R) (R) (R) (R) (R) (R) (R)	X 0.98 0.98 100 0.96 0.96 0.96 0.96 0.96 0.96 0.96 0.	Range	0 0 0.02 0.02	Soilloss	Materioss 0.02 0.02 0.02 0.02 0.02 0.02 0.02 0.	* Ammonia volatilization	PA
TP med (R) & &	X 0.98 0.98 100 0.96 100 0.96 0.96 100 0.97 0.97 100 0.96 0.97 100 0.97 100 0.98 100 0.97 100 0.98 100	Range	0 0 0.02 0.02	Soilloss	more likely to be required. Waterloss 0.02 0.02 0.02 0.02 0.02 0.02 0.02 0	* Ammonia volatilization	PA
TP med (R) k TN med (R) (R) (R) (R) (R) (R) (R) (R) (R) (R)	X 0.98 0.98 100 0.96 0.96 0.96 100 0.97 0.97 0.97	Range	0 0 0.02 0.02	Soilloss	Materioss 0.02 0.02 0.02 0.02 0.02 0.02 0.02 0.	* Ammonia volatilization	PA
TP med (R) & &	X 0.98 0.98 100 0.96 100 0.96 0.96 100 0.97 0.97 100 0.96 0.97 100 0.97 100 0.98 100 0.97 100 0.98 100	Range	0 0 0.02 0.02	Soilloss	more likely to be required. Waterloss 0.02 0.02 0.02 0.02 0.02 0.02 0.02 0	* Ammonia volatilization	PA

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### Company of the Co							
Month Mont		Values	Data Source				
### Description Company	UNIQUE IDENTIFIER (ID)	human-powered_emptying_solids	-				
Control of Control o	DATA COMPILER	Julian Fritzsche sludge, transferred_sludge, processed_sludge, pithumus, dried_faccs, stabilized_sludge, stored_faccs, organics, compost,	- Spuhler, D. & Roller, L. (2020)				
Column C	OUTPUT PRODUCT RELATIONS	NA [Ifor SaniChoice, use x] Input: OR Output: sludge > transferred_sludge > processed_sludge > pithumus >					
Management Man		stored_faeces > organics > compost >					
Security Column Processing Column Security	COMMENTS						
Process Proc							
		city = 0)					
Separate Separate							
Manual Part 1997	opex_req_level	5	Spuhler, D. et al. (2021)				
March Part		(acute = 1, stabilisation = 1,					
well or well and the second of	eening Criteria		Applicable for this Functional Group?	Categories [Unit]	Technology Values (Data)	Data Source / Assumptions	Internal Review Done?
were _ dans	water supply	Performance, Categorical	FALSE	house	NA	NA	NA
works within the Performance Traps (PEE) Adapted 1 11 11 11 11 11 11 11 11 11 11 11 11				yard			
Septiments of the control of the con			TOUS	none	/- 0 b 0 - 000 l		V
Administration of the control of the	water_volume	Performance, Trapez	TRUE	[L/cap/day]	(a = 0, b = 0, c = 999, d = 999)	vaults and tanks can be done in one of two ways: 1) using buckets and shovels, or 2) using a portable, manually operated pump" (Compendium) if the sludge is too thick/Soild, it is possible manually shovel it. Therefore, unlike motorized transport (where pumping is must), an optimal water requirement (value "b") need not be defined for human-powered transport. Although handling too high water volumes is not ideal for this	Yes
International Content						aspect, and a default value of 999U/cap/day is still assumed (Desludging frequency can always be increased to handle large volumes). (Akanksha Jain) Note: Technologies "Motorized transport dry" and "Human powered transport dry" were filled in conjunction, and their TechCase attribute values should be looked at together.	
for the proper performance, Cotegorical TRUE (build be the property of the pro	electricity_supply	renormance, categorical	PALSE	intermittent	NA .	NA .	IVA
frequency_of_con PDF, Categorical TRUE regular continuous PDF (Setegorical TRUE regular continuous regular regular continuous regular regular continuous regular re	fuel_supply	Performance, Categorical	TRUE	fuel	(fuel = 1, no fuel = 1)	No fuel is required.	yes
pump_supply Performance, Categorical TRUE pump_supply Performance, Categorical TRUE pump_supply Performance, Categorical TRUE pump_supply Performance, Categorical TRUE pump_supply pump_s				irregular regular continuous	= 0)	require daily maintenance (cleaning, repairing and disinfection). Workers who manually empty latrines should clean and maintain their protective clothing and tools to prevent contact with the sludge." (Compendium) Regular maintenance is necessary to maintain hygienic requirements.	
pump_supty Performance, Categorical TRUE	pipe_supply	Performance, Categorical	TRUE			No pipes are required.	yes
concrete_supply Performance, Categorical TRUE spare_parts PDF, Categorical TRUE spare_parts PDF, Categorical TRUE spare_parts PDF, Categorical TRUE special special poetal poetal spare_parts PDF, Categorical TRUE special spe	pump_supply	Performance, Categorical	TRUE	pipes no pumps difficultly available	(no pumps = 1, difficultly available = 1,	manual hand-held pumps. These latter manual pumps are not included in pump supply, as they cannot handle	yes
Spare_parts PDF, Categorical TRUE simple technical special (simple = 0.7, technical = 0.3, special = capability of technical specia	concrete_supply	Performance, Categorical	TRUE	difficultly available		No concrete necessary	yes
O FALSE O NA NA NA NA Temperature Performance, Categorical FALSE very cold cold temperate warm Not Flooding Performance, Categorical TRUE Flooding (flooding=0.1, no flooding=1) There is significant hazard associated with walking or driving a vehicle through a flood. Given so, the performance of the technology is surely reduced for the category of "Flooding", a performance of 10% is allotted to the category of "Flooding", a performance of 10% is allotted to the category of "Flooding", a performance of 10% is allotted to the category of "Flooding", a performance of 10% is allotted to the category of "Flooding", a performance of 10% is allotted to the category of "Flooding", a performance of 10% is allotted to the category of "Flooding", a performance of 10% is allotted to the category of "Flooding", a performance of 10% is allotted to the category of "Flooding", a performance of 10% is allotted to the category of "Flooding", a performance of 10% is allotted to the category of "Flooding", a performance of 10% is allotted to the category of "Flooding", a performance of 10% is allotted to the category of "Flooding", a performance of 10% is allotted to the category of "Flooding", a performance of 10% is allotted to the category of "Flooding", a performance of 10% is allotted to the category of "Flooding", a performance of 10% is allotted to the category of "Flooding", a performance of 10% is allotted to the category of "Flooding", a performance value of the performan				simple technical special	0)	repaired with locally available materials", "Some devices may require specialized repair (welding)" (Compendium) Most devices can be built and repaired with low-tech materials. Some require more technical repair such as welding.	
temperature Performance, Categorical FALSE very cold cold temperate warm hot flooding Performance, Categorical TRUE flooding Performance, Categorical TRUE flooding no flooding no flooding flooding	0	0	FALSE	0	NA	NA	NA
flooding Performance, Categorical TRUE Rooding				very cold			
no flooding with walking or driving a vehicle through a flood. Given so, the performance of this technology is surely reduced for the category of "Flooding", A performance of 10% is allotted to the category "Flooding" given the possibility that the desludging time can be adjusted, and the service is performed after the flooding went is over and waters have receded. (Akanksha Jain) It is assumed that it is equally risky for human-powered transport and motorized transport to operate during flooding and therefore, all technologies related to the two are allotted same performance values. (Akanksha Jain) vehicular_acces Performance, Categorical FALSE no access official to the category "Flooding" given the possibility that the desludging time can be adjusted, and the effect of flooding and therefore, all technologies related to the two are allotted same performance values. (Akanksha Jain) NA NA NA NA NA NA NA NA NA N				cold temperate warm hot			
vehicular_acces Performance, Categorical FALSE no access difficult full slope Performance, Categorical TRUE flat (flat = 1, not flat = 1) Does not rely on a hydraulic gradient. yes	flooding	Performance, Categorical	INUE		(nooding=0.1, no flooding=1)	with walking or driving a vehicle through a flood. Given so, the performance of this technology is surely reduced for the category of "flooding." A performance of 10% is allotted to the category "Flooding," given the possibility that the desludging time can be adjusted, and the service is performed after the flooding event is over and waters have receded. (Akanksha Jain) that is equally risky for human-powered transport and motorized transport to operate during flooding and therefore, all technologies related to the two are allotted same performance values.	Yes
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	slope	Performance, Categorical	TRUE		(flat = 1, not flat = 1)	Does not rely on a hydraulic gradient.	yes

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Part								
Part Part								
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March Marc								
Soliton Professor Profes	excavation	renormance, categorical	INGE		(easy = 1, naid = 1)	No need for excavation.	yes	
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1	surface area offsite	Performance Transz	FAISE	m2/ners	NΔ	NΔ	NΔ	
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Marie								
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O O O O O O O O O O			<u> </u>		1	not require special skills.	<u> </u>	
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moderate (few weeks up to three month)								
scalability Performance, Categorical TRUE any difficult (easy = 1, difficult = 1) any difficult (sample = 1, technical = 0, special = 0) thorough and aniso can be done in one or of the complex properties of the business and conducting more emptying of pits, volume and raises can be done in one or of the ways: "Insuran powered emptying of pits, volume and raises can be done in one or of the ways: "Insuran powered emptying of pits, volume and raises can be done in one or of the ways: "Insuran powered emptying of pits, volume and raises can be done in one or of the ways: "Insuran powered emptying of pits, volume and raises can be done in one or of the ways: "Insuran powered emptying of pits, volume and raises can be done in one or of the ways: "Insurant powered emptying of pits, volume and raises can be done in one or of the ways: "Insurant powered emptying of pits, volume and raises can be done in one or of the ways: "Insurant powered emptying of pits, volume and raises can be done in one or of the college, read of pits, the pits participated showing, or control was purpose and hard volves in a volume purpose can be built and volves in a volume purpose can be built and volves in a volume purpose can be to cally made with seter fook and volves in a volume purpose can be to cally made with seter fook and volves in a volume purpose and hard volves in a volume purpose and hard volves in a volume purpose and hard volves in a volume purpose and hard volves in a volume purpose and hard volves in a volume purpose and hard volves in a volume purpose and hard volves in a volume purpose and hard volves in a volume purpose and hard volves in a volume purpose and hard volves in a volume purpose and hard volves in a volume purpose and hard volves in a volume purpose and hard volume purpose and hard volume purpose and hard volume purpose and hard volume purpose and hard volume purpose and hard volume purpose and hard volume purpose and hard volume purpose and hard volume purpose and hard volume purpose and hard volume purpos	peed_implement_treatment	PDF, Categorical	FALSE		NA	NA	ING.	
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Construction_parts POF, Categorical TNUE Simple Construction Constructi				moderate (few weeks up to three months) slow (> 3 months) easy		The emptying can be scaled-up by scaling-up the business and		
## Coefficients International Coefficients Septical Septica				moderate (few weeks up to three months) slow (> 3 months) easy		The emptying can be scaled-up by scaling-up the business and conducting more emptying. (Kukka		
Special Downward Special Downward Special Downward Special Downward Special	scalability	Performance, Categorical	TRUE	moderate (few weeks up to three months) slow (> 3 months) easy difficult	(easy = 1, difficult = 1)	The emptying can be scaled-up by scaling-up the business and conducting more emptying. (Kukka Ilmanen, Eawag 2021)	yes	
31 Justing buckets and showls, or 2 Justing a protection, manually operated pump specially designed for studge (e.g., the dioley, the Rammer, the MUHP or the MAPET)."	scalability	Performance, Categorical	TRUE	moderate (few weeks up to three months) slow (> 3 months) easy difficult simple	(easy = 1, difficult = 1)	The emptying can be scaled-up by scaling-up the business and conducting more emptying. (Kukka limanen, Eawag 2021) "Human-powered emptying of pits,	yes	
2) using a portable, manually operated young specially designed for studge (e.g., the Gulper, the Rammer, the MOHP or the MAPET).* (Compendium) Simple hand pumps can be built and repaired with bically validable material such in bically validable material such 1 Hard pumps can be will and repaired with bically validable material such in bically validable material such in bically validable material such in a see and PVC pales. Prediction is also possible. For some pumps, additional piping is needed. Other tools such as buckets and shores should be available locally." (Emerant) Overall, buckets, showed and some shores should be available locally." (Emerant) Overall, buckets, showed and some shores should be available locally." (Emerant) Overall, buckets, showed and some shores should be available locally." (Emerant) Overall, buckets, showed and some shores should be available locally." (Emerant) Overall, buckets, showed and some shores should be available locally." (Emerant) Overall, buckets, showed and some shores should be available locally." (Emerant) Overall, buckets, showed and some shores should be available locally." (Emerant) Overall, buckets, showed and some shores should be available locally." (Emerant) Overall, buckets, showed and some shores should be available locally." (Emerant) Overall, buckets, showed and some shores should be available locally." (Emerant) Overall, buckets, showed and some shores should be available locally." (Emerant) Overall, buckets, showed and some shores should be available locally." (Emerant) Overall, buckets, showed and some shores should be available locally." (Emerant) Overall, buckets, showed and some shores should be available locally." (Emerant) Overall, buckets, showed and showed should be available locally." (Emerant) Overall, buckets, showed and showed should be available locally." (Emerant) Overall, buckets, showed and showed should be available locally." (Emerant) Overall, buckets, showed and showed showed showed showed s	scalability	Performance, Categorical	TRUE	moderate (few weeks up to three months) slow (> 3 months) easy difficult simple technical	(easy = 1, difficult = 1)	The emptying can be scaled-up by scaling-up the business and conducting more emptying. (Kukka limanen, Eawag 2021) "Human-powered emptying of pits,	yes	
Operated pump specially designed for sludge (e.g., the Gulper, the Rammer, the MMPFD or the MAPET)." Comprendium)	scalability	Performance, Categorical	TRUE	moderate (few weeks up to three months) slow (> 3 months) easy difficult simple technical	(easy = 1, difficult = 1)	The emptying can be scaled-up by scaling-up the business and conducting more emptying. (Kukka Ilmanen, Eawag 2021) Human-powered emptying of pits, vaults and tanks can be done in one of	yes	
Sudge (e.g., the Culper, the Rammer, the MMPer of the AMPERT?" (Compendium)	scalability	Performance, Categorical	TRUE	moderate (few weeks up to three months) slow (> 3 months) easy difficult simple technical	(easy = 1, difficult = 1)	The emptying can be scaled-up by scaling-up the business and conducting more emptying, (Kukka limanen, Eawag 2021) "Human-powered emptying of pits, vaults and tanks can be done in one of two ways:	yes	
### Table 1 Table 2 Ta	scalability	Performance, Categorical	TRUE	moderate (few weeks up to three months) slow (> 3 months) easy difficult simple technical	(easy = 1, difficult = 1)	The emptying can be scaled-up by scaling-up the business and conducting more emptying. (Kukka limanen, Eawag 2021) "Human-powered emptying of pits, vaults and tanks can be done in one of two ways: Ju using buckets and shovels, or	yes	
### Table 1 Table 2 Ta	scalability	Performance, Categorical	TRUE	moderate (few weeks up to three months) slow (> 3 months) easy difficult simple technical	(easy = 1, difficult = 1)	The emptying can be scaled-up by scaling-up the business and conducting more emptying. (Kukka limanen, Eawag 2021) "Human-powered emptying of pits, vaults and tanks can be done in one of two ways: 1) using buckets and shovels, or 2) using a portable, manually	yes	
Compendum	scalability	Performance, Categorical	TRUE	moderate (few weeks up to three months) slow (> 3 months) easy difficult simple technical	(easy = 1, difficult = 1)	The emptying can be scaled-up by scaling-up the business and conducting more emptying. (Kukka limanen, Eawag 2021) "Human-powered emptying of pits, vaults and tanks can be done in one of two ways: 1) using buckets and shovets, or 2) using a portable, manually operated pump specially designed for	yes	
Simple hand gumps can be built and repaired with food and values in a PVC casing. "Compendium! are received and values in a PVC casing." (Compendium! are received using locally made with set ords and values in a PVC casing. "Compendium! are received using locally available materials. [] Hand gumps and hand car's can often be constructed using locally available material such as steel and PVC pipes. Predatrication is also possible. For some gumps, additional piping is needed. Other tools such as buckets and shoves should be available locally. "Emersan] Overall, buckets, browle and some simple pumps can be built locally. Tamsfer Coefficients X	scalability	Performance, Categorical	TRUE	moderate (few weeks up to three months) slow (> 3 months) easy difficult simple technical	(easy = 1, difficult = 1)	The emptying can be scaled-up by scaling-up the business and conducting more emptying. (Kukka limanen, Eawag 2021) "Human powered emptying of pits, vaults and tanks can be done in one of two ways: 1) using buckets and shovels, or 2) using a portable, manually operated pump specially designed for sludge (e.g., the Gulper, the Rammer,	yes	
Repaired with focally available materials	scalability	Performance, Categorical	TRUE	moderate (few weeks up to three months) slow (> 3 months) easy difficult simple technical	(easy = 1, difficult = 1)	The emptying can be scaled-up by scaling-up the business and conducting more emptying. (Kukka limanen, Eawag 2021) "Human-powered emptying of pits, vaults and tanks can be done in one of two ways: 1) using buckets and showels, or 2) using a portable, manually operated pump specially designed for sludge (e.g., the Guijper, the Rammer, the MDHP or the MAPET)."	yes	
materials Hand pumps can be locally made with steet roofs and valves in a PVC casing." (Compendium)	scalability	Performance, Categorical	TRUE	moderate (few weeks up to three months) slow (> 3 months) easy difficult simple technical	(easy = 1, difficult = 1)	The emptying can be scaled-up by scaling-up the business and conducting more emptying. (Kukka limanen, Eawag 2021) "Human-powered emptying of pits, vaults and tanks can be done in one of two ways: 1) using buckets and shoveks, or 2) using a portable, manually operated pump specially designed for sludge (e.g., the Guiper, the Rammer, the MDHP or the MAPET)."	yes	
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"In principle, hand pumps and hand carts can often be constructed using locally available material such as steel and PVC pipes. Prefabrication is also possible. For some pumps, additional piping is needed. Other tools such as buckets and shoveds should be available locally." (Emersan) Variable locally." (Emersan) Variable locally."	scalability	Performance, Categorical	TRUE	moderate (few weeks up to three months) slow (> 3 months) easy difficult simple technical	(easy = 1, difficult = 1)	The emptying can be scaled-up by scaling-up the business and conducting more emptying. (Kukka limanen, Eawag 2021) "Humanen, Dewag 2021) "Humanen, Dewag 2021) "Humanen, Dewag 2021) "Humanen, Dewag 2021) "Humanen, Dewag 2021) "Humanen, Dewag 2021) "Humanen, Dewag 2021) "Humanen, Dewag 2021) "Humanen, Dewag 2021) "Humanen, Dewag 2021) "Humanen, Dewag 2021, Dewag 202	yes	
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	scalability	Performance, Categorical	TRUE	moderate (few weeks up to three months) slow (> 3 months) easy difficult simple technical	(easy = 1, difficult = 1)	The emptying can be scaled-up by scaling-up the business and conducting more emptying. (Kukka limanen, Eawag 2021) "Human-powered emptying of pits, vaults and tanks can be done in one of two ways: 1) using buckets and shovets, or 2) using a portable, manually operated pump specially designed for studge (e.g., the Guiper, the Rammer, the MDHP or the MAPET)." (Compendium) "Simple hand pumps can be built and repaired with locally available materials. [] Hand pumps can be locally made with steel rods and valves in a PVC casing." (Compendium)	yes	
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	scalability	Performance, Categorical	TRUE	moderate (few weeks up to three months) slow (> 3 months) easy difficult simple technical	(easy = 1, difficult = 1)	The emptying can be scaled-up by scaling-up the business and conducting more emptying. (Kukka limanen, Eawag 2021) "Human-powered emptying of pits, vaults and tanks can be done in one of two ways: 1) using uportable, manually operated pump specially designed for study get age. The Guilden of the Guilden o	yes	
buckets and shovels should be available locally. ("Emersan) Overall, buckets, shovels and some simple pumps can be built locally.	scalability	Performance, Categorical	TRUE	moderate (few weeks up to three months) slow (> 3 months) easy difficult simple technical	(easy = 1, difficult = 1)	The emptying can be scaled-up by scaling-up the business and conducting more emptying. (Kukka limanen, Eawag 2021) "Human-powered emptying of pits, vaults and tanks can be done in one of two ways: 1) using buckets and shovets, or 2) using a portable, manually operated pump specially designed for studge (e.g., the Guiper, the Rammer, the MDHP or the MAPET). "Simple hand pumps can be built and repaired with locally vailable materials. [] Hand pumps can be locally made with steel rods and valves in a PVC casing." (Compendium) "in principle, hand pumps and hand carts can often be constructed using locally available materials such as steel foods and valves in a PVC casing." (Femplement with the constructed using locally available materials such as steel and PVC pipes. Prefabrication is also	yes	
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ransfer Coefficients X Range Airloss Soilloss Waterloss Comments Reference	scalability	Performance, Categorical	TRUE	moderate (few weeks up to three months) slow (> 3 months) easy difficult simple technical	(easy = 1, difficult = 1)	The emptying can be scaled-up by scaling-up the business and conducting more emptying. (Rukka limanen, Eawag 2021) "Human-powered emptying of pits, vaults and tanks can be done in one of two ways: 1) using buckets and showels, or 2) using a portable, manually operated pump specially designed for sludge (e.g., the Gulper, the Rammer, the MDHP or the MAPET). (Compendium) "Simple hand pumps can be built and repaired with locally available materials. [] Hand pumps can be locally made with steel rods and valves in a PVC casing." (Compendium) In principle, hand pumps and hand carts can often be constructed using locally available materials us has steel and PVC pipes. Prefabrication is also possible. For some pumps, additional piping is needed. Other tools such as buckets and shovels should be available locally." ("Emersan)	yes	
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Name Name	scalability	Performance, Categorical	TRUE	moderate (few weeks up to three months) slow (> 3 months) easy difficult simple technical	(easy = 1, difficult = 1)	The emptying can be scaled-up by scaling-up the business and conducting more emptying. (Kukka limanen, Eawag 2021) "Human-powered emptying of pits, vaults and tanks can be done in one of two ways: "Jusing a bortable, manually operated pump specially designed for studge (e.g., the Guiper, the Rammer, the MDHP or the MAPET)." (Compendium) "Simple hand pumps can be built and repaired with locally available materials. [] Hand pumps can be locally made with steel rods and valves in a PVC casing." (Compendium) "In principle, hand pumps and hand carts can often be constructed using locally available material such as steel and PVC pipes. Prefabrication is also possible. For some pumps, additional pping is needed. Other tools such as buckets and shoveds should be available locally." (Emersan)	yes	
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Name Name	scalability construction_parts	Performance, Categorical PDF, Categorical	TRUE	moderate (few weeks up to three months) slow (> 3 months) easy difficult simple technical	(easy = 1, difficult = 1)	The emptying can be scaled-up by scaling-up the business and conducting more emptying. (Kukka limanen, Eawag 2021) "Human-powered emptying of pits, vaults and tanks can be done in one of two ways: "Jusing a bortable, manually operated pump specially designed for studge (e.g., the Guiper, the Rammer, the MDHP or the Kupler, the Rammer, the MDHP or the MAPET)." (Compendium) "Simple hand pumps can be built and repaired with locally available materials. [] Hand pumps can be locally made with steel rods and valves in a PVC casing." (Compendium) "In principle, hand pumps and hand carts can often be constructed using locally available material such as steel and PVC pipes. Prefabrication is also possible. For some pumps, additional pping is needed. Other tools such as buckets and shoveds should be available locally." (Emersan)	yes	
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med (R) 0.95 0.02 0 0.02 - k 100 - - - - PA HZO 0.97 - 0.01 0 0.02 PA med (R) 0.97 - 0.01 0 0.02 - - k 100 - - - PA TS 0.98 - 0 0 0.02 PA med (R) 0.98 - 0 0 0.02 - PA k 100 - - - PA	scalability construction_parts construction_parts	Performance, Categorical PDF, Categorical PDF, Categorical Consideration_Technologies_TC_database_201 (0.98	TRUE TRUE TRUE TRUE Range	moderate (few weeks up to three months) slow (> 3 months) easy difficult simple technical special	(easy = 1, difficult = 1) (simple = 1, technical = 0, special = 0)	The emptying can be scaled-up by scaling-up the business and conducting more emptying. (Kukka limanen, Eawag 2021) "Human-powered emptying of pits, vaults and tanks can be done in one of two ways: 1) using buckets and showels, or 2) using a portable, manually operated pump specially designed for sludge (e.g., the Gulper, the Rammer, the MDHP or the MAPET). (Compendium) "Simple hand pumps can be built and repaired with locally available materials. [] Hand pumps can be locally available materials. [] Hand pumps and hand carts can often be constructed using locally available materials uch as steel may available locally available materials uch as steel piping is needed. Other tools such as buckets and showels should be available locally. ("Emersan) Overall, buckets, shovels and some simple pumps can be built locally.	yes	PA -
k 100 - - PA HD 0.97 - 0.01 0 0.02 PA med (R) 0.97 - 0.01 0 0.02 - k 100 - - - PA T5 0.98 - 0 0 0.02 PA med (R) 0.98 - 0 0 0.02 - PA k 100 - - - PA	construction_parts construction_parts ransfer Coefficients TP med (R)	Performance, Categorical PDF, Categorical PDF, Categorical O 58 0 58	TRUE TRUE TRUE TRUE Range	moderate (few weeks up to three months) slow (o. 3 months) easy difficult simple technical special	(easy = 1, difficult = 1) (simple = 1, technical = 0, special = 0) Soilloss	The emptying can be scaled-up by scaling-up the business and conducting more emptying. (Rukka limanen, Eawag 2021) "Human-powered emptying of pits, "Human-powered emptying of pits, vaults and tanks can be done in one of two ways: 1) using buckets and showels, or 2) using a portable, manually operated pump specially designed for sludge (e.g., the Gulper, the Rammer, the MDHP or the KAPET)." (Compendium) "Simple hand pumps can be built and repaired with locally available materials. [] Hand pumps can be locally made with steel rods and valves in a PVC casing." (Compendium) 1) principle, hand pumps and hand carts can often be constructed using locally available materials such as steel and PVC pipes. Prefabrication is also possible. For some pumps, additional piping is needed. Other tools such as buckets and showels should be available locally." (Femersan) Overall, buckets, shovels and some simple pumps can be built locally.	yes	PA - PA
H2O 0.97 - 0.01 0 0.02 PA Med (R) 0.97 - 0.01 0 0.02 ### 100 - 0.02 PA PA 101 - 0.05 PA PA 102 PA PA Med (R) 0.98 - 0 0 0 0.02 PA #### 100 PA #### 100 PA #### 100 PA PA PA PA	scalability construction_parts construction_parts private to the second of the seco	Performance, Categorical PDF, Categorical PDF, Categorical PDF, Categorical O 98 O 98 O 98	TRUE TRUE TRUE TRUE A series of the seri	moderate (few weeks up to three months) slow (> 3 months) easy difficult simple technical special	(easy = 1, difficult = 1) (simple = 1, technical = 0, special = 0) Soilloss	The emptying can be scaled-up by scaling-up the business and conducting more emptying. (Kukka limanen, Eawag 2021) "Human-powered emptying of pits, vaults and tanks can be done in one of two ways: 1) using buckets and shovels, or 2) using a portable, manually operated pump specially designed for studge (e.g., the Gulper, the Rammer, the MDHP or the Kulper, the Rammer, the MDHP or the MAPET). "Simple hand pumps can be built and repaired with locally available materials. [] Hand pumps can be locally made with steel rods and valves in a PVC casing." (Compendium) "in principle, hand pumps and hand carts can often be constructed using locally available material such as steel and PVC pipes. Prefabrication is also possible. For some pumps, additional piping is needed. Other tools such as buckets and shoveds should be available locally." (Emersan) Ocarall, buckets, shovels and some simple pumps can be built locally. Waterloss 0.02	yes yes Comments * Ammonia volatilization	PA - PA
med (R) 0.97 0.01 0 0.02 - k 100 - - - PA T5 0.98 - 0 0 0.02 PA med (R) 0.98 - 0 0 0.02 - - k 100 - - - - PA	construction_parts construction_parts construction_parts ransfer Coefficients TP med (R) TN med (R)	Performance, Categorical PDF, Categorical PDF, Categorical Copied from "Sentation" Technologies, TC_Gittbase, 200 G. 986 0.986 0.96 0.96	TRUE TRUE TRUE TRUE Ange Ange	moderate (few weeks up to three months) slow (> 3 months) easy difficult simple technical special	(easy = 1, difficult = 1) (simple = 1, technical = 0, special = 0) Soilloss	The emptying can be scaled-up by scaling-up the business and conducting more emptying. (Kukka limanen, Eawag 2021) "Human-powered emptying of pits, vaults and tanks can be done in one of two ways: 1) using buckets and shovels, or 2) using a portable, manually operated pump specially designed for studge (e.g., the Gulper, the Rammer, the MDHP or the Kulper, the Rammer, the MDHP or the MAPET). "Simple hand pumps can be built and repaired with locally available materials. [] Hand pumps can be locally made with steel rods and valves in a PVC casing." (Compendium) "in principle, hand pumps and hand carts can often be constructed using locally available material such as steel and PVC pipes. Prefabrication is also possible. For some pumps, additional piping is needed. Other tools such as buckets and shoveds should be available locally." (Emersan) Ocarall, buckets, shovels and some simple pumps can be built locally. Waterloss 0.02	yes yes Comments * Ammonia volatilization	PA - PA Udert et al. (2006) -
k 100 - - - PA 15 0.98 - 0 0 0.02 PA med (R) 0.98 - 0 0 0.02 - k 100 - - - PA	scalability construction_parts construction_parts 7 TP med (R) A TMN med (R)	Performance, Categorical PDF, Categorical PDF, Categorical PDF, Categorical O 38 O 38 O 38 O 38 O 396 O 396	TRUE TRUE TRUE TRUE TRUE	moderate (few weeks up to three months) slow (> 3 months) easy difficult simple technical special	(easy = 1, difficult = 1) (simple = 1, technical = 0, special = 0)	The emptying can be scaled-up by scaling-up the business and conducting more emptying. (Kukka limanen, Eawag 2021) "Human-powered emptying of pits, vaults and tanks can be done in one of two ways: 1) using buckets and shovets, or 2) using a portable, manually operated pump specially designed for studge (e.g., the Gulper, the Rammer, the MDHP or the Kulper, the Rammer, the MDHP or the MAPET). (Compendium) "Simple hand pumps can be built and repaired with locally available materials, [] Hand pumps can be locally made with steel rods and valves in a PVC casing." (Compendium) "In principle, hand pumps and hand carts can often be constructed using locally available materials such as steel and PVC pipes. Perfabrication is also possible. For some pumps, additional piping is needed. Other tools such as buckets and shovels should be available locally." (Emersan) Overall, buckets, shovels and some simple pumps can be built locally. Waterloss 0.002 0.02	yes Yes Camments Ammonia volatilization	PA
TS 0.38 - 0 0 0.02 PA med (R) 0.38 - 0 0 0.02 - - k 100 - - - - PA	construction_parts construction_parts construction_parts TP med (R) TN med (R) H2O H2O	Performance, Categorical PDF, Categorical PDF, Categorical PDF, Categorical Open Communication Technologies TC detabase 201 Open Com	TRUE TRUE TRUE TRUE	moderate (few weeks up to three months) slow (> 3 months) easy difficult simple technical special Airloss	(easy = 1, difficult = 1)	The emptying can be scaled-up by scaling-up the business and conducting more emptying. (Kukka limanen, Eawag 2021) "Human-powered emptying of pits, vaults and tanks can be done in one of two ways: 1) using buckets and shovets, or 2) using a portable, manually operated pump specially designed for studge (e.g., the Gulper, the Rammer, the MDHP or the MAPET)." (Compendium) "Simple hand pumps can be built and repaired with locally available materials]. Hand pumps can be locally made with steel rods and values in a PVC casing." (Compendium) "In principle, hand pumps and hand carts can often be constructed using locally available material such as steel and PVC pipes. Prefabrication is also possible. For some pumps, additional piping is needed. Other tools such as buckets and shovels should be available locally." (Emersan) Overall, buckets, shovels and some simple pumps can be built locally. Waterloss 0.02 0.02 0.02	yes Yes Comments * Ammonia volatilization	PA PA Udert et al. (2006) PA
med (R) 0.38 0 0 0.02 - k 100 - - - - PA	construction_parts construction_parts construction_parts TP med (R) TN med (R) H2O H2O	Performance, Categorical PDF, Categorical PDF, Categorical PDF, Categorical OSS OSS OSS OSS OSS OSS OSS OSS OSS O	TRUE TRUE TRUE TRUE Range	moderate (few weeks up to three months) slow (> 3 months) easy difficult simple technical special Airloss	(easy = 1, difficult = 1)	The emptying can be scaled-up by scaling-up the business and conducting more emptying. (Kukka limanen, Eawag 2021) "Human-powered emptying of pits, vaults and tanks can be done in one of two ways: 1) using buckets and shovets, or 2) using a portable, manually operated pump specially designed for studge (e.g., the Gulper, the Rammer, the MDHP or the MAPET)." (Compendium) "Simple hand pumps can be built and repaired with locally available materials]. Hand pumps can be locally made with steel rods and values in a PVC casing." (Compendium) "In principle, hand pumps and hand carts can often be constructed using locally available material such as steel and PVC pipes. Prefabrication is also possible. For some pumps, additional piping is needed. Other tools such as buckets and shovels should be available locally." (Emersan) Overall, buckets, shovels and some simple pumps can be built locally. Waterloss 0.02 0.02 0.02	yes Yes Comments * Ammonia volatilization	PA - PA Udert et al. (2006) - PA - PA - PA - PA - PA - PA - PA - P
k 100 PA	construction_parts construction_parts construction_parts ransfer Coefficients TP med (R) K TN med (R) L20 med (R)	Performance, Categorical PDF, Categorica	TRUE TRUE TRUE Range	Airloss Airloss Airloss Airloss	(easy = 1, difficult = 1) (simple = 1, technical = 0, special = 0) Soilloss C C C C C C C C C C C C	The emptying can be scaled-up by scaling-up the business and conducting more emptying. (Kukka limanen, Eawag 2021) "Human-powered emptying of pits, vaults and tanks can be done in one of two ways: 1) using buckets and shovets, or 2) using a portable, manually operated pump specially designed for studge (e.g., the Gulper, the Rammer, the MDHP or the MAPET)." (Compendium) "simple hand pumps can be built and repaired with locally available materials. [] Hand pumps can be locally made with steel rods and valves in a PVC casing." (Compendium) "in principle, hand pumps and hand carts can often be constructed using locally available material such as steel and PVC pipes. Prefabrication is also possible. For some pumps, additional piping is needed. Other tools such as buckets and shoves should be available locally." (Emersan) Overall, buckets, shovels and some simple pumps can be built locally. Waterloss 0.02 0.02 0.02	yes yes Comments * Ammonia volatilization	PA
	construction_parts construction_parts construction_parts y TP med (R) k TN med (R) H200 med (R) k TS	Performance, Categorical PDF, Categorical PDF, Categorical PDF, Categorical Open Company Com	TRUE TRUE TRUE TRUE TRUE	Airloss Airloss 0.0 0.0 0.0	(easy = 1, difficult = 1) (simple = 1, technical = 0, special = 0) Soilloss 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	The emptying can be scaled-up by scaling-up the business and conducting more emptying. (Kukka Ilmanen, Eawag 2021) "Human-powered emptying of pits, vaults and tanks can be done in one of two ways: 1) using buckets and shoveks, or 2) using a portable, manually operated pump specially designed for sludge (e.g., the Guiper, the Rammer, the MDHP or the MAPET)." (Compendium) "Simple hand pumps can be built and repaired with locally available materials. [] Hand pumps can be locally made with steel rods and valves in a PVC casing." (Compendium) "In principle, hand pumps and hand carts can often be constructed using locally available materials uch as steel and PVC pipes. Prefabrication is also possible. For some pumps, additional and PVC pipes. Prefabrication is also possible. For some pumps, additional piping is needed. Other tools such as buckets and shovels should be available locally." ("Emersan) Overall, buckets, shovels and some simple pumps can be built locally. Waterloss 0.02 0.02 0.02 0.02 0.02 0.02	yes yes Comments * Annonia volatilization	PA
	construction_parts construction_parts construction_parts y TP med (R) k TN med (R) H200 med (R) k TS	Performance, Categorical PDF, Categorica	TRUE TRUE TRUE TRUE TRUE	Airloss Airloss 0.0 0.0 0.0	(easy = 1, difficult = 1) (simple = 1, technical = 0, special = 0) Soilloss 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	The emptying can be scaled-up by scaling-up the business and conducting more emptying. (Kukka Ilmanen, Eawag 2021) "Human-powered emptying of pits, vaults and tanks can be done in one of two ways: 1) using buckets and shoveks, or 2) using a portable, manually operated pump specially designed for sludge (e.g., the Guiper, the Rammer, the MDHP or the MAPET)." (Compendium) "Simple hand pumps can be built and repaired with locally available materials. [] Hand pumps can be locally made with steel rods and valves in a PVC casing." (Compendium) "In principle, hand pumps and hand carts can often be constructed using locally available materials uch as steel and PVC pipes. Prefabrication is also possible. For some pumps, additional and PVC pipes. Prefabrication is also possible. For some pumps, additional piping is needed. Other tools such as buckets and shovels should be available locally." ("Emersan) Overall, buckets, shovels and some simple pumps can be built locally. Waterloss 0.02 0.02 0.02 0.02 0.02 0.02	yes Yes Comments * Ammonia volatilization	PA
eferences	construction_parts construction_parts construction_parts y TP med (R) k TN med (R) H200 med (R) k TS	Performance, Categorical PDF, Categorica	TRUE TRUE TRUE TRUE TRUE	Airloss Airloss 0.0 0.0 0.0	(easy = 1, difficult = 1) (simple = 1, technical = 0, special = 0) Soilloss 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	The emptying can be scaled-up by scaling-up the business and conducting more emptying. (Kukka Ilmanen, Eawag 2021) "Human-powered emptying of pits, vaults and tanks can be done in one of two ways: 1) using buckets and shoveks, or 2) using a portable, manually operated pump specially designed for sludge (e.g., the Guiper, the Rammer, the MDHP or the MAPET)." (Compendium) "Simple hand pumps can be built and repaired with locally available materials. [] Hand pumps can be locally made with steel rods and valves in a PVC casing." (Compendium) "In principle, hand pumps and hand carts can often be constructed using locally available materials uch as steel and PVC pipes. Prefabrication is also possible. For some pumps, additional and PVC pipes. Prefabrication is also possible. For some pumps, additional piping is needed. Other tools such as buckets and shovels should be available locally." ("Emersan) Overall, buckets, shovels and some simple pumps can be built locally. Waterloss 0.02 0.02 0.02 0.02 0.02 0.02	yes Yes Comments * Ammonia volatilization	PA

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						<u> </u>	
	/alues	Data Source					
FUNCTIONAL GROUP C							
UNIQUE IDENTIFIER (ID) co	onventional_sewer ulian Fritzsche						
INPUT PRODUCT bl	lackwater, effluent, greywater,	Spuhler, D. & Roller, L. (2020)					
	econdary_effluent, stormwater IA [Ifor SaniChoice, use x]	Spuhler, D. & Roller, L. (2020)					
RELATIONS In	nput: OR	Spuhler, D. & Roller, L. (2020)					
COMMENTS	Output: blackwater > effluent >						
ilter Criteria Va		Data Source					
	household = 0, neighbourhood = 0.5, ity = 1)	Tilley, E. et al. (2014)					
	household = 0, shared = 0, public = 1)	Tilley, E. et al. (2014)					
		Spuhler, D. et al. (2021)					
capex_req_level opex_req_level	8	Spuhler, D. et al. (2021)					
technical_maturity	acute = 0, stabilisation = 0.5,	Tilley, E. et al. (2014) Gensch, R. et al. (2018)					
de	levelopment/recovery = 1)						
ning Criteria Ty	ype and Function Performance, Categorical	Applicable for this Functional Group?		Technology Values (Data)	Data Source / Assumptions NA	Internal Review Done?	
water_supply	renormance, Categorical	INUE	house yard	no.	DO.	ING.	
			public				
water_volume	Performance, Trapez	TRUE	none [L/cap/day]	(a = 50, b = 100, c = 999, d = 999)	"The sewer must be designed, however, so that	Yes	
	,				it maintains self-cleansing velocity (i.e., a flow		
					that will not allow particles to accumulate). For typical sewer diameters, a minimum velocity of		
					0.6 to 0.7 m/s during peak dry weather		
					conditions should be adopted. This requires a		
					daily water consumption rate of more than 100 L per person per day."		
					"Local drinking water consumption is at least		
					50L/person/day (this varies according to the gradient and diameter of the network)."		
					(Monvois et al. (2012))		
					Based on the above two sources and values, a		
					min. water requirement was set at 50L/cap/day		
					and an optimal water requirement was set at		
					100L/cap/day. (Akanksha Jain) An upper bound to how much water the sewers		
					can handle is not considered here, as this is		
					more a design aspect. Note: Performance values of all sewer		
					technologies (Conventional-Simplified-		
					SolidsFree) are filled together, in accordance with each other and should be viewed together.		
					cacii odiei anu siloulu be viewed together.		
electricity_supply	Performance, Categorical	FALSE	electricity intermittent	NA	NA	NA	
			no electricity				
fuel_supply	Performance, Categorical	TRUE	fuel	(fuel = 1, no fuel = 1)	A sewer does not rely on fuel for operation.	yes	
frequency_of_om	PDF, Categorical	TRUE	no fuel irregular	(irregular = 0.3, regular = 0.7,	"Manholes are used for routine inspection and	yes	
	.,		regular	continuous = 0)	sewer cleaning. Debris (e.g., grit, sticks or rags)		
			continuous		may accumulate in the manholes and block the lines. To avoid clogging caused by grease, it is		
					important to inform the users about proper oil		
					and grease disposal. Common cleaning methods for conventional gravity sewers include rodding,		
					flushing, jetting and bailing. Sewers can be		
					dangerous because of toxic gases and should be		
					maintained only by professionals, although, in well-organised communities, the maintenance		
					of tertiary networks might be handed over to a		
					well-trained group of community members. Proper protection should always be used when		
					entering a sewer." (Compendium)		
					Proper and regular maintenance is required.		
					However, maintenance is only required for routine inspections or in the event of blocking.		
pipe_supply	Performance, Categorical	IKUÉ	no pipes difficultly available	(no pipes = 0, difficultly available = 0.5, pipes = 1)	" Commonly used materials are concrete, PVC, ar	yes	
			pipes				
pump_supply	Performance, Categorical	TRUE	no pumps difficultly available	(no pumps = 0.5, difficultly available =	"A constant downhill gradient must be	yes	
			difficultly available pumps	0.75, pumps = 1)	guaranteed along the length of the sewer to maintain self-cleansing flows, which can require		
					deep excavations. When a downhill grade		
					cannot be maintained, a pumping station must be installed." (Compendium)		
					It depends on the local slope distribution if		
					pumps are necessary or not. We therefore, set the performance for no pumps to 0.5 and for		
					difficultly available to 0.75. Also check the		
					comments of the attribute "electricity supply"		
concrete_supply	Performance, Categorical	TRUE	no concrete	(no concrete = 1, difficultly available =	and "slope" " Commonly used materials are concrete, PVC, ar	yes	
/			difficultly available	1, concrete = 1)			
spare_parts	PDF, Categorical	TRUE	concrete simple	(simple = 0.8, technical = 0.2, special =	Besides pipes, concrete or material for	yes	
	.,		technical	0)	manholes, no technical spare parts are required.		
			special		Concrete and pipes are already covered in the attributes above. However, special tools might		
					be necessary to repair sewer systems, therefore		
					some technical parts might be necessary.		
		FALSE	0	NA	NA	NA	
0	0	FALSE				NA	
0	0	FALSE	0	NA	NA NA		
0	0	FALSE FALSE	0	NA NA NA	NA NA	NA NA	
0	0	FALSE FALSE	0 0 very cold cold	NA	NA	NA	
0	0	FALSE FALSE	0 0 very cold	NA	NA	NA	

flooding flooding vehicular_acces	Performance, Categorical Performance, Categorical Performance, Categorical	FALSE	flooding no flooding no access difficult full flat not flat	(flooding=0.9, no flooding=1) NA (flat = 0.2, not flat = 1)	flooding events. They are built to be leak proof and designed to handled certain amount of storm water and/or groundwater infiltration. However, in reality of course their performance can be hampered during flooding events. A 10% reduction in performance in considered for Conventional Gravity Sewers, I.e. Flooding is allotted a performance of 90%. This is because they can comparitively handle large volumes and are better equipped to deal with flooding than simplified or solids free sewers (both of which are allotted a performance of 80%) (Akanksha Jain) Note: Performance values of all sewer technologies (Conventional-Simplified-Solidisfree) are filled together, in accordance with each other and should be viewed together. NA "A constant downhill gradient must be guaranteed along the length of the sewer to maintain self-cleansing flows, which can require deep excavations." (Compendium) A slope steeper than 1% is recommended	Yes NA yes	
soil_type	Performance, Categorical	FALSE	clay	NA NA	(Monvois et al. 2012). However, if the slope is less than 1%, a conventional gravity sewer can still be used with pumps. Also check attribute "pumps" and "electricity supply" NA	NA .	
			sand gravel rock				
groundwater_depth	Performance, Trapez		water depth [m]	NA		NA	
excavation	Performance, Categorical		easy hard	(easy = 1, hard = 0.25)	"Requires deep excavations" (Compendium)Deep	yes	
surface_area_onsite	Performance, Trapez	FALSE	[m2/plot]	NA	NA	NA	
surface_area_offsite	Performance, Trapez		m2/pers	NA		NA NA	
0	0	FALSE FALSE	0	NA NA		NA NA	
0 drinking_water_exposure	0 Performance, Categorical	FALSE	Close	NA NA	NA NA	NA NA	
drinking_water_exposure			Not close				
0		FALSE FALSE		NA NA		NA NA	
construction_skills	Performance, Categorical		Ladder:	(unskilled = 0, skilled = 0, professional	"Planning, construction, operation and	yes	
			unskilled skilled	= 1)	maintenance require expert knowledge. " (Compendium)		
design_skills	Performance, Categorical	TRUE	professional Ladder: unskilled skilled professional	(unskilled = 0, skilled = 0, professional = 1)	"Planning, construction, operation and maintenance require expert knowledge." (Compendium)	yes	
om_skills	Performance, Categorical	TRUE	Ladder: Unskilled Skilled	(unskilled = 0, skilled = 0, professional = 1)	"Planning, construction, operation and maintenance require expert knowledge." (Compendium)	yes	
0	0	FALSE	Professional 0	NA	NA .	NA	
0		FALSE FALSE	0	NA NA	NA	NA NA	
0	0	FALSE	0	NA	NA	NA	
cleansing_method	Performance, Categorical	FALSE	Washers Soft wipers	NA	NA	NA	
0	0	FALSE	Hard wipers 0	NA	NA .	NA	
0 lifetime	0 Performance, Categorical	FALSE	short (< 1 year)	NA NA	NA NA	NA NA	
medine	renormance, categorical	TABL	medium (1-5 years) long (>5 years)	NA.	no.	NA.	
speed_implement_toilet	PDF, Categorical	FALSE	rapid (< 3 days) moderate (3 days to 2 weeks) slow (> 2 weeks)	NA	NA	NA	
speed_implement_treatment	PDF, Categorical		rapid (few days to a week) moderate (few weeks up to three months) slow (> 3 months)	NA	NA	NA	
scalability	Performance, Categorical		easy difficult	(easy = 1, difficult = 0.3)	changes and grows" (Emersan) A sewer network can be expensive and difficult to construct especially below existing infrastructure. Therefore, it is possible but difficult to extend the sewer network.	yes	
construction_parts	PDF, Categorical		simple technical special	(simple = 0.6, technical = 0.4, special = 0)	"Commonly used materials are concrete, PVC, vitrified clay and duttile or cast-iron pipes. Excavation requires an excavator or numerous workers with shovels, depending on soil properties." (Emersan) Mostly a sewer system consists of pipes, which are assumed to be simple locally available parts. Technical parts might be required for machinery to excavate or pumps in areas with low gradient.	yes	
Transfer Coefficients	(copied from "Sanitation_Technologies_TC_database_202 X	10622.xism*) Range	Airloss	Soilloss	Waterloss	Comments	Reference
TP	0.9	-	0	0.1		* PA based on H2O, assuming P in	PA PA
med (R)	0.90		0	0.10	0	particulate form is contained in solids	-
k TN	5 0.85		0.05	0.1		*PA based on H2O	PA PA
med (R)	0.85		0.05				-
k H2O	<u>5</u> 0.8		- 0	0.2	0	*Italy	PA Howard (2007)
	0.95	-	0	0.05	0	*Germany	Reynolds and Barrett (2003)
	0.95		0			*UK	Howard (2007)
med (R)	0.70		0			* PA for developing countries	PA -
k TS	5	[0.25]	-	-		*PA based on H2O	PA PA
med (R)	0.90	-	0				
k	5		-				Spuhler et al. (2021)
References							

References

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lified Sewer	Values	Data Source					
FUNCTIONAL GROUP	С	-					
UNIQUE IDENTIFIER (ID) DATA COMPILER	simplified_sewer SaniChoice Project Team	-					
INPUT PRODUCT	blackwater, effluent, greywater,	Tilley, E. et al. (2014)					
	secondary_effluent NA [Ifor SaniChoice, use x]	Tilley, E. et al. (2014)					
RELATIONS		Tilley, E. et al. (2014)					
COMMENTS	Output: blackwater > effluent >						
ilter Criteria	Values	Data Source					
applicability_level	(household = 0, neighbourhood = 1, city = 0.5)	Tilley, E. et al. (2014)					
management_level	(household = 0.5, shared = 1, public =	Tilley, E. et al. (2014)					
capex_req_level	1)	Spuhler, D. et al. (2021)					
opex_req_level		Spuhler, D. et al. (2021)					
technical_maturity		Tilley, E. et al. (2014)					
	(acute = 0, stabilisation = 0.5, development/recovery = 1)	Gensch, R. et al. (2018)					
	Type and Function	Applicable for this Functional Group?		Technology Values (Data)	Data Source / Assumptions	Internal Review Done?	
water_supply	Performance, Categorical	FALSE	house yard	NA	NA	NA	
			public				
water_volume	Performance, Trapez	TRUE	none [L/cap/day]	(a = 40, b = 60, c = 999, d=999)	"Local drinking water consumption is at least	Ves	
water_volume	r criormance, rrapez	THOSE .	[2] Cap/ ad y j	(4 - 40, 5 - 60, 5 - 555, 6-555)	40 to 50L/person/day (this varies according		
					to the gradient and diameter of the		
					network)." (Monvois et al. (2012)) "They should be considered		
					as an option where there is a sufficient		
					population density (about 150 people per		
					hectare) and a reliable water supply (at least 60 L/person/day)." (Compendium)		
					Based on the above two sources and values, a min. water requirement was set at		
					40L/cap/day and an optimal water		
					requirement was set at 60L/cap/day.		
					(Akanksha Jain) An upper bound to how much water the		
					sewers can handle is not considered here, as		
					this is more a design aspect.		
					Note: Performance values of all sewer technologies (Conventional-Simplified-		
					SolidsFree) are filled together, in accordance		
					with each other and should be viewed		
electricity_supply	Performance, Categorica	FALSE	electricity	NA	together. NA	NA	
			intermittent				
fuel_supply	Performance, Categorical	TRUE	no electricity fuel	(fuel = 1, no fuel = 1)	No fuel required.	ves	
ruel_supply			no fuel			,	
frequency_of_om	PDF, Categorical	TRUE	irregular	(irregular = 0, regular = 0.7,	"Requires repairs and removals of blockages	yes	
			regular continuous	continuous = 0.3)	more frequently than a Conventional Gravity Sewer", "Alternatively, a private contractor		
					or users committee can be hired to do the		
					maintenance." (Compendium) Maintenance can extend to a full time job		
pipe_supply	Performance, Categorica	TRUE	no pipes	(no pipes = 0, difficultly available =	Maintenance can extend to a full time job. Pipes are required. However, the pipes have a	yes	
			difficultly available	0.5, pipes = 1)	, , , , , , , , , , , , , , , , , , , ,		
Mariable P. Marian C.	Parforman C-t	TDITE	pipes	(no numns = 0.5 difficults 11-b.)	In some cases numerica stations	vec	
pump_supply	Performance, Categorical	INUE	no pumps difficultly available	(no pumps = 0.5, difficultly available = 0.75, pumps = 1)	In some cases pumping stations are necessary (if gradient not sufficient)	yes	
			pumps		(Monvois et al. (2012)).		
concrete_supply	Performance, Categorical	TRUE	no concrete	(no concrete = 1, difficultly available =	No concrete is needed.	yes	
		<u> </u>	difficultly available concrete	1, concrete = 1)			
spare_parts	PDF, Categorical	TRUE	simple			yes	
			technical special	0)	technical spare parts are required. Pipes are already covered in the attribute		
					"PIPE.SUPPLY". However, special tools might		
					be necessary to repair sewer systems,		
					therefore some technical parts might be necessary.		
0		FALSE		NA	NA	NA	
0		FALSE FALSE	0	NA NA	NA NA	NA NA	
temperature	Performance, Categorical		very cold	NA NA	NA NA	NA NA	
			cold				
			temperate warm				
			hot				
flooding	Performance, Categorica	TRUE	flooding	(flooding=0.8, no flooding=1)	Ideally, sewers should be unaffected by	Yes	
			no flooding		ongoing flooding events. They are built to be leak proof and designed to handle a certain		
					amount of storm water and/or groundwater		
					infiltration. However, in reality ofcourse their		
					performance can be hampered during flooding events. A 20% reduction in		
					performance in considered for Simplified		
					Sewers and Solids free sewers, i.e. Flooding is		
					allotted a performance of 80%. This is because they can comparitively handle lesser		
					volumes than conventional gravity sewers		
					(which are better equipped to deal with		
					flooding than these technologies, e.g. combined sewers) (Akanksha Jain)		
					Note: Performance values of all sewer		
	1				technologies (Conventional-Simplified-		
		i e			SolidsFree) are filled together, in accordance with each other and should be viewed		
				1			
					together.		
vehicular acces	Performance Categorical	FALSE	no access	NA .		NA	
vehicular_acces	Performance, Categorical	FALSE	no access difficult	NA	NA	NA NA	
			difficult full		NA .		
vehicular_acces	Performance, Categorical Performance, Categorical		difficult full flat	NA (flat = 0.5, not flat = 1)	NA "A gradient of 0.5% is usually sufficient."	NA yes	
			difficult full		NA "A gradient of 0.5% is usually sufficient." ((Compendium) Monvois et al. (2012) recommend a		
			difficult full flat		NA "A gradient of 0.5% is usually sufficient." (Compendium) Morvois et al. (2012) recommend a minimum gradient of 1% to let the		
			difficult full flat		NA "A gradient of 0.5% is usually sufficient." ((Compendium) Monvois et al. (2012) recommend a		
			difficult full flat		NA "A gradient of 0.5% is usually sufficient." (Compendium) Monvois et al. (2012) recommend a minimum gradient of 1% to let the wastewater flow. The performance for flat areas is therefore 0.5. However, further calculations have to be carried out to		
			difficult full flat		NA "A gradient of 0.5% is usually sufficient." (Compendium) Monvois et al. (2012) recommend a minimum gradient of 1% to let the wastewater flow. The performance for flat areas is therefore 0.5. However, further calculations have to be carried out to evaluate the efficiency of a simplified sewer		
slope	Performance, Categorical	TRUE	difficult full flat		NA "A gradient of 0.5% is usually sufficient." (Compendium) Monvois et al. (2012) recommend a minimum gradient of 1% to let the wastewater flow. The performance for flat areas is therefore 0.5. However, further calculations have to be carried out to		
		TRUE	difficult full flat not flat clay sit	(flat = 0.5, not flat = 1)	NA "A gradient of 0.5% is usually sufficient." (Compendium) Monvois et al. (2012) recommend a minimum gradient of 1% to let the wastewater flow. The performance for flat areas is therefore 0.5. However, further calculations have to be carried out to be evaluate the efficiency of a simplified sever system.	yes	
slope	Performance, Categorical	TRUE	difficult full flat not flat clay silt sand	(flat = 0.5, not flat = 1)	NA "A gradient of 0.5% is usually sufficient." (Compendium) Monvois et al. (2012) recommend a minimum gradient of 1% to let the wastewater flow. The performance for flat areas is therefore 0.5. However, further calculations have to be carried out to be evaluate the efficiency of a simplified sever system.	yes	
slope	Performance, Categorical	TRUE	difficult full full full clay silt sand gravel	(flat = 0.5, not flat = 1)	NA "A gradient of 0.5% is usually sufficient." (Compendium) Monvois et al. (2012) recommend a minimum gradient of 1% to let the wastewater flow. The performance for flat areas is therefore 0.5. However, further calculations have to be carried out to be evaluate the efficiency of a simplified sever system.	yes	
slope soil_type groundwater_depth	Performance, Categorical Performance, Categorical Performance, Trapez	TRUE FALSE	difficult full flat not flat clay silt sand gravel rock water depth [m]	(flat = 0.5, not flat = 1) NA NA	NA "A gradient of 0.5% is usually sufficient." (Compendium) Monvois et al. (2012) recommend a minimum gradient of 1% to let the wastewater flow. The performance for flat areas is therefore 0.5. However, further calculations have to be carried out to evaluate the efficiency of a simplified sewer system. NA	yes NA	
slope soil_type	Performance, Categorical Performance, Categorical	TRUE FALSE	difficult full flat not flat Clay silt sand gravel rock water depth [m] easy	(flat = 0.5, not flat = 1) NA	"A gradient of 0.5% is usually sufficient." (Compendium) Monvois et al. (2012) recommend a minimum gradient of 1% to let the wastewater flow. The performance for flat area is therefore 0.5. However, further calculations have to be carried out to evaluate the efficiency of a simplified sewer system. NA NA NA Simplified sewer systems are not buried as	yes NA	
slope soil_type groundwater_depth	Performance, Categorical Performance, Categorical Performance, Trapez	TRUE FALSE	difficult full flat not flat clay silt sand gravel rock water depth [m]	(flat = 0.5, not flat = 1) NA NA	NA "A gradient of 0.5% is usually sufficient." (Compendium) Monvois et al. (2012) recommend a minimum gradient of 1% to let the wastewater flow. The performance for flat areas is therefore 0.5. However, further calculations have to be carried out to evaluate the efficiency of a simplified sewer system. NA	yes NA	
slope soil_type groundwater_depth excavation	Performance, Categorical Performance, Categorical Performance, Trapes Performance, Categorical	TRUE FALSE FALSE TRUE	difficult full flat not flat clay silt sand gravel rock water depth [m] easy hard	NA NA (easy = 1, hard = 0.5)	NA "A gradient of 0.5% is usually sufficient." (Compendium) Monvois et al. (2012) recommend a minimum gradient of 1% to let the wastewater flow. The performance for flat area is therefore 0.5. However, further calculations have to be carried out to evaluate the efficiency of a simplified sewer system. NA NA Simplified sewer systems are not buried as deep as conventional sewer systems, but they still rely on excavation (Compendium). Shallow and wide excavation necessary.	yes NA NA Ves	
slope soil_type groundwater_depth	Performance, Categorical Performance, Categorical Performance, Trapez	TRUE FALSE FALSE TRUE	difficult full flat not flat Clay silt sand gravel rock water depth [m] easy	(flat = 0.5, not flat = 1) NA NA	"A gradient of 0.5% is usually sufficient." (Compendium) Monvois et al. (2012) recommend a minimum gradient of 1% to let the wastewater flow. The performance for flat area is therefore 0.5. However, further calculations have to be carried out to evaluate the efficiency of a simplified sewer system. NA NA Simplified sewer systems are not burled as deep as conventional sewer systems, but they still rely one excavation (Compendium).	yes NA	
slope soil_type groundwater_depth excavation	Performance, Categorical Performance, Categorical Performance, Trapes Performance, Categorical	FALSE FALSE FALSE FALSE FALSE	difficult full flat not flat clay sit sand gravel rock water depth [m] easy hard	(flat = 0.5, not flat = 1) NA NA (easy = 1, hard = 0.5)	NA 'A gradient of 0.5% is usually sufficient." (Compendium) Monvois et al. (2012) recommend a minimum gradient of 1% to let the wastewater flow. The performance for flat area is therefore 0.5. However, further calculations have to be carried out to evaluate the efficiency of a simplified sewer system. NA NA Simplified sewer systems are not buried as deep as conventional sewer systems, but they still rely on excavation (Compendium). Shallow and wide excavation necessary. NA	yes NA NA Ves	

-				Taxas .	I	T	٦
0		FALSE		NA .	NA	NA	4
0		FALSE		NA NA	NA	NA	
0	0	FALSE	C	NA NA	NA	NA	
drinking_water_exposure	Performance, Categorical	FALSE	Close	NA	NA	NA	
			Not close				
0	0	FALSE		NA NA	NA	NA	
0		FALSE		NA .	NA	NA	1
construction_skills	Performance, Categorical		Ladder:	(unskilled = 0, skilled = 0, professional	"High-level skills (technical engineering firm)"	IVA.	1
construction_skills	Performance, Categoricai	IRUE					
			unskilled	= 1)	(Monvois et al. (2012))		
			skilled		"Requires expert design and construction"		
			professional		(Compendium)		
					The design and construction still is slightly		
					easier than for the conventional sewer.		4
design_skills	Performance, Categorical	TRUE	Ladder:	(unskilled = 0, skilled = 0, professional	"High-level skills (technical engineering firm)"		
			unskilled	= 1)	(Monvois et al. (2012))		
			skilled		"Requires expert design and construction"		
			professional		(Compendium)		
					The design and construction still is slightly		
					easier than for the conventional sewer.		
							4
om_skills	Performance, Categorical	TRUE	Ladder:	(unskilled = 0, skilled = 0.5,	"Medium-level skills (people with experience		
			Unskilled	professional = 1)	of management and maintenance)" (Monvois		
			Skilled		et al. (2012))		
			Professional		· "		
2	•	FALSE		NA.	NA.	N/A	†
0				NA .	NA	NA	4
0		FALSE		NA NA	NA	NA	4
0	0	FALSE		NA .	NA	NA	
0		FALSE) NA	NA	NA	
cleansing_method	Performance, Categorical		Washers	NA .	NA .	NA .	1
cleansing_inetilod	remormance, categorical						
			Soft wipers				
			Hard wipers	1			4
0		FALSE		NA .	NA	NA	
0	0	FALSE	0	NA	NA	NA	
lifetime	Performance, Categorical		short (< 1 year)	NA	NA	NA	
meenie	r crioimance, categorica	THE SE					
			medium (1-5 years)				
			long (>5 years)				4
speed_implement_toilet	PDF, Categorical	FALSE	rapid (< 3 days)	NA	NA	NA	
			moderate (3 days to 2 weeks)				
			slow (> 2 weeks)				
eed_implement_treatment	PDF, Categorical	EALSE	rapid (few days to a week)	NA	NA	NA	1
eeu_impiement_treatment	PDF, Categorical	FALSE		NA .	NA .	INA	
			moderate (few weeks up to three				
			months)				
			slow (> 3 months)				
scalability	Performance, Categorical	TRUE	easy	(easy = 1, difficult = 0.5)	"Can be extended as a community grows"	yes	
•			difficult		(Emersan)	ľ.	
					A sewer network can be expensive and		
					difficult to construct especially below existing		
					infrastructure, but a simplified sewer is easier		
					to extend than a conventional one.		
				1			
construction name	PDF, Categorical	TRUE	simple	(simple = 1, technical = 0, special = 0)	"DVC nines are recommended for the	ves	1
construction_parts	PDF, Categorical	INUE	simple	(simple = 1, technical = 0, special = 0)	"PVC pipes are recommended for the	yes	
			technical		Simplified Sewer. Inspection chambers can		
			special	1	be constructed using bricks with mortared		
					cover to avoid the influx of unwanted		
					products, such as stormwater, soil or grit.		
					Plastic junction boxes can be pre-fabricated.		
					Concrete should not be used in simplified		
				1	sewerage, as it will corrode quickly."		
					(Emersan)		
					"Can be built and repaired with locally		
					available materials" (Simplified-and-		
	copied from "Sanitation_Technologies_TC_database_202	10522 v(rm*)	·		Condominial-Sewers SSWM Toolbox)	l	
ansfer Coefficients	robec nom nameanon_recimologies_rc_database_zoz	l				1	
	x	Range	Airloss	Soilloss	Waterloss	Comments	Reference
	0.9		- C	0.1	0	-	PA
TP	0.9		- 0				-
			·	-			PΔ
med (R)	. 25						
med (R)	25		- 0.05				PA
med (R) k TN	0.85				1		-
med (R)	0.85 0.85		- 0.05	0.1	ı U		
med (R) k TN	0.85			0.1			PA
med (R) k TN med (R)	0.85 0.85				-		PA PA
med (R) k TN med (R) k H20	0.85 0.85 25 0.9		- 0.05 0	0.1			
med (R)	0.85 0.85 25 0.9		- 0.05	0.1	0		
med (R) k TN med (R) k H20 med (R)	0.85 0.85 25 0.9 0.9		- 0.05 - C	0.3	0 0		PA - PA
med (R) k TN med (R) k H20 med (R) r TS	0.85 0.885 25 0.9 0.9 25 0.9		- 0.05 - C	0.1	0		1000
med (R) k TN med (R) k H20 med (R)	0.85 0.85 25 0.9 0.9		- 0.05 - C	0.1	0		PA - PA

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Loetscher, T., & Keller, J. (2002). A decision support system for selecting sanitation systems in developing countries. Socio-Economic Planning Science, 36 (k), 267–290. https://doi.org/10.1016/S0038-0121(02)00007-1.
Spubler, D., de Morasi Lima, P., Frischer, L., Ilmanen, K., Jain, A., van Slotten, M., & Williaman, C. (2012). Sanitation sterknology (Eawag), Dibendorf, Switzerland.
Spubler, D., de Roller, L. (2020). Sanitation technology (Farance and Technology (Eawag), Dibendorf, Switzerland.
Spubler, D., et al. (2012). How to select appropriate technical solutions for sanitation, Accorded Municipal Strategies (CMS), a program coordinated by the Municipal Development Partnership (MDP) and programme Solidarité Eau (pS-Eau). n'4.
Conradin, K., et al. (2010). "The SSWM Toolbox: "from http://www.vswm.info.
Tilley, E., Ulrich, L., Lüthi, C., Reymond, P., & Zurbrügg, C. (2014). Compendium of Sanitation Systems and Technologies—2nd revised edition. Swiss Federal Institute of Aquatic Science and Technology (EAWAG).

Solids-Free Sewer						
	Values	Data Source				
UNIQUE IDENTIFIER (ID)		-				
DATA COMPILER INPUT PRODUCT	SaniChoice Project Team effluent, greywater,	- Tilley, E. et al. (2014)				
	secondary effluent NA [Ifor SaniChoice, use x]	Tilley, E. et al. (2014)				
RELATIONS	Input: OR Output: effluent > greywater >	Tilley, E. et al. (2014)				
COMMENTS	secondary effluent					
Pre-Filter Criteria	Values	Data Source				
applicability_level	(household = 0, neighbourhood = 1, city = 0.5)	Tilley, E. et al. (2014)				
management_level	(household = 0.5, shared = 1, public = 1)	Tilley, E. et al. (2014)				
capex_req_level		Spubler, D. et al. (2021)				
opex_req_level technical_maturity	3	Spuhler, D. et al. (2021) Tilley, E. et al. (2014)				
development_phase	(acute = 0, stabilisation = 0.5, development/recovery = 1)	Same values allotted as all other sewer based technologies in the Emersan Compendium (Akanksha Jain) Not suitable (0) for acute emergency phase. Less suitable (+) for stabilisation emergency phase. Suitable (++) for recovery emergency phase. (Gensch, R. et al. (2018))				
Screening Criteria	Type and Function	Applicable for this Functional Group?	Categories [Unit]	Technology Values (Data)		Internal Review Done?
water_supply	Performance, Categorical	FALSE	house	NA	NA	NA
			yard public			
water_volume	Performance, Trapez	TRUE	none [L/cap/day]	(a = 7, b = 30, c = 999, d = 999)	"Can be used where water supply is limited" "Does not	Yes
					require a minimum gradient or flow velocity" (Compendium). "As opposed to simplified sewers, a solids free sewer can also be used where domestic water consumption is limited" "With sewered pour-flush tollets the total wastewater flow will normally be low, in the region of 30-80 litres per capita per day." (Otis & Mara, (1985)) Based on the above three sources, the optimal water requirement was set at 30L/cap/day whereas the minimum water requirement was calculated assuming a	
electricity_supply	Performance, Categorica	FALSE	electricity	NA NA	limited domestic water consumption for e.g., where a pour-flush system is used as a user interface. Assuming 7 toilet visits/person/day and 11/flush for pour flush tech (Compendium), we set a minimum water requirement of 71/cap/day. (Akansha Jain) An upper bound to how much water the sewers can handle is not considered here, as this is more a design aspect. Note: Performance values of all sewer technologies (Conventional-Simplified-Soildsree) are filled together, in accordance with each other and should be viewed treasther.	NA NA
electricity_supply	Performance, Categorical	FALSE	intermittent	NA .	NA .	NA .
fuel_supply	Performance, Categorical	TRUE	no electricity fuel	(fuel = 1, no fuel = 1)	No fuel required.	yes
frequency_of_om	PDF, Categorical		no fuel irregular	(irregular = 0, regular = 1, continuous		yes
pipe_supply	Performance, Categorical		regular continuous	(no pipes = 0, difficultly available =	clogging" (Compendium) "Requirts repairs and removals of blockages more frequently than a conventional gravity sewer" (Compendium) Since usually no solids are transported, clogging should occur less often than for a simplified sewer. Pipes are required. However, the pipes have a smaller diam	
F-F-2-5-F-7	r errormance, categorica		difficultly available	0.5, pipes = 1)	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	,
pump_supply	Performance, Categorical	TRUE	pipes no pumps difficultly available pumps	(no pumps = 1, difficultly available = 1, pumps = 1)	Usually no pumps are required.	yes
concrete_supply	Performance, Categorical	TRUE	no concrete difficultly available	(no concrete = 1, difficultly available = 1, concrete = 1)	No concrete necessary.	yes
spare_parts	PDF, Categorical	TRUE	concrete simple	(simple = 1, technical = 0, special = 0)	"Can be built and repaired with locally available	yes
			technical special		materials" (Solids-Free Sewer SSWM Toolbox)	
0		FALSE FALSE	0	NA NA		NA NA
0	0	FALSE	0	NA	NA	NA
temperature	Performance, Categorical	PALSE	very cold cold temperate warm	NA	NA	NA
flooding	Performance, Categorical	TRUE	hot flooding no flooding	(flooding=0.8, no flooding=1)	Ideally, sewers should be unaffected by ongoing flooding events. They are built to be leak proof and designed to handle a certain amount of storm water and/or groundwater infiltration. However, in reality ofcourse their performance can be hampered during flooding events. A 20% reduction in performance in considered for Smylifled Sewers and Solids free sewers, I.e. Flooding is allotted a performance of 80%. This is because they can comparitively handle lesser volumes than conventional gravity sewers (which are better equipped to deal with flooding than these technologies, e.g. combined sewers) (Akansha Jain). Note: Performance values of all sewer technologies (Conventional-Simplified Solidsfree) are filled together, in accordance with each other and should be viewed treether.	Yes
vehicular_acces	Performance, Categorical	FALSE	no access difficult full	NA	NA	NA
slope	Performance, Categorical	TRUE	flat	(flat = 1, not flat = 1)		yes
soil_type	Performance, Categorical	FALSE	not flat clay silt sand gravel rock	NA NA	(Compendium)	NA .
groundwater_depth excavation	Performance, Trapez Performance, Categorical	FALSE TRUE	water depth [m] easy hard	NA {easy = 1, hard = 0.5}	NA Solids-free sewers are not buried as deep as conventional sewers. They still require excavation, but since no hydraulic gradient has to be maintained and even negative slopes are allowed, the excavation might be easier compared to the simplified sewer (Compendium). Shallow and wide excavations necessary.	NA yes
surface_area_onsite	Performance, Trapez	FALSE	[m2/plot]	NA	NA	NA
surface_area_offsite	Performance, Trapez		m2/pers	NA		NA
0		FALSE FALSE		NA NA	NA	NA NA
0		FALSE		NA		NA NA

,		1	1				•
drinking_water_exposure	Performance, Categorical	FALSE	Close	NA	NA	NA	
			Not close				
0		FALSE		0 NA	NA	NA NA	
construction_skills		FALSE		O NA	NA	NA .	
CONSTRUCTION_SKINS	Performance, Categorical	INDE	Ladder: unskilled	(unskilled = 0, skilled = 0, professional = 1)	"Requires expert design and construction" (Compendium) The design and construction skills required are similar to		
			skilled	- 1)			
			professional		the construction and design skills of the simplified sewer.		
			professional				
design_skills	Performance, Categorical	TRUE	Ladder:	(unskilled = 0, skilled = 0, professional	"Requires expert design and construction" (Compendium)		
design_skins	renormance, categorical	THOSE THOSE	unskilled	= 1)	The design and construction skills required are similar to		
			skilled	- 1)	the construction and design skills of the simplified sewer.		
			professional		the construction and design skins of the simplified sewer.		
			proressional				
om_skills	Performance, Categorical	TRUE	Ladder:	(unskilled = 0, skilled = 1, professional	"Requires repairs and removals of blockages more		
_			Unskilled	= 1)	frequently than a conventional gravity sewer",		
			Skilled	•	"Interceptors require regular desludging to prevent		
			Professional		clogging" (Compendium)		
					The operation and maintenance is easier than the one of		
					a simplified sewer system. No mechanical cleaning		
					equipment is required.		
0		FALSE		0 NA	NA	NA	
0		FALSE		0 NA	NA	NA	
0	0	FALSE		0 NA	NA	NA	
0	0	FALSE		0 NA	NA	NA	
cleansing_method	Performance, Categorical	FALSE	Washers	NA	NA	NA	
			Soft wipers				
			Hard wipers				
0		FALSE		0 NA	NA	NA	
0		FALSE		0 NA	NA	NA	
lifetime	Performance, Categorical	FALSE	short (< 1 year)	NA	NA	NA	
			medium (1-5 years)				
			long (>5 years)				
speed_implement_toilet	PDF, Categorical	FALSE	rapid (< 3 days)	NA	NA	NA	
			moderate (3 days to 2 weeks)				
peed_implement_treatment	DDF Cohonstan	FALSE	slow (> 2 weeks)	NA	NA .	NA	
peed_implement_treatment	PDF, Categorical	PALSE	rapid (few days to a week)	NA	INA	NA.	
			moderate (few weeks up to three				
			months) slow (> 3 months)				
scalability	Performance, Categorical	TRUE	easy	(easy = 1, difficult = 0.5)	"This technology is a flexible option that can be easily	yes	
scalability	renormance, categorical	INGE	difficult	(easy = 1, difficult = 0.5)	extended as the population grows." (Emersan)	yes	
			difficult		A sewer network can be expensive and difficult to		
					construct especially below existing infrastructure, but a		
			1		solids-free sewer is easier to extend than a conventional		
			ĺ		one.		
construction_parts	PDF, Categorical	TRUE	simple	(simple = 1, technical = 0, special = 0)	"Can be built and repaired with locally available	yes	•
ports	, categorical	-	technical		materials" (Solids-Free Sewer SSWM Toolbox)		
			special				
ransfer Coefficients	(copied from "Sanitation_Technologies_TC_database_2021	0622.xlsm*)					
1	x	Range	Airloss	Soilloss	Waterloss	Comments	Reference
TP	0.9			0 0.1			PA
med (R)	0.9			0 0.1	0		-
k	25			-			PA
TN	0.85		- 0.				PA
med (R)	0.85		- 0.	05 0.1	0		-
k	25						PA
H2O	0.9			0 0.1			PA
med (R)	0.9			0 0.1	0		-
k	25						PA
	0.9		1	0 0.1			PA
TS							
TS med (R)	0.9			0 0.1	O.)	-
				0 0.1	-		PA

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Stormwater Drainage	Values	Data Source				
FUNCTIONAL GROUP UNIQUE IDENTIFIER (ID)	С					
DATA COMPILER	SaniChoice Project Team	-				
INPUT PRODUCT OUTPUT PRODUCT	greywater, stormwater NA [Ifor SaniChoice, use x]	Gensch, R. et al. (2018) Gensch, R. et al. (2018)				
RELATIONS	Input: OR	Gensch, R. et al. (2018)				
COMMENTS	Output: greywater > stormwater					
Pre-Filter Criteria	Values	Data Source				
applicability_level	city = 1)	Gensch, R. et al. (2018)				
management_level	(household = 0.5, shared = 0.5, public	Gensch, R. et al. (2018)				
capex_req_level		Spuhler, D. et al. (2021)				
opex_req_level		Spuhler, D. et al. (2021)				
technical_maturity development_phase	(acute = 0, stabilisation = 0.5,	Gensch, R. et al. (2018) Gensch, R. et al. (2018)				
icreening Criteria	development/recovery = 1) Type and Function	Applicable for this Functional Group?	Catagories [Linit]	Technology Values (Data)	Data Source / Assumptions	Internal Review Done?
screening criteria			Categories [Onit]			
water_supply	Performance, Categorical	FALSE	house yard	NA	NA	NA
			public			
water_volume	Performance, Trapez	TRUF	none [L/cap/day]	(a = 0, b = 0, c = 999, d = 999)	Collects rainwater only, not affected	Yes
water_volume	r criomance, rrapez	THOSE .	[2,000,001]	(4 - 0, 5 - 0, 6 - 333, 4 - 333)	by case attribute values where the	
					user defines sanitary water consumption. (Akanksha Jain)	
electricity_supply	Performance, Categorical	FALSE	electricity	NA	NA	NA
			intermittent no electricity			
fuel_supply	Performance, Categorical	TRUE	fuel	(fuel = 1, no fuel = 1)	No fuel required.	yes
			no fuel			
frequency_of_om	PDF, Categorical	INOL	irregular regular	(irregular = 0.3, regular = 0.7, continuous = 0)	"Solid waste must be removed from stormwater channels on a regular	yes
			continuous		basis and particularly before the start	
					of a rainy season or expected rainfall events to assure proper functioning.	
					After the rains it may be necessary to	
					empty sediments from a channel, after the water flow has decreased	
					below the self-cleansing velocity.	
					Structural damages also need to be tended to on a regular basis. These	
					can occur especially in channels with	
					high gradients and runoff velocities." (Emersan)	
					Regular maintenance required, but	
					the technology still performs with irregular maintenance, just not as	
					good.	
pipe_supply	Performance, Categorical	TRUE	no pipes difficultly available	(no pipes = 1, difficultly available = 1, pipes = 1)	No pipes, but lining material required.	yes
			pipes			
pump_supply	Performance, Categorical	TRUE	no pumps difficultly available	(no pumps = 1, difficultly available = 1, pumps = 1)	No pumps required. Open surface flow.	yes
			pumps			
concrete_supply	Performance, Categorical	TRUE	no concrete difficultly available	(no concrete = 0.5, difficultly available = 0.75, concrete = 1)	"For lined stormwater channels, lining r	yes
			concrete			
spare_parts	PDF, Categorical	TRUE	simple technical	(simple = 1, technical = 0, special = 0)	"Basic tools are needed for cleaning secondary channels, such as shovels	yes
			special		and rakes." (Emersan)	
0		FALSE FALSE		NA NA	NA NA	NA NA
0	0	FALSE	0	NA	NA	NA
temperature	Performance, Categorical	FALSE	very cold cold	NA	NA	NA
			temperate			
			warm hot			
flooding	Performance, Categorical	TRUE	flooding	(flooding=1, no flooding=1)	"Stormwater drainage can be	Yes
			no flooding		implemented in areas with regular flooding and/or greywater production	
					and where there is no conventional	
vehicular_acces	Performance, Categorical	FALSE	no access	NA	sewerage." (Emersan) NA	NA
vernicular_acces	renormance, categorical	, rede	difficult			
glene	Performance, Categorical	TDIJE	full	(flat = 0.5, not flat = 1)	"Constructing stormunter shann-1-	vec
slope	renormance, categorical	- Inot	not flat	nac = 0.5, not lidt = 1)	"Constructing stormwater channels for drainage can be challenging in	yes
					areas with flat terrain due to the lack of gradient, as well as in steep areas ,	
					where run-off velocities become high	
					and difficult to control." (Emersan) It is assumed, that a gradient of at	
					least 0.5% is necessary in order to	
	Dayforman - C-t	EALSE	clav	NA	divert stormwater efficiently.	NA .
soil_type	Performance, Categorical	I ALJE	clay silt	ING.	NA	ING.
			sand			
			gravel rock			
groundwater_depth			water depth [m]	NA (cosy = 1, bord = 0.5)	NA "Stormunter channels should always be	NA
excavation	Performance, Categorical	IKUE	easy hard	(easy = 1, hard = 0.5)	"Stormwater channels should always be	yes
surface_area_onsite	Performance, Trapez	FALSE	[m2/plot]	NA	NA	NA
surface_area_offsite	Performance, Trapez	FALSE	m2/pers	NA	NA	NA
0	0	FALSE	0	NA	NA	NA
0		FALSE FALSE		NA NA	NA NA	NA NA
drinking_water_exposure	Performance, Categorical		Close	NA NA		NA NA
0	0	FALSE	Not close 0	NA	NA	NA
0	0	FALSE	0	NA	NA	NA NA
construction_skills	Performance, Categorical	IKUE	Ladder: unskilled	(unskilled = 0, skilled 0.5, professional = 1)	The necessary construction skills of a stormwater drainage is assumed to be	
			skilled		rather moderate than high.	
design_skills	Performance, Categorical	TRUE	professional Ladder:	(unskilled = 0, skilled = 0, professional	"Design of Stormwater Drainage	
	and the second		unskilled	= 1)	needs to be done by a skilled and	
			skilled professional		experienced engineer." (Emersan) High level skills for design necessary.	
	i	ı	It - wasterner	1	, sor oca-girriecessary.	1

		ma	l		He H I		1
om_skills	Performance, Categorical	TRUE	Ladder:	(unskilled = 1, skilled = 1, professional	"Solid waste must be removed from		
			Unskilled	= 1)	stormwater channels on a regular		
			Skilled		basis and particularly before the start		
			Professional		of a rainy season or expected rainfall		
					events to assure proper functioning.		
					After the rains it may be necessary to		
					empty sediments from a channel,		
					after the water flow has decreased		
					below the self-cleansing velocity.		
					Structural damages also need to be		
					tended to on a regular basis. These		
					can occur especially in channels with		
					high gradients and runoff velocities."		
					(Emersan)		
					Low operation and maintenance skills		
					required.		
0	0	FALSE		NA		NA	
0	0	FALSE	0	NA	NA	NA	
0	0	FALSE			NA	NA	
0	0	FALSE		NA .		NA NA	
			Washers	NA NA		NA NA	
cleansing_method	Performance, Categorical	PALSE		NA .	NA .	NA .	
			Soft wipers				
			Hard wipers				
0	0	FALSE		NA NA	NA	NA	
0		FALSE				NA	
lifetime	Performance, Categorical		short (< 1 year)	NA .		NA .	
metinie	r en ormance, categorical						
			medium (1-5 years)				
			long (>5 years)				
speed_implement_toilet	PDF, Categorical	FALSE	rapid (< 3 days)	NA	NA	NA	
			moderate (3 days to 2 weeks)				
			slow (> 2 weeks)				
speed_implement_treatment	PDF, Categorical	FΔISE	rapid (few days to a week)	NA	NA	NA	
speed_implement_treatment	1 D1 , categorical	THE SE		147		147	
			moderate (few weeks up to three				
			months)				
			slow (> 3 months)				
scalability	Performance, Categorical	TRUE		(easy = 1, difficult = 0.8)	A drainage network can be extended	yes	
scalability	Performance, Categorical	TRUE	easy	(easy = 1, difficult = 0.8)		yes	
scalability	Performance, Categorical	TRUE		(easy = 1, difficult = 0.8)	by adding new channels to it.	yes	
scalability	Performance, Categorical	TRUE	easy	(easy = 1, difficult = 0.8)	by adding new channels to it. However, the existing channels might	yes	
scalability	Performance, Categorical	TRUE	easy	(easy = 1, difficult = 0.8)	by adding new channels to it. However, the existing channels might not be sufficiently large to accept	yes	
scalability	Performance, Categorical	TRUE	easy	(easy = 1, difficult = 0.8)	by adding new channels to it. However, the existing channels might not be sufficiently large to accept additional stormwater into the	yes	
scalability	Performance, Categorical	TRUE	easy	(easy = 1, difficult = 0.8)	by adding new channels to it. However, the existing channels might not be sufficiently large to accept	yes	
scalability	Performance, Categorical	TRUE	easy	(easy = 1, difficult = 0.8)	by adding new channels to it. However, the existing channels might not be sufficiently large to accept additional stormwater into the drainage network. The consequence	yes	
scalability	Performance, Categorical	TRUE	easy	(easy = 1, difficult = 0.8)	by adding new channels to it. However, the existing channels might not be sufficiently large to accept additional stormwater into the drainage network. The consequence could be overflooding. If the drainage	yes	
scalability	Performance, Categorical	TRUE	easy	(easy = 1, difficult = 0.8)	by adding new channels to it. However, the existing channels might not be sufficiently large to accept additional stormwater into the drainage network. The consequence could be overflooding. If the drainage network is above ground it is easier to	yes	
scalability	Performance, Categorical	TRUE	easy	(easy = 1, difficult = 0.8)	by adding new channels to it. However, the existing channels might not be sufficiently large to accept additional stormwater into the drainage network. The consequence could be overflooding. If the drainage network is above ground it is easier to extend then sewers below the ground.	yes	
scalability	Performance, Categorical	TRUE	easy	(easy = 1, difficult = 0.8)	by adding new channels to it. However, the existing channels might not be sufficiently large to accept additional stormwater into the drainage network. The consequence could be overflooding. If the drainage network is above ground it is easier to extend then sewers below the ground. Extending the nextwork is possible,	yes	
scalability	Performance, Categorical	TRUE	easy	(easy = 1, difficult = 0.8)	by adding new channels to it. However, the estisting channels might not be sufficiently large to accept additional stormwater into the drainage network. The consequence could be overflooding. If the drainage network is above ground it is easily entwork is above ground it is easily Extending the nextwork by possible, but drawbacks exist. (Kukka limanen,	yes	
scalability	Performance, Categorical	TRUE	easy	(easy = 1, difficult = 0.8)	by adding new channels to it. However, the existing channels might not be sufficiently large to accept additional stormwater into the drainage network. The consequence could be overflooding. If the drainage network is above ground it is easier to extend then sewers below the ground. Extending the nextwork is possible,	yes	
scalability	Performance, Categorical	TRUE	easy	(easy = 1, difficult = 0.8)	by adding new channels to it. However, the estisting channels might not be sufficiently large to accept additional stormwater into the drainage network. The consequence could be overflooding. If the drainage network is above ground it is easily entwork is above ground it is easily Extending the nextwork by possible, but drawbacks exist. (Kukka limanen,	yes	
			easy difficult		by adding new channels to it. However, the existing channels might not be sufficiently large to accept additional stormwater into the drainage network. The consequence could be overflooding. If the drainage network is above ground it is earlied to actend then sewers below the ground. Extending the nextwork is possible, but drawbacks exist. (Kukka limanen, Eawag 2021)		
scalability construction_parts	Performance, Categorical PDF, Categorical		easy difficult	(easy = 1, difficult = 0.8) (simple = 1, technical = 0, special = 0)	by adding new channels to it. However, the existing channels might not be sufficiently large to accept additional stormwater into the drainage network. The consequence could be overflooding. If the drainage network is above ground it is easier to extend then sewers below the ground. Extending the nextwork is possible, but drawback exist. (Kukka Ilmanen, Eawag 2021) "For lined stormwater channels, lining		
			easy difficult simple technical		by adding new channels to it. However, the existing channels might not be sufficiently large to accept addinal stormwater into the drainage network. The consequence could be overflooding. If the drainage network is above ground it is easily betwork is above ground it is easily Extending the nextwork is possible, but drawbacks exist. (Kukka Ilmanen, Eawag 2021) For lined stormwater channels, lining materials are needed. These can be		
			easy difficult		by adding new channels to it. However, the estisting channels might not be sufficiently large to accept additional stormwater into the drainage network. The consequence could be overflooding. If the drainage network is above ground it is earlied to extend then sewers below the ground. Extending the nextwork is possible, but drawbacks exist. (Rukka Ilmanen, Eawag 2021) "For lined stormwater channels, lining materials are needed. These can be prefabricated drain elements, cement		
			easy difficult simple technical		by adding new channels to it. However, the existing channels might not be sufficiently large to accept addinal stormwater into the drainage network. The consequence could be overflooding. If the drainage network is above ground it is easily betwork is above ground it is easily Extending the nextwork is possible, but drawbacks exist. (Kukka Ilmanen, Eawag 2021) For lined stormwater channels, lining materials are needed. These can be		
			easy difficult simple technical		by adding new channels to it. However, the estisting channels might not be sufficiently large to accept additional stormwater into the drainage network. The consequence could be overflooding. If the drainage network is above ground it is earlied to extend then sewers below the ground. Extending the nextwork is possible, but drawbacks exist. (Rukka Ilmanen, Eawag 2021) "For lined stormwater channels, lining materials are needed. These can be prefabricated drain elements, cement		
			easy difficult simple technical		by adding new channels to it. However, the estisting channels might not be sufficiently large to accept additional stormwater into the drainage network. The consequence could be overflooding. If the drainage network is above ground it is earlier to extend then sewers below the ground. Extending the nextwork is possible, but drawbacks exist. (Rukka Ilmanen, Eawag 2021) "For lined stormwater channels, lining materials are needed. These can be prefabricated drain elements, cement or local materials such as wood. For unlined channels the ground can be		
			easy difficult simple technical		by adding new channels to it. However, the estiling channels might not be sufficiently large to accept additional stormwater into the drainage network. The consequence could be overflooding; if the drainage network is above ground it is easier to extend then sewers below the ground. Extending the nextwork is possible, but drawbacks exist. (Kukka Ilmanen, Eawag 2021) "For lined stormwater channels, lining materials are needed. These can be prefabricated drain elements, cement or local materials such as wood. For unlined channels the ground can be reinforced with chicken wire and		
			easy difficult simple technical		by adding new channels to it. However, the existing channels might not be sufficiently large to accept additional stormwater into the drainage network. The consequence could be overflooding. If the drainage network is above ground it is easiest to extend then sewers below the ground stending the network is possible, but drawbacks exist. (Kukka limanen, Eawag 2021) "For lined stormwater channels, lining materials are needed. These can be prefabricated drain elements, cement or local materials such as wood. For unlined channels the ground can be reinforced with chicken wire and plants.", "Can be built with local		
construction_parts	PDF, Categorical	TRUE	easy difficult simple technical		by adding new channels to it. However, the estiling channels might not be sufficiently large to accept additional stormwater into the drainage network. The consequence could be overflooding; if the drainage network is above ground it is easier to extend then sewers below the ground. Extending the nextwork is possible, but drawbacks exist. (Kukka Ilmanen, Eawag 2021) "For lined stormwater channels, lining materials are needed. These can be prefabricated drain elements, cement or local materials such as wood. For unlined channels the ground can be reinforced with chicken wire and		
		TRUE (20622-36m*)	easy difficult simple technical special	(simple = 1, technical = 0, special = 0)	by adding new channels to it. However, the existing channels might not be sufficiently large to accept addinal stormwater into the drainage network. The consequence could be overflooding. If the drainage network is above ground it is easier to extend then sewers below the ground. Extending the nextwork is possible, but drawbacks exist. (Kukka Ilmanen, Eawag 2021) "For lined stormwater channels, lining materials are needed. These can be prefabricated drain elements, cement or local materials such as wood for unlined channels the ground can be reinforced with chicken wire and plants.", "Can be built with local materials" (Emersan)	yes	
construction_parts Transfer Coefficients	PDF, Categorical	TRUE	easy difficult simple technical special	(simple = 1, technical = 0, special = 0) Soilloss	by adding new channels to it. However, the existing channels might not be sufficiently large to accept additional stormwater into the drainage network. The consequence could be overflooding. If the drainage network is above ground it is earlier to extend then sewers below the ground. Extending the nextwork is possible, but drawbacks exist. (Rukka Ilmanen, Eawag 2021) "For lined stormwater channels, lining materials are needed. These can be prefabricated drain elements, cement or local materials such as wood. For unlined channels the ground can be reinforced with chicken wire and plants.", "Can be built with local materials" (Emersan)	yes	Reference
construction_parts Transfer Coefficients	PDF, Categorical	TRUE (20622-36m*)	easy difficult simple technical special	(simple = 1, technical = 0, special = 0) Soilloss	by adding new channels to it. However, the existing channels might not be sufficiently large to accept additional stormwater into the drainage network. The consequence could be overflooding. If the drainage network is above ground it is earlier to extend then sewers below the ground. Extending the nextwork is possible, but drawbacks exist. (Rukka Ilmanen, Eawag 2021) "For lined stormwater channels, lining materials are needed. These can be prefabricated drain elements, cement or local materials such as wood. For unlined channels the ground can be reinforced with chicken wire and plants.", "Can be built with local materials" (Emersan)	yes	Reference PA
construction_parts Transfer Coefficients	PDF, Categorical	TRUE (20622-36m*)	easy difficult simple technical special	(simple = 1, technical = 0, special = 0) Soilloss	by adding new channels to it. However, the existing channels might not be sufficiently large to accept additional stormwater into the drainage network. The consequence could be overflooding. If the drainage network is above ground it is easier to extend then sewers below the ground. Extending the nextwork is possible, but drawbacks exist. (Kukka Ilmanen, Eawag 2021) "For lined stormwater channels, lining materials are needed. These can be prefabricated drain elements, cement or local materials such as wood. For unlined channels the ground can be reinforced with chicken wire and plants.", "Can be built with local materials" (Emersan) Waterloss	yes	
construction_parts Transfer Coefficients	PDF, Categorical	TRUE	easy difficult simple technical special	(simple = 1, technical = 0, special = 0) Soilloss	by adding new channels to it. However, the existing channels might not be sufficiently large to accept additional stormwater into the drainage network. The consequence could be overflooding. If the drainage network is above ground it is easier to extend then sewers below the ground. Extending the nextwork is possible, but drawbacks exist. (Kukka Ilmanen, Eawag 2021) "For lined stormwater channels, lining materials are needed. These can be prefabricated drain elements, cement or local materials such as wood. For unlined channels the ground can be reinforced with chicken wire and plants.", "Can be built with local materials" (Emersan) Waterloss	yes Comments	
Construction_parts Transfer Coefficients TP med (R)	PDF, Categorical Connect from "Sanitation_Technologies_IT_distables_202 X 1 1 2 755	TRUE	easy difficult simple technical special	(simple = 1, technical = 0, special = 0) Soilloss	by adding new channels to it. However, the existing channels might not be sufficiently large to accept additional stormwater into the drainage network. The consequence could be overflooding. If the drainage network is above ground it is easier to extend then sewers below the ground. Extending the nextwork is possible, but drawbacks exist. (Kukka Ilmanen, Eawag 2021) For lined stormwater channels, lining materials are needed. These can be prefabricated drain elements, cement or local materials such as wood. For unlined channels the ground can be reinforced with chicken wire and plants.", "Can be built with local materials" (Emersan) Waterloss 0 0 0	yes Comments	PA - PA
Construction_parts Transfer Coefficients TP med (R) R	PDF, Categorical (copied from "Sentation, Technologies, TC, Galabase, 202 X 1 25	TRUE	easy difficult simple technical special	(simple = 1, technical = 0, special = 0) Soilloss	by adding new channels to it. However, the existing channels might not be sufficiently large to accept additional stormwater into the drainage network. The consequence could be overflooding, if the drainage network is above ground it is easies to extend then sewers below the ground. Extending the nextwork is possible, but drawbacks exist. (Kukka limanen, Eawag 2021) "For lined stormwater channels, lining materials are needed. These can be prefabricated drain elements, cement or local materials such as wood. For unlined channels the ground can be reinforced with chicken wire and plants.", "Can be built with local materials" (Emersan) Waterloss 0 0 0 0	yes Comments	PA -
Construction_parts Transfer Coefficients TP med (R)	PDF, Categorical PDF, Categorical Copied from "Sentation_Technologue_TC_displace_202 X 1 1 25 1	TRUE 19922-16m*) Range	easy difficult simple technical special	(simple = 1, technical = 0, special = 0) Soilloss	by adding new channels to it. However, the existing channels might not be sufficiently large to accept additional stormwater into the drainage network. The consequence could be overflooding, if the drainage network is above ground it is easies to extend then sewers below the ground. Extending the nextwork is possible, but drawbacks exist. (Kukka limanen, Eawag 2021) "For lined stormwater channels, lining materials are needed. These can be prefabricated drain elements, cement or local materials such as wood. For unlined channels the ground can be reinforced with chicken wire and plants.", "Can be built with local materials" (Emersan) Waterloss 0 0 0 0	yes Comments	PA - PA
construction_parts Transfer Coefficients TP med (R) TN med (R)	PDF, Categorical Copied from "Santation_Technologies_TC_database_200 X 1 255 1 1 1 1	TRUE	easy difficult simple technical special Airloss	(simple = 1, technical = 0, special = 0) Soilloss 0	by adding new channels to it. However, the existing channels might not be sufficiently large to accept additional stormwater into the drainage network. The consequence could be overflooding, if the drainage network is above ground it is easier to extend then sewers below the ground. Extending the nextwork is possible, but drawbacks exist. (Kukka Ilmanen, Eawag 2021) "For lined stormwater channels, lining materials are needed. These can be prefabricated drain elements, cement or local materials such as wood for unlined channels the ground can be reinforced with chicken wire and plants.", "Can be built with local materials" (Emersan) Waterloss 0 0 0 0	yes Comments	PA - PA - PA - PA - PA - PA - PA - PA -
construction_parts Transfer Coefficients TP med (8) TN med (8)	PDF, Categorical PDF, Categorical (copied from "Sentation_Technologies_TC_distables_200" X 1 1 25 1 25 1 25	TRUE	easy difficult simple technical special	(simple = 1, technical = 0, special = 0) Soilloss 0 0 0	by adding new channels to it. However, the existing channels might not be sufficiently large to accept additional stormwater into the drainage network. The consequence could be overflooding; if the drainage network is above ground it is easier to extend then sewers below the ground. Extending the nextwork is possible, but drawbacks exist. (Kukka Ilmanen, Eawag 2021) "For lined stormwater channels, lining materials are needed. These can be prefabricated drain elements, cement or local materials such as wood. For unlined channels the ground can be reinforced with chicken wire and plants.", "Can be built with local materials" (Emersan) Waterloss 0 0 0 0 0 0 0	yes Comments	PA - PA
construction_parts Transfer Coefficients TP med (R) TN med (R)	PDF, Categorical Copied from "Santation_Technologies_TC_database_200 X 1 255 1 1 1 1	TRUE	easy difficult simple technical special Airloss	(simple = 1, technical = 0, special = 0) Soilloss 0 0 0	by adding new channels to it. However, the existing channels might not be sufficiently large to accept additional stormwater into the drainage network. The consequence could be overflooding; if the drainage network is above ground it is easier to extend then sewers below the ground. Extending the nextwork is possible, but drawbacks exist. (Kukka Ilmanen, Eawag 2021) "For lined stormwater channels, lining materials are needed. These can be prefabricated drain elements, cement or local materials such as wood. For unlined channels the ground can be reinforced with chicken wire and plants.", "Can be built with local materials" (Emersan) Waterloss 0 0 0 0 0 0 0	yes Comments	PA - PA - PA - PA - PA - PA - PA - PA -
construction_parts Transfer Coefficients TP med (8) TN med (8)	PDF, Categorical PDF, Categorical (copied from "Sentation_Technologies_TC_distables_200" X 1 1 25 1 25 1 25	TRUE	easy difficult simple technical special	(simple = 1, technical = 0, special = 0) Soilloss 0 0 0	by adding new channels to it. However, the existing channels might not be sufficiently large to accept additional stormwater into the drainage network. The consequence could be overflooding; if the drainage network is above ground it is easier to extend then sewers below the ground. Extending the nextwork is possible, but drawbacks exist. (Kukka Ilmanen, Eawag 2021) "For lined stormwater channels, lining materials are needed. These can be prefabricated drain elements, cement or local materials such as wood. For unlined channels the ground can be reinforced with chicken wire and plants.", "Can be built with local materials" (Emersan) Waterloss 0 0 0 0 0 0 0	yes Comments	PA - PA - PA - PA - PA - PA - PA - PA -
construction_parts Transfer Coefficients TP med (R) k TN med (R) k H2O med (R)	PDF, Categorical torough from "Soutation_Technologies_TC_database_202 X 1 25 1 1 25 1 1 25 1 1 25 1 1 1 25	TRUE	easy difficult simple technical special	(simple = 1, technical = 0, special = 0) Soilloss	by adding new channels to it. However, the existing channels might not be sufficiently large to accept additional stormwater into the drainage network. The consequence could be overflooding. If the drainage network is above ground it is earlier to extend then sewers below the ground. Extending the nextwork is possible, but drawbacks exist. (Rukka limanen, Eawag 2021) "For lined stormwater channels, lining materials are needed. These can be prefabricated drain elements, cement or local materials such as wood. For unlined channels the ground can be reinforced with chicken wire and plants.", "Can be built with local materials" (Emersan) Waterloss 0 0 0 0 0 0 0 0 0 0 0 0	yes Comments	PA
Construction_parts Transfer Coefficients TP med (R) # TN med (R) # H2O med (R) # K	PDF, Categorical Copyed from "Smitaton_Technologies_TC_disblass_202 X 1 1 25 1 1 25 1 25	TRUE	easy difficult simple technical special	(simple = 1, technical = 0, special = 0) Soilloss 0 0 0	by adding new channels to it. However, the existing channels might not be sufficiently large to accept additional stormwater into the drainage network. The consequence could be overflooding. If the drainage network is above ground it is easier to extend then sewers below the ground. Extending the nextwork is possible, but drawbacks exist. (Kukka Ilmanen, Eawag 2021) "For lined stormwater channels, lining materials are needed. These can be prefabricated drain elements, cement or local materials such as wood. For unlined channels the ground can be reinforced with chicken wire and plants.", "Can be built with local materials" (Emersan) Waterloss 0 0 0 0 0 0 0 0 0 0	yes Comments	PA
Construction_parts Transfer Coefficients TP med (R) k TN med (R) k H2O med (R)	PDF, Categorical (copied from "Sentation, Technologies, TC, Galabase, 202 X 1 25 1 1 25 1 1 25	TRUE	easy difficult simple technical special	(simple = 1, technical = 0, special = 0) Soilloss 0 0 0	by adding new channels to it. However, the existing channels might not be sufficiently large to accept additional stormwater into the drainage network. The consequence could be overflooding. If the drainage network is above ground it is easier to extend then sewers below the ground. Extending the nextwork is possible, but drawbacks exist. (Kukka Ilmanen, Eawag 2021) "For lined stormwater channels, lining materials are needed. These can be prefabricated drain elements, cement or local materials such as wood. For unlined channels the ground can be reinforced with chicken wire and plants.", "Can be built with local materials" (Emersan) Waterloss 0 0 0 0 0 0 0 0 0 0	yes Comments	PA
Construction_parts Transfer Coefficients TP med (R) # TN med (R) # H2O med (R) # K	PDF, Categorical Copyed from "Smitaton_Technologies_TC_disblass_202 X 1 1 25 1 1 25 1 25	TRUE	easy difficult simple technical special	(simple = 1, technical = 0, special = 0) Soilloss 0 0 0	by adding new channels to it. However, the existing channels might not be sufficiently large to accept additional stormwater into the drainage network. The consequence could be overflooding. If the drainage network is above ground it is easier to extend then sewers below the ground. Extending the nextwork is possible, but drawbacks exist. (Kukka Ilmanen, Eawag 2021) "For lined stormwater channels, lining materials are needed. These can be prefabricated drain elements, cement or local materials such as wood. For unlined channels the ground can be reinforced with chicken wire and plants.", "Can be built with local materials" (Emersan) Waterloss 0 0 0 0 0 0 0 0 0 0	yes Comments	PA
construction_parts Transfer Coefficients TP med (R) RM med (R) 120 med (R) 120 med (R) 120 med (R) 120	PDF, Categorical (copied from "Sentation, Technologies, TC, Galabase, 202 X 1 25 1 1 25 1 1 25	TRUE	easy difficult simple technical special	(simple = 1, technical = 0, special = 0) Soilloss 0 0 0	by adding new channels to it. However, the existing channels might not be sufficiently large to accept additional stormwater into the drainage network. The consequence could be overflooding. If the drainage network is above ground it is easier to extend then sewers below the ground. Extending the nextwork is possible, but drawbacks exist. (Kukka Ilmanen, Eawag 2021) "For lined stormwater channels, lining materials are needed. These can be prefabricated drain elements, cement or local materials such as wood. For unlined channels the ground can be reinforced with chicken wire and plants.", "Can be built with local materials" (Emersan) Waterloss 0 0 0 0 0 0 0 0 0 0	yes Comments	PA

References

Gensch, R., Jennings, A., Renggli, S., & Reymond, P. [2018]. Compendium of Sanitation Technologies in Emergencies. German WASH Network (GWN), Swiss Federal Institute of Aquatic Science and Technology (Eawag), Global WASH Cluster (GWC) and Sustainable Sanitation Alliance (SuSanA).

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Spubler, D., de Morais Lima, P., Fritzsche, J., Imanen, K., Jain, A., van Solten, M., & Willimann, C. (2021). Sanitation version of the Solid Control of Soli

Urine Bank						
General Information	Values	Data Source				
FUNCTIONAL GROUP UNIQUE IDENTIFIER (ID)		-	+			
DATA COMPILER	SaniChoice Project Team	-				
INPUT PRODUCT	transportedurine, transportedstored_urine	Spuhler, D. & Roller, L. (2020)				
OUTPUT PRODUCT	transportedstabilized_urine	Spuhler, D. & Roller, L. (2020)	†			
RELATIONS	Input: OR	Spuhler, D. & Roller, L. (2020)				
COMMENTS	Output: NA		+			
	Values	Data Source				
applicability_level	(household = 1, neighbourhood = 1, city = 1)	Compared to small urine storage tanks,				
		application on the city level is possible with urine banks. (Tilley, E. et al. (2014))				
	(household = 1, shared = 1, public = 1)	Tilley, E. et al. (2014)	1			
capex_req_level opex_req_level		Spuhler, D. et al. (2021) Spuhler, D. et al. (2021)	+			
technical_maturity	3	McConville, J. et al. (2020)				
development_phase	(acute = 0, stabilisation = 1, development/recovery = 1)	Same value as Urine Storage Tank (Tilley, E. et al. (2014))				
Screening Criteria	Type and Function	Applicable for this Functional Group?	Categories [Unit]	Technology Values (Data)	Data Source / Assumptions	Internal
						Review
water_supply	Performance, Categorical	FALSE	house	NA	NA	Done? NA
			yard			
			public none			
water_volume	Performance, Trapez		[L/cap/day]	NA	NA	NA
electricity_supply	Performance, Categorical	TRUE	electricity intermittent	(electricity = 1, intermittent = 1, no electricity = 1)	No electricity required.	
			no electricity			
fuel_supply	Performance, Categorical	FALSE	fuel no fuel	NA	NA	NA
frequency_of_om	PDF, Categorical	TRUE	irregular	(irregular = 0.5, regular = 0.5, continuous = 0)	"To avoid faecal contamination, special	
]		regular		precautions must be taken during instances of diarrhoea and when children or unaccustomed	
			continuous		adults use the toilet.", "Urine collection pipes	
					need to be checked for precipitates and bottom	
					sludge needs either to be used separately or mixed with the urine before reuse. It should be	
					regularly checked that the urine tanks are not	
					ventilated." (SSWM)	
					Irregular to regular maintenance.	
		Tous	an elec-	for along A 4950 to the control of	No observation d	
pipe_supply	Performance, Categorical	IKUE	no pipes difficultly available	(no pipes = 1, difficultly available = 1, pipes = 1)	No pipes required.	
			pipes			
pump_supply	Performance, Categorical	TRUE	no pumps	(no pumps = 1, difficultly available = 1, pumps = 1	Usually no pumps are required.	
			difficultly available pumps			
concrete_supply	Performance, Categorical	TRUE	no concrete	(no concrete = 0.5, difficultly available = 0.75,	"Urine is very corrosive and therefore tanks	
			difficultly available concrete	concrete = 1)	should be made of resistant material, e.g. plastic or high quality concrete, while metals should be	
					avoided " (SSWM)	
spare_parts	PDF, Categorical	TRUE	simple technical	(simple = 1, technical = 0, special = 0)	No special or technical spare parts required.	
			special			
0		FALSE FALSE		NA D NA	NA NA	NA NA
0	0	FALSE	(NA NA	NA	NA NA
temperature	Performance, Categorical	TRUE	very cold	(very cold = 0.5, cold = 0.7, temperate = 1, warm :		yes
			cold temperate		removal and therefore decreases the necessary storage time (SSWM).	
			warm		200 - 100 -	
flooding	Performance, Categorical	TDIE	hot flooding	(flooding = 1, no flooding = 1)	For this technology the criterion "flooding" is	yes
nooung	r errormance, categorica	1102	no flooding	(11004116 - 1) 110 11004116 - 1)	considered to irrelevant. It should function	,
					successfully (100% performance) in flood prone	
vehicular_acces	Performance, Categorical	FALSE	no access	NA	areas without any issues. (Akanksha Jain) NA	NA
_			difficult			
slope	Performance, Categorical	FALSE	full	NA .	NA .	NA
			not flat			
soil_type	Performance, Categorical	FALSE	clay silt	NA	NA	NA
			sand			
			gravel rock			
groundwater_depth	Performance, Trapez		water depth [m]	NA	NA	NA
excavation	Performance, Categorical		easy	(easy = 1, hard = 0.75)	Depending on the design, excavation might be	yes
			hard		necessary. 🛮	
surface_area_onsite	Performance, Trapez	FALSE	[m2/plot]	NA	NA	NA
surface_area_offsite	Performance, Trapez	TRUE	m2/pers	(a = 0.1, b = 0.1, c = 999, d = 999)	The space requirements of urine banks are	
ucc_u.ca_onsite	. criormance, frapez			,	difficult to define as they strongly depend on the	
					number of users. Some assumptions need to be	
					made.	
					"The storage guidelines for urine correspond to	
					the temperature of storage and the intended crop for which it would be used as fertilizer, but	
					all urine should be stored for at least 1 month	
					before use (see WHO guidelines for specific storage and application guidelines)"	
					(Compendium).	
					"On average, a person generates about 1.2 L of urine a day" (Compendium).	
					To estimate the minimum space requirements, we assume that the urine needs to be stored for	
					at least 1 month. At least two tanks need to	
					ensure that one tank can be filled while the other	
					remains untouched during the storage time. This results in at least 72 liters of storage per person.	
					It is assumed that this results in minimum space	
					requirements of 0.1 m2/cap for a urine bank (Eawag, 2021).	
0	0	FALSE		NA NA	NA	NA
	0	FALSE FALSE		NA D NA	NA NA	NA NA
0			Close	NA NA	NA NA	NA NA
0 0 drinking_water_exposure			Not close		No.	N/A
0 drinking_water_exposure				NA D NA	NA NA	NA NA
0	0	FALSE FALSE	·			
0 drinking_water_exposure 0	0	FALSE	Ladder:	(unskilled = 0.7, skilled = 1, professional = 1)	No special design or construction skills necessary.	
0 drinking_water_exposure 0 0	0	FALSE	Ladder: unskilled	(unskilled = 0.7, skilled = 1, professional = 1)	No special design or construction skills necessary.	
0 drinking_water_exposure 0 0	0	FALSE	Ladder:	(unskilled = 0.7, skilled = 1, professional = 1)	No special design or construction skills necessary.	
0 drinking_water_exposure 0 0	0	FALSE TRUE	Ladder: unskilled skilled professional Ladder:	(unskilled = 0.7, skilled = 1, professional = 1) (unskilled = 0.7, skilled = 1, professional = 1)	No special design or construction skills necessary. No special design or construction skills necessary.	
drinking_water_exposure 0 0 construction_skills	0 Performance, Categorical	FALSE TRUE	Ladder: unskilled skilled professional			

om_skills	Performance, Categorical	TRUE	Ladder:	(unskilled = 0.7, skilled = 1, professional = 1)	No special O&M skills required.		l
			Unskilled				l
			Skilled				l
			Professional				1
0	0	FALSE	0	NA	NA	NA	l .
0	0	FALSE	0	NA	NA	NA	l
0	0	FALSE	0	NA	NA	NA	l
0	0	FALSE	0	NA	NA	NA	
cleansing_method	Performance, Categorical			NA	NA	NA	l
			Soft wipers				1
			Hard wipers				1
0	0	FALSE		NA .	NA .	NA	l
0		FALSE		NA .	NA NA	NA	
lifetime	Performance, Categorical		short (< 1 year)	(short = 1, medium = 1, long = 1)	"All urine should be stored for at least 1 month	ves	1
meume	remormance, categorical	INGE	medium (1-5 years)	(SHOTE = 1, INEGIGIN = 1, IONG = 1)	before use (see WHO guidelines for specific	yes	1
			long (>5 years)		storage and application guidelines)."		1
			long (>3 years)		(Compendium)		l
							l
					Therefore, lifetimes of less than 1 month are in		
					theory not suitable, but limitations of		l
					technologies for short lifetimes are not	1	l
					considered here. In general, the concept of	1	l
					storing urine does not have a lifetime and can	1	l
					therefore be used at anytime. The actual	1	l
					technology (the storage devices, such as urine	1	ı
					tanks) can be replaced easily and do not limit the		l
					lifetime of the technology. (Kukka Ilmanen,	1	l
					Eawag 2021)		1
speed_implement_toilet	PDF, Categorical	FALSE	rapid (< 3 days)	NA	NA	NA	l
			moderate (3 days to 2 weeks)				l
			slow (> 2 weeks)				J
peed_implement_treatment	PDF, Categorical	TRUE	rapid (few days to a week)	(rapid=1, moderate=0, slow=0)	"Mobile storage tanks should be made of plastic	yes	
			moderate (few weeks up to three months)		or fibreglass (prefab), but permanent ones can		l
			slow (> 3 months)		be comprised of concrete or plastic."		
					(Compendium)		l
					Simply a storage device, no time required for		
					implementation i.e., very quick implementation.		
					(Akanksha Jain)		l .
					,,		1
scalability	Performance, Categorical	TRUE	easy	(easy = 1, difficult = 1)	The number of urine storage containers and	yes	1
,			difficult	(, -,	tanks can be changed to scale the technology up.	,	l
					Same value as for Urine Storage Tank (FG S) are		1
					chosen. (Kukka Ilmanen, Eawag 2021)		
construction_parts	PDF, Categorical	TRUE	simple	(simple = 1, technical = 0, special = 0)	"The storage tanks can be made of any	yes	l
construction_parts	F Di , Categoricai	INGE	technical	(Simple = 1, technical = 0, special = 0)	watertight material, such as glass fibre reinforced	yes	l
			special		plastic, PE, PP or PVC, but they can also be made	1	1
			special		of rubber bladders or reinforced concrete (von	1	l
						1	l
					Münch and Winker, 2011). Usually the tanks are		l
					placed on reinforced concrete slabs." (Griesauer,	1	l
					C. (2014))		l
					It is assumed that the parts required for urine	1	l
m	copied from "Sanitation_Technologies_TC_database_20210622.xlsm")				banks are locally available.		
				la m	l		2.6
		Range	Airloss	Soilloss	Waterloss	Comments	Refere
	stabilized Urine					1	
TP	Stabilized Urine 1	-	0		0		PA
	1 1	-	0		0		PA -
TP med (R)	1 1 25		0		0		PA - PA
TP med (R) k TN	1 1 25 0.95	0.92 - 0.98	0.05		0 0		PA - PA PA
TP med (R)	1 1 1 25 0.95 0.95	0.92 - 0.98 (0.92 - 0.98)	0.05		0 0 0		PA -
TP med (R) <i>k</i> TN med (R) <i>k</i>	1 1 25 0.95 0.95	0.92 - 0.98 (0.92 - 0.98) [0.06]	0.05 0.05		0		PA - PA
TP med (R) k TN med (R) k H2O	1 1 25 0.95 0.95 100	0.92 - 0.98 (0.92 - 0.98) [0.06]	0.05 0.05 0.05		0		PA -
TP med (R) <i>k</i> TN med (R) <i>k</i>	1 1 25 0.95 0.95	0.92 - 0.98 (0.92 - 0.98) [0.06]	0.05 0.05		0		PA - PA
TP med (R) k TN med (R) k H2O	1 1 25 0.95 0.95 100	0.92 - 0.98 (0.92 - 0.98) (0.06)	0.05 0.05 0.05		0		PA - PA
TP med (R) k TN med (R) k k to the the the the the the the the the the	1 1 25 0.95 0.95 100 0.96	0.92 - 0.98 (0.92 - 0.98) [0.06]	0.05 0.05 0.05		0		PA - PA PA
TP med (R) k TN med (R) k +20 med (R) k +20	1 1 1 25 0.955 100 0.959 100 0.969 0.969	0.92 - 0.98 (0.92 - 0.98) [0.06]	0.05 0.05 0.05 0.04		0		PA PA PA PA PA
TP med (R)	1 25 0.95 0.95 100 0.996 25	0.92 - 0.98 (0.92 - 0.98) (0.05)	0.05 0.05 0.05 0.04 0.04		0		PA PA PA PA PA

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Gensch, R., Isonings, A., Rengell, S., & Beymond, P. (2018), Compendium of Sonitation Technologies in Emergencies. German WASH Network (GWN), Swiss Federal Institute of Aquatic Science and Technology (Eawag), Global WASH Cluster (GWC) and Sustainable Sanitation Alliance (SuSanA).

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Struvite Precipitation General Information	Values	Data Source					
FUNCTIONAL GROUP	Т	Data Source					
UNIQUE IDENTIFIER (ID) DATA COMPILER	struvite_precipitation SaniChoice Project Team	-	-				
	urine, transportedurine, greywater,	McConville, J. et al. (2020)					
OUTPUT PRODUCT	transportedgreywater struvite, transportedstruvite, effluent,	McConville, J. et al. (2020)					
RELATIONS	transportedeffluent Input: OR	McConville, J. et al. (2020)	_				
	Output: AND	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,					
COMMENTS							
Pre-Filter Criteria applicability_level	Values (household = 0, neighbourhood = 0.5,	McConville, J. et al. (2020)	T .				
	city = 1)						
capex_req_level		McConville, J. et al. (2020) Spuhler, D. et al. (2021)					
opex_req_level technical_maturity		Spuhler, D. et al. (2021) McConville, J. et al. (2020)					
development_phase	(acute = 0, stabilisation = 0,	Phosphorus recovery can be considered					
	development/recovery = 1)	not to be a priorty in the acute and stabilisation phases of an emergency,					
		however since the complexity of this technology is low, and can be built with					
		locally available materials it can be					
		considered as a good option for recovery phases. (Akanksha Jain, based on					
Screening Criteria	Type and Function	McConville, J. et al. (2020)) Applicable for this Functional Group?	Categories [Unit]	Technology Values (Data)	Data Source / Assumptions	Internal Review Done?	
water_supply	Performance, Categorica		house	NA NA	NA NA	NA NA	
			yard public				
yearhan conf	hf=	EALCE	none	NA	NA .	NA.	<u> </u>
water_volume electricity_supply	Performance, Trapez Performance, Categorica	TRUE	[L/cap/day] electricity	NA (electricity = 1, intermittent = 1, no	NA	NA	†
			intermittent no electricity	electricity = 1)	"The system can operate with or without electricity" (SLU).		
fuel_supply	Performance, Categorica	FALSE	fuel	NA	NA	NA	İ
frequency_of_om	PDF, Categorica	TRUE	no fuel irregular	(irregular = 1, regular = 0, continous = 0)	EJ (SLU).	yes	†
			regular continuous				
pipe_supply	Performance, Categorica	TRUE	no pipes	(no pipes = 1, difficultly available = 1,	EJ (SLU).		İ
			difficultly available pipes	pipes = 1)			
pump_supply	Performance, Categorica	TRUE	no pumps difficultly available	(no pumps = 0.5, difficultly available = 0.5, pumps = 1)	Meyer et al. (2011)		
enner-t t	Dorformanno Cotton	TDIJE	pumps		EL/SIII)	vec	
concrete_supply	Performance, Categorica	INUE	no concrete difficultly available	(no concrete = 1, difficultly available = 1, concrete = 1)	EJ (JEU).	yes	
spare_parts	PDF, Categorica	TRUE	concrete simple	(simple = 0.5, technical = 0.5, special = 0)	EJ (SLU).	yes	1
_parc_parts	, or, categories		technical				
0		FALSE) NA		NA	
0		FALSE FALSE		NA NA	NA NA	NA NA	1
temperature	Performance, Categorica		very cold	(very cold = 0.2, cold = 0.4, temperate =	Darwish, M. et al. (2016)	yes	İ
			cold temperate	0.6, warm = 0.8, hot = 1)			
			warm hot				
flooding	Performance, Categorica	TRUE	flooding	(flooding = 1, no flooding = 1)	Germann, V. (2019)	yes	†
vehicular_acces	Performance, Categorica	FALSE	no flooding no access	NA	NA	NA .	†
			difficult full				
slope	Performance, Categorica	FALSE	flat not flat	NA	NA	NA	
soil_type	Performance, Categorica	FALSE	clay	NA	NA	NA	İ
			silt sand				
			gravel rock				
groundwater_depth	Performance, Trapez		water depth [m]	NA	NA .	NA	‡
excavation	Performance, Categorica		easy hard	(easy = 1, hard = 1)	No excavation needed.	yes	
surface_area_onsite	Performance, Trapez	FALSE	[m2/plot]	NA	NA	NA	
surface_area_offsite	Performance, Trapez	TRUE	m2/pers	(a = 0.03, b = 0.03, c = 999, d = 999)	"Common reactors for struvite		İ
					crystallisation are upflow fluidised bed reactors and air-		
					agitated		
					reactors." (Struvite Precipitation SLU Compendium)		
					Surface area assumed to be equal to an UASB.		
0		FALSE	0) NA		NA	†
0	(FALSE	0) NA	NA	NA	‡
0 drinking_water_exposure	Performance, Categorica	FALSE FALSE	Close	NA NA	NA NA	NA NA	†
0		FALSE	Not close) NA	NA	NA .	1
0	(FALSE	0	NA NA	NA	NA	‡
construction_skills	Performance, Categorica	TRUE	Ladder: unskilled	(unskilled = 0, skilled = 0, professional = 1)	Requires expertise.	yes	
			skilled professional		"Common reactors for struvite crystallisation are upflow fluidised bed		
			p. 2. California		reactors and air-agitated reactors" (SLU).		
design_skills	Performance, Categorica	TRUE	Ladder:	(unskilled = 0, skilled = 0, professional = 1)	Requires expertise.	yes	†
			unskilled skilled				
			professional		"Common reactors for struvite crystallisation are upflow fluidised bed		
					reactors and air-agitated reactors" (SLU).		
om_skills	Performance, Categorica	TRUE	Ladder:	(unskilled = 0, skilled = 0, professional = 1)	Requires expertise.	yes	Ī
			Unskilled Skilled		"Struvite recovery is controlled by the		
			Professional		solution's supersaturation point, pH, molar ratio of nutrients (Mg:NH4:PO4),		
					temperature, reaction time and mixing		
					conditions. To ensure a high recovery rate, these factors have to be monitored		
0		FALSE	0) NA	closely" (SLU). NA	NA	1
0	(FALSE	0) NA	NA	NA	‡
0	(FALSE FALSE	0	NA NA	NA NA	NA NA	
cleansing_method	Performance, Categorica		Washers Soft wipers	NA	NA	NA	
		FALCE	Hard wipers		110	NA.	1
0		FALSE FALSE		NA NA	NA NA	NA NA	İ
				•			-

lifetime	Performance, Categorical	TRUE	short (< 1 year) medium (1-5 years) long (>5 years)	(short = 1, medium = 1, long = 1)	"Life time of the reactor, its equipment and of the pumps is assumed to be 10 y." (Struvite production Griesauer, C. (2014)). In a study by Griesauer on the CLARA planning tool the expected lifetimes of	yes		
					parts were larger than 5 years.			
speed_implement_toilet	PDF, Categorical	FALSE	rapid (< 3 days) moderate (3 days to 2 weeks) slow (> 2 weeks)	NA	NA	NA		
speed_implement_treatment	PDF, Categorical	TRUE	rapid (few days to a week) moderate (few weeks up to three months) slow (> 3 months)	(rapid=0.5, moderate=0.5, slow=0)	If the materials can be made available locally fast, then implementation does not require much time at all. From the VUNA Handbook, it looks like the entire setup is made from prefab units. Lower probability is allotted to the category "rapid" (50%) because materials required for operation are quite specialised and therefore may be difficult to procure in a short time, i.e., less than a week. (Akanisha Jain, based on text in SLU Compendium and VUNA Handbook)	yes		
scalability	Performance, Categorical	TRUE	easy difficult	(easy = 1, difficult = 1)	"Struvite precipitation is a process used to recover phosphorus (P) from either urine or concentrated wastewater. Struvite precipitation occurs under specific pt A conditions when concentrations of mapnesium (Mg), phosphate (PO43-) and ammonium (NH44) are close to an equimolar ratio of 1:1:1." (Struvite Precipitation SLU Compendium) If the struvite reactor is large enough, one needs to change the pH and increase the amount of added Mg salts to scale up the technology. (Kukka limanen, Eawag 2021)	yes		
construction_parts	PDF, Categorical		simple technical special	(simple = 1, technical = 0, special = 0)	"Reactors for struvite precipitation can be constructed with local materials and be operated in batches." (Struvite Precipitation SLU Compendium)	yes		
Transfer Coefficients								
	(copied from "Sanitation_Technologies_TC_database_202106			Aiden		Materian		Deference
	Struvite 0.93	Range -	Effluent 0.07		Soilloss (Waterloss 0	* p recovery >90%	Etter et al. (2014)
	Struvite 0.93 0.9	Range -	0.07	1		Waterloss 0	* P recovery >90% * as P, see calculation in 21.2.1	Etter et al. (2014) Etter et al. (2011)
ТР	O.93 0.93		0.07	2		Waterloss 0	* P recovery >90% * as P, see calculation	Etter et al. (2014) Etter et al.
TP med (R)	0.93 0.93 0.98	Range	0.07	2		0	* P recovery >90% * as P, see calculation in 21.2.1	Etter et al. (2014) Etter et al. (2011) Maurer et al. (2006)
ТР	O.93 0.93	Range	0.07	2	Soilloss 0 (0	* P recovery >90% * as P, see calculation in 21.2.1 * as P	Etter et al. (2014) Etter et al. (2011) Maurer et
TP med (R) k	0.93 0.93 0.98	0,9 - 0,98	0.07	2	Soilloss 0 (0 0	* p recovery >90% * as P, see calculation in 21.2.1 * as P * N recovery <5% * as N, see calculation	Etter et al. (2014) Etter et al. (2011) Maurer et al. (2006) PA Etter et al.
TP med (R) k	0.93 0.93 0.98 0.98 0.93 100 0.04	0,9-0,98 (0.03)	0.07 0.1 0.07 0.07 0.99	7 2 2 7 8	Soilloss 0 (* p recovery >90% * as P, see calculation in 21.2.1 * as P * N recovery <5% * as N, see calculation in 21.2.1	Etter et al. (2014) Etter et al. (2011) Maurer et al. (2006) - PA Etter et al. (2014) Etter et al. (2011) Maurer et al. (2011)
TP med (R) k	0.93 0.98 0.98 0.98 0.90 0.04 0.02	0,9-0,98 (0,08]	0.07 0.02 0.02 0.09 0.96	7 2 2 7 5 5	Soilloss		* p recovery >90% * as P, see calculation in 21.2.1 * as P * N recovery <5% * as N, see calculation in 21.2.1 * as N	Etter et al. (2014) Etter et al. (2011) Maurer et al. (2006) - PA Etter et al. (2014) Etter et al. (2011) Maurer et al. (2011)
TP	0.93 0.98 0.98 0.98 0.90 0.04 0.02 0.03	0,9 - 0,98 (0.08)	0.07 0.07 0.07 0.09 0.96 0.96	7 2 2 7 5 8	Soilloss 0 0 0 0 0 0 0 0 0 0 0 0		* p recovery >90% * as P, see calculation in 21.2.1 * as P * N recovery <5% * s, see calculation in 21.2.1	Etter et al. (2014) Etter et al. (2011) Maurer et al. (2006) - PA Etter et al. (2014) Etter et al. (2011) Maurer et al. (2011)
TP med (R) k	0.93 0.98 0.98 0.99 0.00 0.00 0.00 0.00 0.00	0,9 - 0,98 (0,08)	0.07 0.02 0.02 0.09 0.96	7 2 2 7 5 8	Soilloss		* p recovery >90% * as P, see calculation in 21.2.1 * as P * N recovery <5% * as N, see calculation in 21.2.1 * as N	Etter et al. (2014) Etter et al. (2011) Maurer et al. (2006) PA Etter et al. (2014) Etter et al. (2014) Maurer et al. (2014)
med (R) med (R) med (R) # H20	0.93 0.93 0.93 0.93 0.93 0.04 0.02 0.03 0.01 0.03 0.01 0.02	0,9 - 0,98 (0,08]	0.07 0.00 0.00 0.96 0.99 0.99	7 2 2 7 8 8 8	Soilloss 0 0 0 0 0 0 0 0 0 0 0 0		* precovery >90% * as P, see calculation in 21.2.1 * as P * N recovery <5% * as N, see calculation in 21.2.2.1 * as N	Etter et al. (2014) Etter et al. (2011) Maurer et al. (2006) PA Etter et al. (2014) Etter et al. (2014) Maurer et al. (2014)
med (R)	0.93 0.98 0.98 0.98 0.99 0.04 0.02 0.03 0.01	0,9-0,98 (0,03)	0.03 0.02 0.02 0.03 0.09 0.09 0.09	7 2 2 7 8 8 8	Soilloss 0 0 0 0 0 0 0 0 0 0 0 0		* Precovery > 99% * as p, see calculation in 21.2.1 * as p * N recovery < 5% * as N, see calculation in 21.2.1. * as N * Ammonia * PA based on 2% volume reduction	Etter et al. (2014) Etter et al. (2011) Maurer et al. (2006)
med (R)	0.93 0.95 0.98 0.93 100 0.04 0.02 0.03 0.01 0.04 0.02	0,9-0,98 (0,08)	0.07 0.00 0.00 0.96 0.99 0.99	7 2 2 7 7 8 8 9 9	Soilloss 0 0 0 0 0 0 0 0 0 0 0 0		Precovery >90% * as p, see calculation in 21.2.1 * as P * N recovery <5% * as N, see calculation in 21.2.1 * as N * as N, see calculation in 21.2.1 * as N * BA Ammonia * PA based on 2% volume reduction stated by: Spuhler et	Etter et al. (2014) Etter et al. (2014) Maurer et al. (2005) FA Etter et al. (2005) Etter et al. (2011) Maurer et al. (2011) Udert et al. (2006) PA Maurer et al. (2006) - PA Maurer et al. (2006) - PE Etter et al. (2006)
med (R) med (R) med (R) h h h h h h h h h h h h h	0.93 0.93 0.93 0.93 0.93 0.04 0.02 0.03 0.01 0.02 0.02 0.03 0.01 0.02	0,9-0,98 (0,08) 0,01-0,08 (0,02)	0.03 0.02 0.02 0.05 0.96 0.96 0.97 0.99	7 2 2 7 8 8 9 9 9 7	Soilloss 0 0 0 0 0 0 0 0 0 0 0 0		Precovery >90% * as p, see calculation in 21.2.1 * as P * N recovery <5% * as N, see calculation in 21.2.1 * as N * as N, see calculation in 21.2.1 * as N * BA Ammonia * PA based on 2% volume reduction stated by: Spuhler et	Etter et al. (2014) Etter et al. (2014) Maurer et al. (2006) PA Etter et al. (2006) Etter et al. (2011) Maurer et al. (2011) Maurer et al. (2006) U(2006) Haurer et al. (2006) Maurer et al. (2006)
med (R) med (R) med (R) h to med (R) f f f f f f f f f f f f f	0.93 0.93 0.93 0.93 0.93 0.04 0.02 0.03 0.01 0.02 0.02 0.03 0.01 0.02 0.02	0,9-0,98 (0,08) 0,01-0,08 (0,02)	0.03 0.02 0.02 0.05 0.96 0.96 0.96 0.96 0.96	7 2 2 7 8 8 9 9 9 7	Soilloss 0 0 0 0 0 0 0 0 0 0 0 0		Precovery >90% * as p, see calculation in 21.2.1 * as P * N recovery <5% * as N, see calculation in 21.2.1 * as N * as N, see calculation in 21.2.1 * as N * BA Ammonia * PA based on 2% volume reduction stated by: Spuhler et	Etter et al. (2014) Etter et al. (2014) Maurer et al. (2006) - PA Etter et al. (2011) Maurer et al. (2011) Maurer et al. (2006) Udert et al. (2006) - PA Maurer et al. (2006) - PA Etter et al. (2006) - PE Etter et al. (2006) - Etter et al. (2006) - Etter et al. (2006)
med (R) med (R) med (R) # # # # # # # # # # # # #	0.93 0.93 0.93 0.93 0.93 0.04 0.02 0.03 0.01 0.02 0.02 0.03 0.01 0.02 0.02	0,9-0,98 (0,08) 0,01-0,08 (0,02)	0.03 0.02 0.02 0.05 0.96 0.96 0.96 0.96 0.96	7 2 2 7 8 8 9 9 9 7	Soilloss 0 0 0 0 0 0 0 0 0 0 0 0		Precovery >90% * as p, see calculation in 21.2.1 * as P * N recovery <5% * as N, see calculation in 21.2.1 * as N * as N, see calculation in 21.2.1 * as N * BA Ammonia * PA based on 2% volume reduction stated by: Spuhler et	Etter et al. (2014) Etter et al. (2014) Maurer et al. (2006) - PA Etter et al. (2011) Maurer et al. (2011) Maurer et al. (2006) Udert et al. (2006) - PA Maurer et al. (2006) - PA Etter et al. (2006) - PE Etter et al. (2006) - Etter et al. (2006) - Etter et al. (2006)
med (R) med (R) med (R) k H2O med (R) k Additional Information	0.93 0.93 0.93 0.93 0.93 0.04 0.02 0.03 0.01 0.02 0.02 0.03 0.01 0.02 0.02	0,9-0,98 (0,08) 0,01-0,08 (0,02)	0.03 0.03 0.09 0.99 0.99 0.99 0.99	7 2 2 7 8 8 9 9 9 7	Soilloss 0 0 0 0 0 0 0 0 0 0 0 0		Precovery >90% * as P, see calculation in 21.2.1 * as P * N recovery <5% * as N, see calculation in 21.2.1 * as N * as N, see calculation in 21.2.1 * as N * BA Ammonia * PA based on 2% volume reduction stated by: Spuhler et	Etter et al. (2014) Etter et al. (2014) Maurer et al. (2006) - PA Etter et al. (2011) Maurer et al. (2011) Maurer et al. (2006) Udert et al. (2006) - PA Maurer et al. (2006) - PA Etter et al. (2006) - PE Etter et al. (2006) - Etter et al. (2006) - Etter et al. (2006)
med (R) med (R) k TN med (R) k H2O med (R) k Additional information 21.2.1	Struvite	0,9-0,98 0,08 0,01-0,04 0,01-0,04 0,02-0,04 0,02-0,04 0,02-0,04 0,02-0,04 0,03-0,04 0,04-0,04 0,04-0,04 0,04-0,04 0,04-0,04	0.03 0.03 0.09 0.99 0.99 0.99 0.99 0.99	Z Z Z Z Z Z Z Z Z Z Z Z Z Z Z Z Z Z Z	Soilloss 0	O O O O O O O O O O O O O O O O O O O	* Precovery - 90% * as P, see calculation in 21.2.1 * as P * N recovery - 55% * as N, see calculation in 21.2.1 * as N * as Ammonia * PA based on 25% volume reduction stated by: Spuhler et al. (2021)	Etter et al. (2014) Etter et al. (2014) Maurer et al. (2006) - PA Etter et al. (2006) Etter et al. (2011) Maurer et al. (2014) Udert et al. (2006) - PA Maurer et al. (2006) - PA Etter et al. (2006) - PE Etter et al. (2006)
med (R) med (R) med (R) # #20 ## ## ## ## ## ## ## ##	0.93 0.93 0.93 0.93 0.93 0.93 0.04 0.02 0.03 0.01 0.05 0.02 0.02 0.02 0.02 0.02 0.02 0.02	After storage	0.03 0.02 0.02 0.05 0.96 0.96 0.96 0.96 0.96 0.96 0.96 0.96	Struvite	Soilloss	TC Struvite 0.02 TC Struvite Substance Mass in Struvite / 0.02 TC Struvite Substance Mass in Struvite / 0.02	* Precovery ->90% * as P, see calculation in 21.2.1 * as P * N recovery -<5% * as N, see calculation in 21.2.1 * as N see calculation in 21.2.1 * as N see calculation in 21.2.1 * as N * as Ammonia * PA based on 2% volume reduction stated by: Spuhler et al. (2021)	Etter et al. (2014) Etter et al. (2014) Maurer et al. (2006) - PA Etter et al. (2006) Etter et al. (2011) Maurer et al. (2014) Udert et al. (2006) - PA Maurer et al. (2006) - PA Etter et al. (2006) - PE Etter et al. (2006)
med (8) Med (8) Med (0.93	After storage	0.03 0.02 0.02 0.05 0.96 0.96 0.96 0.96 0.96 0.96 0.96 0.96	Struvite	Soilloss	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	* Precovery ->90% * as P, see calculation in 21.2.1 * as P * N recovery -<5% * as N, see calculation in 21.2.1 * as N see calculation in 21.2.1 * as N see calculation in 21.2.1 * as N * as Ammonia * PA based on 2% volume reduction stated by: Spuhler et al. (2021)	Etter et al. (2014) Etter et al. (2014) Maurer et al. (2006) - PA Etter et al. (2006) Etter et al. (2011) Maurer et al. (2014) Udert et al. (2006) - PA Maurer et al. (2006) - PA Etter et al. (2006) - PE Etter et al. (2006)
med (R) med (R) med (R) # 120 med (R) # 120 #	0.93 0.93 0.93 0.93 0.93 0.93 0.04 0.02 0.03 0.01 0.01 0.02 0.02 0.02 0.03 0.05 0.05 0.05 0.05 0.05 0.05 0.05	Range	0.03 0.02 0.02 0.05 0.96 0.96 0.96 0.96 0.96 0.96 0.96 0.96	Struvite	Soilloss	TC Struvite 0.02 TC Struvite Substance Mass in Struvite / 0.02 TC Struvite Substance Mass in Struvite / 0.02	* Precovery ->90% * as P, see calculation in 21.2.1 * as P * N recovery -<5% * as N, see calculation in 21.2.1 * as N see calculation in 21.2.1 * as N see calculation in 21.2.1 * as N * as Ammonia * PA based on 2% volume reduction stated by: Spuhler et al. (2021)	Etter et al. (2014) Etter et al. (2014) Maurer et al. (2006) - PA Etter et al. (2006) Etter et al. (2011) Maurer et al. (2014) Udert et al. (2006) - PA Maurer et al. (2006) - PA Etter et al. (2006) - PE Etter et al. (2006)

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Uddert, K. M., et al. (2006). "Frate of major compounds in source-separated urine." Water Science and Technology 54(11-12): 413–420.

Uddert, K. M., et al. (2006). "Total manufaction of the Michael Manufaction of the Mi

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	Values	Data Source					
FUNCTIONAL GROUP UNIQUE IDENTIFIER (ID)	nitrification_distillation_urine	-					
DATA COMPILER	SaniChoice Project Team transportedurine,	- Spuhler, D. & Roller, L. (2020)					
	transportedstored_urine						
	transportedconcentrated_urine, transportedsecondary_effluent	Spuhler, D. & Roller, L. (2020)					
RELATIONS	Input: OR Output: AND	Spuhler, D. & Roller, L. (2020)					
COMMENTS							
Pre-Filter Criteria	Values	Data Source					
applicability_level	(household = 0.5, neighbourhood = 1, city = 0.5)	McConville, J. et al. (2020)					
management_level	(household = 0.5, shared = 1, public = 0.5)	McConville, J. et al. (2020)					
capex_req_level		Spuhler, D. et al. (2021)					
opex_req_level technical_maturity		Spuhler, D. et al. (2021) McConville, J. et al. (2020)					
development_phase	(acute = 0, stabilisation = 0.5, development/recovery = 1)	"Complexity of construction is High" (McConville, J. et al. (2020).					
	development/recovery = 1)	According to the Emersan Compendium					
		the appropriateness of a technology to a given phase is determined based on the					
		following three factors: applicability, speed of implementation, and material					
		requirements. (Gensch, R. et al. (2018)) Implementation of this technology can					
		be thought of in the recovery phases but					
		given the lack of locally available special equipment and therefore, possibly slow					
		speed of implementation, this technology can be considered unsuitable					
		for acute and stabilisation phases of					
		emergencies. In addition to this, the primary purpose of this technology is to					
		produce a liquid fertiliser, which is perhaps not a priority in emergency					
		situations. (Akanksha Jain) "					
Screening Criteria water_supply	Type and Function Performance, Categorical		Categories [Unit] house	NA	Data Source / Assumptions NA	Internal Review Done? NA	
			yard public				
		SALCE.	none	NA.	ALA	NA.	
water_volume electricity_supply	Performance, Trapez Performance, Categorical	TRUE	[L/cap/day] electricity	NA (electricity = 1, intermittent = 0, no	"Requires electricity, especially for	NA .	
			intermittent no electricity	electricity = 0)	efficient distillation and for the required automatic control nitrification"		
			,		(Mcconville, J., et al. (2020)).		
fuel_supply	Performance, Categorical	FALSE	fuel	NA	NA	NA	
frequency_of_om	PDF, Categorical	TRUE	no fuel irregular	(irregular = 0, regular = 0.3, continuous =	The operation and maintenance of the		
	,		regular	0.7)	technology can be quite time consuming.		
pipe_supply	Performance, Categorical	TRUE	no pipes	(no pipes = 0, difficultly available = 0.5,	Pipes are required.		
			difficultly available pipes	pipes = 1)			
pump_supply	Performance, Categorical	TRUE	no pumps difficultly available	(no pumps = 0, difficultly = 0.5, pumps = 1)	Air pumps are required.		
	Performance, Categorical	TRUE	pumps		Concrete is usually not required.		
concrete_supply	Регтогтаnce, Categorical	INUE	no concrete difficultly available	(no concrete = 1, difficultly available = 1, concrete = 1)	concrete is usually not required.		
spare_parts	PDF, Categorical	TRUE	concrete simple	(simple = 0.3, technical = 0.6, special =	from old library		
	,		technical special	0.1)			
0		FALSE	C	NA NA	NA NA	NA NA	
0	0	FALSE FALSE	C	NA NA	NA NA	NA NA	
temperature	Performance, Categorical	TRUE	very cold cold	(very cold = 1, cold = 1, temperate = 1, warm = 1, hot = 1)	The process is independent from the ambient temperature and should be		
			temperate warm		adaptable in various climates.		
			hot				
flooding	Performance, Categorical	IKUE	flooding no flooding	(flooding = 1, no flooding = 1)	For this technology the criterion "flooding" is considered to irrelevant. It	yes	
					should function successfully (100% performance) in flood prone areas		
	Budania A	EALCE	no accord	NA.	without any issues. (Akanksha Jain)	NA NA	
vehicular_acces	Performance, Categorical	FALSE	no access difficult	NA	NA	NA	
slope	Performance, Categorical	FALSE	full flat	NA	NA	NA	
	Performance, Categorical		not flat	NA NA	NA	NA .	
soil_type	r errormance, Categorical		clay silt				
			sand gravel				
groundwater_depth	Performance, Trapez	FALSE	rock water depth [m]	NA NA	NA	NA	
excavation	Performance, Categorical		easy	(easy = 1, hard = 1)	No excavation necessary.	yes	
surface_area_onsite	Performance, Trapez	FALSE	hard [m2/plot]	NA	NA	NA	
surface_area_offsite	Performance, Trapez	TRUE	m2/pers	(a = 0.03, b = 0.03, c = 999, d = 999)	"Current nitrification and distillation		
					systems can treat up to 200 L of urine per day" (Mcconville, J., et al. (2020)).		
					"One person generates 1.2 L of urine per day" (Compendium).		
					"The complete installation of the system has a footprint of approximately 5 m2,		
					whereas the room accommodating it should not be smaller than 10 m2 to		
					ensure proper access and ventilation"		
					(Mcconville, J., et al. (2020)).		
					Based on these assumptions, we derive a minimum space requirement of 0.03		
					m2/cap (Eawag, 2021):		
					5m2 / (200 L/d / 1.2 L/P/d)		
					= 0.03 m2/P		
0		FALSE FALSE		NA NA	NA NA	NA NA	
0	0	FALSE	C	NA	NA NA	NA	
drinking_water_exposure	Performance, Categorical	FALSE	Close Not close	NA	NA	NA	
0		FALSE FALSE	C	NA NA	NA NA	NA NA	
		JL		lies.	J	lie.	ı l

Printered printe	SOUTH RECOULT SWIIS			Ladder:	(unskilled = 0, skilled = 0, professional = 1)	High technical complexity requires		l .
### CONTROL OF THE PROPERTY OF			INOE		(driskilled = 0, skilled = 0, professional = 1)		yes	
Portionary Comments of the com								
Page 148 Personal Caption (Caption C						"The system consists of the following		
And the property of the proper				professional				
COLUMN AND THE TERM COLUMN BELL COLUMN AND THE TERM COLUMN AND THE								
Part Part						vacuum distiller and final product storage		
### Professor According to 162 Address Add								
### A SAGE 1992 199								
A								
Total Production Control Con				1			<u> </u>	
Color Colo				1				
						et al. (2020)).		
	design_skills	Performance, Categorical	TRUE	Ladder:	(unskilled = 0, skilled = 0, professional = 1)	High technical complexity requires	yes	
### Professor Company (1920) ### Pr				unskilled		expertise in design.		
### Description of the property of the propert								
Properties Company Continue Company Continue Company Continue						"The system consists of the following		
Management Man								
### Company Professional Configuration 1992 Professional Con								
March Marc								
Production Companies Com								
### Anthony Company (No. 2) ***Company (No. 2								
Marie Mari								
In Judie Control (1997) Transmission Diagrams (TAL) Selection (1997) Transmission Diagrams (1997) Tr								
On Control of Control								
Province Column								
Indicate						et al. (2020)).		
Indicate								
Section Produc	om_skills	Performance, Categorical	TRUE		(unskilled = 0, skilled = 1, professional = 1)		yes	
Plantament Planta						pH probe and rinsing of pipes twice a		
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Concentrated Urine Range Secondary Effluent Airloss Soilloss Waterloss Comments Refere				difficult simple technical	(simple = 0.3, technical = 0.6, special =	"rapid" (50%) because materials required for operation are quite specialised and therefore may be difficult to procure in a short time, i.e., less than a week. (Akanska) ain, based on text in Mcconville, J., et al. (2020) Compendium (feeh Name: Nirrification and distillation of urine) and VUNA Handbook) "It is theoretically possible to scale the technology down for household use or scale it up by having multiple installations citywide." (Nitrification and Distillation of Urine Mcconville, J., et al. (2020) Compendium) A single unit has a complex design and cannot be extended easily, however if the material is available it is possible to extend the treatment capacity by adding further installations." "The system consists of the following parts: a urine storage tank, nitrification column with automatic control, activated carbon filter, intermediate storage tank, vacuum distiller and final product storage tanks. The critical components are the nitrification column activated carbon column and the distillation unit.", "The treatment unit necessitates sufficient air space and ventilation, like any technical equipment placed in a building." (Nitrification and Distillation of Urine Mcconville, J., et al. (2020) Compendium) Technical and special parts are required to construct the system. The values are copiel from the spare parts supply in the		
Concentrated Urine Range Secondary Effluent Airloss Soilloss Waterloss Comments Refere				difficult simple technical	(simple = 0.3, technical = 0.6, special =	"rapid" (50%) because materials required for operation are quite specialised and therefore may be difficult to procure in a short time, i.e., less than a week. (Akanska) ain, based on text in Mcconville, J., et al. (2020) Compendium (feeh Name: Nirrification and distillation of urine) and VUNA Handbook) "It is theoretically possible to scale the technology down for household use or scale it up by having multiple installations citywide." (Nitrification and Distillation of Urine Mcconville, J., et al. (2020) Compendium) A single unit has a complex design and cannot be extended easily, however if the material is available it is possible to extend the treatment capacity by adding further installations." "The system consists of the following parts: a urine storage tank, nitrification column with automatic control, activated carbon filter, intermediate storage tank, vacuum distiller and final product storage tanks. The critical components are the nitrification column activated carbon column and the distillation unit.", "The treatment unit necessitates sufficient air space and ventilation, like any technical equipment placed in a building." (Nitrification and Distillation of Urine Mcconville, J., et al. (2020) Compendium) Technical and special parts are required to construct the system. The values are copiel from the spare parts supply in the		
				difficult simple technical	(simple = 0.3, technical = 0.6, special =	"rapid" (50%) because materials required for operation are quite specialised and therefore may be difficult to procure in a short time, i.e., less than a week. (Akanska) ain, based on text in Mcconville, J., et al. (2020) Compendium (feeh Name: Nirrification and distillation of urine) and VUNA Handbook) "It is theoretically possible to scale the technology down for household use or scale it up by having multiple installations citywide." (Nitrification and Distillation of Urine Mcconville, J., et al. (2020) Compendium) A single unit has a complex design and cannot be extended easily, however if the material is available it is possible to extend the treatment capacity by adding further installations." "The system consists of the following parts: a urine storage tank, nitrification column with automatic control, activated carbon filter, intermediate storage tank, vacuum distiller and final product storage tanks. The critical components are the nitrification column activated carbon column and the distillation unit.", "The treatment unit necessitates sufficient air space and ventilation, like any technical equipment placed in a building." (Nitrification and Distillation of Urine Mcconville, J., et al. (2020) Compendium) Technical and special parts are required to construct the system. The values are copiel from the spare parts supply in the		
iry 및 - 이 이 이 이 Uderto	construction_parts construction_parts	PDF, Categorical PDF, Categorical	TRUE	difficult simple technical special	(simple = 0.3, technical = 0.6, special = 0.1)	"rapid" (50%) because materials required for operation are quite specialised and therefore may be difficult to procure in a short time, i.e., less than a week. (Akanksha Jain, based on text in Mcconville, J., et al. (2020) Compendium (Tech Name: Nitrification and distillation of urine) and VUNA Handbook) "It is theoretically possible to scale the technology down for household use or scale it up by having multiple installations citywide." (Nitrification and Distillation of Urine Mcconville, J., et al. (2020) Compendium) A single unit has a complex design and cannot be extended easily, however if the material is available it is possible to extend the treatment capacity by adding further installations." "The system consists of the following parts: a urine storage tank, nitrification column with automatic control, activated carbon filter, intermediate storage tank, vacuum distiller and interproduct storage tanks. The critical components are the nitrification column activated acribon column and the distillation unit.", "The treatment unit necessitates sufficient air space and ventilation, like any technical equipment placed in a building." (Nitrification and Distillation of Urine Mcconville, J., et al. (2020) Compendium) Technical and special parts are required to construct the system. The values are copied from the space parts supply in the old library and might need to be adapted.	yes	
(2015)	construction_parts construction_parts	PDF, Categorical PDF, Categorical	TRUE	difficult simple technical special	(simple = 0.3, technical = 0.6, special = 0.1)	"rapid" (50%) because materials required for operation are quite specialised and therefore may be difficult to procure in a short time, i.e., less than a week. (Akanksha Jain, based on text in Mcconville, J., et al. (2020) Compendium (Tech Name: Nitrification and distillation of urine) and VUNA Handbook) "It is theoretically possible to scale the technology down for household use or scale it up by having multiple installations citywide." (Nitrification and Distillation of Urine Mcconville, J., et al. (2020) Compendium) A single unit has a complex design and cannot be extended easily, however if the material is available it is possible to extend the treatment capacity by adding further installations." "The system consists of the following parts: a urine storage tank, nitrification column with automatic control, activated carbon filter, intermediate storage tank, vacuum distiller and interproduct storage tanks. The critical components are the nitrification column activated acribon column and the distillation unit.", "The treatment unit necessitates sufficient air space and ventilation, like any technical equipment placed in a building." (Nitrification and Distillation of Urine Mcconville, J., et al. (2020) Compendium) Technical and special parts are required to construct the system. The values are copied from the space parts supply in the old library and might need to be adapted.	yes	

	0.99	-	0	0.01	Ō	0	PC with Bastian
med (R)	0.99	0.99 - 1	0	0.01	0	0	Etter
k	100	[0.01]		5.51	-	-	PA
TN	0.97	-	0	0.03	0	0	Udert et al (2015)
	0.99	-	0	0.01	0	0	PC with Bastian Etter
med (R)	0.99	0.97 - 0.99	0	0.02	0	0	-
k	100	[0.02]	-			-	PA
H2O	0.04	-	0.96	0	0	0 95 - 97% of water are removed	(2015)
	0.075	-	0.925	0	o	0	PC with Bastian Etter
med (R)	0.06	0.04 - 0.075	0.94	0	0	0	-
k	100	[0.035]					PA
TS.	0.35		0	0.65	0	o * up to 99% of organic matter content is degraded; Organic matter makes up between 65% and 85% of urine dry solids (Rose et al) > TC airloss range 0.58	3
		-	0		0	Ğ	PC with Bastian Etter
med (R)	0.375	0.35 - 0.4	0	0.625	0	0 Spuhler et al. (2021)	
k	5	[0.05]					PA

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Alkaline Dehydration of Urine						
	Values T	Data Source				
UNIQUE IDENTIFIER (ID)	alkaline_dehydration_of_urine					
INPUT PRODUCT	SaniChoice Project Team transportedurine, transportedstored_urine	- McConville, J. et al. (2020)	1			
OUTPUT PRODUCT RELATIONS	transporteddried_urine	McConville, J. et al. (2020) McConville, J. et al. (2020)	1			
	Output: AND					
COMMENTS re-Filter Criteria	Values	Data Source				
applicability_level		McConville, J. et al. (2020) McConville, J. et al. (2020)				
capex_req_level	4	Spuhler, D. et al. (2021)				
opex_req_level technical maturity		Spuhler, D. et al. (2021) McConville, J. et al. (2020)	1			
	(acute = 0, stabilisation = 0,	Urine treatment alone is perhaps not a priority in emergencies. Additionally, it usually requires an				
	development/recovery = 1)	electricity supply for operation. However, it can				
		be assembled using off-the-shelf materials and could be a potentially good option for recovery				
		phases since complexity of operation is low				
creening Criteria	Type and Function	(Spuhler, D. et al. (2021)). Applicable for this Functional Group?	Categories [Unit]	Technology Values (Data)	Data Source / Assumptions	Internal
						Review Done?
water_supply	Performance, Categorical	FALSE	house vard	NA	NA	NA
			public			
water_volume	Performance, Trapez	FALSE	none [L/cap/day]	NA .	NA .	NA
electricity_supply	Performance, Categorical	TRUE	electricity intermittent	(electricity = 1, intermittent = 0, no electricity = 0)	"Usually requires an electricity supply" (Mcconville, J., et al. (2020)).	
			no electricity			
fuel_supply	Performance, Categorical		fuel no fuel	NA	NA	NA
frequency_of_om	PDF, Categorical	TRUE	irregular	(irregular = 0.2, regular = 0.8, continous = 0)	Expert judgement (Senecal-Smith, J. (2021))	
			regular continuous			
pipe_supply	Performance, Categorical	TRUE	no pipes difficultly available	(no pipes = 1, difficultly available = 1, pipes = 1)	Expert judgement (Senecal-Smith, J. (2021))	
Mar 1990	Doefor Cata	TOLIE	pipes	(no pumps = 1, difficultly available = 1, pumps = 1)	Evnert judgement /Seneral Smith 1 (2024)	
pump_supply	Performance, Categorical	INGE	no pumps difficultly available	μιο ματιρs = 1, αιτισαιτιγ available = 1, pumps = 1)	Expert Juugement (Senecal-Smith, J. (2021))	
concrete_supply	Performance, Categorical	TRUE	pumps no concrete	(no concrete = 1, difficultly available = 1,	Expert judgement (Senecal-Smith, J. (2021))	
			difficultly available	concrete = 1)		
spare_parts	PDF, Categorical	TRUE	concrete simple	(simple = 0.5, technical = 0.5, special = 0)	Expert judgement (Senecal-Smith, J. (2021))	
			technical special			
0		FALSE	(NA NA	NA NA	NA NA
0	0	FALSE FALSE		NA NA	NA NA	NA NA
temperature	Performance, Categorical	TRUE	very cold cold	(very cold = 1, cold = 1, temperate = 1, warm = 1,	Expert judgement (Senecal-Smith, J. (2021))	
			temperate			
			warm hot			
flooding	Performance, Categorical	TRUE	flooding no flooding	(flooding = 0.5, no flooding = 1)	Expert judgement (Senecal-Smith, J. (2021))	
vehicular_acces	Performance, Categorical	FALSE	no access	NA	NA	NA
			difficult full			
slope	Performance, Categorical	FALSE	flat	NA	NA	NA
soil_type	Performance, Categorical	FALSE	not flat clay	NA NA	NA .	NA
			silt sand			
			gravel			
groundwater_depth	Performance, Trapez	FALSE	rock water depth [m]	NA .	NA .	NA
excavation	Performance, Categorical	TRUE	easy hard	(easy = 1, hard = 1)	Expert judgement (Senecal-Smith, J. (2021))	
surface_area_onsite	Performance, Trapez	FALSE	[m2/plot]	NA	NA	NA
surface_area_offsite	Performance, Trapez	TRUE	m2/pers	(a = 0.2, b = 0.3, c = 999, d = 999)	Expert judgement (Senecal-Smith, J. (2021))	
0		FALSE FALSE		NA NA	NA NA	NA NA
0	0	FALSE	(NA NA	NA	NA
drinking_water_exposure	Performance, Categorical	FALSE	Close Not close	NA	NA	NA
0		FALSE FALSE		NA NA	NA NA	NA NA
construction_skills	Performance, Categorical		Ladder:	(unskilled = 0, skilled = 1, professional = 1)	"Urine dehydration rates can be increased by: (1)	
			unskilled skilled		increasing the surface area of drying substrate; (2) increasing air-flow; (3) increasing air	
			professional		temperature; and (4) reducing air humidity. Warming the inlet air, by either solar or other	
					means, would increase dehydration rate by	
					increasing the water-holding capacity of air" (Mcconville, J., et al. (2020)).	
					Relatively simple system which can be	
		TRUE	Indian.	Constituted A state 1 A S	constructed by skilled workers.	
design_skills	Performance, Categorical	TRUE	Ladder: unskilled	(unskilled = 0, skilled = 0.5, professional = 1)	"The operating conditions dictate how often the alkaline substrate needs to be replaced"	
			skilled professional		(Mcconville, J., et al. (2020)). "Urine dehydration rates can be increased by: (1) increasing the	
			professional		surface area of drying substrate; (2) increasing	
					air-flow; (3) increasing air temperature; and (4) reducing air humidity. Warming the inlet air, by	
					either solar or other means, would increase dehydration rate by increasing the water-holding	
					capacity of air" (Mcconville, J., et al. (2020)).	
					Simple systems can be designed with a certain	
		1			understanding of the underlying chemical processes. Specialized knowledge is necessary to	
				I	design efficient systems.	
om_skills	Performance, Categorica	TRUE	Ladder:	(unskilled = 0.5, skilled = 1, professional = 1)	"Maintenance should include: (1) cleaning the	l l
om_skills	Performance, Categorical	TRUE	Unskilled	(unskilled = 0.5, skilled = 1, professional = 1)	pipes with an alkaline solution (to prevent biofilm	
om_skills	Performance, Categorical	TRUE		(unskilled = 0.5, skilled = 1, professional = 1)	pipes with an alkaline solution (to prevent biofilm building up); (2) regularly changing the dehydration substrate; and (3) checking the	
om_skills	Performance, Categorical	TRUE	Unskilled Skilled	(unskilled = 0.5, skilled = 1, professional = 1)	pipes with an alkaline solution (to prevent biofilm building up); (2) regularly changing the	
om_skills	Performance, Categorical	TRUE	Unskilled Skilled	(unskilled = 0.5, skilled = 1, professional = 1)	pipes with an alkaline solution (to prevent biofilm building up); (2) regularly changing the dehydration substrate; and (3) checking the system components (fans)" (Mcconville, J., et al. (2020)).	
om_skills	Performance, Categorical	TRUE	Unskilled Skilled	(unskilled = 0.5, skilled = 1, professional = 1)	pipes with an alkaline solution (to prevent biofilm building up); (2) regularly changing the dehydration substrate; and (3) checking the system components (fans)" (Mcconville, J., et al. (2020)). Relatively simple tasks that can be done by unskilled workers. Adapting the system to the	
om_skills	Performance, Categorical	TRUE	Unskilled Skilled	(unskilled = 0.5, skilled = 1, professional = 1)	pipes with an alkaline solution (to prevent biofilm building up). [2 regularly changing the dehydration substrate; and (3) checking the system components (fans)* (Mcconville, J., et al. (2020)). Relatively simple tasks that can be done by unskilled workers. Adapting the system to the ambient air conditions in the initial phase might	
0		FALSE	Unskilled Skilled Professional	NA NA	pipes with an alkaline solution (to prevent biofilm building up). [2 regularly changing the dehydration substrate; and (3) checking the system components (fans)* (Mcconville, J., et al. (2020)). Relatively simple tasks that can be done by unskilled workers. Adapting the system to the ambient air conditions in the initial phase might require more skills.	NA NA
0 0 0		FALSE FALSE FALSE	Unstilled Skilled Professional	I NA NA NA	pipes with an alkaline solution (to prevent biofilm building up); (2) regularly changing the dehydration substrate; and (3) checking the system components (fans)" (Mcconville, J., et al. (2020)). Relatively simple tasks that can be done by unskilled workers. Adapting the system to the ambient air conditions in the initial phase might require more skills. NA NA NA NA	NA NA
0 0		FALSE FALSE FALSE FALSE	Unstilled Skilled Professional	NA NA	pipes with an alkaline solution (to prevent biofilm building up); (2) regularly changing the dehydration substrate; and (3) checking the system components (fans)" (Mcconville, J., et al. (2020)). Relatively simple tasks that can be done by unskilled workers. Adapting the system to the ambient air conditions in the initial phase might require more skills. NA	NA
0 0 0		FALSE FALSE FALSE FALSE	Unskilled Skilled Professional) NA NA NA NA	pipes with an alkaline solution (to prevent biofilm building up); [2] regularly changing the dehydration substrate; and (3) checking the system components (flans)" (Mcconville, J., et al. (2020)). Relatively simple tasks that can be done by unskilled workers. Adapting the system to the ambient air conditions in the initial phase might require more skills. NA NA NA NA NA NA NA NA NA NA NA NA NA	NA NA NA

0	^	FALSE	^	NA	NA	NA	1
lifetime	Performance, Categorical	TRUE	short (< 1 year) medium (1-5 years) long (>5 years)	(short = 1, medium = 1, long = 1)	It is assumed that the concept can be applied over a short- or long-term, since the technology is easy to construct and use. It mainly depends on sufficient electricity for ventilation and access to alkaline substances. Both are no impediment for a long lifetime. (Kukka Ilmanen, Eawag 2021)	yes	
speed_implement_toilet	PDF, Categorical	FALSE	rapid (< 3 days) moderate (3 days to 2 weeks) slow (> 2 weeks)	NA	NA	NA	
speed_implement_treatment	PDF, Categorical	TRUE	rapid (few days to a week) moderate (few weeks up to three months) slow (> 3 months)	(rapid=0.5, moderate=0.5, slow=0)	If the materials can be made available locally fast, then implementation does not require much time at all. The entire setup is made from prefab units (Simha et al.), Lower probability is allotted to the category-rapid' because materials required for operation are quite specialised and therefore may be difficult to procure in a short time, i.e., less han a week.[Akanksha Jain, based on text in Mcconville, J., et al. (2020) Compendium)	yes	
scalability	Performance, Categorical		easy difficult	(easy = 1, difficult = 0.8)	"It is a two-step, on-site treatment technology. First, fresh huma urine collected from a urine-diverting toilet or urinal is added to an alkaline substrate (e.g., lime or wood ash). [] Subsequently, the alkaline urine and substrate mixture is dehydrated by forced ventilation to yield a dry end product", "For helmith teggs, at thermal treatment (242° C for 5 days) or a storage treatment in a sealed container (111 days at 20° C or 79 days at 35°C) is recommended in order to meet the WHO and U.S. EPA guidelines for unrestricted reuse of excreta in agriculture", "Compact and fits into existing bathrooms with minimal retrofitting." (Alkaline Dehydration of Urine Mccomille, J. et al. (2020) Compendium). The dehydration units appear to be small so to scale up the technology one could build more units with ventilators and access more alkaline substances. For large scale treatment plants, heating elements or additional ventilators could be implemented to reduce the treatment time and therefore increase the capacity. (Kukka Ilmanen, Eawag 2021)	yes	
construction_parts	PDF, Categorical PDF, Categorical (copied from "Saintarion_Technologies_TC_database_20016622 xfom")	TRUE	simple technical special	(simple = 1, technical = 0, special = 0)	"The treatment unit can be assembled by the user using off-the-sheff materials, since it does not require sophisticated components." It further requires alkaline substances: "tocally sourced substrate could be ash, biochar and/or linne." (Alkaline Dehydration of Urine Mcconville, J., et al. (2020) Compendium) It is assumed that the parts for the treatment unit as well as the alkaline substances are locally available.	yes	
	Dried Urine	Range	Airloss	Soilloss	Waterloss	Comments	Reference Expert
							judgement (Senecal- Smith, J. (2021))
med (R)	1 2		0	(0		PA
TN	0.9	-	0.1	C	C		Expert judgement (Senecal- Smith, J. (2021))
med (R)	0.9		0.1				PA PA
H2O	0.05		0.95		C		Expert judgement (Senecal- Smith, J. (2021))
k							PA
TS mod (P.)			0.02		C		Expert judgement (Senecal- Smith, J. (2021))
med (R)	0.98 5		0.02				PA PA
References							
Gensch, R., Jennings, A., Renggli, Loetscher, T., & Keller, J. (2002). A Spuhler, D., de Morais Lima, P., Fr Spuhler, D., & Roller, L. (2020). Sa Mcconville, J., et al. (2020). "Guid Senecal, J. and B. Vinnerås (2017)	A decision support system for selecting sanitation systen ritzsche, J., Ilmanen, K., Jain, A., van Sloten, M., & Willim mitation technology library: Details and data sources fo. le to Sanitation Resource-Recovery Products & Technolo I. "Urea stabilisation and concentration for urine-divertii	ns in developing countries. Socio-Economic Planning Sci ann, C. (2021). SaniChoice Project Team. Department Sa oppropriateness profiles and transfer coefficients. Eav gies: a supplement to the Compendium of Sanitation Sy ng dry toilets: Urine dehydration in ash." Science of The		0121(02)00007-1 ries (Sandec), Swiss Federal Institute of Aquatic Science nology.			

FUNCTIONAL GROUP T						
FUNCTIONAL GROUP	Values	Data Source	T			
UNIQUE IDENTIFIER (ID)	unplanted_drying_bed_sludge	-				
	SaniChoice Project Team sludge, transportedsludge,	- Spuhler, D. & Roller, L. (2020)				
t	transportedtransferred sludge stabilized_sludge,	Spuhler, D. & Roller, L. (2020)				
t	transportedstabilized_sludge, effluent,	Spuller, D. & Roller, L. (2020)				
RELATIONS I	transportedeffluent Input: OR	Spuhler, D. & Roller, L. (2020)				
	Output: AND					
COMMENTS						
	Values (household = 0, neighbourhood = 0.5,	Data Source Tilley, E. et al. (2014)				
c	city = 1)					
management_level (capex req level	(household = 0, shared = 0, public = 1) 5	Tilley, E. et al. (2014) Spuhler, D. et al. (2021)				
opex_req_level	4	Spuhler, D. et al. (2021)				
technical_maturity development_phase ((acute = 0.5, stabilisation = 0.5,	Tilley, E. et al. (2014) Gensch, R. et al. (2018)				
reening Criteria T	development/recovery = 1) Type and Function	Applicable for this Functional Group?	Catagories (Unit)	Technology Values (Data)	Data Source / Assumptions	Internal Review Done?
water_supply	Performance, Categorical	FALSE	house	NA NA	NA	NA NA
			yard public			
			none			
water_volume electricity_supply	Performance, Trapez Performance, Categorical		[L/cap/day] electricity	NA (electricity = 1, intermittent = 1, no	NA "No electrical energy required" (Compendium)	NA yes
			intermittent no electricity	electricity = 1)		
fuel_supply	Performance, Categorical	FALSE	fuel	NA	NA	NA
frequency_of_om	PDF, Categorical	TRUE	no fuel irregular	(irregular = 0, regular = 1, continous = 0)	"Simple operation, only infrequent attention	yes
mequency_or_on	1 DI , Catagorica	THOSE STATE OF THE	regular	(iregular - 0, regular - 1, continues - 0)	required" (Compendium)	763
			continuous		"Dried sludge can be removed after 10 to 15 days, but this depends on the climate conditions."	
ate	Dayforma C-+	TRUE	no niner	(no pipes = 0, difficulture = 1-1-1-	(Compendium)	was
pipe_supply	Performance, Categorical	INUE	no pipes difficultly available	(no pipes = 0, difficultly available = 0.5, pipes = 1)	"The bottom of the drying bed is lined with perforated pipes to drain the leachate away that	yes
			pipes		percolates through the bed."(Compendium) Therefore pipes are needed for the technology.	
pump_supply	Performance, Categorical	TRUE	no pumps		No need for pumps.	yes
			difficultly available pumps	pumps = 1)		
concrete_supply	Performance, Categorical	TRUE	no concrete	(no concrete = 0.5, difficultly available =	"The bed frame is usually made from concrete or a	yes
			difficultly available concrete	0.75, concrete = 1)	plastic liner with the bottom surfaces slightly sloped in order to facilitate percolation and	
					drainage." (Spuhler, n.d.)	
					"The bed itself can be constructed with cement and bricks or concrete and needs to be sealed at	
					the bottom." (Emersan)	
					It is assumed that concrete has a longer lifetime and locals have more experience with it than with	
					plastic liners. Therefore, the performance is slightly	
spare_parts	PDF, Categorical	TRUE	simple	(simple = 1, technical = 0, special = 0)	better with concrete. "Drying beds require the availability of gravel and	yes
			technical special		sand of the correct grain size. Furthermore, piping for the drainage is needed. To remove dried sludge,	
			special		shovels and rakes are required as well as personal	
					protective equipment for the workers. The bed itself can be constructed with cement and bricks or	
					concrete and needs to be sealed at the bottom."	
					(Emersan) "Can be built and repaired with locally available	
					materials" (Compendium)	
0		FALSE FALSE		NA NA	NA NA	NA NA
0	0	FALSE	0	NA	NA	NA
temperature	Performance, Categorical	IKUE	very cold cold	(very cold = 0.3, cold = 0.5, temperate = 1, warm = 1, hot = 1)	"This is a low-cost option that can be installed in most hot and temperate climates." (Compendium)	yes
			temperate warm		Sludge application rates of 100 to 250 kg/m2/year have been reported in warm tropical climates. In	
			hot		colder climates, such as northern Europe, rates up	
					to 80 kg/m2/year are typical. (Compendium -> T.15 Planted Drying Beds)	
					Yearly average temperatures in Europe are	
					assumed to be cold.	
flooding	Performance, Categorical			(flooding = 0.5, no flooding = 1)		
		TRUE	flooding	, , ,	"Excessive rain or high humidity may prevent the	yes
		TRUE	flooding no flooding	, , , , , , , , , , , ,	"Excessive rain or high humidity may prevent the sludge from properly drying.","If installed in wet climates, the facility should be covered by a roof	yes
		TRUE	flooding no flooding		sludge from properly drying.","If installed in wet climates, the facility should be covered by a roof and special caution should be given to prevent the	yes
	,	TRUE	flooding no flooding		sludge from properly drying.", "If installed in wet climates, the facility should be covered by a roof and special caution should be given to prevent the inflow of surface runoff." (Emersan) It's assumed that a special caution must be given	yes
		TRUE	flooding no flooding		sludge from properly drying.","If installed in wet climates, the facility should be covered by a roof and special caution should be given to prevent the inflow of surface runoff." (Emersan) It's assumed that a special caution must be given to prevent the inflow of surface runoff at places	yes
		TRUE	flooding no flooding		sludge from properly drying, ""If installed in wet climates, the facility should be covered by a roof and special caution should be given to prevent the inflow of surface runoff." (Emersan) It's assumed that a special caution must be given to prevent the inflow of surface runoff at places where there is regular flooding as well. Old library; as 0,b=0,c=6,d=12 abps ery ear ->	yes
		TRUE	flooding no flooding		sludge from properly drying.","If installed in wet climates, the facility should be covered by a roof and special caution should be given to prevent the inflow of surface runoff." (Emersan) It's assumed that a special caution must be given to prevent the inflow of surface runoff at places where there is regular flooding as well.	yes
		TRUE	flooding no flooding		sludge from properly drving.""If installed in wet climates, the facility should be covered by a roof and special caution should be given to prevent the inflow of surface runoff: (Temes) it is assumed that a special caution must be given to prevent the inflow of surface runoff at places where there is regular flooding as well. old library: a=0,b=0,c=6,d=12 days per year -> strongly affected. This is a technology that is necessarily built on the	yes
		TRUE	flooding no flooding		sludge from properly driving.""If installed in wet climates, the facility should be covered by a roof and special caution should be given to prevent the inflow of surface runoff." (Emersan) it's assumed that a special caution must be given to prevent the inflow of surface runoff at places where there is regular flooding as well. od library: aa0,b=0,c=6,d=12 days per year -> strongly affected This is a technology that is necessarily built on the ground surface and its raised configuration is not to	yes
		TRUE	flooding no flooding		sludge from properly drying.""If installed in wet climates, the facility should be covered by a roof and special caution should be given to prevent the inflow of surface runoff." (Emersan) it's assumed that a special caution must be given to prevent the inflow of surface runoff at places where there is regular flooding as well. old library. as 0,b=0,c=6,d=12 days per year -> strongly affected This is a technology that is necessarily built on the ground surface and its raised configuration is not possible. (e.g., all pond-based, wetlands, drying beds etc.). Note: All pond-based, wetlands, drying beds etc.). Note: All pond-based, wetlands, drying beds etc.). Note: All pond-based, wetlands, drying beds etc.). Note: All pond-based, wetlands, drying beds etc.). Note: All pond-based vetand/drying	yes
		TRUE	flooding no flooding		sludge from properly drying."," in installed in wet climates, the facility should be covered by a roof and special caution should be given to prevent the inflow of surface runoff." (Emersan) It's assumed that a special caution must be given to prevent the inflow of surface runoff at places where there is regular flooding as well. old library: a=0,b=0,c=6,d=12 days per year -> strongly affected This is a technology that is necessarily built on the ground surface and its raised configuration is not possible. (e.g., all pond-based, wetlands, drying beds etc.). Note: All pond-based wetlands, drying bed technologies are allotted similar performance	yes
		TRUE	flooding no flooding		sludge from properly drying.""If installed in wet climates, the facility should be covered by a roof and special caution should be given to prevent the inflow of surface runoff : (Emersan) it's assumed that a special caution must be given to prevent the inflow of surface runoff at places where there is regular flooding as well. old library: and, b=0,c=0,d=12 days per year -> strongly affected. This is a technology that is necessarily built on the ground surface and its raised configuration is not possible. (e.g., all pnoth-based, weltands, drying beds etc.). Note: All pond-based wetlands, drying bed technologies are allotted similar performance values. Their functioning can be severely disrupted by flooding events. However, it is possible to the possible of the property of the proposition of the property of the proper	yes
		TRUE	flooding no flooding		sludge from properly drving.""If installed in wet climates, the facility should be covered by a roof and special caution should be given to prevent the inflow of surface runoff." (Emersan) It's assumed that a special caution must be given to prevent the inflow of surface runoff at places where there is regular flooding as well. old library. as 0,b=0,c=6,d=12 days per year > strongly affected. This is a technology that is necessarily built on the ground surface and its raised configuration is not possible. (eg., all plond-based, weltands, drying beds etc.). Note: All pond-based weltands, drying bed technologies are aliotted similar performance values. Their functioning can be severely disrupted by flooding events. However, it is possible that they can be protected from flooding by building	yes
		TRUE	flooding no flooding		sludge from properly driving.""If installed in wet climates, the facility should be covered by a roof and special caution should be given to prevent the inflow of surface runoff." (Emersan) It's assumed that a special caution must be given to prevent the inflow of surface runoff at places where there is regular flooding as well. old library. as 0,b=0,c=6,d=12 days per year -> strongly affected. This is a technology that is necessarily built on the ground surface and its raised configuration is not possible (e.g. all plond-based, well-ands, drying beds etc.). Note: All pond-based well-ands, drying bed technologies are allotted similar performance values. Their functioning can be severely disrupted by flooding events. However, it is possible that they can be protected from flooding by building embankments or mounds of adequate height around them. Since a flood-preventive	yes
		TRUE	flooding no flooding		sludge from properly drying.""If installed in wet climates, the facility should be covered by a roof and special caution should be given to prevent the inflow of surface runoff." (Emersan) it's assumed that a special caution must be given to prevent the inflow of surface runoff at places where there is regular flooding as well. old library. aa0,b=0,c=6,d=12 days per year -> strongly affected This is a technology that is necessarily built on the ground surface and its raised configuration is not possible. (e.g., all pond-based, wetlands, drying bed technologies are allotted similar performance values. Their functioning can be severely disrupted by flooding events. However, it is possible that they can be protected from flooding by building embankments or mounds of adequate height around them. Since a flood-preventive configuration of the technology is possible, it is	yes
ushirular seces			no flooding		sludge from properly drying.""If installed in wet climates, the facility should be covered by a roof and special caution should be given to prevent the inflow of surface runoff." (Emersan) it's assumed that a special caution must be given to prevent the inflow of surface runoff at places where there is regular flooding as well. old library. as 0,b=0,c=6,d=12 days per year -> strongly affected This is a technology that is necessarily built on the ground surface and its raised configuration is not possible. (e.g., all pond-based, wetlands, drying bed technologies are allotted similar performance values. Their functioning can be severely disrupted by flooding events. However, it is possible that they can be protected from flooding by building embankments or mounds of adequate height around them. Since a flood-preventive configuration of the technology is possible, it is allotted a performance of 50%. (Akanksha Jain)	
vehicular_acces	Performance, Categorical		no access	NA NA	sludge from properly drying.""If installed in wet climates, the facility should be covered by a roof and special caution should be given to prevent the inflow of surface runoff." (Emersan) it's assumed that a special caution must be given to prevent the inflow of surface runoff at places where there is regular flooding as well. old library. aa0,b=0,c=6,d=12 days per year -> strongly affected This is a technology that is necessarily built on the ground surface and its raised configuration is not possible. (e.g., all pond-based, wetlands, drying bed technologies are allotted similar performance values. Their functioning can be severely disrupted by flooding events. However, it is possible that they can be protected from flooding by building embankments or mounds of adequate height around them. Since a flood-preventive configuration of the technology is possible, it is	yes NA
	Performance, Categorical	FALSE	no access difficult full	NA NA	sludge from properly drving.""If installed in wet climates, the facility should be covered by a roof and special caution should be given to prevent the inflow of surface runoff." (Emersan) It's assumed that a special caution must be given to prevent the inflow of surface runoff at places where there is regular flooding as well. old library. and, b=0,c=6,d=12 days per year-> strongly affected. This is a technology that is necessarily built on the ground surface and its raised configuration is not possible. (e.g., all pond-based, weltands, drying beds etc.). Note: All pond-based weltands, drying beds etc.). Note: All pond-based wettands, drying beds etc.). Note: All pond-based weltands, drying beds etc.). Note: The functioning can be severely disrupted by flooding events. However, it is possible that they can be protected from flooding by building embankments or mounds of adequate height around them. Since a flood-preventive configuration of the technology is possible, it is allotted a performance of 50%. (Akaniskha Jain)	NA NA
slope	Performance, Categorical Performance, Categorical	FALSE	no access difficult full flat noe flat	NA NA	sludge from properly drving.""If installed in wet climates, the facility should be covered by a roof and special caution should be given to prevent the inflow of surface runoff." (Emersan) It's assumed that a special caution must be given to prevent the inflow of surface runoff at places where there is regular flooding as well. old library. and, b=0,c=6,d=12 days per year.> strongly affected. This is a technology that is necessarily built on the ground surface and its raised configuration is not possible. (e.g., all pond-based, well-ands, drying beds etc.). Note: All pond-based well-ands, drying beds etc.].	NA NA
	Performance, Categorical	FALSE	no access difficult full flat nof flat clay	NA NA	sludge from properly drving.""If installed in wet climates, the facility should be covered by a roof and special caution should be given to prevent the inflow of surface runoff." (Emersan) It's assumed that a special caution must be given to prevent the inflow of surface runoff at places where there is regular flooding as well. old library. and, b=0,c=6,d=12 days per year-> strongly affected. This is a technology that is necessarily built on the ground surface and its raised configuration is not possible. (e.g., all pond-based, weltands, drying beds etc.). Note: All pond-based weltands, drying beds etc.). Note: All pond-based wettands, drying beds etc.). Note: All pond-based weltands, drying beds etc.). Note: The functioning can be severely disrupted by flooding events. However, it is possible that they can be protected from flooding by building embankments or mounds of adequate height around them. Since a flood-preventive configuration of the technology is possible, it is allotted a performance of 50%. (Akaniskha Jain)	NA NA
slope	Performance, Categorical Performance, Categorical	FALSE	no access difficult full flat not flat clay silt sand	NA NA	sludge from properly drving.""If installed in wet climates, the facility should be covered by a roof and special caution should be given to prevent the inflow of surface runoff." (Emersan) It's assumed that a special caution must be given to prevent the inflow of surface runoff at places where there is regular flooding as well. old library. and, b=0,c=6,d=12 days per year.> strongly affected. This is a technology that is necessarily built on the ground surface and its raised configuration is not possible. (e.g., all pond-based, well-ands, drying beds etc.). Note: All pond-based well-ands, drying beds etc.].	NA NA
slope	Performance, Categorical Performance, Categorical	FALSE	no access difficult full flat not flat clay silt sand gravel	NA NA	sludge from properly drving.""If installed in wet climates, the facility should be covered by a roof and special caution should be given to prevent the inflow of surface runoff." (Emersan) It's assumed that a special caution must be given to prevent the inflow of surface runoff at places where there is regular flooding as well. old library. and, b=0,c=6,d=12 days per year.> strongly affected. This is a technology that is necessarily built on the ground surface and its raised configuration is not possible. (e.g., all pond-based, well-ands, drying beds etc.). Note: All pond-based well-ands, drying beds etc.].	NA NA
slope soil_type groundwater_depth	Performance, Categorical Performance, Categorical Performance, Categorical	FALSE FALSE FALSE FALSE	no access difficult full flat not flat clay silt sand	NA NA	sludge from properly drving." I'll installed in wet climates, the facility should be covered by a roof and special caution should be given to prevent the inflow of surface runoff : (femersar) it's assumed that a special caution must be given to prevent the inflow of surface runoff at places where there is regular flooding as well. old library: and, b=0,esc, d=12 days per year-> strongly affected. This is a technology that is necessarily built on the ground surface and its raised configuration is not possible. (e.g., all pinor4-based, well-ands, drying beds etc.). Note: All pond-based well-ands, drying beds etc.). Note: All pond-based well-ands, drying beds etc.). Note: All pond-based well proscible to the propose are allotted similar performance values. Their functioning can be severely disrupted by flooding events. However, it is possible that they can be protected from flooding by building embantments or mounds of adequate height around them. Since a flood-preventive configuration of the technology is possible, it is allotted a performance of 50%. (Akanisha Jain) NA NA	NA NA NA
slope soil_type	Performance, Categorical Performance, Categorical Performance, Categorical	FALSE FALSE FALSE FALSE	no access difficult full flat noef flat clay silt sand gravel grock water depth [m] easy	NA NA	sludge from properly driving."" In installed in wet climates, the facility should be covered by a roof and special caution should be given to prevent the inflow of surface runoff." (Emersan) It's assumed that a special caution must be given to prevent the inflow of surface runoff at places where there is regular flooding as well. old library. as 0, b=0,c=6,d=12 days per year -> strongly affected. This is a technology that is necessarily built on the ground surface and its raised configuration is not possible. (e.g. all plond-based, well-ands, dryving beds etc.). Note: All pond-based well-ands, dryving bed technologies are allotted similar performance values. Their functioning can be severely disrupted by flooding events. However, it is possible that they can be protected from flooding by building embankments or mounds of adequate height around them. Since a flood-preventive configuration of the technology is possible, it is allotted a performance of 50%. (Akanisha Jain) NA NA NA Especially for bigger application the construction of Especially for bigger application the construction of	NA NA NA
slope soil_type groundwater_depth	Performance, Categorical Performance, Categorical Performance, Categorical	FALSE FALSE FALSE FALSE	no access difficult full flat not flat clay silt sand gravel rock water depth [m]	NA NA	sludge from properly driving.""If installed in wet climates, the facility should be covered by a roof and special caution should be given to prevent the inflow of surface runoff." (Emersan) It's assumed that a special caution must be given to prevent the inflow of surface runoff at places where there is regular flooding as well. old library. and, b=0,c=6,d=12 days per year. > strongly affected. This is a technology that is necessarily built on the ground surface and its raised configuration is not possible, lee, all plond-based, well-ands, drying beds etc.). Note: All pond-based well-ands, drying beds etc.). Note: All pond-based well-ands, drying beds etc.). Note: All pond-based well-ands, drying beds etc.). Note: The frunctioning can be severely disrupted by flooding events. However, it is possible that they can be protected from flooding by building embankments or mounds of adequate height arround them. Since a flood-preventive configuration of the technology is possible, it is allotted a performance of 50%. (Akanisha Jain) NA NA Especially for bigger application the construction of the technology relies on excavation. On rocky resp. gravely ground there could be difficulties with	NA NA NA
slope soil_type groundwater_depth	Performance, Categorical Performance, Categorical Performance, Categorical	FALSE FALSE FALSE FALSE	no access difficult full flat noef flat clay silt sand gravel grock water depth [m] easy	NA NA	sludge from properly drving." If installed in wet climates, the facility should be covered by a roof and special caution should be given to prevent the inflow of surface runoff = (Renesan). It's assumed that a special caution must be given to prevent the inflow of surface runoff at places where there is regular flooding as well. oil library: and, b=0, esc, d=12 days per year-> strongly affected. This is a technology that is necessarily built on the ground surface and its raised configuration is not possible. (e.g., all pond-based, well-tands, drying beds etc.). Note: All pond-based well-tands, drying beds etc.). Note: All pond-based well-tands, drying beds etc.). Note: All pond-based well-tands, drying beds etc.). Note: All pond-based well-tands, drying beds etc.). Note: All pond-based well-tands, drying beds etc.). Note: All pond-based well-tands, drying beds etc.). Note: All pond-based well-tands, drying beds etc.). Note: All pond-based well-tands, drying beds etc.). Note: All pond-based well-tands, drying beds etc.). Note: All pond-based well-tands, drying beds etc.). Note: All pond-based well-tands, drying beds etc.). Note: All pond-based well-tands, drying beds etc.). Note: All pond-based well-tands, drying beds etc.). Note: All pond-based well-tands, drying beds etc.). Note: All pond-based well-tands, drying beds etc.). Note: All pond-based well-tands, drying beds etc.]. Note: All pond-based well-tands, drying beds etc.]. Note: All pond-based well-tands, drying beds etc.]. Note: All pond-based well-tands, drying beds etc.]. Note: All pond-based well-tands, drying beds etc.]. Note: All pond-based well-tands, drying beds etc.]. Note: All pond-based well-tands, drying beds etc.]. Note: All pond-based well-tands, drying beds etc.]. Note: All pond-based well-tands, drying beds etc.]. Note: All pond-based well-tands, drying beds etc.]. Note: All pond-based well-tands, drying beds etc.]. Note: All pond-based well-tands, drying beds etc.]. Note: All pond-based well-tands, drying beds etc.]. Note: All pond-based	NA NA NA
slope soil_type groundwater_depth	Performance, Categorical Performance, Categorical Performance, Categorical	FALSE FALSE FALSE FALSE	no access difficult full flat noef flat clay silt sand gravel grock water depth [m] easy	NA NA	sludge from properly driving.""If installed in wet climates, the facility should be covered by a roof and special caution should be given to prevent the inflow of surface runoff." (Emersan) It's assumed that a special caution must be given to prevent the inflow of surface runoff at places where there is regular flooding as well. old library. and, b=0,c=6,d=12 days per year. > strongly affected. This is a technology that is necessarily built on the ground surface and its raised configuration is not possible, lee, all plond-based, well-ands, drying beds etc.). Note: All pond-based well-ands, drying beds etc.). Note: All pond-based well-ands, drying beds etc.). Note: All pond-based well-ands, drying beds etc.). Note: The frunctioning can be severely disrupted by flooding events. However, it is possible that they can be protected from flooding by building embankments or mounds of adequate height arround them. Since a flood-preventive configuration of the technology is possible, it is allotted a performance of 50%. (Akanisha Jain) NA NA Especially for bigger application the construction of the technology relies on excavation. On rocky resp. gravely ground there could be difficulties with	NA NA NA
slope soil_type groundwater_depth excavation	Performance, Categorical Performance, Categorical Performance, Categorical Performance, Trapez Performance, Categorical	FALSE FALSE FALSE TRUE	no access in access difficult full flat noet flat clay silt sand gravel cock water depth (m) easy hard	NA NA NA (easy = 1, hard = 0.5)	sludge from properly drving.""If installed in wet climates, the facility should be covered by a roof and special caution should be given to prevent the inflow of surface runoff." (Emersan) It's assumed that a special caution must be given to prevent the inflow of surface runoff at places where there is regular flooding as well. old library. and, b=0,c=6,d=12 days per year. > strongly affected. This is a technology that is necessarily built on the ground surface and its raised configuration is not possible. (e.g., all piond-based, well-ands, drying beds etc.). Note: All pond-based well-ands, drying beds etc.). Note: All pond-based well-ands, drying beds etc.). Note: All pond-based well-ands, drying beds etc.). Note: Though the severely disrupted by flooding events. However, it is possible that they can be protected from flooding by building embankments or mounds of adequate height around them. Since a flood-preventive configuration of the technology is possible, it is allotted a performance of 50%. (Akanksha Jain) NA NA Especially for bigger application the construction of the technology relies on excavation. On rocky resp. gravelly ground there could be difficulties with excavation that is needed for the construction. Assuming that shallow and wide excavation is necessary.	NA NA NA NA Ves
slope soil_type groundwater_depth	Performance, Categorical Performance, Categorical Performance, Categorical	FALSE FALSE FALSE TRUE	no access difficult full flat noef flat clay silt sand gravel grock water depth [m] easy	NA NA	sludge from properly drving.""If installed in wet climates, the facility should be covered by a roof and special caution should be given to prevent the inflow of surface runoff." (Emersan) It's assumed that a special caution must be given to prevent the inflow of surface runoff at places where there is regular flooding as well. old library. and, b=0,c=6,d=12 days per year. > strongly affected. This is a technology that is necessarily built on the ground surface and its raised configuration is not possible. (e.g., all piond-based, well-ands, drying beds etc.). Note: All pond-based well-ands, drying beds etc.). Note: All pond-based well-ands, drying beds etc.). Note: All pond-based well-ands, drying beds etc.). Note: Though the severely disrupted by flooding events. However, it is possible that they can be protected from flooding by building embankments or mounds of adequate height around them. Since a flood-preventive configuration of the technology is possible, it is allotted a performance of 50%. (Akanksha Jain) NA NA Especially for bigger application the construction of the technology relies on excavation. On rocky resp. gravelly ground there could be difficulties with excavation that is needed for the construction. Assuming that shallow and wide excavation is necessary.	NA NA NA
slope soil_type groundwater_depth excavation	Performance, Categorical Performance, Categorical Performance, Categorical Performance, Trapez Performance, Categorical	FALSE FALSE TAUE FALSE TRUE	no access in access difficult full flat noet flat clay silt sand gravel cock water depth (m) easy hard	NA NA NA (easy = 1, hard = 0.5)	sludge from properly driving.""If installed in wet climates, the facility should be covered by a roof and special caution should be given to prevent the inflow of surface runoff." (Emersan) It's assumed that a special caution must be given to prevent the inflow of surface runoff at places where there is regular flooding as well. old library. as 0,b=0,c=6,d=12 days per year -> strongly affected. This is a technology that is necessarily built on the ground surface and its raised configuration is not possible, e.g. all plond-based, weltands, drying beds etc.). Note: All pond-based weltands, drying beds etc.). Note: All pond-based weeterly disrupted by flooding events. However, it is possible that they can be protected from flooding by building embankments or mounds of adequate height around them. Since a flood-preventive configuration of the technology is possible, it is allotted a performance of 50%. (Akanksha Jain) NA NA NA Especially for bigger application the construction of the technology relies on excavation. On rocky resp. gravely ground there could be difficulties with escavation that is needed for the construction. Assuming that shallow and wide excavation is necessary. NA "There must be sufficient space available for	NA NA NA NA Ves
slope soil_type groundwater_depth excavation surface_area_onsite	Performance, Categorical Performance, Categorical Performance, Trapez Performance, Categorical Performance, Trapez Performance, Trapez	FALSE FALSE TRUE FALSE TRUE	no access difficult full flat not flat clay silt sand gravel rock water depth [m] easy hard [m2/plot] m2/pers	NA NA (easy = 1, hard = 0.5) NA (a = 0.05, b = 0.05, c = 999, d = 999)	sludge from properly drving."" In installed in wet climates, the facility should be covered by a roof and special caution should be given to prevent the inflow of surface runoff." (Emersan) It's assumed that a special caution must be given to prevent the inflow of surface runoff at places where there is regular flooding as well. old library. as 0, b=0,c=6,d=12 days per year -> strongly affected. This is a technology that is necessarily built on the ground surface and its raised configuration is not possible. (e.g., all plond-based, weltands, drying bed technologies are allotted similar performance values. Their functioning can be severely disrupted by flooding events. However, it is possible that they can be protected from flooding by building embankments or mounds of adequate height around them. Since a flood-preventive configuration of the technology is possible, it is allotted a performance of 50%. (Akanksha Jain) NA NA NA NA NA There must be sufficient space available for creation of the treatment is needed for the construction. Assuming that shallow and wide excavation is necessary. NA "There must be sufficient space available for creation of the treatment plant (50m*/1000 inhabitants)." (Monwise et al. 2017).	NA NA NA NA NA NA
slope soil_type groundwater_depth excavation surface_area_onsite surface_area_offsite	Performance, Categorical Performance, Categorical Performance, Categorical Performance, Trapez Performance, Trapez Performance, Trapez	FALSE FALSE TAUE FALSE TRUE FALSE	no access in acc	NA NA NA (easy = 1, hard = 0.5) NA (a = 0.05, b = 0.05, c = 999, d = 999) NA	sludge from properly drving." If installed in wet climates, the facility should be covered by a roof and special caution should be given to prevent the inflow of surface runoff : (tenses) it is assumed that a special caution must be given to prevent the inflow of surface runoff at places where there is regular flooding as well. old library: a=0,b=0,c=6,d=12 days per year-> strongly affected. This is a technology that is necessarily built on the ground surface and its raised configuration is not possible. (e.g., all pond-based, well-ands, drying beds etc.). Note: All pond-based well-ands, drying beds etc.). Note: All pond-based well-ands, drying beds etc.). Note: All pond-based well-ands, drying beds etc.). Note: All pond-based well-ands, drying beds etc.). Note: All pond-based well-ands, drying beds etc.). Note: All pond-based well-ands, drying beds etc.). Note: All pond-based well-ands, drying beds etc.). Note: All pond-based well-ands, drying beds etc.). Note: All pond-based well-ands, drying beds etc.). Note: All pond-based well-ands, drying beds etc.). Note: All pond-based well-ands, drying beds etc.). Note: All pond-based well-ands, drying beds etc.). Note: All pond-based well-ands, drying beds etc.). Note: All pond-based well-ands, drying beds etc.). Note: All pond-based well-ands, drying beds etc.). Note: All pond-based well-ands, drying beds etc.). Note: All pond-based well-ands, drying beds etc.). Note: All pond-based well-ands, drying beds etc.]. Note: All pond-based well-ands, drying beds etc.]. Note: All pond-based well-ands, drying beds etc.]. Note: All pond-based well-ands, drying beds etc.]. Note: All pond-based well-ands, drying beds etc.]. Note: All pond-based well-ands, drying beds etc.]. Note: All pond-based well-ands, drying beds etc.]. Note: All pond-based well-ands, drying beds etc.]. Note: All pond-based well-ands, drying beds etc.]. Note: All pond-based well-ands, drying beds etc.]. Note: All pond-based well-ands, drying beds etc.]. Note: All pond-based well-ands, drying beds etc.]. No	NA NA NA NA NA NA NA NA NA
slope soil_type groundwater_depth excavation surface_area_onsite surface_area_offsite 0 0 0	Performance, Categorical Performance, Categorical Performance, Categorical Performance, Trapez Performance, Trapez Performance, Trapez Performance, Trapez	FALSE FALSE FALSE TRUE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE	no access difficult full flat not flat clay silt sand grave\ rock water depth [m] easy hard [m2/plot] m2/pers	NA NA (easy = 1, hard = 0.5) NA (a = 0.05, b = 0.05, c = 999, d = 999) NA NA NA NA NA	sludge from properly drying." If installed in wet climates, the facility should be covered by a roof and special caution should be given to prevent the inflow of surface runoff : (femeran) it's assumed that a special caution must be given to prevent the inflow of surface runoff at places where there is regular flooding as well. old library: and, b=0,c=6,d=12 days per year-> strongly affected. This is a technology that is necessarily built on the ground surface and its raised configuration is not possible. (e.g., all pond-based, well-ands, drying beds etc.). Note: All pond-based well-ands, drying beds etc.). N	NA NA NA NA NA NA NA NA
slope soil_type groundwater_depth excavation surface_area_onsite surface_area_offsite	Performance, Categorical Performance, Categorical Performance, Trapez Performance, Trapez Performance, Trapez	FALSE FALSE FALSE TRUE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE	no access difficult full flat noef tlat clay silt sand gravel rock water depth [m] easy hard [m2/plot] m2/pers	NA NA NA (easy = 1, hard = 0.5) NA (a = 0.05, b = 0.05, c = 999, d = 999) NA NA	sludge from properly driving."," in installed in wet climates, the facility should be covered by a roof and special caution should be given to prevent the inflow of surface runoff." (Emersan) it's assumed that a special caution must be given to prevent the inflow of surface runoff at places where there is regular flooding as well. old library. as 0, b=0,c=6,d=12 days per year -> strongly affected. This is a technology that is necessarily built on the ground surface and its raised configuration is not possible. (e.g. all plond-based, well-ands, drying beds etc.). Note: All pond-based, well-ands, drying bed technologies are allotted similar performance values. Their functioning can be severely disrupted by flooding events. However, it is possible that they can be protected from flooding by building embankments or mounds of adequate height around them. Since a flood-preventive configuration of the technology is possible, it is allotted a performance of 50%. (Akaniskha Jain) NA NA NA *There must be sufficient space available for creation of the treatment plant (50m²/1000 inhabitants)." (Monvois et al. 2012). NA	NA NA NA NA NA NA NA

0	0	FALSE		NA .	NA	NA	1	
construction_skills	Performance, Categorical		Ladder: unskilled	(unskilled = 0, skilled = 0.5, professional	"Requires expert design and construction" (Compendium)	yes		
			skilled	= 1)	The construction can be done with moderate			
			professional		construction skills. But if there are high skills available the performance could be better due to			
design_skills	Performance, Categorical	TRUE	Ladder:	(unskilled = 0, skilled = 0, professional =	better construction. "Requires expert design and construction"	yes		
200.0			unskilled	1)	(Compendium) "Both the incoming and dried sludge are	,		
			skilled professional		pathogenic; []." (Compendium)			
					Because there is a high risk of contamination with pathogens a proper desingn is very important.			
om_skills	Performance, Categorical	TRUE	Ladder: Unskilled	(unskilled = 0.5, skilled = 1, professional = 1)	"Simple operation, only infrequent attention required" (Compendium)	yes		
			Skilled	- 1)	Once the process is designed with high skills the			
			Professional		operation and maintenance is pretty easy and does not require special skills. But therefore it is			
					important the labourer follow the rules of the process design.			
0		FALSE FALSE	0	NA NA	NA NA	NA NA		
0	0	FALSE	0	NA NA	NA	NA		
0 cleansing_method	0 Performance, Categorical	FALSE FALSE	Washers	NA NA	NA NA	NA NA		
			Soft wipers Hard wipers					
0		FALSE FALSE	0	NA NA	NA NA	NA NA		
0 lifetime	Performance, Categorical		short (< 1 year)	(short = 1, medium = 1, long = 1)	Simple and durable installation." (Solar drying	yes	-	
			medium (1-5 years) long (>5 years)		SLU Compendium) Durable solution that can be used in the short- or			
speed_implement_toilet	PDF, Categorical	ENICE	rapid (< 3 days)	NA	long-term (Kukka Ilmanen, Eawag 2021) NA	NA		
speed_implement_toilet	1 DT, Categorical	Trust	moderate (3 days to 2 weeks)					
speed_implement_treatment	PDF, Categorical	TRUE	slow (> 2 weeks) rapid (few days to a week)	(rapid=0, moderate=1, slow=0)	"The bed itself can be constructed with cement	yes		
			moderate (few weeks up to three months)		and bricks or concrete and needs to be sealed at the bottom." "Can be built and repaired with			
			slow (> 3 months)		locally available materials" (Emersan Compendium)			
					Construction is quite simple however, since bricks and/or concrete is used for construction, minimum			
					7 days curing is required- and since no prefab units are available, probability is allotted only to			
					moderate category and not rapid. (Akanksha Jain)			
scalability	Performance, Categorical	TRUE	easy difficult	(easy = 1, difficult = 1)	"To improve drying and percolation, sludge application can alternate between two or more	yes		
					beds. The number of beds needed is a function of			
					the frequency of sludge arrivals and the number of days necessary for drying in the local climate, to			
					which a few days must be added for sludge removal." (Emersan)			
					Additional drying beds can be easily added, if			
					sufficient land area is available. (Kukka Ilmanen, Eawag 2021)			
construction_parts	PDF, Categorical	TRUE	simple technical	(simple = 1, technical = 0, special = 0)	"Can be built and repaired with locally available materials" (Compendium)	yes		
T	[copied from "Sanitation_Technologies_TC_database_20210623	wifeon*1	special		materials (compendium)			
Transfer Coefficients	Stabilized Sludge		Effluent	Airloss	Soilloss			Reference
TP	0.7		0.3	3	0			Nikiema et al. (2014)
							paved drying beds	
	0.53	0.48-0.58	0.46	s c	0	0	* TP	Kuffour
							removal given	(2010)
med (R)	0.62	[0.22]	0.38	-	0	0	given	- PA
	0.62 5 0.6	[0.22]	0.38 0.3	-	C	0	given .	PA Nikiema et
k	5	[0.22]		-	o c	0	* TN recovery in sludge,	- PA
k	S 0.6	[0.22]	0.3	0.3	C	0	* TN recovery in sludge, paved drying beds	PA Nikiema et al. (2014)
k	5	[0.22]		0.3	c c	0	* TN recovery in sludge, paved drying beds * see calculations	PA Nikiema et
k	S 0.6	[0.22]	0.3	0.1	c	0	* TN recovery in sludge, paved drying beds * see calculations in 22.2.1 * NH4	PA Nikiema et al. (2014) Cofie et al. (2006) Montanger
k	5 0.6 0.61	[0.22]	0.39	0.1	c	0	* TN recovery in sludge, paved drying beds * see calculations in 22.2.1 * NH4 removal	PA Nikiema et al. (2014) Cofie et al. (2006)
k	5 0.6 0.61	[0.22]	0.39	0.3	c	0	* TN recovery in sludge, paved drying beds * see calculations in 22.2.1 * NH4 removal rates given (0.4 - 0.6) * Removals	PA Nikiema et al. (2014) Cofie et al. (2006) Montanger o and Strauss (2002) Kuffour
k	0.61 0.5	[0.22]	0.39	0.3	c	0	* TN recovery in sludge, paved drying beds * see calculations in 22.2.1 * NH4 retail rates given (0.4 - 0.6)	PA Nikiema et al. (2014) Cofie et al. (2006) Montanger o and Strauss (2002) Kuffour
k	0.61 0.5	[0.22]	0.39	0.3	c	0	*TN recovery in sludge, paved drying beds *see calculations in 22.2.1 *NH4 removal rates given (0.4 - 0.6) *Removals of different N compounds	PA Nikiema et al. (2014) Cofie et al. (2006) Montanger o and Strauss (2002) Kuffour
k	0.61 0.50 0.70		0.39	2 0.3	o c	0	*TN recovery in sludge, paved drying beds * see calculations in 22.2.1 * NH4 removal rates given (0.4 - 0.6) * Removals of different N compounds given (0.2-0.4)	PA Nikiema et al. (2014) Cofie et al. (2006) Montanger o and Strauss (2002) Kuffour (2010)
k	0.61 0.5		0.39	0.3		0	*TN recovery in sludge, paved drying beds *see calculations in 22.2.1 *NH4 removal rates given (0.4 - 0.6) *Removals of different N compounds given (0.2-0.4) *Net TN	PA Nikiema et al. (2014) Cofie et al. (2006) Montanger o and Strauss (2002) Kuffour (2010) PA O'Shaughne
k	0.61 0.50 0.70		0.39	0.1		0	*TN recovery in sludge, paved drying beds * see calculations in 22.2.1 * NH4 removal rates given (0.4 - 0.6) * Removals of different N compounds given (0.2- 0.4) * Net TN loss due to volatilizatio	PA Nikiema et al. (2014) Cofie et al. (2006) Montanger o a nd Strauss (2002) Kuffour (2010)
k	0.61 0.50 0.70		0.39	0.1		0 0 0	*TN recovery in sludge, paved drying beds calculations in 22.2.1 *NH4 removal rates given: (0.4 - 0.6) *Removals of different N compounds given (0.2- 0.4) *Net TN loss due to volatilizatio n, solar	PA Nikiema et al. (2014) Cofie et al. (2006) Montanger o and Strauss (2002) Kuffour (2010) PA O'Shaughne ssy et al.
k	0.61 0.50 0.70		0.39	0.1		0 0 0	*TN recovery in sludge, pawed drying beds - calculations in 22.2.1 *NH4 removal rates given (0.4 - 0.6) *Removals of different N compounds given (0.2- 0.4) *Net TN loss due to volatilizatio n, solar drying, no effluent,	PA Nikiema et al. (2014) Cofie et al. (2006) Montanger o and Strauss (2002) Kuffour (2010) PA O'Shaughne ssy et al.
k	0.61 0.50 0.70		0.39	0.1		0 0 0	*TN recovery in sludge, paved drying beds *see calculations in 22.2.1 *NH4 rates given (0.4 - 0.6) *Removals of different N compounds given (0.2- 0.4) *Net TN loss due to : volatilization in, solar drying, no effluent, differences due to due to	PA Nikiema et al. (2014) Cofie et al. (2006) Montanger o and Strauss (2002) Kuffour (2010) PA O'Shaughne ssy et al.
k	0.61 0.52		0.39 0.20 0.1	0.1		0 0 0	*TN recovery in sludge, paved drying beds * see calculations in 22.2.1 * n. 14.2 * n.	PA Cofie et al. (2024) Cofie et al. (2006) Montanger o and Strauss (2002) Kuffour (2010) PA O'Shaughne ssy et al. (2008)
k	0.61 0.50 0.70		0.39	0.1		0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	*TN recovery in studge, paved drying beds *See Calculations in 22.2.1 *NH4 rates given (0.4 - 0.6) *Removals or different N compounds given (0.2- 0.4) *Net TN loss due to volatilizatio n, solar drying, no effluent, differences due to volatilizatio n, solar *TN off	PA. Dikikema et al. (2014) Cofie et al. (2006) Montanger o and Strauss (2002) Kuffour (2010) PA. O'Shaughne ssy et al. (2008)
k	0.61 0.52		0.39 0.20 0.1	0.1		0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	*TN recovery in sludge, pawed visudge, pawed visudge, pawed visudge, pawed visudge, pawed visudge, pawed visudge, pawed visudge, pawed visudge, pawed visudge, visudge, visudge, visudge, visudge, visudge, visudge, visudge, pawed visudge,	PA Cofie et al. (2024) Cofie et al. (2006) Montanger o and Strauss (2002) Kuffour (2010) PA O'Shaughne ssy et al. (2008)
k	0.61 0.52		0.39 0.20 0.1	0.1		0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	*TN recovery in studge, pawed visudge, pawed visudge, pawed visudge, pawed visudge, pawed visudge, pawed visudge, pawed visudge, pawed visudge, pawed visudge, visudg	PA Cofie et al. (2014) Cofie et al. (2006) Montanger o and Strauss (2002) Kuffour (2010) PA O'Shaughne ssy et al. (2008)
TN	0.61 0.70 0.70 0.70 0.55	0.41-0.7	0.39 0.30 0.30 0.30 0.30 0.30 0.30 0.30	0.3 0.3 0.3 0.48		0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	*TN recovery in sludge, pawed drying beds * see calculations in 22.2.1 * NH4 removal rates given (0.4 - 0.6) * Removals of different N compounds given (0.2- 0.4) * Net TN loss due to volatilizatio n, solar drying, no effluent, differences due to tillage and temp * TN of sludges decreased by 30-59%	PA Cofie et al. (2014) Cofie et al. (2006) Montanger o and Strauss (2002) Kuffour (2010) PA O'Shaughne ssy et al. (2008)
med (R)	0.61 0.51 0.52 0.55 0.58	0.41-0.7	0.39 0.20 0.11	0.3 0.3 0.3 0.48		0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	*TN recovery in studge, paved drying beds *see calculations in 22.2.1 *NH4 removal rates given (0.4-0.6) *Removals of different (0.4-0.6) *Removals of different (0.4-0.6) *Net TN loss due to volatilizatio n, solar drying, no effluent, "TN of sludges and temp *TN of sludges by 30-59% through air drying,	PA Cofie et al. (2014) Cofie et al. (2006) Montanger o and Strauss (2002) Kuffour (2010) PA O'Shaughne ssy et al. (2008)
TN	0.61 0.70 0.70 0.70 0.55	0.41-0.7	0.39 0.30 0.30 0.30 0.30 0.30 0.30 0.30	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		0 0 0	*TN recovery in sludge, pawed drying beds * see calculations in 22.2.1 * NH4 removal rates given (0.4 - 0.6) * Removals of different N compounds given (0.2- 0.4) * Net TN ioss due to: volatilizatio n, solar drying, no effluent, differences due to tillage and temp * TN of sludges decreased by 30-59% through air drying Spuhler et	PA PA PA PA PA PA PA PA PA PA PA PA PA P
med (N)	0.61 0.61 0.50 0.70 0.70 0.55 0.55	0.41-0.7 0.41-0.7	0.39 0.30 0.10 0.10 0.10 0.11 0.18	0 0 1 0 1 0 1 0 1 0 1 0 1 0 1 0 1 0 1 0		0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	*TN recovery in sludge, pawed drying beds * see calculations in 22.2.1 * NH4 removal rates given: (0.4 - 0.6) * Removals of different N compounds given (0.2- 0.4) * Net TN ioss due to: volatilizatio n, solar drying, no effluent, differences due to tillage and temp * TN of sludges decreased by 30-59% through air drying Spuhler et al. (2021) * see	PA PA PA PA PA Nikiema et al. (2014) Nikiema et al. (2024) Nikiema et al. (2026) Nikiema et al. (2026) Nikiema et al. (2026) Nikiema et al. (2020) Nikiema
med (N)	0.61 0.61 0.50 0.70 0.70 0.50 0.50 0.50 0.50 0.50	0.41-0.7 0.41-0.7	0.39 0.39 0.15 0.18 0.18 0.18	0 0 1 0 1 0 1 0 1 0 1 0 1 0 1 0 1 0 1 0		0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	*TN recovery in sludge, pawed drying beds * see calculations in 22.2.1 * NH4 removal rates given (0.4 - 0.6) * Removals of different N compounds given (0.2- 0.4) * Net TN ioss due to: volatilizatio n, solar drying, no effluent, differences due to tillage and temp * TN of sludges decreased by 30-59% through air drying Spuhler et al. (2021) * see calculations in 22.2.2	PA PA PA PA Nikiema et al. (2014) Nikiema et al. (2024) Nikiema et al. (2024) Nikiema et al. (2026) Nikiema et al. (2026) Nikiema et al. (2020) Nikiema et
med (R)	0.61 0.61 0.50 0.70 0.70 0.50 0.50 0.50 0.50 0.50	0.41-0.7 0.41-0.7 0.42-0.79	0.39 0.39 0.15 0.18 0.18 0.18	0.3 0.3 0.3 0.4 0.4 0.4 0.3 0.25 0.25		0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	*TN recovery in sludge, pawed drying beds * see calculations in 22.2.1 * NH4 removal rates given (0.4 - 0.6) * Removals of different N compounds given (0.2- 0.4) * Net TN loss due to volatilizatio n, solar drying, no effluent, differences due to tillage and temp * TN of sludges decreased by 30-59% through air drying Spublier et al. (2021) * see calculations in 22.2.2 * solar	PA PA PA PA PA PA PA PA PA PA PA PA PA P
med (N)	0.61 0.61 0.50 0.70 0.70 0.55 0.58 0.58	0.41-0.7 0.41-0.7 0.42-0.79	0.39 0.30 0.10 0.11 0.18 0.18 0.18 0.22	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	*TN recovery in studge, paved drying beds *see calculations in 2.2	P. P. P. P. P. P. P. P. P. P. P. P. P. P
med (R) bal. k H2O	0.58 0.58 0.59 0.50 0.70 0.70 0.70 0.52 0.58 0.58 0.58 0.58 0.20 0.20 0.20	0.41-0.7 0.41-0.7 0.42-0.79	0.39 0.30 0.10 0.11 0.12 0.12 0.13 0.13 0.13 0.14 0.15 0.15 0.15 0.15 0.15 0.15 0.15 0.15	0 0.3 0 0.3 0 0.3 0 0.3 0 0.3 0 0.3 0 0.3 0 0.3 0 0.3 0 0.3 0 0.3 0 0.3 0 0.3 0 0.3 0 0.3 0 0.3 0 0.3 0 0.3			*TN recovery in studge, paved drying beds *see calculations in 2.2.1 *NH4 removal rates given (0.4 - 0.6) *Removals different N compounds given (0.2- 0.4) *Net TN loss due to votalitizatio n, solar drying, no effluent, "TN of studge by 30-59% through air drying speed by 30-59% through air drying speed spe	PA PA PA PA PA PA PA PA PA PA PA PA PA P
med (R) med (R) bal. ### H2O med (R)	0.50 0.50 0.50 0.50 0.50 0.50 0.50 0.50	0.41-0.79 0.41-0.79 (0.14-0.79) (0.14-0.79)	0.39 0.39 0.30 0.30 0.30 0.30 0.30 0.30	0 0.3 0 0.3 0 0.3 0 0.3 0 0.3 0 0.25 0 0.25 0 0.3 0 0.36			*TN recovery in studge, paved drying beds *see calculations in 22.2.1 *NH4 removal rates given (0.4 - 0.6) *Removals of different N compounds given (0.2-0.4) *Net TN loss due to volstilization, solar drying, no effluent time.	P. P. P. P. P. P. P. P. P. P. P. P. P. P
med (R) bull med (R) med (R)	0.61 0.61 0.50 0.70 0.70 0.52 0.55 0.58 0.58 0.14 0.20 0.21	0.41-0.79 0.41-0.79 (0.14-0.79) (0.14-0.79)	0.39 0.39 0.15 0.15 0.18 0.18 0.18 0.18 0.19 0.22	0 0.3 0 0.3 0 0.3 0 0.3 0 0.3 0 0.25 0 0.25 0 0.3 0 0.36			*TN recovery in studge, paved drying beds *see calculations in 22.2.1 *NH4 removal rates given (0.4 - 0.6) *Removals of different N compounds given (0.2-0.4) *Net TN loss due to volstillization, osolar drying, no effluent time. *TN of studges and time time time time time to the time time time time time time time. Spuhler et al. (2021) *see calculations in 22.2.2 *solar drying, no effluent efficient.	PA PA PA Nikiema et al. (2014) Nikiema et al. (2014) Nikiema et al. (2014) Nikiema et al. (2016) Nikiema et al. (2016) Nikiema et al. (2016) PA PA PA PA PA PA PA PA PA PA PA PA PA
med (R) med (R) bal. #20 med (R)	0.50 0.50 0.50 0.50 0.50 0.50 0.50 0.50	0.41-0.7 0.41-0.7 0.41-0.7 (0.4) (0.4) (0.4)	0.39 0.39 0.30 0.30 0.30 0.30 0.30 0.30	0 0.1 0 0.3 0 0.3 0 0.3 0 0.3 0 0.3 0 0.3 0 0.3 0 0.3 0 0.3 0 0.3 0 0.3 0 0.3 0 0.3 0 0.3 0 0.3		0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	*TN recovery in sludge, pawed drying beds * see calculations in 22.2.1 * NH4 removal rates given in (0.4 - 0.6) * Removals of different N compounds given (0.2- 0.4) * Net TN compounds given (0.2- 0.4) * Net TN ioss due to volatilizatio n, solar drying, no effluent, differences due to tillage and temp * TN of sludges decreased by 30-59% through air drying. Spuhler et al. (2021) * see calculations in 22.2.2 * solar drying, no effluent.	PA PA PA Nikiema et al. (2014) Nikiema et al. (2014) Nikiema et al. (2014) Nikiema et al. (2016) Nikiema et al. (2016) Nikiema et al. (2016) PA PA PA PA PA PA PA PA PA PA PA PA PA
med (R) med (R) bal. #20 med (R)	0.61 0.52 0.52 0.55 0.55 0.56 0.56 0.57 0.57 0.58 0.58 0.14 0.20 0.33 0.33	0.41-0.7 0.41-0.7 0.41-0.7 (0.4) (0.4) (0.4)	0.39 0.39 0.15 0.15 0.18 0.18 0.18 0.19 0.20 0.30 0.30 0.33	0 0.1 0 0.3 0 0.3 0 0.3 0 0.3 0 0.3 0 0.3 0 0.3 0 0.3 0 0.3 0 0.3 0 0.3 0 0.3 0 0.3 0 0.3 0 0.3		0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	*TN recovery in sludge, pawed furying beds * see calculations in 22.2.1 * NH4 removal rates given (0.4 - 0.6) * Removals of different N compounds given (0.2- 0.4) * Net TN ioss due to: volatilizatio n, solar drying, no effluent, differences due to tillage and temp * TN of sludges decreased by 30-59% through air drying Spuhler et al. (2021) * see calculations in 22.2.2 * solar drying, no effluent * see calculations in 22.2.2 * solar drying, no effluent	PA Nikiema et al. (2014) Cofie et al. (2024) Cofie et al. (2006) Montanger O'Shaughne (2010) PA O'Shaughne (2010) Riyan und Reeney (1975) A Normal A Normal Cofie et al. (2014) O'Shaughne Cofie et al. (2014) A A A A A A A A A A A A A A A A A A
med (R) med (R) bal. #20 med (R)	0.61 0.52 0.52 0.55 0.55 0.56 0.56 0.57 0.57 0.58 0.58 0.14 0.20 0.33 0.33	0.41-0.7 0.41-0.7 0.41-0.7 (0.4) (0.4) (0.4)	0.39 0.39 0.15 0.15 0.18 0.18 0.18 0.19 0.20 0.30 0.30 0.33	0 0.1 0 0.3 0 0.3 0 0.3 0 0.3 0 0.3 0 0.3 0 0.3 0 0.3 0 0.3 0 0.3 0 0.3 0 0.3 0 0.3 0 0.3 0 0.3		0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	*TN recovery in sludge, pawed furying beds *see calculations in 22.2.1 *NH4 removal rates given (0.4 - 0.6) *Removals of different N compounds given (0.2- 0.4) *Net TN compounds given (0.2- 0.4) *Net TN coss due to: volatilization n, solar drying, no effluent, differences due to tillage and temp *TN of sludges decreased by 30-59% through air drying Spuhler et al. (2021) *see calculations in 22.2.2 *solar drying, no effluent *see calculations in 22.2.2 *solar drying, no effluent *see calculations in 22.2.2 *solar removal SS (TS=0.78, estimated	PA PA PA PA PA PA PA PA PA PA PA PA PA P
med (R) med (R) bal. #20 med (R)	0.61 0.52 0.53 0.58 0.58 0.14 0.20 0.33 0.33 0.78	0.41-0.7 0.41-0.7 0.41-0.7 (0.4) (0.4)	0.39 0.30 0.15 0.15 0.18 0.18 0.18 0.18 0.22 0.03 0.33 0.33	0 0.1 0 0.3 0 0.3 0 0.3 0 0.3 0 0.3 0 0.3 0 0.3 0 0.3 0 0.3 0 0.3 0 0.3 0 0.3 0 0.3 0 0.3 0 0.3 0 0.3 0 0.3 0 0.3		0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	*TN recovery in sludge, pawed drying beds *see calculations in 22.2.1 *NH4 removal rates given (0.4 - 0.6) *Removals given (0.2 - 0.6) *Net TN compounds given (0.2 - 0.4) *Net TN loss due to : volatilization , solar drying, no effluent temp *TN of sludges decreased by 30-59% through air drying with the side of the si	PA Niklema et al. (2014) Cofie et al. (2024) Montanger O'Shaughne PA O'Shaughne (2010) PA Strauss (2002) ASTraus Sayet al. (2014) Signade et al. (2014) ASTraus (2008) Montanger ASTraus (2000) Montanger ASTraus (2000) Montanger ASTraus (2000) Montanger ASTraus (2000) Montanger ASTraus (2000)
med (R) bal. k H20 med (R) Fig. 15	0.61 0.52 0.52 0.53 0.58 0.58 0.14 0.20 0.33	0.41-0.79 (0.14-0.79) (0.14-0.79)	0.39 0.39 0.15 0.15 0.15 0.16 0.18 0.18 0.20 0.20 0.20	0 0.1 0 0.3			*TN recovery in sludge, paved drying beds *see calculations in 22.2.1 *NH4 removal rates given (0.4 - 0.6) *Removals of different N compounds given (0.2- 0.4) *Net TN loss due to volatilizatio n, solar drying, no effluent temp *TN of sludges decreased by 30-59% through air drying *Spuhler et al. (2021) *see calculations in 22.2.2 *solar *see calculations in 22.2.1 *Solar *See calculations in 22.2.1 *Solar *See calculations in 22.2.3 *Solar *Sola	PA A A A A A A A A A A A A A A A A A A
med (R) med (R) bal. #20 med (R)	0.61 0.62 0.70 0.70 0.52 0.55 0.55 0.58 0.14 0.20 0.31 0.20 0.38 0.37 0.38 0.38 0.38 0.38 0.38 0.38 0.38 0.38	(0.14-0.79) (0.14-0.79) (0.15-0.78)	0.39 0.39 0.15 0.15 0.15 0.16 0.18 0.18 0.20 0.20 0.20	0 0.1 0 0.3			*TN recovery in sludge, paved drying beds *see calculations in 22.2.1 *NH4 removal rates given (0.4 - 0.6) *Removals of different N compounds given (0.2- 0.4) *Net TN loss due to volatilizatio n, solar drying, no effluent temp *TN of sludges decreased by 30-59% through air drying *Spuhler et al. (2021) *see calculations in 22.2.2 *solar *see calculations in 22.2.1 *Solar *See calculations in 22.2.1 *Solar *See calculations in 22.2.3 *Solar *Sola	PA Niklema et al. (2014) Cofie et al. (2024) Montanger O'Shaughne PA O'Shaughne (2010) PA Strauss (2002) ASTraus Sayet al. (2014) Signade et al. (2014) ASTraus (2008) Montanger ASTraus (2000) Montanger ASTraus (2000) Montanger ASTraus (2000) Montanger ASTraus (2000) Montanger ASTraus (2000)
med (R) bal. k 120 med (R) bal. k 120	0.61 0.52 0.52 0.53 0.58 0.58 0.14 0.20 0.31 0.78	0.41-0.7 0.41-0.7 (0.41-0.79) (0.14-0.79) (0.15-0.78)	0.39 0.30 0.30 0.30 0.30 0.30 0.30 0.30	0 0.1 0 0.3			*TN recovery in sludge, paved drying beds *see calculations in 22.2.1 *NH4 removal rates given (0.4 - 0.6) *Removals of different N compounds given (0.2- 0.4) *Net TN loss due to volatilizatio n, solar drying, no effluent temp *TN of sludges decreased by 30-59% through air drying *Spuhler et al. (2021) *see calculations in 22.2.2 *solar *see calculations in 22.2.1 *Solar *See calculations in 22.2.1 *Solar *See calculations in 22.2.3 *Solar *Sola	PA Nikiema et al. (2014) Cofie et al. (2024) Montanger O'Shaughne PA O'Shaughne (2010) PA Strauss (2002) ASTraus Sayet al. (2014) Sayet al. (2014) Montanger ASTraus (2008) Montanger ASTraus (2000) Montanger ASTraus (2000) Montanger ASTraus (2000) Montanger ASTraus (2000) Montanger ASTraus (2000)
med (R) bul. k H2O med (R) bul. k TS	0.61 0.52 0.52 0.53 0.58 0.58 0.14 0.20 0.31 0.78	(0.14-0.79) (0.14-0.79) (0.15-0.78)	0.39 0.30 0.30 0.30 0.30 0.30 0.30 0.30	0 0.1 0 0.3			*TN recovery in sludge, paved drying beds *see calculations in 22.2.1 *NH4 removal rates given (0.4 - 0.6) *Removals of different N compounds given (0.2- 0.4) *Net TN loss due to volatilizatio n, solar drying, no effluent temp *TN of sludges decreased by 30-59% through air drying *Spuhler et al. (2021) *see calculations in 22.2.2 *solar *see calculations in 22.2.1 *Solar *See calculations in 22.2.1 *Solar *See calculations in 22.2.3 *Solar *Sola	PA Nikiema et al. (2014) Cofie et al. (2024) Montanger O'Shaughne PA O'Shaughne (2010) PA Strauss (2002) ASTraus Sayet al. (2014) Sayet al. (2014) Montanger ASTraus (2008) Montanger ASTraus (2000) Montanger ASTraus (2000) Montanger ASTraus (2000) Montanger ASTraus (2000) Montanger ASTraus (2000)

TS	0.8	_	0.2	0	0	0 * see
						calculations
						in 22.2.1
	0.78	-	0.22	0	0	0 * 95%
						removal SS
						(TS=0.78,
						estimated
						from ratio
						in 22.2.3)
	0	-	0	0.04	0	0
med (R)	0.79	(0.75 -0.78)	0.21	0.04	0	0
bal.	0.75	-	0.21	0.04	0	0
k		[0.03)				
Additional Information						
Moisture content	H2O Sludge					
Incoming 0.95	·					
Dried sludge high moisture 0.75	0.79					
Dried sludge medium moisture 0.6	0.63					

Additional Information				
	Moisture content		H2O Sludge	
Incoming	0.95			
Dried sludge high moisture	0.75		0.79	
Dried sludge medium moisture	0.6		0.63	
Dried sludge low moisture	0.3		0.32	
			0.58	
Calculation			H2O Sludge = Moisture content in dried sludge	ge/
			moisture content in incoming sludge	
22.2.3	Data from Cofie et al. (2006)			
	Removal		Ratio TS:SS removal	
TS		0.8		
TSS		0.97		0.82
Calculation			Ratio= TS removal/ TSS removal	

References

References

References

References

References

Results, R., Renggl, S., & Reymond, P. (2018). Compendium of Sonitation Technologies in Emergencies. German WASH Network (GWN), Swiss Federal Institute of Aquatic Science and Technology (Eawag), Global WASH Cluster (GWC) and Sustainable Sanitation Alliance (SuSanA). Lockstok, T., & Reller, J. (2002). A decision support system for selecting sanitation systems in developing countries. Socio-Economic Planning Sciences, 38 (4), 267–290. https://doi.org/10.1016/S0038-0121(02)00007-1 Spubler, D., & Roll

		Data Source				
FUNCTIONAL GROUP UNIQUE IDENTIFIER (ID) DATA COMPILER	T planted_drying_bed SaniChoice Project Team		1			
INPUT PRODUCT	sludge, transportedsludge,	Spuhler, D. & Roller, L. (2020)				
OUTPUT PRODUCT	stabilized_sludge, transportedstabilized sludge, effluent,	Spuhler, D. & Roller, L. (2020)				
RELATIONS	Input: OR	Spuhler, D. & Roller, L. (2020)				
COMMENTS	Output: AND		-			
Filter Criteria applicability_level	Values (household = 0, neighbourhood = 0.5, city = 1)	Data Source Tilley, E. et al. (2014)				
management level capex reg level		Tilley, E. et al. (2014) Spuhler, D. et al. (2021)	1			
opex reg level technical maturity	5	Spuhler, D. et al. (2021) Tilley, E. et al. (2014)				
	(acute = 0, stabilisation = 0.5, development/recovery = 1)	Gensch, R. et al. (2018) Applicable for this Functional Group?	Categories [Unit]	W. A. J. J. M. J. (B. J.)	Data Source / Assumptions	Internal Review Done?
water_supply	Type and Function Performance, Categorical	FALSE	house yard	Technology Values (Data) NA	NA NA	NA NA
			public none			
water volume electricity_supply	Performance, Trapez Performance, Categorical	TRUE	[L/cap/day] electricity intermittent	NA (electricity = 1, intermittent = 1, no electricity = 1)	NA "No electrical energy required" (Compendium)	NA yes
fuel_supply	Performance, Categorical	FALSE	no electricity fuel	NA NA		NA .
frequency_of_om	PDF, Categorical		no fuel irregular	(irregular = 0, regular = 1, continous = 0)		yes
	<u> </u>		regular continuous		is required to ensure proper functioning. The drains must be maintained and the effluent properly collected and disposed of. The	
	<u> </u>				plants should have grown sufficiently before applying the sludge. The acclimation phase is	
	<u> </u>				crucial and requires much care. The plants should be periodically thinned and/or	
	 				harvested. After 3 to 5 years the sludge can be removed." (Compendium)	
pipe_supply	Performance, Categorical	TRUE	no pipes	(no pipes = 0, difficultly available = 0.5, pipes	"A planted drying bed is similar to an	yes
			difficultly available pipes	=1)	Unplanted Drying Bed []." (Compendium) "The bottom of the unplanted drying bed is	
	 				lined with perforated pipes to drain the leachate away that percolates through the bed."(Compendium -> T.14 Unplanted Drying	
	 				Beds) Therefore pipes are needed for the	
pump_supply	Performance, Categorical	TRUE	no pumps	(no pumps = 1, difficultly available = 1,	technology. No need for pumps	yes
	Budan	TOHE	difficultly available pumps no concrete	pumps = 1)		MAP
concrete_supply	Performance, Categorical	Inut	no concrete difficultly available concrete	(no concrete = 0.5, difficultly available = 0.75, concrete = 1)	Unplanted Drying Bed []." (Compendium) "The bed frame (of an unplanted drying bed)	yes
	 				is usually made from concrete or a plastic liner with the bottom surfaces slightly sloped	
	 				in order to facilitate percolation and drainage." (Spuhler, n.d.) "The bed itself can be constructed with	
	<u> </u>				"The bed itself can be constructed with cement and bricks or concrete and needs to be sealed at the bottom." (Emersan)	
	<u> </u>				It is assumed that concrete has a longer lifetime and locals have more experience	
	<u> </u>				with it than with plastic liners. Therefore, the performance is slightly better with concrete.	
spare_parts	PDF, Categorical	TRUE	simple technical	(simple = 1, technical = 0, special = 0)	gravel and sand with the right grain size.	yes
	 		special		Local plants can be used. Furthermore, piping is needed for drainage and ventilation. To	
	<u> </u>				remove dried sludge, shovels and rakes are required as well as personal protective equipment (PPE). The bed itself can be	
	 				constructed with cement and bricks or concrete and needs to be sealed at the	
	 				bottom", "Can be built and repaired with locally available materials" (Emersan)	
0		FALSE) NA	NA NA	NA NA
0 0 temperature	0 0 Performance, Categorical	FALSE FALSE TRUE	very cold	NA NA (very cold = 0.3, cold = 0.5, temperate = 1,	NA "A planted drying bed is similar to an	NA NA yes
temperature	i chamante, categorical		cold temperate	(very coid = 0.3, coid = 0.5, temperate = 1, warm = 1, hot = 1)	Unplanted Drying Bed []." (Compendium) "This is a low-cost option that can be	•
	 		warm hot		installed in most hot and temperate climates." (Compendium)	
	 				Sludge application rates of 100 to 250 kg/m2/year have been reported in warm tropical climates. In colder climates, such as	
	 		I		northern Europe, rates up to 80 kg/m2/year are typical. (Compendium -> T.15 Planted	
	i '					
flooding					Drying Beds) Yearly average temperatures in Europe are	
	Performance, Categorical	TRUE	flooding no flooding	(flooding = 0.5, no flooding = 1)	Drying Beds) Yearly average temperatures in Europe are assumed to be cold. "A planted drying bed is similar to an Unplanted Drying Bed []." (Compendium)	yes
	Performance, Categorical	TRUE	flooding na flooding	(flooding = 0.5, no flooding = 1)	Drying Beds) Yearly average temperatures in Europe are assumed to be cold. "A planted drying bed is similar to an Unplanted Drying Bed []." (Compendium) "If installed in wet climates, the facility should be covered by a roof and special	yes
	Performance, Categorical	TRUE	flooding no flooding	(flooding = 0.5, no flooding = 1)	Drying Beds) Yearly average temperatures in Europe are assumed to be cold. A planted drying bed is similar to an Unplanted Drying Bed [].* (Compendium) 'If installed in wet climates, the facility should be covered by a roof and special caution should be given to prevent the inflow of surface runoff. (Compendium - 7-1.4	yes
	Performance, Categorical	TRUE	flooding no flooding	(flooding = 0.5, no flooding = 1)	Drying Beds) Yesriy average temperatures in Europe are assumed to be cold. "A planted drying bed is similar to an Uspianted Drying Bed []" (Compendium) "If installed in wet climates, the facility should be covered by a roof and special caution should be given to prevent the influence of surface runoff." (Compendium > T.1.4 Uspianted Drying Beds) old library = 20-Dec_dd=12 days per year >	yes
	Performance, Categorical	TRUE	Reading no fooding	(flooding = 0.5, no flooding = 1)	Drying Blods) Veryin yaverage temperatures in Europe are assumed to be cold. A plainted drying bed is similar to an "A plainted drying bed is similar to an "A plainted drying bed is similar to an "A plainted drying bed is similar to an "A plainted drying bed in the similar to an expension of the similar to a simil	yes
	Performance, Categorical	TAUE	Reading no fooding	(Rooding = 0.5, no flooding = 1)	Oring Bod) Text's yearing emperatures in Europe are assumed to be cold. A planted drying Bod is smile to an oring a second or a second oring a second oring a second oring a second oring a second oring a second oring oring second oring se	भ वः
	Performance, Categorical	TAUE	Reading no flooding	(Rooding = 0.5, no flooding = 1)	Oring Bod) Text's yearing entire in Europe are assumed by be cold. "A plainted drying Bed L.]-" (Compendium) to the plainter to an implanted bying Bed L.]-" (Compendium) to plainted bying Bed L.]-" (Compendium) to the cold bed green to prevent the inflow of unification should be given to prevent the inflow of unification should be given to prevent the inflow of unification should be given to prevent the inflow of unification should be given to prevent the inflow of unification should be given to prevent the inflow of unification should be given to prevent the inflow of unification should be given to prevent the inflow of unification should be given and unification should be given all products and the insulation should be given all products and the insulation should be given all products and the insulation should be given all products and the insulation should be given all products and the insulation should be given all products and the insulation should be given all products and the insulation should be given as a should	भ वः
	Performance, Categorical	TAUE	Reading no flooding	(Rooding = 0.5, no flooding = 1)	Oring Body Textly swenge from the standard stan	yes
	Performance, Categorical	TANE	Reading no flooding	(Rooding = 0.5, no flooding = 1)	Oring Bed) Text's yearing entire in Europe are assumed by be cold. A planted drying Bed1 is smile to an animal by a cold in the cold. A planted drying Bed1 is smile to animal in the cold in the c	yes
	Performance, Categorical	TRUE	Reading no flooding	(Rooding = 0.5, no flooding = 1)	Dring Bedő) ir Kranji wenge temperature in Europe are Kranji wenge temperature in Europe are Kranji wenge temperature in Europe are A planted drying Bed is similar to an Uniformation of the European (Eu	yes
			Reading no flooding	(Reading = 0.5, no flooding = 1)	Coring Bods) Texts yearing entures in Europe are assumed to be cold. Texts yearing entures in Europe are assumed to be cold. Linch yearing entures in Service to an Unique to the Cold of the Cold	ha:
vehicular_acces	Performance, Categorical Performance, Categorical		Reading no flooding	(Reading = 0.5, no flooding = 1)	Chring Bedd) Text's yearing entires in Europe are sixtened by the cold. Text's yearing entires in Europe are sixtened by the cold. Text's yearing entire in Statistical to an important of the cold	yes
vehicular_acces slope		FALSE	no flooding no lectors no lectors find fail flat	(Booding = 0.5, no flooding = 1) NA NA	Coring Bods) Christy berding temperatures in Europe are insumed by the cold. It shared by the cold of the cold o	
	Performance, Categorical Performance, Categorical	FALSE FALSE	no fooding no access official fast fast mon fast	NA.	Oring Body Christy berge from perstures in Europe are sistended by be cold. It share you write get many the cold of the cold	NA.
slope	Performance, Categorical Performance, Categorical	FALSE FALSE	no flooding no access difficult full flat end f	NA.	Oring Body Christy berge from perstures in Europe are sistended by be cold. It share you write get many the cold of the cold	NA.
slope soil_type groundwater_depth	Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical	FALSE FALSE FALSE	no flooding De access of access of access of access of access full flat nor file clay stand graved rock water depth (m)	NA NA NA	Coring Bedol : Throwly wenge remperatures in Europe are assumed by the Say of the Say o	NA NA
slope soil_type	Performance, Categorical Performance, Categorical Performance, Categorical	FALSE FALSE FALSE	no fooding no access official flat met flat clay stand gravel costs.	NA.	Coring Bedol : Strawly sering emperatures in Europe are seament be the cold. Texts yearing extension of the continuation of the cold. Texts yearing extension of the cold o	NA. NA.
slope soil_type groundwater_depth	Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical	FALSE FALSE FALSE	no ficoding no access difficult fall fall fall fall fall fall fall fa	NA NA NA	Chring Bedin Threshy average remogratures in Europe are Tarishy average remogratures in Europe are Tarishy average remogratures in Europe are Taplanted Chring Bed (L) (Compendium* Til Installed L) (To Compendium* Til Installed in west dimates, the facility should be covered by a road and special should be covered by a road and special food should be covered by a road and persist by the should be covered by a road should be covered by a road and persist by a road should be covered by a road food should be covered by a road food should be covered by a road to a should be covered by a road to a should be covered This is a technology that in necessarily built on the ground souries and first sined configurations in not possible. (e.g., all pond- based of whith of prings be of the other layers fooding events. However, it is possible that though a possible that should be a should be a should be should be a should be should be a should be should be should be should be should be should be should be should be should be should be should be should be should be should be should be should b	NA NA
signe soil_tyne soil_tyne groundwater desch gescantion	Performance, Categorical Performance, Categorical Performance, Categorical Performance, Topgorical Performance, Categorical	FALSE FALSE FALSE FALSE FALSE FALSE FALSE	no nocess of the control of the cont	NA NA NA	Coring Bedol Treaty were generatures in Europe are seamed to be cold. It shared by engine temperatures in Europe are seamed to be cold. It shared by engine the cold to an include the cold to the c	NA NA NA NA
signe soil_type groundwater_death excavation surface_eres_onaire	Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical	FALSE FALSE FALSE FALSE FALSE FALSE	no flooding no sccess file control of the control	NA NA NA NA NA NA NA NA NA NA NA NA NA N	Coring Bedol Trans) were get emperatures in Europe are seamed to be cold. It shared by engine the control of the control of the cold of t	NA NA
slope soil_type soil_type groundwater death groundwater death	Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical	FALSE FALSE FALSE FALSE FALSE FALSE	no nocess of the control of the cont	NA NA NA	Coring Bedd) Texts yearing entures in Europe are insumed by the cold. Texts yearing entures in Europe are insumed by the cold. Texts yearing enture in Section 2 in Section	NA NA NA NA
signe soil_type groundwater_death excavation surface_area_onaire	Performance, Categorical Performance, Categorical Performance, Categorical Performance, Trapez Performance, Trapez Performance, Trapez Performance, Trapez	FALSE FALSE FALSE TAUE FALSE FALSE FALSE FALSE FALSE	no flooding no access of the control of the contro	NA NA NA NA NA (easy = 1, hard = 0.5) NA (a = 0.05, b = 0.05, c = 999, d = 999)	Coring Bedol Treatly serving enterior in Europe are assumed to be cold. Treatly serving enterior in Europe are assumed to be cold. Treatly serving enterior in Europe are assumed to be cold. The Composition of the Europe Treatly and the Europe Treatly and the Europe Treatly and the Europe Treatly and Europe Treatly and Europe Treatly and Europe Treatly and Europe Treatly and Europe Treatly and Treatly Treatly and Treatly and Treatly Treatl	NA NA NA NA NA NA NA NA NA NA NA NA NA N
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signe soil_type soil_type groundwater_death excavation surface_area_onsite surface_area_offsite ointerior_area_offsite drinking_water_exposure construction_skills design_skills	Performance, Categorical Performance, Categorical Performance, Categorical Performance, Trapez Performance, Trapez Performance, Trapez Performance, Trapez Performance, Categorical O Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical	FALSE FALSE	no fooding no access of the property of the p	NA NA NA NA (easy = 1, hard = 0.5) NA (a = 0.05, b = 0.05, c = 999; d = 9999) NA NA NA NA NA NA NA NA (onskilled = 0, skilled = 0.5, professional = 1) (onskilled = 0, skilled = 1, professional = 1)	Chring Bedd) Throwly swenger temperatures in Europea are assumed the bet cold. Throwly swenger temperatures in Europea are assumed to be cold. Throwly swenger temperatures in Europea are assumed to be cold. Throwly swenger temperatures are assumed to the cold to the	NA. NA. NA. NA. NA. NA. NA. NA.

		FALSE	Washers Soft wipers	100	NA .	NA		
			Hard wipers					
0	0	FALSE		0 NA	NA .	NA.		
0 lifetime	0 Performance, Categorical	FALSE	short (< 1 year)	0 NA (short = 1, medium = 1, long = 1)	NA "Sludge drying reed beds can be continuously	NA yes	4	
meane.	Terramente, Casagorica		medium (1-5 years) long (>5 years)	(mon = 1, monum = 2, ong = 2)	used for a couple of years before sludge removal is required. [] Literature reports accumulation periods of 5-12 years with annual sludge accumulation rates of 0.08-0.2 m/y" (Sludge drying reed bed Griesauer, C. (2014)) Accumulation periods of more than 5 years			
					suggests that this technology can be used for a longer period of time. The whole sludge drying reed bed is expected to last for 30 years' (Sludge drying reed bed Jiersauer, C. (2014) in a study by Griesauer on the CLARA planning tool the expected lifetimes were larger than 5 years.			
speed_implement_toilet	PDF, Categorical		rapid (< 3 days) moderate (3 days to 2 weeks) slow (> 2 weeks)	NA	NA	NA		
speed_implement_treatment	PDF, Categorical	TRUE	rapid (few days to a week) moderate (few weeks up to three months) slow (> 3 months)	(rapid=0, moderate=1, slow=0)	"The bed kself can be constructed with cement and bricks or concrete and meds to be sealed at the bottom." "Can be built and repaired with locally available materials" (Emersan Compendium) Construction is quite simple however, since bricks and/or concrete is used for construction, minimum? days curing is required- and since no prefab units are	ув		
					available, probability is allotted only to moderate category and not rapid. (Akanksha Jain)			
scalability	Performance, Categorical	TRUE	easy difficult	(easy = 1, difficult = 0.8)	"On average, a 6 month start-up is recommended" (Planted Drying Beds - Strande et al. 2014) The planted drying bed capacity can be increased by increasing the number of drying beds. Due to a long start-up time to get the macrophytes acclimatised it will take time to stdf further planted droine beds. (Wolfe.)	yes		
construction_parts	PDF, Categorical	TRUE	simple technical	(simple = 1, technical = 0, special = 0)	add further planted drying beds. (Kukka Ilmanen, Eawag 2021) "Can be built and repaired with locally available materials" (Compendium)	yes	_	
ficients	[copied from "Sanitation_Technologies_TC_database_20210622.slsm	9	special					Į.
TP	Stabilized Sludge 0.97	Range	Effluent 0.0	Airloss 3	Soilloss	Waterloss	Comments * as PO4-P	Reference {Kengne, 2014 #1433}
med (R)	0.97		0.0	3		0	1	
								PA
k	5	PA	0.51	-				
	5 0.385	PA 0.35-0.42	0.61				* as TKN	(Kengne, 2014 #1433)
	0.385 0.905 0.90	PA 0.35-0.42	0.09	1	5	0	* as TKN * as TKN * as TKN	{Kengne, 2014 #1433} {Kengne, 2014 #1433} {Kengne, 2014 #1433}
	5 0.385 0.905 0.90 0.79	PA 0.35-0.42 0.82-0.99	0.09: 0.2: 0.2:	1	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0	* as TKN * as TKN * as TKN * as TKN * as TKN	(Kengne, 2014 #1433) (Kengne, 2014 #1433) (Kengne, 2014 #1433) (Kengne, 2014 #1433)
	0.385 0.905 0.905 0.9 0.7 0.85	9A 0.35-0.42 0.82-0.99 	0.09 0. 0.2 0.1:	5 1 1 1	5 () () () () () () () () () (* as TKN * as TKN * as TKN * as TKN * as TKN * as TKN	(Kengne, 2014 #1433) (Kengne, 2014 #1433) (Kengne, 2014 #1433) (Kengne, 2014 #1433) (Kengne, 2014 #1433)
k TN	0.385 0.905 0.90 0.79 0.85	0.35-0.42 0.82-0.99 	0.09 0. 0.2 0.1:	5 1 1 1 1 1 5 6			* as TKN * as TKN * as TKN * as TKN * as TKN	(Kengne, 2014 #1433) (Kengne, 2014 #1433) (Kengne, 2014 #1433) (Kengne, 2014 #1433)
	0.385 0.905 0.905 0.9 0.7 0.85	0.82-0.99 0.70-0.99 0.692-0.993	0.09 0. 0.2 0.1:	5 1 1 1 1 1 5 6	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		* as TKN * as TKN * as TKN * as TKN * as TKN * as TKN	(Kengne, 2014 #1433) (Kengne, 2014 #1433) (Kengne, 2014 #1433) (Kengne, 2014 #1433) (Kengne, 2014 #1433)
k TN	\$ 0.385 0.95	0 35-042 0 32-049 0 32-059 0 0.92-059 0 0.93-059 0 0.35-059	0.09 0.2 0.2 0.1 0.1 0.1 0.0 0.0 0.0 0.0	5 099			* 35 TXN * 35 TXN * 35 TXN * 35 TXN * 35 TXN * 35 TXN * 35 TXN * 35 TXN * 35 TXN * 35 TXN * 35 TXN * 35 X volume reduction within a year, assumed by evaportampiration, TCs in sludge and efficient sall of remaining MXD and a single sall of the state of th	[Kengne, 2014 #1433] [Kengne, 2014 #1433] [Kengne, 2014 #1433] [Kengne, 2014 #1433] [Kengne, 2014 #1433] [Kengne, 2014 #1433] [Kengne, 2014 #1433]
TN med (R) HZO	0.383 0.305 0.305 0.305 0.305 0.305 0.305 0.305 0.305 0.305 0.345 0.345 0.345 0.355 0.325	86 03-04 02 02-09 07-099 080-099 080-099 060-099	0.099 0.02 0.1 0.11 0.11 0.10 0.02	5 039			* 25 TEN * - 25 TEN *	[Kengne, 2014 #1433] [Kengne, 2014 #1433] [Kengne, 2014 #1433] [Kengne, 2014 #1433] [Kengne, 2014 #1433] [Kengne, 2014 #1433] [Kengne, 2014 #1433]
# TN med (R)	3 0.385 0.00	90 035-0175	0.09 0.2 0.2 0.1 0.1 0.1 0.1 0.2 0.2 0.2	5 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1		6	* as TNN * a	Storges, 2014 #1433 Storges, 2014 #1433 Storges, 2014 #1433 Storges, 2014 #1433 Storges, 2014 #1433 Storges, 2014 #1433 Storges, 2014 #1433 (Storges, 2014 #1433) (Storges, 2014 #1433)
TN med (R) ###################################	0.383 0.000	98 03-04-02 022-059 022-059 0202-059 0202-059 (041)	0.09 0.0 0.2 0.1 0.1 0.1 0.0 0.0 0.0 0.0 0.0 0.0 0.0	037		G G G G G G G G G G G G G G G G G G G	* as TNN * a	Sengine, 2014 #1413 Sengine, 2014 #1413 Sengine, 2014 #1413 Sengine, 2014 #1413 Sengine, 2014 #1413 Sengine, 2014 #1413 Sengine, 2014 #1413 Sengine, 2014 #1413 Sengine, 2014 #1433
med (R) med (R)	0.151 0.050 0.050 0.070 0.070 0.080 0.050 0.050 0.050 0.050 0.050 0.070 0.070 0.070 0.070 0.070 0.070 0.070 0.070 0.070 0.070 0.070 0.070 0.070 0.070	0.05-0.12 0.2-0.29 0.2-0.29 0.2-0.29 0.2-0.29 0.2-0.29 0.2-0.29 0.2-0.29 0.2-0.29 0.2-0.29 0.2-0.29 0.2-0.29 0.2-0.29 0.2-0.29 0.2-0.29	0.09 0.20 0.21 0.01 0.01 0.02 0.02 0.02 0.03 0.03 0.03 0.03 0.03	0.99		6	** a TNV ** a T	Searger, 2014 814133 (Searger, 2014 81413) (Searger, 2014 81413) (Searger, 2014 8143) (Searger, 2014 8143) (Searger, 2014 8143) (Searger, 2014 8143) (Searger, 2014 8143) (Searger, 2014 8143)
med (R) med (R)	0.155 0.000	0.03-0.22 0.03-0.03 0.03 0.03 0.03 0.03 0.03 0.03	0.09 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	0.55 0.57 0.57 0.57 0.57 0.57 0.57 0.57		0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	* as TNN * as T	Sengre, 2014 #1413 Sengre, 2014 #1413 Sengre, 2014 #1413 Sengre, 2014 #1413 Sengre, 2014 #1413 Sengre, 2014 #1413 Sengre, 2014 #1413 Sengre, 2014 #1413 Sengre, 2014 #1413 Sengre, 2014 #1413 Sengre, 2014 #1413 Sengre, 2014 #1413
med (R.) med (R.)	0.151 0.050 0.050 0.070 0.070 0.080 0.050 0.050 0.050 0.050 0.050 0.070 0.070 0.070 0.070 0.070 0.070 0.070 0.070 0.070 0.070 0.070 0.070 0.070 0.070	96 0.35-6.47 0.35-6.45 0.3	0.09 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	0.99			** a TNV ** a T	Searger, 2014 814133 (Searger, 2014 81413) (Searger, 2014 81413) (Searger, 2014 8143) (Searger, 2014 8143) (Searger, 2014 8143) (Searger, 2014 8143) (Searger, 2014 8143) (Searger, 2014 8143)
med (R) med (R)	0.055 0.050 0.050 0.070 0.050	98 0.35-0.47 0.22 0.99 0.22 0.99 0.22 0.99 0.23 0.99 0.99 0.99 0.99 0.99 0.99 0.99 0.9	0.09 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	0 0 0 0 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1			* as TNN * as T	Georgies, 2014 #1433 Georgies, 2014 #1433 Georgies, 2014 #1433 Georgies, 2014 #1433 Georgies, 2014 #1433 Georgies, 2014 #1433 Georgies, 2014 #1433 Georgies, 2014 #1433 Georgies, 2014 #1433 Georgies, 2014 #1433 Georgies, 2014 #1433 Georgies, 2014 #1433 Georgies, 2014 #1433 Georgies, 2014 #1433 Georgies, 2014 #1433 Georgies, 2014 #1433 Georgies, 2014 #1433 Georgies, 2014 #1433 Georgies, 2014 #1433 Georgies, 2014 #1433
med (R) med (R)	0.255 0.255	0.03-0.12 0.20-0.03 0.20-0.09 0.09-0	0.09 0.20 0.21 0.21 0.21 0.21 0.21 0.22 0.22	0.59			** as TNN ** as	Stenger, 2014 81433 Stenger, 2014 81433
med (1) 100 med (2) 100 med (3) 100 med (5	0.155 0.055	0.03-0.27 0.22-0.99 0.2-0.99 0.3-0.99 0.35-0.99 0.35-0.99 0.35-0.99 0.35-0.99 0.35-0.99 0.35-0.99 0.35-0.99	0.09 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	0.37			* as TNN * a	Ferrages, 2014 #1413 Ferrages, 2014 #1413
med (R.) med (R.)	0.255 0.055	0.31-0.27 0.22-0.99 0.7-0.99 0.35-0.99 0.35-0.99 (0.55) (0.55) 0.35-0.17 (0.55) 0.35-0.17 (0.55) 0.35-0.17 (0.55) 0.35-0.27 0.35-	0.09 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	0.50 0.50 0.50 0.50 0.50 0.50 0.50 0.50			* as TNN * a	Georgee, 2014 #1413
med (8) ### ### ############################	0.255 0.305	0.05-0.17 0.25-0.97 0.25-0.97 0.890 0.99 0.890 0.99 0.690 0.990 0.99 0.690 0.99 0.690 0.99 0.690 0.99 0.690 0.99 0.690 0.99 0.690 0.99 0.690 0.99 0.690 0.99 0.690 0.99 0.690 0.99 0.690 0.990 0.99 0.690 0.990 0.99 0.690 0.990 0.990 0.990 0.990 0.690 0.990 0.	0.09 0.20 0.10 0.10 0.10 0.10 0.10 0.10 0.10	0.50 0.50 0.50 0.50 0.50 0.50 0.50 0.50			* as TNN * a	Sengre, 2014 #1433 Sengre, 2014 #1433 Sengre, 2014 #1433 Sengre, 2014 #1433 Sengre, 2014 #1433 Sengre, 2014 #1433 Sengre, 2014 #1433 Sengre, 2014 #1433 Sengre, 2014 #1433 Sengre, 2014 #1433 Sengre, 2014 #1433 Sengre, 2014 #1433 Sengre, 2014 #1433 Sengre, 2014 #1433 Sengre, 2014 #1433
med (8) ### ### ############################	0.15 0.05 0.05 0.05 0.05 0.05 0.05 0.05	0.15-0.17 0.25-0.19 0.2-0.09 0.2-0.09 0.3-0.09 0	0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.0	0.99 0.17 0.17 0.17 0.17 0.17 0.17 0.17 0.17			* as TNN * a	Georgies, 2014 #1413
med (8) ### ### ############################	0.255 0.255 0.255 0.255 0.275 0.275 0.275 0.275 0.275 0.275 0.275 0.277	0.25-0.25 0.25-0.25	0.09 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0			* as TNN * as TN * as TN	Georgies, 2014 #1413
med (n) med (n) M20 med (n) med (n) med (n) med (n) med (n)	0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25	0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.0	0.09 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	0.91 0.17 0.17 0.17 0.17 0.17 0.17 0.17 0.1			* as TNN * a	Georgies, 2014 #1413
med (8) 120 med (8) 120 med (8) 120 med (8) med (8) med (8)	0.285 0.285 0.205	0.15-0.25 0.12-0.25 0.12-0.25 0.12-0.25 0.12-0.25 0.0820 0.29 0.0830 0.29 0.15-0.15 0.	0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.0	0.91 0.17 0.17 0.17 0.17 0.17 0.17 0.17 0.1			* as TNN * as TN * as TN	Georgee, 2014 #1413
med (1) med (2) M20 med (2) solution med (3) med (4)	0.285 0.285 0.205	0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.0	0.09 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	0.91 0.17 0.17 0.17 0.17 0.17 0.17 0.17 0.1			* as TNN * as TN * as TN	Georges, 2014 81433
med (1) med (2) H2O med (3) med (6) a med (7) bad. med (8)	0.285 0.285 0.205	0.15-0.25 0.12-0.25 0.12-0.25 0.12-0.25 0.12-0.25 0.0820 0.29 0.0830 0.29 0.15-0.15 0.	0.09 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	0.91 0.17 0.17 0.17 0.17 0.17 0.17 0.17 0.1			* as TNN * as TN * as TN	Georges, 2014 81433
	0.181 0.000	0.31-0.22 0.12-0.29 0.12-0.29 0.12-0.29 0.12-0.29 0.13-0.29 0.13-0.29 0.13-0.29 0.13-0.29 0.13-0.29 0.13-0.29 0.13-0.29 0.14-0.26 0.74-0.26 0.74-0.26 0.74-0.26 0.74-0.26 0.74-0.26 0.74-0.26 0.74-0.26	0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.0	0.000 0.000			* as TNN * as TN * as TN	Georges, 2014 81433
	0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25	0.15-0.27 0.12-0.99 0.1-0.99 0.10-0.	0.09 0.10 0.10 0.10 0.10 0.10 0.10 0.10	0.99 0.17 0.17 0.59 0.59 0.17 0.17 0.59 0.59 0.17 0.17 0.17 0.17 0.17 0.17 0.17 0.17			* as TNN * as TN * as TN	Georges, 2014 81433
med (8) 120 med (8) 120 med (8) 120 med (8) sermation med (8) sermation		0.35-0.25 0.20.20.99 0.20.20.99 0.20.20.99 0.35-0.29 0.3	0.09 0.20 0.21 0.21 0.21 0.22 0.22 0.23 0.23 0.23 0.23 0.23 0.23	0.39 0.37 0.37 0.37 0.37 0.37 0.37 0.37 0.37	sustainable sontration Alliance (Schand).		* as TNN * as TN * as TN	Georges, 2014 81433
med (in) med (in) from (in) med (in) from (in) med (in)		0.31-0.22 0.32-0.39 0.32-0.39 0.32-0.39 0.32-0.39 0.33-0	0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.0	0.99 0.17 0.18 0.19 0.19 0.19 0.19 0.19 0.19 0.19 0.19	sustainable sontration Alliance (Schand).		* as TNN * as TN * as TN	Georgee, 2014 #1413
med (8) HID med (9) HID med (9) HID med (9) med (9		0.31-0.20 0.20-0	0.09 0.20 0.10 0.10 0.10 0.10 0.10 0.10 0.10	0.99 0.17 0.99 0.17 0.99 0.17 0.99 0.17 0.17 0.17 0.17 0.17 0.17 0.17 0.17	sustainable sontration Alliance (Schand).		* as TNN * as TN * as TN	Georgee, 2014 #1413
med (1)		9.50 - 0.20 - 0.	0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.0	0.99 0.17 0.99 0.17 0.99 0.17 0.99 0.17 0.17 0.17 0.17 0.17 0.17 0.17 0.17	sustainable sontration Alliance (Schand).		* as TNN * as TN * as TN	Georges, 2014 81433

Unplanted Drying Bed Dry						
	Values T	Data Source				
UNIQUE IDENTIFIER (ID)	unplanted_drying_bed_dry Matthias van Sloten					
	stored_faeces, transportedstored_faeces pithumus, transportedpithumus	Spuhler, D. & Roller, L. (2020)				
OUTPUT PRODUCT RELATIONS	dried_faeces, transporteddried_faeces	Spuhler, D. & Roller, L. (2020) Spuhler, D. & Roller, L. (2020)	†			
COMMENTS	Output: AND					
Pre-Filter Criteria	Values (household = 0, neighbourhood = 0.5, city = 1)	Data Source Tilley, E. et al. (2014)				
	(household = 0, shared = 0, public = 1)	Tilley, E. et al. (2014) Spuhler, D. et al. (2021)				
opex_req_level technical_maturity		Spuhler, D. et al. (2021) Tilley, E. et al. (2014)				
development_phase	(acute = 0.5, stabilisation = 0.5, development/recovery = 1)	Same values given as Unplanted drying beds with sludge (Gensch, R. et al. (2018))				
Screening Criteria	Type and Function	Applicable for this Functional Group?	Categories [Unit]	Technology Values (Data)	Data Source / Assumptions	Internal Review
water_supply	Performance, Categorical	FALSE	house	NA	NA	NA NA
			yard public			
water_volume	Performance, Trapez	FALSE	none [L/cap/day]		NA	NA
electricity_supply	Performance, Categorical	IRUE	electricity intermittent	(electricity = 1, intermittent = 1, no electricity = 1)	"No electricity required" (Compendium)	yes
fuel_supply	Performance, Categorical	FALSE	no electricity fuel no fuel	NA	NA	NA
frequency_of_om	PDF, Categorical	TRUE	irregular regular	(irregular = 0, regular = 1, continous = 0)	"Simple operation, only infrequent attention required" (Compendium)	yes
			continuous		"Dried sludge can be removed after 10 to 15 days, but this depends on the climate	
pipe_supply	Performance, Categorical	TRUE	no pipes	(no pipes = 0, difficultly available = 0.5, pipes = 1)	conditions." (Compendium) "The bottom of the drying bed is lined with	ves
			difficultly available pipes	,	perforated pipes to drain the leachate away that percolates through the bed."(Compendium)	
					Therefore pipes are needed for the technology.	
pump_supply	Performance, Categorical	TRUE	no pumps difficultly available	(no pumps = 1, difficultly available = 1, pumps = 1)	No need for pumps	yes
concrete_supply	Performance, Categorical	TRUE	no concrete	(no concrete = 0.5, difficultly available = 0.75,	"The bed frame is usually made from concrete or	yes
			difficultly available concrete		a plastic liner with the bottom surfaces slightly sloped in order to facilitate percolation and	
					drainage." (Spuhler, n.d.) "The bed itself can be constructed with cement	
					and bricks or concrete and needs to be sealed at the bottom." (Emersan) It is assumed that concrete has a longer lifetime	
					and locals have more experience with it than with plastic liners. Therefore, the performance is	
spare_parts	PDF, Categorical	TRUE	simple	(simple = 1, technical = 0, special = 0)	slightly better with concrete. "Drying beds require the availability of gravel and	ves
	,		technical special		sand of the correct grain size. Furthermore, piping for the drainage is needed. To remove	
					dried sludge, shovels and rakes are required as well as personal protective equipment for the	
					workers. The bed itself can be constructed with cement and bricks or concrete and needs to be	
					sealed at the bottom." (Emersan) "Can be built and repaired with locally available	
0		FALSE		0 NA	materials" (Compendium) NA	NA
0	0	FALSE FALSE	(0 NA 0 NA 0 NA	NA NA NA	NA NA
0	0	FALSE FALSE	very cold cold	0 NA 0 NA	NA NA "This is a low-cost option that can be installed in most hot and temperate climates."	NA
0	0	FALSE FALSE	very cold cold temperate warm	0 NA 0 NA 0 NA 0 NA (very cold = 0.3, cold = 0.5, temperate = 1, warm =	NA NA NA "This is a low-cost option that can be installed in most hot and temperate climates." (Compendium) Sludge application rates of 100 to 250	NA NA
0	0	FALSE FALSE	very cold cold temperate	0.NA 0.NA (Very cold = 0.3, cold = 0.5, temperate = 1, warm =	NA NA NA This is a low-cost option that can be installed in most hot and temperate climates." (Compendium) Sludge application rates of 100 to 250 kg/mz/year have been reported in warm tropical climates. In colder climates, such as northern	NA NA
0	0	FALSE FALSE	very cold cold temperate warm	0.NA 0.NA (Very cold = 0.3, cold = 0.5, temperate = 1, warm =	NA NA NA "This is a low-cost option that can be installed in most hot and temperate climates." (Compendium) Sludge application rates of 100 to 250 kg/m2/year have been reported in warm tropical	NA NA
0 0 temperature	0 0 Performance, Categorical	FALSE FALSE TRUE	very cold cold temperate warm hot	O NA O NA O NA (very cold = 0.3, cold = 0.5, temperate = 1, warm =	NA NA NA This is a low-cost option that can be installed in most hot and temperate climates." (Compendium) Sludge application rates of 100 to 250 kg/m2/year have been reported in warm tropical climates. in colder climates, used has northern Europe, rates up to 80 kg/m2/year are typical. (Compendium > T.15 Planted Drying Beds) Yearly average temperatures in Europe are assumed to be cold.	NA NA yes
0	0	FALSE FALSE TRUE	very cold cold temperate warm	O INA O INA O INA (very cold = 0.3, cold = 0.5, temperate = 1, warm = (flooding = 0.5, no flooding = 1)	NA NA NA This is a low-cost option that can be installed in most hot and temperate climates." (Compendium) Sludge application rates of 100 to 250 kg/mz/year have been reported in warm tropical climates. In colder climates, such as northern Europe, rates up to 80 kg/mz/year are typical. (Compendium - 1.15 Painted Drying Bets) Yearly average temperatures in Europe are assumed to be cold. "If installed in wet climates, the facility should be covered by a roof and special caution should be	NA NA yes
0 0 temperature	0 0 Performance, Categorical	FALSE FALSE TRUE	very cold cold temperate warm hot	O INA O INA O INA (very cold = 0.3, cold = 0.5, temperate = 1, warm = (flooding = 0.5, no flooding = 1)	NA NA NA This is a low-cost option that can be installed in most hot and temperate climates." (Compendium) Sludge application rates of 100 to 250 kg/mz/year have been reported in warm tropical climates. In colder climates, such as northern Europe, rates up to 80 kg/mz/year are typical. (Compendium > 1.51 Painted Drying Beds) Yearly average temperatures in Europe are assumed to be cold. "If installed in wet climates, the facility should be covered by a roof and special caution should be given to prevent the inflow of surface runoff." (Compendium)	NA NA yes
0 0 temperature	0 0 Performance, Categorical	FALSE FALSE TRUE	very cold cold temperate warm hot	O INA O INA O INA (very cold = 0.3, cold = 0.5, temperate = 1, warm = (flooding = 0.5, no flooding = 1)	NA NA NA This is a low-cost option that can be installed in most hot and temperate climates." (Compendium) Sludge application rates of 100 to 250 kg/mz/year have been reported in warm tropical climates. In colder climates, such as northern Europe, rates up to 80 kg/mz/year are typical. (Compendium - 1.15 Planted Dring Beds) Yearly average temperatures in Europe are assumed to be cold. "If installed in wet climates, the facility should be covered by a rofo and special caution should be given to prevent the inflow of surface runoff." (Compendium) It's assumed that a special caution must be given to prevent the inflow of surface runoff."	NA NA yes
0 0 temperature	0 0 Performance, Categorical	FALSE FALSE TRUE	very cold cold temperate warm hot	O INA O INA O INA (very cold = 0.3, cold = 0.5, temperate = 1, warm = (flooding = 0.5, no flooding = 1)	NA NA NA This is a low-cost option that can be installed in most hot and temperate climates." (Compendium) Sludge application rates of 100 to 250 kg/mz/year have been reported in warm tropical climates. In colder climates, such as northern Europe, rates up to 80 kg/mz/year are typical. (Compendium - 7.15 Planted Drying Beds) Yearly average temperatures in Europe are assumed to be cold. "If installed in wet climates, the facility should be covered by a roof and special caution should be given to prevent the inflow of surface runoff." (Yeonpendium) It's assumed that a special caution must be given to prevent the inflow of surface runoff at places where there is regular flooding as well. (Ill library; a-90-pC-6;6-d12 day sell-old library; a-90-pC-6;6-d12 days per year > 1	NA NA yes
0 0 temperature	0 0 Performance, Categorical	FALSE FALSE TRUE	very cold cold temperate warm hot	O INA O INA O INA (very cold = 0.3, cold = 0.5, temperate = 1, warm = (flooding = 0.5, no flooding = 1)	NA NA NA NA This is a low-cost option that can be installed in most hot and temperate climates." (Compendium) Sludge application rates of 100 to 250 kg/mz/year have been reported in warm tropical climates. In colder climates, such as northern Europe, rates up to 80 kg/mz/year are typical. (Compendium - 7.15 Planted Drying Beds) Yearly average temperatures in Europe are assumed to be coid. "If installed in wet climates, the facility should be covered by a roof and special caution should be given to prevent the inflow of surface runoff." (Compendium) It's assumed that a special caution must be given to prevent the inflow of surface runoff at places where there is regular flooding as well. old library: a-0.9-D-c.6-d.=12 days per year -> strongly affected	NA NA yes
0 0 temperature	0 0 Performance, Categorical	FALSE FALSE TRUE	very cold cold temperate warm hot	O INA O INA O INA (very cold = 0.3, cold = 0.5, temperate = 1, warm = (flooding = 0.5, no flooding = 1)	NA NA NA This is a low-cost option that can be installed in most hot and temperate climates." (Compendium) Sludge application rates of 100 to 250 kg/m2/year have been reported in warm tropical climates. In colder climates, such as northern Europe, rates up to 80 kg/m2/year are typical. (Compendium > 7.15 Planted Drying Beds) Yearly average temperatures in Europe are assumed to be cold. "If installed in wet climates, the facility should be covered by a roof and special caution should be given to prevent the inflow of surface runoff." (Compendium) It's assumed that a special caution must be given to prevent the inflow of surface runoff at places where there is regular flooding as well. old library. a=0,b=0,c=6,d=12 days per year > strongly affected	NA NA yes
0 0 temperature	0 0 Performance, Categorical	FALSE FALSE TRUE	very cold cold temperate warm hot	O INA O INA (very cold = 0.3, cold = 0.5, temperate = 1, warm = (flooding = 0.5, no flooding = 1)	NA NA NA This is a low-cost option that can be installed in most hot and temperate climates." (Compendium) Sludge application rates of 100 to 250 kg/mz/year have been reported in warm tropical climates. In colder climates, such as northern Europe, rates up to 80 kg/mz/year are typical. (Compendium - 1.15 Planted Drying Beds) Yearly average temperatures in Europe are assumed to be cold. Til installed in wet climates, the facility should be covered by a rofo and special caution should be given to prevent the inflow of surface runoff." (Compendium) It's assumed that a special caution must be given to prevent the inflow of surface runoff at places where there is regular flooding as well. old library; and pb-0,c6,d=12 days per year > strongly affected This is a technology that is necessarily built on the ground surface and its raised configuration is not possible. (e.g. all pond-based, wetlands, drying beds etc.). Note: All pond-based/wetlands/drying bed technologies are	NA NA yes
0 0 temperature	0 0 Performance, Categorical	FALSE FALSE TRUE	very cold cold temperate warm hot	O INA O INA (very cold = 0.3, cold = 0.5, temperate = 1, warm = (flooding = 0.5, no flooding = 1)	NA NA NA This is a low-cost option that can be installed in most hot and temperate climates." (Compendium) Sludge application rates of 100 to 250 kg/mz/year have been reported in warm tropical climates. In colder climates, such as northern Europe, rates up to 80 kg/mz/year are typical. (Compendium - 1.15 Planted Drying Beds) Yearly average temperatures in Europe are assumed to be cold. "If installed in wet climates, the facility should be covered by a roof and special caution should be given to prevent the inflow of surface runoff." (Compendium) It's assumed that a special caution must be given to prevent the inflow of surface runoff at places where there is regular flooding as well. old library: a-0b-0,C-6.d-12 days per year > strongly affected This is a technology that is necessarily built on the ground surface and its raised configuration is not possible. (e.g., all pond-based, wetlands, drying beds etc.). Note: All pond-based/wetland/drying bed technologies are allotted similar performance values. Their functioning can be severely distrupted by flooding.	NA NA yes
0 0 temperature	0 0 Performance, Categorical	FALSE FALSE TRUE	very cold cold temperate warm hot	O INA O INA (very cold = 0.3, cold = 0.5, temperate = 1, warm = (flooding = 0.5, no flooding = 1)	NA NA NA This is a low-cost option that can be installed in most hot and temperate climates." (Compendium) Sludge application rates of 100 to 250 kg/mz/year have been reported in warm tropical climates. In colder climates, such as northern Europe, rates up to 80 kg/mz/year are typical. (Compendium - 7.15 Planted Drying Beds) Yearly average temperatures in Europe are assumed to be cold. "If installed in wet climates, the facility should be covered by a roof and special caution should be given to prevent the inflow of surface runoff." (Compendium) It's assumed that a special caution must be given to prevent the inflow of surface runoff." (Compendium) It's assumed that a special caution must be given to prevent the inflow of surface runoff at places where there is regular flooding as well. old library; a-0,b-0,c-6,d-12 days per year-> strongly affected This is a technology that is necessarily built on the ground surface and its raised configuration is not possible, (e.g., all pond-based/wetlands/drying bed technologies are allotted similar performance values. Their functioning can be severely disrunace values. Their functioning can be severely disrunded by flooding events. However, it is possible that they can be protected from flooding by building events. However, it is possible that they can be protected from flooding by building events.	NA NA yes
0 0 temperature	0 9 Performance, Categorical	FALSE FALSE TRUE	very cold cold temperate warm hot	O INA O INA (very cold = 0.3, cold = 0.5, temperate = 1, warm = (flooding = 0.5, no flooding = 1)	NA NA NA NA This is a low-cost option that can be installed in most hot and temperate climates." (Compendium) Sludge application rates of 100 to 250 kg/mz/year have been reported in warm tropical climates. In colder climates, such as northern Europe, rates up to 80 kg/mz/year are typical. (Compendium - 7.15 Planted Drying Beds) Yearly average temperatures in Europe are assumed to be cold. "If installed in wet climates, the facility should be covered by a roof and special caution should be given to prevent the inflow of surface runoff." (Compendium) It's assumed that a special caution must be given to prevent the inflow of surface runoff." (Compendium) This satured that a special caution must be given to prevent the inflow of surface runoff. at places where there is regular flooding as well. old library: a-0)=0,-c6,-6,-12 days per year -> strongly affected This is a technology that is necessarily built on the ground surface and its raised configuration is not possible. (e.g., all pond-based, wetlands, drying beds etc.) Note: All pond-based/wetland/drying bed technologies are allotted similar performance values. Their functioning can be severely disrupted by flooding events. However, it is possible that they can be protected from flooding by building enbankments or mounds of adequate height around them. Since a flood-preventive	NA NA yes
0 0 0 temperature	0 Performance, Categorical Performance, Categorical	FALSE FALSE TRUE	very cold cold temperate warm hot	O INA O INA (very cold = 0.3, cold = 0.5, temperate = 1, warm = (flooding = 0.5, no flooding = 1)	NA NA NA This is a low-cost option that can be installed in most hot and temperate climates." (Compendium) Sludge application rates of 100 to 250 kg/mz/year have been reported in warm tropical climates. In colder climates, such as northern Europe, rates up to 80 kg/mz/year are typical. (Compendium - 1.15 Painted Drying Bets) Yearly average temperatures in Europe are assumed to be cold. "If installed in wet climates, the facility should be covered by a roof and special caution should be given to prevent the inflow of surface runoff." (Compendium) It's assumed that a special caution must be given to prevent the inflow of surface runoff." (Compendium) This is a tenthology that is necessarily built on the ground surface and its raised configuration is not possible. (e.g. all pond-based, wetlands, drying beds etc.). Note: All pond-based/wetland/drying bet technologies are allotted similar performance values. Their functioning can be severely disrupted by flooding events. However, it is possible that they can be protected from flooding by building embankments or mounds of adequate height	NA NA yes
0 0 temperature	0 9 Performance, Categorical	FALSE FALSE TRUE	very cold cold temperate warm hot	0 NA 0 NA (very cold = 0.3, cold = 0.5, temperate = 1, warm = (flooding = 0.5, no flooding = 1)	NA NA NA NA NA This is a low-cost option that can be installed in most hot and temperate climates." (Compendium) Sludge application rates of 100 to 250 kg/mz/year have been reported in warm tropical climates. In colder climates, such as northern Europe, rates up to 80 kg/mz/year are typical. (Compendium - 7.15 Planted Drying Beds) Yearly average temperatures in Europe are assumed to be coid. "If installed in wet climates, the facility should be covered by a roof and special caution should be given to prevent the inflow of surface runoff." (Compendium) It's assumed that a special caution must be given to prevent the inflow of surface runoff." (Compendium) It's assumed that a special caution must be given to prevent the inflow of surface runoff at places where there is regular flooding as well. old library: a-0)=0-0,=6,=12 days per year -> strongly affected This is a technology that is necessarily built on the ground surface and its raised configuration is not possible. (e.g., all pond-based, wetlands, drying beds etc.), Note: All pond-based/wetland/drying bed technologies are allotted similar performance values. Their functioning can be severely disrupted by flooding events. However, it is possible that they can be protected from flooding by building embankments or mounds of adequate height around them. Since a flood-preventive configuration of the technology is possible, it is allotted a self-ormance of 50%. (Akanskha Jain)	NA NA yes
temperature flooding	Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical	FALSE FALSE FALSE FALSE	ro access difficult full flat not flat	NA O NA (very cold = 0.3, cold = 0.5, temperate = 1, warm = (flooding = 0.5, no flooding = 1)	NA NA NA This is a low-cost option that can be installed in most hot and temperate climates." (Compendium) Sludge application rates of 100 to 250 kg/mz/year have been reported in warm tropical climates. In colder climates, such as northern Europe, rates up to 80 kg/mz/year are typical. (Compendium - 1.15 Planted Drying Beds) Yearly average temperatures in Europe are assumed to be cold. Til ristalled in wet climates, the facility should be covered by a rofo and special caution should be given to prevent the inflow of surface runoff." (Compendium) It's assumed that a special caution must be given to prevent the inflow of surface runoff at places where there is regular flooding as well. old library; as 0,00-c,56,d=12 days per year > strongly affected This is a technology that is necessarily built on the ground surface and its raised configuration is not possible. (e.g. ail pond-based, wetlands, drying beds etc.). Note: Ail pond-based/wetland/drying bed technologies are allotted similar performance values. Their functioning can be severely disrupted by flooding events. However, it is possible that they can be protected from flooding by building embankments or mounds of adequate height around them. Since a flood preventive configuration of the technology is possible, it is allotted a performance of 50%. (Akanksha Jain)	yes NA NA NA NA NA
0 0 1 temperature	0 Performance, Categorical Performance, Categorical Performance, Categorical	FALSE FALSE FALSE FALSE	very cold cold temperate warm hot Blooding no flooding no flooding flooding no flooding flo	NA O NA (very cold = 0.3, cold = 0.5, temperate = 1, warm = (flooding = 0.5, no flooding = 1)	NA NA NA This is a low-cost option that can be installed in most hot and temperate climates." (Compendium) Sludge application rates of 100 to 250 kg/mz/year have been reported in warm tropical climates. In colder climates, such as northern Europe, rates up to 80 kg/mz/year are typical. (Compendium - 1.15 Planted Drying Beds) Yearly average temperatures in Europe are assumed to be cold. Til installed in wet climates, the facility should be covered by a rofo and special caution should be given to prevent the inflow of surface runoff." (Compendium) It's assumed that a special caution must be given to prevent the inflow of surface runoff at places where there is regular flooding as well. old library; as 0,00-0,0=6,6d=12 days per year > strongly affected This is a technology that is necessarily built on the ground surface and its raised configuration is not possible. (e.g. all pond-based, wetlands, drying beds etc.). Note: All pond-based/wetland/drying bed technologies are allotted similar performance values. Their functioning can be severely disrupted by flooding events. However, it is possible that they can be protected from flooding by building embankments or mounds of adequate height around them. Since a flood-preventive configuration of the technology is possible, it is allotted a performance of 50%. (Akanksha Jain)	NA NA yes yes
temperature flooding	Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical	FALSE FALSE FALSE FALSE	very cold cold temperate warm hot flooding no flooding no flooding flooding so flooding floo	NA O NA (very cold = 0.3, cold = 0.5, temperate = 1, warm = (flooding = 0.5, no flooding = 1)	NA NA NA This is a low-cost option that can be installed in most hot and temperate climates." (Compendium) Sludge application rates of 100 to 250 kg/mz/year have been reported in warm tropical climates. In colder climates, such as northern Europe, rates up to 80 kg/mz/year are typical. (Compendium - 1.15 Planted Drying Beds) Yearly average temperatures in Europe are assumed to be cold. Til ristalled in wet climates, the facility should be covered by a rofo and special caution should be given to prevent the inflow of surface runoff." (Compendium) It's assumed that a special caution must be given to prevent the inflow of surface runoff at places where there is regular flooding as well. old library; as 0,00-c,56,d=12 days per year > strongly affected This is a technology that is necessarily built on the ground surface and its raised configuration is not possible. (e.g. ail pond-based, wetlands, drying beds etc.). Note: Ail pond-based/wetland/drying bed technologies are allotted similar performance values. Their functioning can be severely disrupted by flooding events. However, it is possible that they can be protected from flooding by building embankments or mounds of adequate height around them. Since a flood preventive configuration of the technology is possible, it is allotted a performance of 50%. (Akanksha Jain)	yes NA NA NA NA NA
0 0 0 temperature flooding flooding vehicular_acces slope soil_type	Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical	FALSE FALSE FALSE FALSE FALSE FALSE	very cold cold cold temperate warm hot flooding no flooding no flooding so flooding flooding flooding no flooding flood	0. NA 0. NA (very cold = 0.3, cold = 0.5, temperate = 1, warm = (flooding = 0.5, no flooding = 1)	NA NA This is a low-cost option that can be installed in most hot and temperate climates." (Compendium) Sludge application rates of 100 to 250 kg/mz/year have been reported in warm tropical climates. In colder climates, such as northern Europe, rates up to 80 kg/mz/year are typical. (Compendium - 1.15 Planted Drying Beds) Yearly average temperatures in Europe are assumed to be cold. "If installed in wet climates, the facility should be covered by a roof and special caution should be given to prevent the inflow of surface runoff." (Compendium) It's assumed that a special caution should be given to prevent the inflow of surface runoff." (Compendium) This as technology that is necessarily built on the pround surface and its raised configuration is not possible. (e.g., all pond-based, wettands, drying beds etc.) Note: All pond-based/wettand/drying bed technologies are allotted similar performance values. Their functioning can be severely disruped by flooding events. However, it is possible that they can be protected from flooding by building embankments or mounds of adequate height around them. Since a flood-preventive configuration of the technology is possible, it is allotted a performance of 50%, (Akanksha Jain) NA	NA NA yes yes NA NA NA NA NA
0 0 0 temperature flooding flooding vehicular_acces slope soil_type	Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical	FALSE FALSE FALSE FALSE FALSE FALSE	very cold cold temperate warm hot flooding no flooding flooding flooding sold flooding flooding sold flooding flooding flooding flooding flooding sold flooding flooding flooding sold flooding flooding sold flooding flooding sold flooding flooding sold flooding flooding sold floodi	NA	NA NA NA This is a low-cost option that can be installed in most hot and temperate climates." (Compendium) Sludge application rates of 100 to 250 kg/mz/year have been reported in warm tropical climates. In colder climates, such as northern Europe, rates up to 80 kg/mz/year are typical. (Compendium - 7.15 Planted Drying Beds) Yearly average temperatures in Europe are assumed to be coid. "If installed in wet climates, the facility should be covered by a roof and special caution should be given to prevent the inflow of surface runoff." (Compendium) It's assumed that a special caution should be given to prevent the inflow of surface runoff." (Compendium) This sate the inflow of surface runoff at places where there is regular flooding as well. old library: a-0)=0-0,=6,=12 days per year -> strongly affected This is a technology that is necessarily built on the ground surface and its raised configuration is not possible. (e.g., all pond-based, wetlands, drying beds est.). Note: All pond-based wetland/drying bed technologies are allotted similar performance values. Their functioning can be severely disrupted by flooding events. However, it is possible that they can be protected from flooding by building embankments or mounds of adequate height around them. Since a flood-preventive configuration of the technology is possible, it is allotted a performance of 50%. (Akanksha Jain) NA NA NA NA Especially for bigger application the construction of the technology relies on exavation. On rocky	yes NA NA NA NA NA NA
0 0 0 temperature flooding flooding vehicular_acces slope soil_type	Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical	FALSE FALSE FALSE FALSE FALSE FALSE	no access difficult full flat not flat clay silt sand gravel water depth [m] easy	NA	NA NA NA This is a low-cost option that can be installed in most hot and temperate climates." (Compendium) Sindge application rates of 100 to 250 kg/mz/year have been reported in warm tropical climates. In colder climates, such as northern Europe, rates up to 80 kg/mz/year are typical. (Compendium - 7.15 Planted Drying Beds) Yearly average temperatures in Europe are assumed to be coid. "If installed in wet climates, the facility should be covered by a roof and special caution should be given to prevent the inflow of surface runoff." (Compendium) It's assumed that a special caution should be given to prevent the inflow of surface runoff at places where there is regular flooding as well. old library: a-0,b-0,c6,d=12 days per year -> strongly affected This is a technology that is necessarily built on the ground surface and its raised configuration is not possible. (e.g., all pond-based, wetlands, drying beds etc.). Note: All pond-based/wetland/drying bed technologies are allotted similar performance values. Their functioning can be severely disrupted by flooding embankments or mounds of adequate height around them. Since a flood-preventive configuration is flooding by building embankments or mounds of adequate height around them. Since a flood-preventive configuration of the technology is possible, it is allotted a performance of 50%. (Akanksha Jain) NA NA NA Especially for bigger application the construction of the technology relies on excavation. On rocky resp. gravely ground there could be difficulties with excavation that is needed for the	NA NA yes yes NA NA NA NA NA
0 0 0 temperature flooding flooding vehicular_acces slope soil_type	Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical	FALSE FALSE FALSE FALSE FALSE FALSE	no access difficult full flat not flat clay silt sand gravel water depth [m] easy	NA 0 NA (very cold = 0.3, cold = 0.5, temperate = 1, warm = (flooding = 0.5, no flooding = 1) NA NA NA NA NA NA NA NA NA N	NA NA NA This is a low-cost option that can be installed in most hot and temperate climates." (Compendium) Sindge application rates of 100 to 250 kg/mz/year have been reported in warm tropical climates. In colder climates, such as northern Europe, rates up to 80 kg/mz/year are typical. (Compendium - 7.15 Planted Drying Beds) Yearly average temperatures in Europe are assumed to be cold. "If installed in wet climates, the facility should be covered by a roof and special caution should be given to prevent the inflow of surface runoff." (Compendium) 1t's assumed to be applicated caution must be given to prevent the inflow of surface runoff at places where there is regular flooding as well. old library: a-0)b-0;c6;d=12 days per year -> strongly affected This is a technology that is necessarily built on the ground surface and its raised configuration is not possible. (e.g., all pond-based, wetlands, drying beds etc.). Note: All pond-based/wetland/drying bed technologies are allotted similar performance values. Their functioning can be severely disrupted by flooding embankments or mounds of adequate height around them. Since a flood-preventive configuration is the technology is possible, it is allotted a performance of 50%. (Akanksha Jain) NA NA NA NA NA NA NA NA NA NA	NA NA yes yes NA NA NA NA NA
0 0 0 temperature flooding flooding vehicular_acces slope soil_type	Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical	FALSE FALSE FALSE FALSE FALSE FALSE FALSE TRUE	no access difficult full flat not flat clay silt sand gravel water depth [m] easy	NA NA NA NA NA (easy = 1, hard = 0.5)	NA NA This is a low-cost option that can be installed in most hot and temperate climates." (Compendium) Sludge application rates of 100 to 250 kg/mz/year have been reported in warm tropical climates. In colder climates, such as northern Europe, rates up to 80 kg/mz/year are typical. (Compendium - 1.15 Planted Dring Beds) Yearly average temperatures in Europe are assumed to be cold. "If installed in wet climates, the facility should be covered by a roof and special caution should be given to prevent the inflow of surface runoff." (Compendium) It's assumed that a special caution must be given to prevent the inflow of surface runoff." (Compendium) It's assumed that a special caution must be given to prevent the inflow of surface runoff at places where there is regular flooding as well. old library: a-0b_pC;e6.d=12 days per year -> strongly affected This is a technology that is necessarily built on the ground surface and its raised configuration is not possible. (e.g. all pond-based, wetlands, drying beds etc.). Note: All pond-based/wetland/drying bed technologies are allotted similar performance values. Their functioning can be severely disrupted by flooding events. However, it is possible that they can be protected from flooding by building embankments or mounds of adequate height around them. Since a flood-preventive configuration of the technology is possible, it is allotted a performance of 50%. (Akanisha Jain) NA NA Especially for bigger application the construction of the technology relies on exaavation. On rocky resp. gravelly ground there could be difficulties with excavation that is needed for the construction.	NA NA yes yes NA NA NA NA NA
0 0 temperature flooding flooding vehicular_acces slope soil_type groundwater_depth excavation	Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical	FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE	no access difficult full flat clay silt sand grave cock water depth [m] easy hard	NA NA NA NA NA (easy = 1, hard = 0.5)	NA NA This is a low-cost option that can be installed in most hot and temperate climates." (Compendium) Sludge application rates of 100 to 250 kg/mz/year have been reported in warm tropical climates. In colder climates, such as northern Europe, rates up to 80 kg/mz/year are typical. (Compendium - 1.15 Planted Drying Beds) Yearly average temperatures in Europe are assumed to be cold. "If installed in wet climates, the facility should be covered by a roof and special caution should be given to prevent the inflow of surface runoff." (Compendium) It's assumed that a special caution should be given to prevent the inflow of surface runoff." (Compendium) It's assumed that a special caution must be given to prevent the inflow of surface runoff. at places where there is regular flooding, as well. old library; a-0.9—0.c=6.d=12 days per year -> strongly affected This is a technology that is necessarily built on the ground surface and its raised configuration is not possible. (e. g., all pond-based, wettands, drying beds etc.). Note: All pond-based/wetland/drying bed technologies are allotted similar performance values. Their functioning can be severely disrupted by flooding events. However, it is possible that they can be protected from flooding by building embankments or mounds of adequate height around them. Since a flood-preventive configuration of the technology is possible, it is allotted a performance of 50%. (Akanksha Jain) NA NA NA NA NA NA NA NA NA N	yes NA NA NA NA NA NA NA NA NA
0 0 temperature flooding flooding vehicular_acces slope soil_type groundwater_depth excavation surface_area_onsite	Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical	FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE	very cold cold temperate warm hot flooding no flooding no flooding no flooding so flooding no flooding so floodi	NA NA NA NA NA NA NA NA NA NA	NA NA This is a low-cost option that can be installed in most hot and temperate climates." (Compendium) Sludge application rates of 100 to 250 kg/mz/year have been reported in warm tropical climates, includer climates, such as northern Europe, rates up to 80 kg/mz/year are typical. (Compendium) — 1.15 Planted Drying Beds) Yearly average temperatures in Europe are assumed to be cold. "If installed in wet climates, the facility should be covered by a roof and special caution should be given to prevent the inflow of surface runoff." (Compendium) It's assumed that a special caution should be given to prevent the inflow of surface runoff." (Compendium) This sate the inflow of surface runoff. at places where there is regular flooding as well. old library; a-0)-pc-6;6;d=12 days per year-> strongly affected This is a technology that is necessarily built on the ground surface and its raised configuration is not possible. (e.g., all pond-based, wetlands, drying bed set.) Note: All pond-based/wetland/drying bed technologies are allotted similar performance values. Their functioning can be severely disrupted by flooding events. However, it is possible that they can be protected from flooding by building mehankments or mounds of adequate height around them. Since a flood-preventive configuration of the technology is possible, it is allotted a performance of 50%. (Akanksha Jain) NA NA NA NA NA NA There must be sufficient space available for creation of the treatment plant (50m²/1000 inhabitants)" (Monvois et al. 2012).	yes NA NA NA NA NA NA NA NA NA
0 0 temperature flooding flooding vehicular_acces slope soil_type groundwater_depth excavation surface_area_onsite	Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical	FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE	very cold cold temperate warm hot flooding no flooding no flooding no flooding so flooding no flooding so floodi	NA NA NA NA NA NA NA NA NA NA	NA NA This is a low-cost option that can be installed in most hot and temperate climates." (Compendium) Sludge application rates of 100 to 250 kg/mz/year have been reported in warm tropical climates. In colder climates, such as northern Europe, rates up to 80 kg/mz/year are typical. (Compendium - 7.15 Planted Drying Beds) Yearly average temperatures in Europe are assumed to be cold. "If installed in wet climates, the facility should be covered by a roof and special caution should be given to prevent the inflow of surface runoff." (Compendium) It's assumed that a special caution should be given to prevent the inflow of surface runoff." (Compendium) It's assumed that a special caution must be given to prevent the inflow of surface runoff at places where there is regular flooding as well. old library; a-90-pc-6;6;d=12 days per year-> strongly affected This is a technology that is necessarily built on the ground surface and its raised configuration is not possible, (e.g., all pond-based/wetlands/drying bed technologies are allotted similar performance values. Their functioning can be severely distruction around them. Since a flood-protected from flooding by building embankments or mounds of adequate height around them. Since a flood-preventive configuration of the technology is possible, it is allotted a performance of 50%. (Akanksha Jain) NA NA NA NA There must be sufficient space available for creation of the treatment plant (50m²/1000) There must be sufficient space available for creation of the treatment plant (50m²/1000)	yes NA NA NA NA NA NA NA NA NA

0		[1		Terr		1
0		FALSE		NA NA		NA	1
		FALSE FALSE		NA	NA	NA	-
drinking_water_exposure	Performance, Categorical		Close	NA NA	NA NA	NA NA	+
drinking_water_exposure	Performance, Categorical	FALSE	Not close	NA .	NA .	NA	
0	0	FALSE		NA NA	NA .	NA	1
0		FALSE		NA.	NA .	NA	1
construction_skills	Performance, Categorical		Ladder:	(unskilled = 0, skilled = 0.5, professional = 1)	"Requires expert design and construction"	yes	1
		1	unskilled		(Compendium)		
		1	skilled		The construction can be done with moderate		
		1	professional		construction skills. But if there are high skills		
		İ			available the performance could be better due to		
					better construction.		1
design_skills	Performance, Categorical	TRUE	Ladder:	(unskilled = 0, skilled = 0, professional = 1)	"Requires expert design and construction"	yes	
		1	unskilled		(Compendium)		
		İ	skilled		"Both the incoming and dried sludge are		
		İ	professional		pathogenic; []." (Compendium)		
		1			Because there is a high risk of contamination		
		1			with pathogens a proper desing is very important.		
om_skills	Performance, Categorical	TRIJE	Ladder:	(unskilled = 0.5, skilled = 1, professional = 1)	"Simple operation, only infrequent attention	ves	1
OIII_3KIII3	renormance, categorical	INGE	Unskilled	(unskilled = 0.5, skilled = 1, professional = 1)	required" (Compendium)	yes	
		İ	Skilled		Once the process is designed with high skills the		
		İ	Professional		operation and maintenance is pretty easy and		
		İ	Troic Salona		does not require special skills. But therefore it is		
		1			important the labourer follow the rules of the		
		İ			process design.	1	1
0	0	FALSE	0	NA.		NA	1
0	0	FALSE		NA NA		NA	1
0		FALSE		NA NA	NA NA	NA	1
0		FALSE		NA NA		NA	1
cleansing_method	Performance, Categorical		Washers	NA	NA	NA	1
		Ì	Soft wipers				1
			Hard wipers				1
0		FALSE		NA NA		NA	1
0		FALSE		NA NA	NA	NA	1
lifetime	Performance, Categorical	TRUE	short (< 1 year)	(short = 1, medium = 1, long = 1)	Simple and durable installation." (Solar drying	yes	
		1	medium (1-5 years)		SLU Compendium)		
		1	long (>5 years)		Durable solution that can be used in the short- or		
		ļ			long-term (Kukka Ilmanen, Eawag 2021)		4
speed_implement_toilet	PDF, Categorical	FALSE	rapid (< 3 days)	NA	NA	NA	
		1	moderate (3 days to 2 weeks)				
			slow (> 2 weeks)				4
ed_implement_treatment	PDF, Categorical	IRUE	rapid (few days to a week)	(rapid=0, moderate=1, slow=0)	"The bed itself can be constructed with cement	yes	
		İ	moderate (few weeks up to three months)		and bricks or concrete and needs to be sealed at		
		İ	slow (> 3 months)		the bottom." "Can be built and repaired with locally available materials" (Emersan		
		İ			Compendium)		
		İ			Construction is quite simple however, since bricks and/or concrete is used for construction,		
		İ			minimum 7 days curing is required- and since no		
		1			prefab units are available, probability is allotted		
		İ			only to moderate category and not rapid.		
		1			(Akanksha Jain)		
scalability	Performance, Categorical	TRUE	easy	(easy = 1, difficult = 1)	"To improve drying and percolation, sludge	ves	1
Scalability	Terrormance, categorical	11102	difficult	(casy = 1, directic = 1)	application can alternate between two or more	,00	
		İ	difficult		beds. The number of beds needed is a function		
		İ			of the frequency of sludge arrivals and the		
		İ			number of days necessary for drying in the local		
		İ			climate, to which a few days must be added for	1	1
		İ			sludge removal." (Emersan)	1	1
		İ			Additional drying beds can be easily added, if	1	1
		Ì			sufficient land area is available. (Kukka Ilmanen,		1
		<u> </u>		1	Eawag 2021)]
construction_parts	PDF, Categorical	TRUE	simple	(simple = 1, technical = 0, special = 0)	"Can be built and repaired with locally available	yes	1
		İ	technical		materials" (Compendium)	1	1
		l	special	1	1		L
						Comments	le -
sfer Coefficients	(copied from "Sanitation_Technologies_TC_database_20210622.xlsm")	Danier .	Aides		Matadasa	Lomments	
sfer Coefficients	[copied from *Sanitation_Technologies_TC_database_20210622.xism"] Dried Faeces	Range	Airloss	Soilloss	Waterloss		
sfer Coefficients	(copied from "Sanitation_Technologies_TC_database_20210622.vism") Dried Faeces 1	Range	Airloss	Soilloss	Waterloss 0		PA
sfer Coefficients	1 1	Range	Airloss C	Soilloss	Waterloss		- PA
sfer Coefficients [TP med (R) k	1 1 25	Range	0		Waterloss 0 0 0		- PA
sfer Coefficients I TP med (R) k TN	1 1 25 0.8	Range	0.2		Waterloss 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		- PA
efer Coefficients [TP med (R)	1 1 25	Range	0		Waterloss 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		- PA
TP med (R) k TN med (R) k k k k k k k k k	1 1 25 0.8 0.8	Range	0.2		Waterloss 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		PA PA PA
sfer Coefficients []	1 1 25 0.8	Range	0.2		Waterloss 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		PA PA
TP med (R) K TN med (R) K K K K K K K K K	1 1 25 08 08 5	Range	0.2 0.2 0.3		Waterloss 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		PA PA PA
sfer Coefficients TP med (R) K TN med (R) k TN med (R) k H2O	1 1 25 08 08 5	Range	0.2 0.2 0.3		Waterloss 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		PA PA PA PA
sfer Coefficients []	1 1 25 08 08 5 0 04	Range	0.2 0.2 0.2 0.6		Waterloss 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		PA PA PA PA
	1 1 255 0.8 0.8 5 0.4 0.4 0.4	Range	0.2 0.2 0.2 0.6 0.6		Waterloss 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		PA PA PA PA
TP med (R) (1 1 255 0.8 0.8 5 0.4 0.4 0.4	Range	0.2 0.2 0.2 0.6 0.6		Waterloss 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		PA PA PA PA
TP med (R) (1 1 255 0.8 0.8 5 0.4 0.4 0.4	Range	0.2 0.2 0.2 0.6 0.6		Waterloss 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		PA PA PA PA
fer Coefficients TP med (R) TN med (R) # H2O med (R) # TS med (R)	1 255 08 08 5 04 04 04 5 5 09		0.2 0.2 0.2 0.6 0.6		0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		PA PA PA PA
fer Coefficients TP med (R) R H200 med (R) E R References h, R., Jennings, A., Renggli, S.	1 1 255 0.8 0.8 0.8 0.8 5 0.4 0.4 0.4 5 0.9 0.9 5 5 0.9 5 0.	zhnologies in Emergencies . German WASH Network (G	0.2 0.2 0.6 0.6 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1	nology (Eawag), Global WASH Cluster (GWC) and Sustai	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		PA PA PA PA
fer Coefficients TP med (R) TN med (R) H20 med (R) TS med (R) References h, R., Jennings, A., Renggil, S.	1 1 1 25 08 08 08 5 04 4 04 5 9 9 9 9 9 .g. Reymond, P. (2018). Compendium of Sonitation Te	chnologies in Emergencies . German WASH Network (GG is in 6 developing countries . Socio-Economic Planning Sci	0.2 0.2 0.6 0.6 0.6 0.1 0.1 0.1 0.1 0.1 0.1 0.1) 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1	nology (Eawag), Global WASH Cluster (GWC) and Sustai 0121(02)00007-1	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		PA PA - PA PA
er Coefficients TP med (R) TN med (R) H20 med (R) FS med (R) References , R, Jennings, A, Renggli, S, Reference, L, 2002), A TO, D, de Moral Sump, P, Fri	1 1 1 25 0.8 0.8 0.8 5 0.4 4 0.4 5 0.9 5 0.9 5 0.9 5 0.9 5 5 0.9 6 6 6 6 6 6 6 7 6 7 6 7 7 7 7 8 8 8 8 8	chnologies in Emergencies . German WASH Network (GV is in developing countries . Socio-Economic Planning Sci nn, C. (2021) . Sanch Department Sci	0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2 0.2	nology (Eawag), Global WASH Cluster (GWC) and Sustai 0122(02)00007-1 ires (Sandec), Swiss Federal Institute of Aquatic Science	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		PA PA - PA
er Coefficients TP med (R) TN med (R) 420 med (R) TS med (R) References , R. Jennings, A. Renggli, S. rer, T. & Keller, L'(2002). Ar	1 1 25 0.8 0.8 0.8 5 0.4 0.4 5 0.9 9.9 9.5 5 4 8. Reymond, P. (2018). Compendium of Sonitation Te-decision system trusches, L., & Reymond, P. (2018). The decision support system for selecting sanitation system tracker, L., limanen, K., Jain, A., van Sloten, M., & William intitation technologi birary: Details and data sources for limitation technologi birary: Details and data sources for limitation technologi birary: Details and data sources for limitation technologi birary: Details and data sources for limitation technologi birary: Details and data sources for limitation technologi birary: Details and data sources for limitation technologi birary: Details and data sources for limitation technologi birary: Details and data sources for limitation technologi birary: Details and data sources for limitation technological birary: Details and data sources for limitation technological birary: Details and data sources for limitation technological birary: Details and data sources for limitation technological birary: Details and data sources for limitation technological birary: Details and data sources for limitation technological birary: Details and data sources for limitation technological birary: Details and data sources for limitation technological birary: Details and data sources for limitation technological birary: Details and data sources for limitation technological birary: Details and data sources for limitation technological birary: Details and data sources for limitation technological birary: Details and data sources for limitation technological birary: Details and data sources for limitation technological birary: Details and data sources for limitation technological birary: Details and data sources for limitation technological birary: Details and data sources for limitation technological birary: Details and data sources for limitation technological birary: Details and data sources for limitation technological birary: Details and data sources for limitation birary birary birary birary birary birary birary birar	chnologies in Emergencies . German WASH Network (G ins in developing countries . Socio-Economic Planning Sci ann, C. (2021). San(Choice Project Team. Department Sa oppropriateness profiles and transfer coefficient s. Earl	0.2 0.2 0.6 0.6 0.6 0.1 0.1 0.1 0.1 0.1 0.1 0.1) 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.1	nology (Eawag), Global WASH Cluster (GWC) and Sustai 0122(02)00007-1 ries (Sandec), Swiss Federal Institute of Aquatic Science nology.	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		PA PA - PA

Sedimentation / Thickening P	onde														
General Information	Values	Data Source													
	sedimentation_thickening_ponds	-													
DATA COMPILER	Julian Fritzsche														
INPUT PRODUCT	transportedsludge, transportedtransferred_sludge	Tilley, E. et al. (2014)													
OUTPUT PRODUCT	transportedprocessed_sludge,	Tilley, E. et al. (2014)													
	transportedeffluent														
RELATIONS															
	Output: AND	Tilley, E. et al. (2014)													
COMMENTS															
Pre-Filter Criteria applicability_level	Values (household = 0, neighbourhood = 0.5,	Data Source Tilley, E. et al. (2014)													
	city = 1)	Tilley, E. et al. (2014)													
capex_req_level		Spuhler, D. et al. (2021)													
opex_req_level technical_maturity	3	Spuhler, D. et al. (2021) Tilley, E. et al. (2014)													
	(acute = 0, stabilisation = 0.5,	Gensch, R. et al. (2018)													
Screening Criteria	development/recovery = 1) Type and Function	Applicable for this Functional Group?	Categories [Unit]	Technology Values (Data)	Data Source / Assumptions	Internal Review Done?									
water_supply	Performance, Categorical		house	NA NA	NA NA	NA NA									
			yard public												
terter.	Performance, Trapez	TALCE.	none	NA .	NA .	NA .									
water_volume electricity_supply	Performance, Categorical		[L/cap/day] electricity	(electricity = 1, intermittent = 0.5, no	"No electrical energy is required if there is no pump"	yes									
			intermittent	electricity = 0.5)	(Emersan)										
fuel_supply	Performance, Categorical	FALSE	no electricity fuel	NA	Depending on the design pumps might be necessary. NA	NA									
frequency_of_om	PDF, Categorical	TRUE	no fuel irregular	(irregular = 0, regular = 1, continous = 0)	"The maintenance is not intensive. The discharging										
rrequericy_or_on	FDI, Categorical	INOL	regular	(irregular = 0, regular = 1, continuus = 0)	area must be maintained and kept clean to reduce the										
			continuous		potential of disease transmission and nuisance (flies and odours). Solid waste that is discharged along with										
					the sludge must be removed from the screen at the										
					inlet of the ponds. The thickened sludge must be mechanically removed (with a frontend loader or										
					other specialised equipment) after it has sufficiently										
					thickened; alternatively, it can be pumped if it is still sufficiently liquid." (Emersan)										
pipe_supply	Performance, Categorical	TRUE	no pipes	(no pipes = 0.5, difficultly available =	Liquid outlet pipes might be necessary. (Emersan)	yes									
hihe_auhhiy	remonnance, categorical		difficultly available	(no pipes = 0.5, difficultly available = 0.75, pipes = 1)	and a description will be necessary. (cineisan)	·									
pump_supply	Performance, Categorical	TRUE	pipes no pumps	(no pumps = 0.75, difficultly available =	"The thickened sludge must be mechanically removed	yes									
,	,		difficultly available	0.75, pumps = 1)	(with a frontend loader or other specialised										
			pumps		equipment) after it has sufficiently thickened; alternatively, it can be pumped if it is still sufficiently										
					liquid." (Emersan)										
					Depending on the design, pumps might be necessary.										
concrete_supply	Performance, Categorical	TRUE	no concrete	(no concrete = 0, difficultly available =	"This is standard civil engineering work, requiring	yes									
			difficultly available concrete	0.5, concrete = 1)	digging and concrete." (Emersan) Usually concrete is required.										
spare_parts	PDF, Categorical	TRUE	simple technical	(simple = 0.7, technical = $\overline{0.3}$, special = 0)	"This is standard civil engineering work, requiring digging and concrete. Key items are the sludge removal	yes									
			special		equipment.", "The thickened sludge must be										
					mechanically removed (with a frontend loader or other specialised equipment) after it has sufficiently										
					thickened; alternatively, it can be pumped if it is still										
					sufficiently liquid." , "Can be built and repaired with locally available materials"(Emersan)										
					Technical spare parts might be necessary for the										
					sludge removal equipment.										
0		FALSE FALSE	0	NA NA	NA NA	NA NA									
0	0	FALSE	0	NA	NA	NA NA									
temperature	Performance, Categorical	TRUE	very cold cold	(very cold = 0.1, cold = 0.5, temperate = 1, warm = 1, hot = 1)	"This is a low-cost option that can be installed in most hot and temperate climates." (SSWM)										
			temperate	_,, = _1j	The functioning of the technology might not be										
			warm hot		guaranteed for temperatures under 0 °C. If the temperature is permanently below 0 °C, the sludge										
B P	Doeforma C-+ : '	TDIE		(flooding = 0.6, no floodin = 4)	would probably freeze.	No.									
flooding	Performance, Categorical	INUC	flooding no flooding	(flooding = 0.6, no flooding = 1)	Assumed to be similar to a WSP regarding flood proneness.	yes									
					"Both the incoming and thickened sludge are pathogenic", "Excessive rain may prevent the sludge										
					from properly settling and thickening." (Emersan)										
					Should avoid floods spreading the pathogenic sludge										
					This is a technology that is necessarily built on the										
					ground surface and its raised configuration is not possible. (e.g., all pond-based, wetlands, drying beds										
					etc.). Note: All pond-based/wetland/drying bed technologies are allotted similar performance values.										
					technologies are allotted similar performance values. Their functioning can be severely disrupted by flooding										
					events. However, it is possible that they can be protected from flooding by building embankments or										
					mounds of adequate height around them. Since a										
					flood-preventive configuration of the technology is possible, it is allotted a performance of 50%. Process										
	i e e e e e e e e e e e e e e e e e e e				wise, flooding or entry of surface run-off can be										
1															
					considered to be more critical for drying beds than										
					ponds and wetlands, therefore technologies of the latter two type are awarded a slightly higher										
					ponds and wetlands, therefore technologies of the										
ushirular as	Dadama · · · · · · · ·	FAISE	20.25005	NA NA	ponds and wetlands, therefore technologies of the latter two type are awarded a slightly higher performance of 60% (Akanksha Jain)	NA.									
vehicular_acces	Performance, Categorical		no access	NA NA	ponds and wetlands, therefore technologies of the latter two type are awarded a slightly higher	NA .									
			difficult full		ponds and wetlands, therefore technologies of the latter two type are awarded a slightly higher performance of 60% (Akanksha Jain)										
slope	Performance, Categorical	FALSE	difficult full flat not flat	NA	ponds and wetlands, therefore technologies of the latter two type are awarded a slightly higher performance of 60% (Akanksha Jain) NA	NA .									
		FALSE	difficult full flat		ponds and wetlands, therefore technologies of the latter two type are awarded a slightly higher performance of 60% (Akanksha Jain)										
slope	Performance, Categorical	FALSE	difficult full flat not flat clay silt sand	NA	ponds and wetlands, therefore technologies of the latter two type are awarded a slightly higher performance of 60% (Akanksha Jain) NA	NA .									
slope soil_type	Performance, Categorical Performance, Categorical	FALSE	difficult full flat mot flat clay silt sand gravel rock	NA NA	ponds and wetlands, therefore technologies of the latter two type are awarded a slightly higher performance of 60% (Akanksha Jain) NA NA	NA NA									
slope soil_type groundwater_depth	Performance, Categorical Performance, Categorical Performance, Trapez	FALSE FALSE FALSE	difficult full flat not flat clay silt sand gravel	NA NA	ponds and wetlands, therefore technologies of the latter two type are awarded a slightly higher performance of 60% (Akanksha Jain) NA NA NA	NA NA									
slope soil_type groundwater_depth excavation	Performance, Categorical Performance, Categorical Performance, Trapez Performance, Categorical	FALSE FALSE TRUE	difficult full flat not flat clay silt sand gravel rock water depth [m] easy	NA NA NA (easy = 1, hard = 0.5)	ponds and wetlands, therefore technologies of the latter two type are awarded a slightly higher performance of 60% (Akanksha Jain) NA NA NA NA NA Assuming that shallow and wide excavation is necessary.	NA NA NA yes									
slope soil_type groundwater_depth	Performance, Categorical Performance, Categorical Performance, Trapez	FALSE FALSE TRUE	difficult full flat not flat clay slit sand gravel gravel water depth [m] easy	NA NA NA (easy = 1, hard = 0.5)	ponds and wetlands, therefore technologies of the latter two type are awarded a slightly higher performance of 60% (Akanksha Jain) NA NA NA Assuming that shallow and wide excavation is	NA NA									
slope soil_type groundwater_depth excavation	Performance, Categorical Performance, Categorical Performance, Trapez Performance, Categorical	FALSE FALSE FALSE FALSE FALSE FALSE	difficult full flat not flat clay silt sand gravel rock water depth [m] easy	NA NA NA (easy = 1, hard = 0.5)	ponds and wetlands, therefore technologies of the latter two type are awarded a slightly higher performance of 60% (Akanksha Jain) NA NA NA NA NA Assuming that shallow and wide excavation is necessary.	NA NA NA yes									
slope soil_type groundwater_depth excavation surface_area_onsite	Performance, Categorical Performance, Categorical Performance, Trapez Performance, Categorical Performance, Trapez	FALSE FALSE FALSE FALSE FALSE FALSE	difficult full flat not flat clay silt sand gravel rock water depth (m) easy haff (m2/plot)	NA NA NA (easy = 1, hard = 0.5)	ponds and wetlands, therefore technologies of the latter two type are awarded a slightly higher performance of 60% (Akanksha Jain) NA NA NA NA NA NA NA NA NA N	NA NA NA yes									
slope soil_type groundwater_depth excavation surface_area_onsite	Performance, Categorical Performance, Categorical Performance, Trapez Performance, Categorical Performance, Trapez	FALSE FALSE FALSE FALSE FALSE FALSE	difficult full flat not flat clay silt sand gravel rock water depth (m) easy haff (m2/plot)	NA NA NA (easy = 1, hard = 0.5)	ponds and wetlands, therefore technologies of the latter two type are awarded a slightly higher performance of 60% (Akanksha Jain) NA NA NA Assuming that shallow and wide excavation is necessary. NA 0.006 m2/cap are required. From Table 8 in Heinss et al. 1998. Based on the following assumptions: 8-week cycle (4 weeks	NA NA NA yes									
slope soil_type groundwater_depth excavation surface_area_onsite	Performance, Categorical Performance, Categorical Performance, Trapez Performance, Categorical Performance, Trapez	FALSE FALSE FALSE FALSE FALSE FALSE	difficult full flat not flat clay silt sand gravel rock water depth (m) easy haff (m2/plot)	NA NA NA (easy = 1, hard = 0.5)	ponds and wetlands, therefore technologies of the latter two type are awarded a slightly higher performance of 60% (Akanksha Jain) NA NA NA NA NA Assuming that shallow and wide excavation is necessary. NA O.006 m2/cap are required. From Table 8 in Heinss et al. 1998. Based on the following assumptions: 8-week cycle (4 weeks loading + 4 weeks consolidating, 6 cycles	NA NA NA yes									
slope soil_type groundwater_depth excavation surface_area_onsite	Performance, Categorical Performance, Categorical Performance, Trapez Performance, Categorical Performance, Trapez	FALSE FALSE FALSE FALSE FALSE FALSE	difficult full flat not flat clay silt sand gravel rock water depth (m) easy haff (m2/plot)	NA NA NA (easy = 1, hard = 0.5)	ponds and wetlands, therefore technologies of the latter two type are awarded a slightly higher performance of 60% (Akanksha Jain) NA NA NA NA NA NA NA NA NA N	NA NA NA yes									
groundwater_depth excavation surface_area_offsite	Performance, Categorical Performance, Categorical Performance, Trapez Performance, Categorical Performance, Trapez Performance, Trapez	FALSE FALSE TRUE TRUE FALSE TRUE FALSE	difficult full flat noef flat clay silt sand gravel gravel gravel muzer depth (m) easy hard (m/z)pict) mu2/pers	NA NA (easy = 1, hard = 0.5) NA (a = 0.006, b = 0.006, c = 999, d = 999)	ponds and wetlands, therefore technologies of the latter two type are awarded a slightly higher performance of 60% (Akanksha Jain) NA NA NA NA NA NA NA NA NA N	NA NA NA Ves NA									
siope soil_type groundwater_depth excavation surface_area_onsite surface_area_offsite	Performance, Categorical Performance, Categorical Performance, Trapez Performance, Categorical Performance, Trapez Performance, Trapez	FALSE FALSE FALSE TRUE FALSE TRUE FALSE FALSE FALSE FALSE FALSE	difficult full flat not flat clay silt sand gravel rock water depth [m] easy hard [m/z/pers	NA NA (easy = 1, hard = 0.5) NA (a = 0.006, b = 0.006, c = 999, d = 999)	ponds and wetlands, therefore technologies of the latter two type are awarded a slightly higher performance of 60% (Akanksha Jain) NA NA NA NA NA NA NA NA NA N	NA NA NA NA NA NA NA NA									
groundwater_depth excavation surface_area_onsite surface_area_offsite	Performance, Categorical Performance, Categorical Performance, Trapez Performance, Categorical Performance, Trapez Performance, Trapez	FALSE FALSE FALSE TRUE FALSE TRUE FALSE FALSE FALSE FALSE FALSE	difficult full flat not flat clay silt sand gravel rock water depth [m] easy hard [m/z]pers 0 0 Close	NA NA (easy = 1, hard = 0.5) NA (a = 0.006, b = 0.006, c = 999, d = 999)	ponds and wetlands, therefore technologies of the latter two type are awarded a slightly higher performance of 60% (Akanksha Jain) NA NA NA NA NA NA NA NA NA N	NA NA NA Ves NA									
groundwater_depth excavation surface_area_offsite surface_area_offsite 0 0	Performance, Categorical Performance, Categorical Performance, Trapez Performance, Trapez Performance, Trapez Performance, Trapez Performance, Trapez O O Performance, Categorical	FALSE FALSE FALSE TRUE FALSE TRUE FALSE FALSE FALSE FALSE FALSE	difficult full flat not flat clay silt sand gravel rock water depth [m] easy hard [mz/plot] m2/pers 0 0 0 Close Not close	NA NA (easy = 1, hard = 0.5) NA (a = 0.006, b = 0.006, c = 999, d = 999) NA NA NA NA	ponds and wetlands, therefore technologies of the latter two type are awarded a slightly higher performance of 60% (Akanksha Jain) NA NA NA Assuming that shallow and wide excavation is necessary. NA 0.006 m2/cap are required. From Table 8 in Heinss et al. 1998. Based on the following assumptions: 8-week cycle (4 weeks loading + 4 weeks consolidating: 6 cycles annually); two parallel settling tanks. NA NA	NA NA NA NA NA NA NA NA NA									
slope soil_type groundwater_depth excavation surface_area_onsite surface_area_offsite 0 0 drinking_water_exposure	Performance, Categorical Performance, Categorical Performance, Trapez Performance, Categorical Performance, Trapez Performance, Trapez O O O O O Performance, Categorical	FALSE FALSE FALSE TRUE FALSE TRUE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE	difficult full flat fl	NA NA (easy = 1, hard = 0.5) NA (a = 0.006, b = 0.006, c = 999, d = 999) NA NA NA NA NA	ponds and wetlands, therefore technologies of the latter two type are awarded a slightly higher performance of 60% (Akanksha Jain) NA NA NA NA NA O.006 m2/cap are required. From Table 8 in Heinss et al. 1998. Based on the following assumptions: 8-week cycle (4 weeks loading as 4 weeks consolidating; 6 cycles annually); two parallel settling tanks. NA NA NA NA NA	NA	construction_ski		+		1	1		_	
---	--	---	--	--	---	-----------	--	--							
	ills Performance, Categorica	TRUE	Ladder: unskilled	(unskilled = 0, skilled = 0.5, professional = 1)	"Requires expert design and construction" (Compendium).	yes									
			skilled	- 1/	(compendium).										
		1	professional												
design_ski	ills Performance, Categorica	TRUE	Ladder: unskilled	(unskilled = 0, skilled = 0, professional = 1)	"Requires expert design and construction" (Compendium).	yes									
			skilled	21	(compendany.										
			professional												
om_ski	ills Performance, Categorica	TRUE	Ladder: Unskilled	(unskilled = 0.5, skilled = 1, professional = 1)	"The thickened sludge is still infectious, although it is easier to handle and less prone to splashing and	yes									
			Skilled	- 27	spraying. Trained staff for operation and maintenance										
			Professional		is required to ensure proper functioning"										
	0	D FALSE	+	O NA	(Compendium).	NA .									
		D FALSE		0 NA 0 NA	NA NA	NA NA									
	0 0	FALSE		0 NA	NA NA	NA .	1								
	0	FALSE		0 NA	NA .	NA									
cleansing_meth	od Performance, Categorica	FALSE	Washers Soft wipers	NA	NA	NA									
			Hard wipers												
		D FALSE		0 NA	NA	NA									
lifetin		FALSE	short (< 1 year)	0 NA (short = 1, medium = 1, long = 1)	NA "Desludging every 2 to 4 or 8 to 12 months for settling	NA									
illetin	ne Performance, Categorica	ITRUE	medium (1-5 years)	(snort = 1, medium = 1, long = 1)	tanks or sedimentation ponds respectively."	yes									
			long (>5 years)		(Thickening Ponds SSWM Toolbox)										
					The ponds can be used with lifetimes shorter than 1										
					year. It is assumed that a long lifetime is also possible, since the ponds can be emptied and reused. (Kukka										
					Ilmanen. Eawag 2021)		1								
speed_implement_toil	let PDF, Categorica	I FALSE	rapid (< 3 days)	NA	NA	NA									
			moderate (3 days to 2 weeks)				1								
speed_implement_treatme	ent PDF, Categorica	TRUE	slow (> 2 weeks) rapid (few days to a week)	(rapid=0, moderate=1, slow=0)	"This is standard civil engineering work, requiring	yes	1								
	,		moderate (few weeks up to three		digging and concrete. " (Emersan Compendium)		1								
			months)		Construction is quite simple however, since bricks		1								
			slow (> 3 months)		and/or concrete is used for construction, minimum 7 days curing is required- and since no prefab units are		1								
					available, probability is allotted only to moderate										
		<u> </u>			category and not rapid. (Akanksha Jain)		4								
scalabili	ity Performance, Categorica	TRUE	easy difficult	(easy = 1, difficult = 0.5)	The technology can be upscaled by increasing the	yes									
			difficult		pond size or the number of ponds. These ponds require large areas to be excavated, which might										
					require machinery and can therefore limit the										
					scalability of the technology. The technology can be										
					upscaled as long as sufficient space is available and										
construction_par	rts PDF, Categorica	TRUE	simple	(simple = 1, technical = 0, special = 0)	excavation is possible. (Kukka Ilmanen, Eawag 2021) "Can be built and repaired with locally available	yes									
			technical		materials"(Emersan)										
Transfer Coefficients	[copied from "Sanitation_Technologies_TC_database_2021062	(2.xlsm*)	special												
mansier coemicients	Processed Sludge	Range	Effluent	Airloss	Soilloss	Waterloss	Comments	Reference							
	TP 0.34	4 0.1 - 0.	.65 0.6	66 0	0	()	PA							
	0.36	6	- 0.6	id (0		* TP	Ingallinella							
					,	,	removal in	et al. (2002							
med (55 0	0	(0								
	k :: TN 0.:		- 0.	7			o * See	PA Strauss et							
							calculations	s al. (2000)							
	0.3	1	- 0.6	9 0	0	C	* See calculations	Koné and Strauss							
							in 24.2.1	(2004)							
	0.39	1	- 0.6		0		* TN removal in	Ingallinella et al. (2002							
							septage								
		<u> </u>	1	- 0.1			pond	PA							
				0.2											
med (1 (0.3-0.3						-							
	pal. 0.24					(0	+							
	k 25	4	- 0.6			(0	PA PA							
н	k 25 120 0.05	4 5 [0.0	- 0.6	0.1		(0 *	PA Montange							
н		4 5 [0.0	- 0.6 09]	0.1		(0 * supernatan	Montange o and							
н		4 5 [0.0	- 0.6 09]	0.1		(t flows of	Montange o and Strauss							
н		4 5 [0.0	- 0.6 09]	0.1	0	(0 * supernatan t flows of settling/thic	Montange o and Strauss							
н		4 5 [0.0	- 0.6 09]	66 0.1	0		t flows of	Montange o and Strauss c (2002)							
	0.09	6 5 5	- 0.6 - 0.9	- 0.03	0	(t flows of	Montange o and Strauss c (2002)							
med (0.09	5 (0.0	- 0.6 09]	66 0.1 55 c			t flows of	Montange o and Strauss c (2002)							
med ((R) 0.00 (R) 0.00 (R) 0.00 (R) 0.00 (R) 0.00	6 (0.0	- 0.6 - 0.9 - 0.9 - 0.9	0.03 0.03 0.03			t flows of settling/thic	Montange o and Strauss c (2002) PA							
med ((R) 0.00 last 0.00	6 (0.0	- 0.6 - 0.9	0.03 0.03 0.03			t flows of settling/thic	Montange o and Strauss c (2002) PA							
med ((R) 0.00 (R) 0.00 (R) 0.00 (R) 0.00 (R) 0.00	5 (0.0 5)	- 0.6 - 0.9 - 0.9 - 0.9	0.03 0.03 0.03 0.03 0.03 0.03 0.03			t flows of settling/thic	Montange o and Strauss c (2002) PA							
med ((R) 0.00 (R) 0.00 (R) 0.00 (R) 0.00 (R) 0.00 (R) 0.00 (R) 0.00	5 (0.0 5)	- 0.67 - 0.67	0.03 0.03 0.03 0.03 0.03 0.03 0.03			t flows of settling/thic	Montange o and Strauss c (2002) PA PA Conradin e al. (2010) Montange o and							
med ((R) 0.00 (R) 0.00 (R) 0.00 (R) 0.00 (R) 0.00 (R) 0.00 (R) 0.00	5 (0.0 5)	- 0.67 - 0.67	0.03 0.03 0.03 0.03 0.03 0.03 0.03			t flows of settling/thic	Montange o and Strauss c (2002) PA PA Conradin e al. (2010) Montange o and							
med ((R) 0.00 kg 22 kg	4	- 0.67 - 0.48	- 0.03 - 0.03 - 0.03 - 0.03 - 0.03			t flows of settling/thic control of settling/thic control of spuhler et control of settling control of settling control of the settling control of	Montange o and Strauss c (2002) PA PA Conradin e al. (2010) Montange o and o Strauss							
med ((R) 0.00 (R) 0.00 (R) 0.00 (R) 0.00 (R) 0.00 (R) 0.00 (R) 0.00	4 (0.0)	0.6 0.9 0.9 0.9 0.9 0.9 0.9 0.67 0.48	- 0.03 - 0.03 - 0.03 - 0.03 - 0.03			t flows of settling/thic of settling/thic of settling/thic of spuhler et of settling of the se	Montange o and Strauss c (2002) PA PA Conradin e al. (2010) Montange o and o Strauss							
med ((R) 0.00 (R) 0.00 (R) 0.00 (R) 0.00 (R) 0.00 (R) 0.00 (R) 0.00	4 (0.0)	0.6 0.9 0.9 0.9 0.9 0.9 0.9 0.67 0.48	- 0.03 - 0.03 - 0.03 - 0.03 - 0.03			t flows of settling/thic control of settling/thic control of spuhler et control of settling control of settling control of the settling control of	Montange o and Strauss c (2002) PA PA Conradin e al. (2010) Montange o and o Strauss							
med ((R) 0.00 (R) 0.00 sal. 0.00 k 22 TS 0.32 0.51	4 (0.0)	0.6 0.9 0.9 0.9 0.9 0.9 0.9 0.67 0.48	- 0.03 - 0.03 - 0.03 - 0.03 - 0.03			t flows of settling/thic control of settling/thic control of spuhler et control of settling control of settling control of the settling control of	Montange o and Strauss c (2002) PA PA Conradin e al. (2010) Montange o and o Strauss							
med ((R) 0.02 (R) 0.02	4 (0.04) 5 (0.04) 5 (0.04) 5 (0.04) 6 (0.04) 7 (0.04) 8 (0.04) 8 (0.04) 9 (- 0.67 - 0.99 - 0.67 - 0.48 - 0.53	- 0.03 - 0.03 - 0.03 - 0.03 - 0.03 - 0.03 - 0.03 - 0.03 - 0.03			t flows of settling/thic control of settling/thic control of spuhler et control of settling control of settling control of the settling control of	Montange o and Strauss c (2002) PA PA Conradin e al. (2010) Montange o and o Strauss							
med ((R)	4 (0.00) 5 (0.00) 5 (0.00) 6 (0.00) 7 (0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5	6 0.1 5 0.03 6 0.03 7 0.03 7 0.03 7 0.03			t flows of settling/thic control of settling/thic control of spuhler et control of settling control of settling control of the settling control of	Montange o and Strauss c (2002) PA PA Conradin e al. (2010) Montange o and o Strauss							
med ((R)	4 (0.00) 5 (0.00) 5 (0.00) 6 (0.00) 7 (- 0.69 - 0.99 - 0.99 - 0.99 - 0.99 - 0.67 - 0.48 - 0.48 - 0.57 - 0.48 - 0.57 - 0.48 - 0.57 - 0.48	6 0.1 5 0.03 6 0.03 7 0.03 7 0.03 7 0.03			t flows of settling/thic control of settling/thic control of spuhler et control of settling control of settling control of the settling control of	Montange o and Strauss c (2002) PA PA Conradin e al. (2010) Montange o and o Strauss							
med (b med (Additional Information 24.1 Net4-N [mg Calculat	(R)	4 (0.00) 5 (0.00) 5 (0.00) 6 (0.00) 7 (0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5	6 0.1 5 0.03 6 0.03 7 0.03 7 0.03 7 0.03			t flows of settling/thic control of settling/thic control of spuhler et control of settling control of settling control of the settling control of	Montange n o and Strauss c (2002) PA PA Conradin e al. (2014) Montange o and n Strauss							
med (b med (Additional Information 24.1 NH4-N [mg Calculat	(R)	4 (0.00) 5 (0.00) 5 (0.00) 6 (0.00) 7 (- 0.69 - 0.99 - 0.99 - 0.99 - 0.99 - 0.67 - 0.48 - 0.48 - 0.57 - 0.48 - 0.57 - 0.48 - 0.57 - 0.48	6 0.1 5 0.03 6 0.03 7 0.03 7 0.03 7 0.03			t flows of settling/thic control of settling/thic control of spuhler et control of settling control of settling control of the settling control of	Montange n o and Strauss c (2002) PA PA Conradin e al. (2014) Montange o and n Strauss							
med (b med (Additional Information 24.1 Net4-N [mg Calculat	R 0.00	4 (0.00) 5 (0.00) 6 (0.00) 7 (TC Effluent TC Effluent = Ammonia content in Effluent/ Ammonia content in influent TC Effluent TC Effluent = TC Effluent = TC Effluent TC Effluent	6 0.1 5 0.03 6 0.03 77 0 77 0 77 C Sludge			t flows of settling/thic control of settling/thic control of spuhler et control of settling control of settling control of the settling control of	Montangen o and Strauss c (2002) PA							
med (b med (Additional Information 24.1 NH4-N [mg Calculat 24.2	R 0.00	4	TC Effluent TC Effluent = Ammonia content in Effluent/ Ammonia content in influent TC Effluent TC Effluent = TC Effluent = TC Effluent TC Effluent	6 0.1 5 0.03 6 0.03 77 0 77 0 77 C Sludge			t flows of settling/thic control of settling/thic control of spuhler et control of settling control of settling control of the settling control of	Montangen o and Strauss c (2002) PA							
med (Additional Information Additional Information	(R) 0.01 k 22 175 0.51 (R) 0.44 k 22 2.1 Data from: Koné and Strauss (2004) Influent 2.2 Data from: Strauss et al. (2000) Influent k 22	4	TC Effluent TC Effluent = Ammonia content in Effluent/ Ammonia content in influent TC Effluent TC Effluent = TC Effluent = TC Effluent TC Effluent	6 0.1 5 0.03 6 0.03 77 0 77 0 77 C Sludge			t flows of settling/thic control of settling/thic control of spuhler et control of settling control of settling control of the settling control of	Montangen o and Strauss c (2002) PA							
med (Additional Information Additional Information 24.2 Additional Information	(R) 0.00 R 0.00 R 22 15 0.51 (R) 0.44 k 22 2.1 Data from: Koné and Strauss (2004) Influent Condition Con	4 (0.0) 5 (0.0) 5 (0.0) 5 (0.0) 6 (0.0) 7 (0.0) 6 (0.0	- 0.69 - 0.9 - 0.9 - 0.9 - 0.67 - 0.48 - 0.48 - 0.5 - 0.48 - 0.5 -	- 0.3 - 0.03 - 0			t flows of settling/thic control of settling/thic control of spuhler et control of settling control of settling control of the settling control of	Montange n o and Strauss c (2002) PA PA Conradin e al. (2014) Montange o and n Strauss							
med (Additional Information 24.1 Additional Information 24.1 Additional Information 24.1	(R)	4 (0.0) 5 (0.0) 5 (0.0) 5 (0.0) 6 (0.0) 7 (0.0) 6 (0.0	7 C Effluent TC Effluent TC Effluent TC Effluent TC Effluent TC Effluent TC Effluent TC Effluent TC Effluent TC Effluent TC Effluent TC Effluent TC Effluent TC Effluent TC Effluent TC Effluent TC Effluent	- 0.3 - 0.03 - 0			t flows of settling/thic control of settling/thic control of spuhler et control of settling control of settling control of the settling control of	Montange n o and Strauss c (2002) PA PA Conradin e al. (2010) Montange o and n Strauss							
med (Additional Information Additional Information 24.2 Additional Information	(R)	4 (0.0) 5 (0.0) 5 (0.0) 5 (0.0) 6 (0.0) 7 (0.0) 6 (0.0	- 0.69 - 0.9 - 0.9 - 0.9 - 0.67 - 0.48 - 0.48 - 0.5 - 0.48 - 0.5 -	- 0.3 - 0.03 - 0			t flows of settling/thic control of settling/thic control of spuhler et control of settling control of settling control of the settling control of	Montange o and Strauss c (2002) PA PA Conradin e al. (2010) Montange o and o Strauss							
med (b med (Additional Information 24.1 NH4-N [mg Calculat 24.1 Additional Information 24.1	(R)	4 (0.0) 5 (0.0) 5 (0.0) 5 (0.0) 6 (0.0) 7 (0.0) 6 (0.0	TC Effluent TC Effluent TC Effluent TC Effluent TC Effluent TC Effluent TC Effluent TC Effluent TC Effluent TC Effluent TC Effluent TC Effluent TC Effluent TC Effluent TC Effluent TC Effluent TC Effluent	- 0.3 - 0.03 - 0			t flows of settling/thic control of settling/thic control of spuhler et control of settling control of settling control of the settling control of	Montange o and Strauss c (2002) PA PA Conradin e al. (2010) Montange o and o Strauss							

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Strauss, P., et al. (2000). "The Country Countries (Countries, Challenge and performance: "Wetland Systems 1: 213-219.
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Co-Composting						
General Information	Values	Data Source				
FUNCTIONAL GROUP UNIQUE IDENTIFIER (ID)	T	-	1			
DATA COMPILER	Matthias van Sloten	-	<u> </u>			
	stored_faeces, transportedstored_faeces, pithumus, transportedpithumus, sludge,	Spuhler, D. & Roller, L. (2020)				
	transportedsludge, ,					
	transportedtransferred_sludge, processed_sludge,					
	transportedprocessed_sludge, organics,					
OLITPLIT PRODUCT	transportedorganics compost, transportedcompost	Spuhler, D. & Roller, L. (2020)	+			
RELATIONS	Input: OR	Spuhler, D. & Roller, L. (2020)	†			
COMMENTS	Output:					
Pre-Filter Criteria	Values	Data Source				
	(household = 0, neighbourhood = 0.5, city = 1) (household = 0, shared = 0.5, public = 1)	Tilley, E. et al. (2014) Tilley, E. et al. (2014)				
capex_req_level		Spuhler, D. et al. (2021)				
opex_req_level technical_maturity		Spuhler, D. et al. (2021) Tilley, E. et al. (2014)	+			
development_phase	(acute = 0.5, stabilisation = 0.5,	"Because of the high level of organisation and				
	development/recovery = 1)	labour needed to sort organic waste, manage the facility and monitor treatment efficiency, this				
		technology is unlikely to be practical in the acute				
		response phase. However, it can be considered a viable option in the stabilisation and recovery				
		phases of an emergency." (Gensch, R. et al.				
Screening Criteria	Type and Function	(2018)) Applicable for this Functional Group?	Categories [Unit]	Technology Values (Data)	Data Source / Assumptions	Internal
						Review
water_supply	Performance, Categorical	FALSE	house	NA	NA	Done? NA
	ĺ		yard public			
			none			
water_volume electricity_supply	Performance, Trapez Performance, Categorical		[L/cap/day] electricity	NA (electricity = 1, intermittent = 1, no electricity = 1)	NA "No electrical energy required" (Compendium)	NA yes
стесствету_заррту	i cirolinance, categorical		intermittent			,
fuel_supply	Performance, Categorical	FALSE	no electricity fuel	NA NA	NA .	NA
			no fuel			
frequency_of_om	PDF, Categorical	IRUE	irregular regular	(irregular = 0, regular = 0.5, continuous = 0.5)	"The mixture must be carefully designed so that it has the proper C:N ratio, moisture and oxygen	yes
			continuous		content. If facilities exist, it would be useful to	
					monitor helminth egg inactivation as a proxy measure of sterilization.	
					A well-trained staff is necessary for the operation	
					and maintenance of the facility. Maintenance staff must carefully monitor the quality of the	
					input material, and keep track of the inflows,	
					outflows, turning schedules, and maturing times to ensure a high quality product.	
					Forced aeration systems must be carefully	
					controlled and monitored. Turning must be periodically done with either a front-end loader	
					or by hand. Robust grinders for shredding large	
					pieces of solid waste (i.e., small branches and coconut shells) and pile turners help to optimize	
					the process, reduce manual labour, and ensure a	
					more homogenous end product." (Compendium)	
					Depending on the design, full-time labour might be required.	
pipe_supply	Performance, Categorical	TRUE	no pipes	(no pipes = 1, difficultly available = 1, pipes = 1)	No pipes required.	yes
			difficultly available			
pump_supply	Performance, Categorical	TRUE	no pumps	(no pumps = 1, difficultly available = 1, pumps = 1)	No pumps required.	yes
	,		difficultly available			
concrete_supply		TRUE	pumps no concrete	(no concrete = 0.75, difficultly available = 0.75,	"A sealed or impervious composting pad (the	yes
	Performance, Categorical		difficultly available	concrete = 1)	surface where the heaps are located) must be	
,	Performance, Categorical			concrete - 17		
	Performance, Categorical		concrete	control = 1	constructed to collect the leachate which can then be reintegrated into the piles or treated.",	
,,	Performance, Categorical			control of	constructed to collect the leachate which can then be reintegrated into the piles or treated.", "The compost pad can be made out of concrete,	
,	Performance, Categorical			Control of the contro	constructed to collect the leachate which can then be reintegrated into the piles or treated.", "The compost pad can be made out of concrete, or well-compressed clay." (Emersan) The composting facility does not necessarily have	
,	Performance, Categorical			Solice Care - aj	constructed to collect the leachate which can then be reintegrated into the piles or treated.", "The compost pad can be made out of concrete, or well-compressed clay." (Emersan) The composting facility does not necessarily have to be built with concrete, but it can be useful to	
	Performance, Categorical			Since E = 27	constructed to collect the leachate which can then be reintegrated into the piles or treated.", "The compost pad can be made out of concrete, or well-compressed clay." (Emersan) The composting facility does not necessarily have to be built with concrete, but it can be useful to avoid leaching into the ground and concrete might perform a bit better than well-compressed.	
	Performance, Categorical			Since E = 27	constructed to collect the leachate which can then be reintegrated into the piles or treated.", "The compost pad can be made out of concrete, or well-compressed clay." (Emersan) The composting facility does not necessarily have to be built with concrete, but it can be useful to avoid leaching into the ground and concrete	
spare_parts		TRUE	simple	(simple = 1, technical = 0, special = 0)	constructed to collect the leachate which can then be reintegrated into the pilos or treated.", "The compost pad can be made out of concrete, or well-compressed clay." (Emersan) The composting facility does not necessarily have to be built with concrete, but it can be useful to avoid leaching into the ground and concrete might perform a bit better than well-compressed clay when it comes to impermeability. "Can be built and maintained with locally	yes
		TRUE	simple technical		constructed to collect the leachate which can then be reintegrated into the piles or treated.", "The compost pad can be made out of concrete, or well-compressed clay." (Emersan) The composting facility does not necessarily have to be built with concrete, but it can be useful to avoid leaching into the ground and concrete might perform a bit better than well-compressed clay when it comes to impermeability. "Can be built and maintained with locally available materials", "If required, a cover/roof	yes
		TRUE	simple		constructed to collect the leachate which can then be reintegrated into the piles or treated.", "The compost pad can be made out of concrete, or well-compressed clay." (Emersan) The composting facility does not necessarily have to be built with concrete, but it can be useful to avoid leaching into the ground and concrete might perform a bit better than well-compressed clay when it comes to impermeability. "Can be built and maintained with locally available materials", "If required, a cover/roof can be made from local materials such as bamboo, grass natting, or wood, plastic or metal	yes
		TRUE	simple technical		constructed to collect the leachate which can then be reintegrated into the piles or treated.", "The compost pad can be made out of concrete, or well-compressed clay "(Emersan) The composting facility does not necessarily have to be built with concrete, but it can be useful to avoid leaching into the ground and concrete might perform a bit better than well-compressed clay when it comes to impermeability. "Can be built and maintained with locally available materials." If required, a cover/roof can be made from local materials such as bamboo, grass matting, or wood, plastic or metal sheeting." (Emersan)	yes
spare_parts 0	PDF, Categorical	FALSE	simple technical special	(simple = 1, technical = 0, special = 0)	constructed to collect the leachate which can then be reintegrated into the piles or treated.", "The compost pad can be made out of concrete, or well-compressed clay." (Emersan) The composting facility does not necessarily have to be built with concrete, but it can be useful to avoid leaching into the ground and concrete might perform a bit better than well-compressed clay when it comes to impermeability. "Can be built and maintained with locally available materials", "If required, a cover/roof can be made from local materials such as bamboo, grass matting, or wood, plastic or metal sheeting." (Emersan) Simple spare parts suffice.	NA
spare_parts	PDF, Categorical	FALSE FALSE	simple technical special	(simple = 1, technical = 0, special = 0) NA NA	constructed to collect the leachate which can then be reintegrated into the piles or treated.", "The compost pad can be made out of concrete, or well-compressed clay." (Emersan) The composting facility does not necessarily have to be built with concrete, but it can be useful to avoid leaching into the ground and concrete might perform a bit better than well-compressed clay when it comes to impermeability. "Can be built and maintained with locally available materials.", "If required, a cover/roof can be made from local materials such as bamboo, grass matting, or wood, plastic or metal sheeting." (Emersan) Simple spare parts suffice. NA	NA NA
spare_parts 0	PDF, Categorical	FALSE FALSE FALSE	simple technical special	(simple = 1, technical = 0, special = 0) NA NA NA NA	constructed to collect the leachate which can then be reintegrated into the piles or treated.", "The compost pad can be made out of concrete, or well-compressed clay." (Emersan) The composting facility does not necessarily have to be built with concrete, but it can be useful to avoid leaching into the ground and concrete might perform a bit better than well-compressed clay when it comes to impermeability. "Can be built and maintained with locally available materials", "If required, a cover/roof can be made from local materials such as bamboo, grass matting, or wood, plastic or metal sheeting." (Emersan) Simple spare parts suffice. NA NA Assumed to be similar to a composting chamber.	NA
spare_parts 0 0	PDF, Categorical 0 0 0	FALSE FALSE FALSE	simple technical special co co co co co co co co co co co co co	(simple = 1, technical = 0, special = 0) NA NA NA NA	constructed to collect the leachate which can then be reintegrated into the piles or treated.", "The compost pad can be made out of concrete, or well-compressed clay." (Emersan) The composting facility does not necessarily have to be built with concrete, but it can be useful to avoid leaching into the ground and concrete might perform a bit better than well-compressed clay when it comes to impermeability. Can be built and maintained with locally available materials", "If required, a cover/roof can be made from local materials such as bamboo, grass matting, or wood, plastic or metal sheeting. "(Emersan) Simple spare parts suffice. NA NA Assumed to be similar to a composting chamber. "Windrow piles should be at least 1 m high and	NA NA NA
spare_parts 0 0	PDF, Categorical 0 0 0	FALSE FALSE FALSE	simple technical special Co Co Co Co Co Co Co Co Co Co Co Co Co	(simple = 1, technical = 0, special = 0) NA NA NA NA	constructed to collect the leachate which can then be reintegrated into the piles or treated.", "The compost pad can be made out of concrete, or well-compressed clay." (Emersan) The composting facility does not necessarily have to be built with concrete, but it can be useful to avoid leaching into the ground and concrete might perform a bit better than well-compressed clay when it comes to impermeability. "Can be built and maintained with locally available materials", "If required, a cover/roof can be made from local materials such as bamboo, grass matting, or wood, plastic or metal sheeting." (Emersan) Simple spare parts suffice. NA NA ASSumed to be similar to a composting chamber. "Windrow piles should be at least 1 m high and insulated with a 30 cm layer of compost; ool, or grass soil to promote an even distribution of	NA NA NA
spare_parts 0 0	PDF, Categorical 0 0 0	FALSE FALSE FALSE	simple technical special col very cold cold temperate	(simple = 1, technical = 0, special = 0) NA NA NA NA	constructed to collect the leachate which can then be reintegrated into the piles or treated.", "The compost pad can be made out of concrete, or well-compressed clay." (Emersan) The composting facility does not necessarily have to be built with concrete, but it can be useful to avoid leaching into the ground and concrete might perform a bit better than well-compressed clay when it comes to impermeability. "Can be built and maintained with locally available materials", "If required, a cover/roof can be made from local materials such as bamboo, grass matting, or wood, plastic or metal sheeting." (Emersan) Simple spare parts suffice. NA Assumed to be similar to a composting chamber. "Windrow piles should be at least 1 m high and insulated with a 30 m layer of compost, soil, or grass soil to promote an even distribution of pheat. In colder fulmates heaps work best at 2.5 m.	NA NA NA
spare_parts 0 0	PDF, Categorical 0 0 0	FALSE FALSE FALSE	simple technical special Co Co Co Co Co Co Co Co Co Co Co Co Co	(simple = 1, technical = 0, special = 0) NA NA NA NA	constructed to collect the leachate which can then be reintegrated into the piles or treated.", "The compost pad can be made out of concrete, or well-compressed clay." (Emersan) The composting facility does not necessarily have to be built with concrete, but it can be useful to avoid leaching facility does not necessarily have to be built with concrete, but it can be useful to avoid leaching into the ground and concrete might perform a bit better than well-compressed clay when it comes to impermeability. Can be built and maintained with locally available materials", "If required, a cover/roof can be made from local materials such as bamboo, grass matting, or wood, plastic or metal sheeting." (Emersan) Simple spare parts suffice. NA NA NA NA NA NA NA NA NA N	NA NA NA
spare_parts 0 0 0 temperature	PDF, Categorical 0 0 Performance, Categorical	FALSE FALSE FALSE TRUE	simple technical special col col col temperate warm hot	(simple = 1, technical = 0, special = 0) NA NA NA (very cold = 0.5, cold = 0.7, temperate = 0.9, warm	constructed to collect the leachate which can then be reintegrated into the piles or treated.", "The compost pad can be made out of concrete, or well-compressed clay." (Emersan) The composting facility does not necessarily have to be built with concrete, but it can be useful to avoid leaching facility does not necessarily have to be built with concrete, but it can be useful to avoid leaching into the ground and concrete might perform a bit better than well-compressed clay when it comes to impermeability. Can be built and maintained with locally available materials", "If required, a cover/roof can be made from local materials such as bamboo, grass matting, or wood, plastic or metal sheeting." (Emersan) Simple spare parts suffice. NA NA Assumed to be similar to a composting chamber. "Windrow piles should be at least 1 m high and insulated with a 30 cm layer of compost, soil, or grass soil to promote an even distribution of heat. In colder climates heaps work best at 2.5 m high and 5 m wide." (Emersan). In colder climates windrows need to be larger to generate more heat.	NA NA NA
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## 1	soil_type	Performance, Categorical	FALSE	clay	NA	NA	NA	1
March Marc								
March Marc								
March Marc				water depth [m]				
Part Part				hard				
Property of the content of the con	surface_area_onsite	Performance, Trapez	FALSE	[m2/plot]	NA NA	NA	NA	
1	surface_area_offsite	Performance, Trapez	TRUE	m2/pers	(a = 0.04, b = 0.04, c = 999, d = 999)	3000kg of compost can be treated in a		
1 1 1 1 1 1 1 1 1 1						2006). From this, we derive minimum space		
Programmer Pro	0	0	FAISE	0	NA.	requirements of 0.04 m2/cap (Eawag, 2021).	NΔ	-
Table Tabl	0	0	FALSE	C	NA NA	NA	NA	
								1
Temperature Company				Not close				
March Marc	0							
Mary Mary	construction_skills	Performance, Categorical	TRUE		(unskilled = 1, skilled = 1, professional = 1)		yes	
March Marc				skilled				
March	design_skills	Performance, Categorical	TRUE		(unskilled = 0, skilled = 0.5, professional = 1)	"Requires expert design and operation by skilled	yes	
Processor Proc								
March Marc								
March Marc	om_skills	Performance, Categorical	TRUE	Ladder:	(unskilled = 0, skilled = 1, professional = 1)	"Requires expert design and operation by skilled	yes	
Post					·	personnel" (Compendium)		
Companies Comp								
Companies Comp	0	n	FALSE	n	NA .	NA .	NA	-
March Marc	0	0	FALSE	C	NA NA	NA	NA	1
March Marc		0	FALSE	C	NA NA	NA	NA	1
1	cleansing_method			Washers				
Part				Hard wipers				1
### Canada Canad								1
Mary Mary				short (< 1 year)		"Life time of the processing machinery and		
Marie Mari						the asphalt pad [used as lining material for the		
						base] is expected to be replaced every 15 y. All		
Separate Performance Separate Separa						asphalt pad and the building) is expected to have		
Part Part								
Part						equipment.] (Composting Griesauer, C. (2014)		
Service of the servic								
Page Page						windrow composting system were larger than 5		
Consequency Technology of Table 1 (1997) Goods Jupinesed Technology								
State the product make the to travel for some times the plane of the state of the memory and the plane of the state of the plane of the state of the plane of the state of the plane of the state of the plane of the state of the plane of the state of the plane of the state of the plane of the state of the plane of the state of the plane of the state of the plane of the state of the plane of the state of the plane of the state of the plane of the state of the plane of the state of the plane of the plane of the state of the plane of the								
Part Part						Since the product needs to be stored for		
Speed_applament_treatment PEF_Categorial EALSE Impact (- Study) Impact (- Stu								
Speed, Injudement, free from PALE (and price of the part of the pa						technologies for short lifetimes are not		
moderate Dispite 10 services) food present pr								
	speed_implement_toilet	PDF, Categorical	FALSE		NA	NA	NA	
moderate (fee weeks up to three months)		DDS Consorted	TOUS	slow (> 2 weeks)	(coald 0 coadcasts 0.7 days 0.2)	II.C. Company of a Wilder and he are should		
compressed day, if required, a cover/root can be selected from the calles which the broads, gas need from the calles which the broads of all centers are abuiltable and the callest of all centers are abuiltable and the callest and the call	speed_implement_treatment	PDF, Categorical	IRUE		(rapid=0, moderate=0.7, slow=0.3)	using locally available material. The compost pad	yes	
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Internation	scalability	Performance, Categorical	INUE	difficult	teasy = 1, difficult = 1)	material (sludge and organic waste) is piled into	yes	
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						constructed pond. (Kukka Ilmanen, Eawag 2021)		
Special Spec	construction_parts	PDF, Categorical	TRUE		(simple = 1, technical = 0, special = 0)		yes	
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						high as 70%	Tanski and
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			Incoming P [t/year]	Outgoing P [t/year]	TC_TN	TC_TP	
From Markets	534		267				
From Households	1005		182				
From Poultry Farms	7		6				
From Breweries	177		44				
From Sawmills							
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To Atmosphere- Airloss Additional Information 27.2.1 Da Int From Markets From Households From Poultry Farms From Eneweries From Sawmills To Atmosphere- Airloss References Gensch, R., Jennings, A., Renggli, S., Jocotscher, T., & Keller, J. (2002). Add Spubler, D., & Botter, I. (2002). Add Spubler, D., & Botter, I. (2002). Material flow anal Heinomen-Tanski, H. and C. van Wijk Letzinger, C. (2011). The Potential of Meinzinger, F. (2011). The Potential of Griesauer, C. (2013). Contribution of	ata from: Leitzinger (2001) coming N [t/year] 534 1005 7 177 172 & Reymond, P. (2018). Compendium of Sanikation Telections output to the cleckion support system for selecting sanitation system scshe, J., Ilmanen, K., Jain, A., van Sloten, M., & Willim totation technology litrary: Debtoits and data sources for hysis as a strategic planning tool for regional waste we-Sijbesma (2005): "Human excreta for plant production of the Uth Go-composting in kumasi-Cuantification of the Uth Co-composting in kumasi-Cuantification of the Uth Ciency of urban sanitation systems: a comparative ass on the development of cost functions for the LIAAR sun	Outgoing N [t/year] 534 Chnologies in Emergencies . German WASH Network (GW wis in developing countries . Socio-Economic Planning Scie ann, C. (2021). SaniChoice Project Team Department San roppropriateness profiles and transfer coefficients . Eaviette and solid waste management. Proceedings of the work." Bior Sociore Science Scie	Incoming P [t/year] 267 182 6 44 N), Swiss Federal Institute of Aquatic Science and Techroces, 36 (4), 267–290. https://doi.org/10.1016/50038-tiation, Water and Solid Waste for Development Count gr. Swiss Federal Institute of Aquatic Science and Techroches of Tec	Outgoing P [t/year] clogy (Eawag), Global WASH Cluster (GWC) and Sustain 1121(02)00007-1 les (Sandec), Swiss Federal Institute of Aquatic Science clogy. Jrban Nutrient Cycle in Sub-Saharan Africa	TC_TN 0.28 hable Sanitation Alliance (SuSanA).	тс_тр	

Part Part								
March Marc			Data Source					
March Marc	UNIQUE IDENTIFIER (ID)	offsite_vermi_composting	-					
Part	INPUT PRODUCT	stored_faeces,	Spuhler, D. & Roller, L. (2020)					
March Marc		transportedpithumus, sludge,						
Company Comp		transportedtransferred_sludge,						
Control Cont		blackwater, transportedblackwater, organics, transportedorganics						
Marie Mari	OUTPUT PRODUCT	compost, transportedcompost, effluent,	Spuhler, D. & Roller, L. (2020)					
Marie		Input: OR	Spuhler, D. & Roller, L. (2020)					
Note 1965		Output: AND						
Part Part			Data Source					
Column C								
Anthony 1987 Anth								
Marca Marc		6	Spuhler, D. et al. (2021) Spuhler, D. et al. (2021)					
September 1	technical_maturity	3	McConville, J. et al. (2020)					
	development_phase		emergency phases provided there is					
Professor Congress Profess			requires a high level of organisation and					
International Content								
Intelligence of the process of the			emergency situations. However, it can					
Wind Wind			stabilisation and recovery phases where					
Second Process Proce								
### CASES Company Co								
March Marc		Type and Function	Applicable for this Functional Group?				Internal Review Done?	I
March Marc	water_supply	иеттоrmance, Categorica	FALSE	yard	THE STATE OF THE S	IVA	NA .	
Design Company Management (Company Mile M]
March 1997 April 1997 Apr		Performance, Trapez	FALSE	[L/cap/day]				
March Marc	electricity_supply	renormance, categorica		intermittent	electricity = 0.7)	a pitch fork or shovel. [] Recirculation, if required for improved effluent quality,	,	
March Marc				no electricity		Installation of a pump would require electrical energy. A pump managed with		
Part Company Part						intermittent electricity could be used for periodic instead of continous		
Programme, of Jan 1997, Congramme 1915. Programme, Congramme 1915. Professionary Congramme	fual cumbi	Performance Catogorica	FAISE	fuel	NA .	peform better than no electricity.	NA .	1
Professional Control (1995) Prof				no fuel				1
Printmense, Companie Note Prin	trequency_of_om	PDF, Categorica	INUE	regular	(irregular = 0.9, regular = 0.1, continous = 0)		yes	
Performance, Chapters Title	pipe supniv	Performance. Categorica	TRUE	continuous	(no pipes = 1, difficultly available = 1		yes	1
purps, pagely Pufformance, Categorial TRUE Performance, Categorial TRUE Pe	F-F-2-0PP1			difficultly available	pipes = 1)		ľ	
pump pu	pump_supply	Performance, Categorica	TRUE	no pumps			yes	1
COCKTRE_Uppil)					0.75, pumps = 1)			
George Legisly Performance, Congested SIME Incomplete Concepts Incomp						Another technology configuration with pumps is possible and performs slightly		
Concrete Part Concrete Con	concrete_supply	Performance, Categorica	TRUE			"Vermi composting tanks can be made from local materials (bricks or concrete).	yes	
PFG, Congenies (TOLE) propy (control in assurance and particles before a control in a control in the control i				difficultly available concrete	0.75, concrete = 1)			
Spare parts PEP, Caspercial Title								
Control of Control of Control Acade Interiors to the clinical event entry control durable materials that eliminate vertice and event and public control of the materials of the vertical and event and even and event and event and event and event and event and event and event and event and event and event and event and event and event and event and event and event and event and event and event	spare_parts	PDF, Categorica	TRUE		(simple = 1, technical = 0, special = 0)	"Can be built and maintained with locally available materials", "Vermicomposting	yes	
Secretary Secr						enclosed reactors made from durable materials that eliminate vermin entry,		
March Marc								
O O O O O O O O O O								
Max	0					NA .		
Codd Contemporate Codd	0		FALSE	0	NA	NA .	NA	
Interpreta Int	temperature	Performance, Categorica	TRUE				yes	
Flooding Performance, Categorical TRUE flooding								
rechinology (Enersian) These should one can arise for direllary water contamination. "Ellhest produced during the wern filtration process one defectly in filtrated into the sol, for thrift resealed from globals, These treatment technologies and butter for such produced during the wern filtration process one be directly in filtrated into the sol, for thrift research during the several produced during the wern filtration process one be directly in filtrated into the sol, for thrift research during the several produced during the wern filtration process one be directly in filtrated into the sol, the sol that is a planted system." These values are alloted for all "hash" based technologies, These treatment technologies and the research during the several and only a 100 reduction in performance a plotted, (Manisha Jain) We histair_scess Performance, Categorical FASE In a no access difficult full NA Sol Lype Performance, Categorical FASE In at NA NA NA NA NA NA NA NA NA NA				hot				
Fifthest produced during the verni filtration process can be directly in filtrated into the soil, or further treated thorus applicately system, and planted system."	flooding	Performance, Categorica	TRUE		(flooding = 0.9, no flooding = 1)		yes	
Into the sol, or further treated through expotrampiration in a planted system."						There should not exist a risk for drinking water contamination. "Effluent produced during the vermi filtration process can be directly in filtrated		
These wakes are allotted to all "Tanis" based technologies. These treatment sechnologies and their corposoning tanks are just to be water-light. Additionally, their raised configurations are possible in flood prone areas. The impact of criterion flooding is therefore not considered to be as severe and only a 10% reduction in performance is allotted. (Alanishta Jain) Webicular_acces Performance, Categorical FALSE no access MA NA Soll_type Performance, Categorical FALSE not flat not flat NA NA NA NA NA NA NA NA NA N						into the soil, or further treated through evapotranspiration in a planted system."		
Additionally, their raised configurations are possible in flood grone areas. The impact of criterio flooding is therefore not considered to be assert earn only a 10% reduction in performance is allotted. (Manisha Jain)						These values are allotted to all "tank" based technologies. These treatment		
welkular_acces Performance, Categorical FALSE On access officult And ANA NA ANA ANA ANA ANA ANA ANA ANA ANA						Additionally, their raised configurations are possible in flood prone areas. The		
Same values allotted to the other compositing technology "Co-compositing"						impact of criterion flooding is therefore not considered to be as severe and only a		
vehicular_acces Performance, Categorical FASE no access officition of inflicult in full NA NA NA slope Performance, Categorical FASE flat not flat not flat NA NA NA NA soll_type Performance, Categorical FASE clay not flat not f								
Sope Performance, Categorical FASE flat NA NA NA NA NA NA NA N	vehicular_acces	Performance, Categorica	FALSE		NA	NA	NA	1
Soil_type				full]
soll_type	slope	Performance, Categorica	FALSE		NA	NA	NA	
groundwater_depth Performance, Trapez FALSE water depth [m] NA NA NA NA NA NA NA NA NA NA NA NA NA	soil_type	Performance, Categorica	FALSE	clay	NA	NA NA	NA	1
groundwater_depth Performance, Trapez FALSE water depth [m] NA NA NA excxvation Performance, Categorical TRUE easy (easy = 1, hard = 0.75) Septen, 2021 yes surface_area_onsite Performance, Trapez FALSE [m2/plot] NA NA NA surface_area_onsite Performance, Trapez TRUE m2/pers (a = 0.04, b = 0.04, c = 999, d = 999) the material of over 3000 households can be treated in a centralized facility of 770m2 (Eawag, 2006). From this, we derive minimum space requirements of 0.04 m2/cap (Jain & Ilmanen, 2021). This value underlies the assumption that space requirements of 0.04 m2/cap (Jain & Ilmanen, 2021). This value underlies the assumption that space requirements of 0.04 m2/cap (Jain & Ilmanen, 2021). This value underlies the assumption that space requirements of 0.04 m2/cap (Jain & Ilmanen, 2021). This value underlies the assumption that space requirements of 0.04 m2/cap (Jain & Ilmanen, 2021). This value underlies the assumption that space requirements of 0.04 m2/cap (Jain & Ilmanen, 2021). This value underlies the assumption that space requirements of 0.04 m2/cap (Jain & Ilmanen, 2021). This value underlies the assumption that space requirements of 0.04 m2/cap (Jain & Ilmanen, 2021). This value underlies the assumption that space requirements of 0.04 m2/cap (Jain & Ilmanen, 2021). This value underlies the assumption that space requirements of 0.04 m2/cap (Jain & Ilmanen, 2021). This value underlies the assumption that space requirements of 0.04 m2/cap (Jain & Ilmanen, 2021). This value underlies the assumption that space requirements of 0.04 m2/cap (Jain & Ilmanen, 2021). This value underlies the assumption that space requirements of 0.04 m2/cap (Jain & Ilmanen, 2021). This value underlies the assumption that space requirements of 0.04 m2/cap (Jain & Ilmanen, 2021). This value underlies the assumption that space requirements of 0.04 m2/cap (Jain & Ilmanen, 2021). This value underlies the assumption that space requirements of 0.04 m2/cap (Jain & Ilmanen, 2021). This va				sand				
groundwater_depth								
Surface_area_onsite				water depth [m]				1
Surface area offsite Performance, Trapez TRUE m2/pers (a = 0.04, b = 0.04, c = 999, d = 999) the material of over 3000 households can be treated in a centralized facility of 770m2 (Eawag 2006). From this, we derive minimum space requirements of 0.04 m2/cap (Jain & Illiamena, 2021). This value underlies the assumption that space requirements of co-composting and vermicomposting facilities are similar (Emersian: "The design of a Vermi composting facility is similar to Co-composting:"). O O FALSE O NA NA NA NA NA NA NA				hard				1
770m2 (Eawag 2006). From this, we derive minimum space requirements of 0.04 m2/cap (Jain & Ilmanes, 2021). This value underlies the assumption that space requirements of co-composting and vermicomposting facilities are similar (Emersan: "The design of a Vermi composting facility is similar to Co-composting:"). O 0 FALSE							NA]
Performance, Categorical FASE	surface_area_offsite	Performance, Trapez	TRUE	m2/pers	(a = 0.04, b = 0.04, c = 999, d = 999)			
Emersan: "The design of a Vermi composting facility is similar to Co-						m2/cap (Jain & Ilmanen, 2021). This value underlies the assumption that space		
Composting."). NA NA NA NA NA NA NA N						(Emersan: "The design of a Vermi composting facility is similar to Co-		
0 0 FASE 0 NA NA NA NA NA NA NA MA MA MA MA MA MA MA MA MA MA MA MA MA						Composting."). NA	NA .	1
			FALSE	0	NA	NA .	NA	1
0 0 FALSE 0 NA NA NA NA O O FALSE 0 NA NA NA NA NA NA NA NA NA NA NA NA NA	drinking_water_exposure			Close		NA		1
0 0 FALSE 0 NA NA NA	0			0				1
	0 construction_skills	(FALSE					1
unskilled 1) Can be built and maintained with locally available materials" (Emersan)				unskilled	1)	Can be built and maintained with locally available materials" (Emersan)		
professional increase the quality of the construction.				professional		increase the quality of the construction.]
design_skills Performance, Categorical TRUE Ladder: (unskilled = 0.5, professional *n separating solid and liquid fractions the quality of the effluent is increased. yes unskilled = 1) ventilation must be sufficient to ensure an experice environment for the worms	design_skills	Performance, Categorica	TRUE	Ladder:		"In separating solid and liquid fractions the quality of the effluent is increased.	yes	
skilled and microorganisms, while also inhibiting entry of unwanted files. The professional temperature within the reactor needs to be maintained within a range suitable for				skilled		and microorganisms, while also inhibiting entry of unwanted flies. The		
the species of compost worms used. The specific design of a vermifilter will				p. o. costonal		the species of compost worms used. The specific design of a vermifilter will		
depend on the characteristics and volume of studge. Vermi composting or vermifilters can be combined with other treatments - for example, the digestate								
from an aerobic digestion could be vermifiltered to achieve solids reduction and increase pathogen elimination. Effluent produced during the vermi filtration						from an aerobic digestion could be vermifiltered to achieve solids reduction and		
process can be directly in filtrated into the soll, or further treated through evaporations in a planted system." (Emersan)						process can be directly in filtrated into the soil, or further treated through		
[augmetranenication in a planted curtom "[Emocran]								

Company Comp	om_skills	Performance, Categorical	TRUE	Ladder: Unskilled	(unskilled = 0, skilled = 1, professional =	"Vermi composting requires a high level of organisation and labour to sort organic waste, manage the facility and monitor treatment efficiency and is therefore	yes	1	
1				Skilled	1)	unlikely to be practical in the acute response phase of emergency situations." (Emersan)			
1						monitor quality and quantity of the input material and worm health as well as			
Company Comp	0	0	FALSE			NA			
March 1997		0	FALSE FALSE		NA NA	NA .	NA		
Transport Tran	cleansing_method			Washers Soft wipers		NA			
March Marc	0			(
March Marc				short (< 1 year)		"Vermicompost should be stored for at least a year before use." (Emersan)			
The date of an extraction process and the company of the company o						year are in theory not suitable, but limitations of technologies for short lifetimes			
Miles March Marc						"The design of a vermicomposting facility is similar to co-composting using			
Marked M						Similarly to co-composting vermicomposting can work well at lifetime of more than 5 years. (Kukka Ilmanen, Eawag 2021)			
West Control	speed_implement_toilet	PDF, Categorical	FALSE	moderate (3 days to 2 weeks)	NA	NA	NA		
March Marc	speed_implement_treatment	PDF, Categorical	I TRUE	rapid (few days to a week)	(rapid=0, moderate=0.8, slow=0.2)		yes		
10 10 10 10 10 10 10 10				months)		vermin entry, usually plastic or concrete. It is possible to find worms in the local			
March Marc				Sow (F S months)		them. Prefabricated composting vessels of different sizes are available on the			
March 1 Marc						access to worms. Vermicomposting requires a high level of organisation and			
March						situations. However, it can be considered a viable option in the stabilisation and			
### CONTRACT OF THE PROPERTY AND ADDRESS OF THE PROPERTY A						waste and space." (Emersan Compendium)			
Market M						vermicomposting, it would be difficult to realise this technology in a short time			
### Advances Colored No. 1997 199						Additionally, here, vermifiltration is also considered which can be implemented			
April Apri						allotted at 80% to "moderate" and 20% to "slow" category. Which is slightly better			
### Company RE Province Company RE ### Comp						for vermifiltration. (Akanksha Jain) Vermifiltration can be implemented quickly, however, depends on the availability			
Company Comp						of materials, hence, "rapid" category gets a performance of 50% (Akanksha Jain)			
Section Sect	scalability	Performance, Categorical	TRUE	easy difficult	(easy = 1, difficult = 0.8)	"The design of a vermicomposting facility is similar to co-composting using vessels, but with the addition of earthwarms. Vermilitary coachs of early-	yes	1	
Page Page				on scarc		reactors containing filter media and worms. These are used on a small scale in			
The specific dispert of membrane but all and property of the						toilet paper) are trapped on top of the filter, where they are processed into			
Interview						The specific design of a vermifilter will depend on the characteristics and volume			
Controlled Fig. Controlled						easily scalable. A vermifilter is designed specifically and might be more difficult to			
	construction_parts	PDF, Categorical	I TRUE	simple	(simple = 1, technical = 0, special = 0)	technologies a value of 80% is chosen. (Kukka Ilmanen. Eawag 2021) "Can be built and maintained with locally available materials", "Vermicomposting	yes		
Second Confidence Continue						enclosed reactors made from durable materials that eliminate vermin entry,			
Second Composition Composi						straw, coir, bark mulch or peat. Worms are required, and three species to date			
Application Application						(Emersan)			
Part Part						sieving with a wire mesh or with a rotating cylindrical screen. [] Worms will			
Second Second						harvested and sold, making a net profit. However, in cases where worms die in the			
Part Part						know in advance where replacement worms can be sourced." (Worms SLU Compendium)" (Worms SLU Compendium)			
Compart Marge State Marter State S	Transfer Coefficients	(copied from "Sanitation, Technologies, TC database, 2021062)	2.xism")			The worms, as well as the technical parts, such as the wire mesh or rotating cylindrical screen are assumed to be available locally.			
	ТР	Compost	Range	Effluent	Airloss	Soilloss (Yadav et al.
								in 12.2.2	
Section Sect		1	-		,		0	prior	(2012)
1								see	i
Company Comp		1	-		9		0	* increase	
March Marc		0.233	3	0.76	7	0	0	content	Amoah, P.,
March Marc									Nartey, E.
March 1									Schrecongo
No.									- -
0.66 0 0.56 0 0 0 0 0 0 0 0 0					0.33	2	0		
0.5		0.00	1		2 22	6		in 12.2.2	
Prior								* includes	al. (1999) Yadav et al.
Coloration Col								prior composting,	(2012)
1								calculations	
1		1	-	·		0	0	* increase of TN	
Contest Cont		1	-		3	0	0	* increase	Gupta and
		0.05	-	0.95	5		0	content	
Schecongo St. A. 2016 St								removal efficency	Gbenatey Nartey, E.
0.2								for NH3-N	Schrecongo
efficacy far NO3 not n		0.2	-	0.8	3	0	0		Amoah, P.,
Marcol M								efficency	Nartey, E. and
bal. 0.565 - 0.25 0.18 0 0 0			,					Snubles -	
National Control Con								al. (2021)	
Composting, Sept. Composting, Sept.	k	1	[0.8]					* includes	
Calculations Calc								composting,	(2012)
0.53 - 0 0.47 0 0 ° see Vadave tal. calculations (2010)								calculations in 12.2.1	
0.7 - 0 0.3 0 0 *moisture Gupta and is Garg (2008) contained contained		0.53	-	. (0.43	7	0	* see calculations	
contained		0.7	7 -	- (0.3	3		* moisture	
	1							contained	

	0.2	-	0.8	0	0	0 estimated Amoah
				-	•	based on Gbena
						drawing Nartey
						and
						Schrec
						st, A.
med (R)	0.51	0.2-0.7	0.8	0.47	0	0 -
bal.	0.48	-	0.2	0.32	0	0 -
k	2	[0.5]				- PA
TS	0.5	-	0	0.5	0	0 * see Yadav
						calculations (2010)
						in 12.2.2
	0.541	-	0	0.459	0	0 * Manure Laland
						al. (20
	0.824	-	0.176	0	0	0 value for Amoah
						TSS Gbena
						Nartey
						and Schrec
						st, A.
med (R)	0.54	0.5 - 0.824	0.18	0.48	0	0 -
	0.7	-	0	0.3	0	0 * moisture PA
						is
						contained
						at 70%
	0.2		0.8	0	0	0 estimated
						based on
						drawing
med (R)	0.51	0.2-0.7	0.8	0.47	0	0
bal.	0.48		0.2	0.32	0	0
		(0.5)				-
TS	0.5	-	0	0.5	0	0 * see
						calculations
						in 12.2.2
	0.541	-	0	0.459	0	0 * Manure
	0.824	-		0	0	0 value for
						TSS
med (R)	0.54	0.5 - 0.824	0.18	0.48	0	0
Calculation 12.2.2 Data from: Yadav et al. (2	2010)	1		IC_vermicompost= Substance m	ass in vermicompost / Substance mass in faecal slurry	
Faeces		TC Vermicompo	and a			
Moisture %	Vermicompost 0.8	0.43	0.5375			
TN [mg/g dry weight]	0.41	0.28	0.682926829			
P as P2O5 [mg/g dry weight]	0.11	0.235	2.136363636			
Calculation			st= Substance mass in			
Calculation		vermicompost /	Substance mass in Substance mass in faecal slurry			

References

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		Data Source				
FUNCTIONAL GROUP						
DATA COMPILER	SaniChoice Project Team	-				
		McConville, J. et al. (2020)				
	transportedsludge, transportedtransferred_sludge,					
	transportedorganics	McCondillo Lot of (2020)				
RELATIONS		McConville, J. et al. (2020) McConville, J. et al. (2020)				
	Output: NA	,,				
COMMENTS	N-L	Data Carres				
		McConville, J. et al. (2020)				
management_level	(household = 1, shared = 1, public = 1)	McConville, J. et al. (2020)				
capex_req_level opex_req_level		Spuhler, D. et al. (2021) Spuhler, D. et al. (2021)				
technical_maturity		McConville, J. et al. (2020)	İ			
	(acute = 0, stabilisation = 0.5, development/recovery = 1)	High technical complexity for production of Larvae, rearing of flies requires environmental				
	development/recovery = 1/	control and trained personnel. However, if larvae				
	I	growth can be maintained, this technology can				
		be very beneficial as it can handle large volumes of organic wastes in a very short amount of time				
	I	and can generate high-protein feed which can be				
	I	sold and used. (Akanksha Jain, based on McConville, J. et al. (2020))				
	I	Given the technical complexity in establishing a				
	I	working flies rearing facility this technology is not				
	I	suitable for acute phase and less suitable (50% performance) for stabilisation phase. However,				
	I	since it can handle organic waste fast and				
	I	efficiently, its applicabtion can be considered to				
	l	some extent in stabilisation phase and definitely in the recovery phases of emergencies.				
	1	Innovative technologies such as this could				
	l	potentially be the ideal sustainable solution in emergencies. (Akanksha Jain)				
	L					
reening Criteria	Type and Function	Applicable for this Functional Group?	Categories [Unit]	Technology Values (Data)	Data Source / Assumptions	Internal Review
		draver.	I	Iv.		Done?
water_supply	Performance, Categorical	FALSE	house yard	NA	NA	NA
	l		public			
water volume	Performance, Trapez	FALSE	none [L/cap/day]	NA .	NA .	NA
electricity_supply	Performance, Categorical	TRUE	electricity	(electricity = 1, intermittent = 0.8, no electricity = 0		
	l		intermittent no electricity			
fuel_supply	Performance, Categorical	FALSE	fuel	NA	NA	NA
frequency_of_om	PDF, Categorical	TOLIE	no fuel irregular	(irregular = 0.25, regular = 0.25, continous = 0.5)	Evnert Judgement (Lalander, C. 2021)	
irequency_oi_oiii	Categorical	INCE	regular	(irregular = 0.23, regular = 0.23, continuus = 0.3)	Expert Judgement (Lalander, C. 2021)	
pipe_supply	Performance, Categorical	TOLIE	no pipes	(no pipes = 1, difficultly available = 1, pipes = 1)	Expert Judgement (Lalander, C. 2021)	
pipe_suppiy	remormance, categorical	INCE	difficultly available	(no pipes = 1, difficultly available = 1, pipes = 1)	Expert Judgement (Lalander, C. 2021)	
pump_supply	Performance, Categorical	TDIE	no pumps	(no pumps = 1, difficultly available = 1, pumps = 1)	Evnert Judgement (Lalander, C. 2021)	
рашр_заррпу		THOSE STATE OF THE	difficultly available	(no pamps = 1, anneally available = 1, pamps = 1)	Expertituogement (Editaliae), e. 2021)	
concrete_supply	Performance, Categorical	TDIE	pumps no concrete	(no concrete = 1, difficultly available = 1,	Expert Judgement (Lalander, C. 2021)	
concrete_supply	renormance, categorical	INCE		concrete = 1, directify available = 1,	Expert Judgement (Lalander, C. 2021)	
	DDF Cotton del	TOUR	concrete	(charles 0.7 technical 0.2 secolal 0.4)	Fire at Index and (Index des C 2024)	
spare_parts	PDF, Categorical	INCE	simple technical	(simple = 0.7, technical = 0.2, special = 0.1)	Expert Judgement (Lalander, C. 2021)	
0		FALSE	special	NA .	NA .	NA
0	0	FALSE	0	NA	NA	NA
0 temperature	0 Performance, Categorical	FALSE		NA (very cold = 0, cold = 0, temperate = 0, warm = 1, h	NA Expert Independ (Lalander C. 2021)	NA
temperature		1102	cold	(very cold = 0, cold = 0, temperate = 0, warm = 1, 1	Expert rangement (Editariati, c. 2021)	
	I		temperate			
	<u> </u>		warm hot			
flooding	Performance, Categorical	TRUE		(flooding = 0.5, no flooding = 1)	Expert Judgement (Lalander, C. 2021)	
vehicular_acces	Performance, Categorical	FALSE	no flooding no access	NA .	NA .	NA
			difficult			
slope	Performance, Categorical	FALSE	full flat	NA .	NA .	NA
			not flat			
soil_type	Performance, Categorical	FALSE	clay silt	NA	NA	NA
	I		said			
	I		gravel			
groundwater_depth	Performance, Trapez	FALSE	rock water depth [m]	NA .	NA .	NA
excavation	Performance, Categorical		easy	(easy = 1, hard = 1)	Expert Judgement (Lalander, C. 2021)	
surface_area_onsite	Performance, Trapez	FALSE	hard [m2/plot]	NA .	NA .	NA
surface_area_offsite	Performance, Trapez	TRUE	m2/pers	(a = 0.02, b = 0.03, c = 999, d = 999)	Assumed values for the calculation: Opimal space requirements: 5 t/d on 900 m^2	
	I				(Dortmans, B. et al. (2021))	
	I				Minimal space requirements: 1 t/d on 250 m^2 (Dortmans, B. et al. (2021))	
	I				faecal sludge production per person and year: 50	
0	0	FALSE	0	NA	kg/pers*a (Vinneras, B. (2006)) NA	NA
0	0	FALSE	0	NA	NA	NA
0 drinking_water_exposure	0 Performance, Categorical	FALSE FALSE		NA NA	NA NA	NA NA
			Not close			
0		FALSE FALSE	0		NA NA	NA NA
construction_skills	Performance, Categorical		Ladder:	(unskilled = 0.5, skilled = 1, professional = 1)	Depends on whether the goal is solely treatment or	
_ '	I		unskilled		the production of larvae to sell them as animal feed.	
	I		skilled professional		More sophisticated systems require specialized facilites (e.g. for rearing). However, also more	
	I				simple systems can be implemented, mostly based	
	İ				on manual labor and not specialized technology. Constructing a small-scale facility should not require	
		1			much specialized knowledge.	
			Í.			
doctor day	Darforman Catalan	TOLIE	Ladder:	(unchilled = 0 chilled = 0 E prof'' 4)		
design_skills	Performance, Categorical	TRUE	Ladder: unskilled	(unskilled = 0, skilled = 0.5, professional = 1)	Depends on whether the goal is solely treatment or the production of larvae to sell them as animal feed.	
design_skills	Performance, Categorical	TRUE	unskilled skilled	(unskilled = 0, skilled = 0.5, professional = 1)	the production of larvae to sell them as animal feed. More sophisticated systems require specialized	
design_skills	Performance, Categorical	TRUE	unskilled	(unskilled = 0, skilled = 0.5, professional = 1)	the production of larvae to sell them as animal feed. More sophisticated systems require specialized facilites (e.g. for rearing). However, also more	
design_skills	Performance, Categorical	TRUE	unskilled skilled	(unskilled = 0, skilled = 0.5, professional = 1)	the production of larvae to sell them as animal feed. More sophisticated systems require specialized facilites (e.g. for rearing). However, also more simple systems can be implemented, mostly based on manual labor and not specialized technology.	
design_skills	Performance, Categorical	TRUE	unskilled skilled	(unskilled = 0, skilled = 0.5, professional = 1)	the production of larvae to sell them as animal feed. More sophisticated systems require specialized facilities (e.g. for rearing). However, also more simple systems can be implemented, mostly based on manual labor and not specialized technology. Even for designing a small-scale facility, a certain	
design_skills	Performance, Categorical	TRUE	unskilled skilled	(unskilled = 0, skilled = 0.5, professional = 1)	the production of larvae to sell them as animal feed. More sophisticated systems require specialized facilites (e.g. for rearing). However, also more simple systems can be implemented, mostly based on manual labor and not specialized technology.	

om_skills	Performance, Categorical	TRUE	Ladder:	(unskilled = 0, skilled = 1, professional = 1)	"Care should be taken to ensure that the waste is		ī I
S.II_3.II.I3	renormance, categorical		Unskilled Skilled Professional	(answere - 5, same) - 2, processoriu - 2,	neither too dry nor too wet, lest the larvae fail to feed" (SLU). "BSFL treatment requires access to eggs, either purchased or reared. Rearing of flies		
					require environmental control and trained personnel" (SLU). Even small-scale facilites that do not rear eggs on-		
					site require skilled workers that understand the requirements of BSFL.		
0		FALSE FALSE		NA NA	NA NA	NA NA	
0	0	FALSE	0	NA	NA	NA	<u> </u>
0 cleansing_method		FALSE FALSE	Washers 0	NA NA	NA NA	NA NA	
<u> </u>			Soft wipers				
0		FALSE		NA NA	NA NA	NA	İ
0 lifetime	Performance, Categorical	FALSE	short (< 1 year)	NA (short = 1, medium = 1, long = 1)	NA "Under optimal conditions, it takes three weeks for	NA yes	
			medium (1-5 years) long (5-5 years)	(around - a) region - a)	BSEL to grow from an egg to reach the final larval stage, in which the larvae craw of up of the residue in the search for a dry and dark place to pupate.", "BSEL can be easily dried for longer storage." (Larvae SLU Compendium) The larvae require three weeks to grow after which they pupated and grow into Black Soldier Files that can lay further eggs and the process can be repeated indefinite times. This is an emerging technology, so there is no empirical data on the possible lifespan of the technology. It is assumed to be applicable for the long-term, (Bukka Ilmanen, Eawag 2021) "May require a year or more of maturation before being safe to use." (Compost SLU Compendium) since the product needs to be stored for minimum a year, lifetimes of less than 1 year are in theory not suitable, but limitations of technologies for short lifetimes are not considered here. (Kukka Ilmanen,	,c	
speed_implement_toilet	PDF, Categorical	FALSE	rapid (< 3 days) moderate (3 days to 2 weeks)	NA NA	Eawag 2021) NA	NA	
speed_implement_treatment	PDF, Categorical	TRUE	slow (> 2 weeks) rapid (few days to a week) moderate (few weeks up to three months) slow (> 3 months)	(rapid=0, moderate=1, slow=0)	"the treatment units can be assembled using relatively cheap, locally available materials, such as metallic sheets." "Rearing of flies require environmental control and trained personnel." "Usually, 4 to 10-day-old larva	yes	
					treatment. They are removed from the BSFL rearing units and placed onto the waste in the treatment units. The number of larvae used depends on the amount of waste per surface area. The larvae are usually fed incrementally over a period of about 3 weeks, until they have grown large enough to be harvested. "ESU Compendium) Setting up not too difficult, however, rearing of files would take time and therefore, the technology cannot be realised with a "rapid" speed of implementation (less than a week) (Akanksha Jain)		
scalability	Performance, Categorical	THUE	easy difficult	(easy = 1, difficult = 1)	"Treatment of waste using BSFL can be carried out at both household and municipal levels." (SLU Compendium) "Horizontal scaling up is possible by adding more decentral treatment sites (e.g. at household level) that treat smaller amounts of local organic waste and accept BSF larvae reared at a larger central site!" (Bram Dortmans, Eawag 2021) Scaling up can be done easily by extending the number of treatment sites or households using BSF treatment. (Kukai lamaene, Eawag 2021)	yes	
construction_parts	PDF, Categorical	TRUE		(simple = 0.7, technical = 0.3, special = 0)	"BSFL technology has low investment costs, as the	yes	•
	(cayled from "Santation_Technologies_TC_database_20210322 viem")		technical special		treatment units can be assembled using relatively cheap, locally available materials, such as metallic sheets.", "BSFL treatment usually takes place in boxes, bins or containers measuring 60 to 100 cm × 40 to 80 cm × 17 to 30 cm. [] using a mesh. For small-scale systems, the growth chambers can be built with ramps. [] A drainage system or ventilation is required when working with wet material such as household waste or pig manure, or if the system is operated in a humid climate. [] It is necessary for large-scale facilities to rear BSFL that the treatment site to ensure continuous production of larvae. [] BSFL treatment requires access to eggs, tether purchased or reared. Rearing of flies require environmental control and trained personnel." (SLU Compendium) Mostly locally available material are required, such as containers, ramps, mesh, etc. Some technical parts might be required for the drainage or ventilation system. BSFL eggs are assumed to be locally available though in some places they might need to be imported. (Kukka Ilmanen, Eawag 2021)		
TP	Compost 0.75	Range 0.6 - 0.9	Airloss 0.25	Soilloss	Waterloss 0	Comment	Reference Expert Judgement
9,7-1					0		(Lalander, C. 2021)
med (R)	0.75	0.6 - 0.9			- 0		PA PA
TN	1		1		0		Expert Judgement
med (R) k H2O	1 2 0.55		1 - 0.45		0 0		(Lalander, C. 2021) - PA Expert Judgement
					-		(Lalander, C. 2021)
med (R)	0.55 1	[0.1]	-		5 0.45		PA PA
TS	0.5	0.4 - 0.6	0.5		0	1	Expert Judgement (Lalander, C. 2021)
med (R)	0.5				0 0		-
k	5	[0.2]					PA
References							
	S Downsond D (2018) Commandium of Contestion To	schnologies in Emergencies German WASH Network (GV	A(A)) Coules Federal lestinate of Associa Science and Technique	(CANC) Control MACU Chiefer (CANC) Control	inable Caritation & Hinney (C. Care)		

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Ladepa-Pelletizing						
	Values T	Data Source				
UNIQUE IDENTIFIER (ID)		-				
	transportedstored_faeces, transportedsludge,	Spuhler, D. & Roller, L. (2020)				
	transportedtransferred_sludge, transportedprocessed_sludge, transportedstabilized_sludge,					
	transportedpithumus					
RELATIONS		Spuhler, D. & Roller, L. (2020) Spuhler, D. & Roller, L. (2020)				
COMMENTS	Output: NA					
Pre-Filter Criteria	Values (household = 0, neighbourhood = 0, city = 1)	Data Source Septien, S. (2021)				
management_level	(household = 0, shared = 0, public = 1)	Septien, S. (2021) Spuhler, D. et al. (2021)				
capex_req_level opex_req_level	7	Spuhler, D. et al. (2021)				
	(acute = 0, stabilisation = 0.5, development/recovery = 1)	Septien, S. (2021) Specialised equipment needs to be purchased/rented specifically from designers (Peartice Separation Systems). The methodology is quite complex (extrusion, patented drying mechanisms, etc.). It is primarily used to generate pelletted soil amender—which unlikely to be a priority during emergencies. Implementation of this technology can be thought of in the recovery phases but given the lack of locally available special equipment and therefore, possibly slow speed of implementation, this technology can be considered unsuitable for acute and stabilisation phases of emergencies. (Akanksha Jain)				
Screening Criteria	Type and Function	Applicable for this Functional Group?	Categories [Unit]	Technology Values (Data)	Data Source / Assumptions	Internal Review
water_supply	Performance, Categorical	FALSE	house	NA	NA	Done?
			yard public			
water_volume	Performance, Trapez	FALSE	none [L/cap/day]	NA NA	NA .	NA
electricity_supply	Performance, Categorical		electricity intermittent	(electricity = 1, intermittent = 0, no electricity = 0)		
	Buden A	FAICE	no electricity	NA.		NA
fuel_supply	Performance, Categorical		fuel no fuel	NA	NA	NA
frequency_of_om	PDF, Categorical	TRUE	irregular regular	(irregular = 1, regular = 0, continuous = 0)	Adapted from Personal Communication wit Santiago Septien (Septien, S. 2021)	
pipe_supply	Performance, Categorical	TRUE	continuous no pipes	(no pipes = 0, difficulty available = 0, pipes = 1)	Adapted from Personal Communication wit	
			difficultly available pipes		Santiago Septien (Septien, S. 2021)	
pump_supply	Performance, Categorical	TRUE	no pumps difficultly available	(no pumps = 1, difficulty available = 1, pumps = 1)	Adapted from Personal Communication wit Santiago Septien (Septien, S. 2021)	
concrete_supply	Performance, Categorical	TRUE	pumps no concrete	(no concrete = 0, difficulty available = 0, concrete		
concrete_supply	r errormance, categorical	THOSE STATE OF THE	difficultly available concrete	= 1)	Santiago Septien (Septien, S. 2021)	
spare_parts	PDF, Categorical	TRUE	simple technical	(simple = 0.3, technical = 0.4, special = 0.3)	Adapted from Personal Communication wit Santiago Septien (Septien, S. 2021)	
			special			
0	0	FALSE FALSE	(NA NA	NA NA	NA NA
0 temperature	Performance, Categorical	FALSE TRUE	very cold	NA (very cold = 0, cold = 0, temperate = 0, warm = 0,		NA
			cold temperate		Santiago Septien (Septien, S. 2021)	
			warm hot			
flooding	Performance, Categorical	TRUE	flooding no flooding	(flooding = 1, no flooding = 1)	For this technology the criterion "flooding" is considered to irrelevant. It should function	yes
					successfully (100% performance) in flood prone areas without any issues. (Akanksha Jain)	
vehicular_acces	Performance, Categorical	FALSE	no access difficult	NA	NA	NA
clone	Performance, Categorical	ENISE	full	NA NA	NA	NA
slope			not flat			
soil_type	Performance, Categorical	FALSE	clay silt	NA	NA	NA
			sand gravel			
groundwater_depth	Performance, Trapez	FALSE	rock water depth [m]	NA	NA NA	NA
excavation	Performance, Categorical	TRUE	easy hard	(easy = 1, hard = 0.75)		
surface_area_onsite	Performance, Trapez	FALSE	[m2/plot]	NA	NA	NA
surface_area_offsite	Performance, Trapez	TRUE FALSE	m2/pers	(a = 0.0004, b = 0.0004, c = 999, d = 999)	Adapted from Personal Communication wit Santia NA	NA NA
0	0	FALSE	(NA NA	NA	NA
drinking_water_exposure	Performance, Categorical	FALSE FALSE	Close	NA NA	NA NA	NA NA
0	0	FALSE	Not close) NA	NA	NA
0 construction_skills	0 Performance, Categorical	FALSE TRUE	Ladder:	NA (unskilled = 0, skilled = 0, professional = 1)	NA Adapted from Personal Communication wit	NA
			unskilled skilled		Santiago Septien (Septien, S. 2021)	
design_skills	Performance, Categorical	TRUE	professional Ladder:	(unskilled = 0, skilled = 0, professional = 1)	Adapted from Personal Communication wit	
20381,28113			unskilled skilled		Santiago Septien (Septien, S. 2021)	
200	Boxforman Catal	TOLLE	professional	(unchilled = 0.2 chilled = 1 prof 4)	Adapted from Dersonal Communication with	
om_skills	Performance, Categorical	INOE	Ladder: Unskilled	(unskilled = 0.3, skilled = 1, professional = 1)	Adapted from Personal Communication wit Santiago Septien (Septien, S. 2021)	
			Skilled Professional			
0	0	FALSE FALSE	(NA D NA	NA NA	NA NA
0		FALSE FALSE		NA NA	NA NA	NA NA
cleansing_method			Washers Soft wipers	NA	NA	NA
0	0	FALSE	Hard wipers) NA	NA	NA .
0 lifetime	0	FALSE	(NA NA	NA "Expected design lifetime is 10 years" (Personal	NA
lifetime	Performance, Categorical	TRUE	short (< 1 year) medium (1-5 years)	(short = 1, medium = 1, long = 1)	Communication wit Santiago Septien (Septien, S.	yes
speed_implement_toilet	PDF, Categorical	FALSE	long (>5 years) rapid (< 3 days)	NA	2021)) NA	NA
			moderate (3 days to 2 weeks) slow (> 2 weeks)			
speed_implement_treatment	PDF, Categorical	TRUE	rapid (few days to a week) moderate (few weeks up to three months)	(rapid=0, moderate=0, slow=1)	"6 months are required to construct and set-up a functional technology" (Personal Communication	yes
			slow (> 3 months)		wit Santiago Septien (Septien, S. 2021))	
. —						. ——

scalability			easy difficult	(easy = 1, difficult = 1)	Adapted from Personal Communication wit Santiago Septien (Septien, S. 2021)	yes	1
construction_parts	PDF, Categorical	TRUE	simple technical special	(simple = 0.3, technical = 0.4, special = 0.3)	Adapted from Personal Communication wit Santiago Septien (Septien, S. 2021)	yes	
Transfer Coefficients	(copied from "Sanitation_Technologies_TC_database_20210622.xism")						
			Airloss	Soilloss	Waterloss	Comments	
ТР			0.01		0	0 *Drying did not affect the nutrient content and calorific value of the dry bone of faecal sludge	al. (2018)
	0.99		0.01		0	0	PC with Rein
med (R)			0.01		0	0	- PA
K TN	0.95		0.05		0	*Drying did not affect the nutrient content and calorific value of the dry bone of faecal sludge	Septien et al. (2018)
	0.99		0.01		0	0	PC with Rein
med (R)					0	0	-
k H2O	0.25	-	0.75		0	0 *Reduction from 80% moisture to 20%	Septien et al. (2018)
	0.225		0.775		0	0	PC with Rein
med (R)					0	0	-
k TS	0.99		0.01		0	0 *Drying did not affect the nutrient content and calorific value of the dry bone of faecal sludge	al. (2018)
	0.99		0.01		0	0	PC with Rein
med (R)	0.99		0.01		0	0	Spuhler et al. (2021) PA

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riquetting						
	Values T	Data Source				
UNIQUE IDENTIFIER (ID)	briquetting	-				
	SaniChoice Project Team transporteddried_faeces, transportedstored_faeces,	Spuhler, D. & Roller, L. (2020)				
	transportedprocessed_sludge, transportedstabilized_sludge, transportedpithumus					
RELATIONS	transportedbriquettes Input: OR Output: NA	Spuhler, D. & Roller, L. (2020) Spuhler, D. & Roller, L. (2020)				
COMMENTS e-Filter Criteria	Values	Data Source				
	(household = 0, neighbourhood = 0.5, city = 1)	From Sanivation Website: The plant has capacity				
		to serve 10,000 people and produce 350 tons of fuel per month. The plant intakes fecal sludge from exhauster trucks and outputs biomass fuels to replace firewood in industrial boilers.				
		Appears to be a centralized technology which is best applied on a high level.				
management_level	(household = 0, shared = 0.5, public = 1)	From Sanivation Website: The plant has capacity to serve 10,000 people and produces 350 tons of				
		fuel per month. The plant intakes fecal sludge from exhauster trucks and outputs biomass fuels to replace firewood in industrial boilers.				
		Appears to be a centralized technology which is best managed on a high level.				
capex_req_level	6	Spuhler, D. et al. (2021)				
opex_req_level technical_maturity		Spuhler, D. et al. (2021) Sanivation successfully piloted this approach and				
technical_maturity	2	is currently expanding. We assume medium				
		maturity. See here: https://www.cdc.gov/globalhealth/stories/transf				
		orming_waste_to_fuel.html#:~:text=Sanivation%				
		20uses%20innovative%2C%20low- cost,source%20for%20cooking%20or%20heating.				
		&text=The%20briquettes%20burn%20more%20cl eanly,and%20risk%20of%20respiratory%20diseas				
		e.%20(CDC%20-%3E%20Sanivation				
	(acute = 0.5, stabilisation = 1, development/recovery = 1)	Can yield a cheap and effective low cost fuel alternative. Briquetting process has proved to be				
	development/recovery = 1/	very helpful especially for women (e.g., Refugees				
		in Ugandan Camps). Mud briquetting does not require complex or expensive equipment.				
		Source: United Nations High Commissioner for Refugees. (2013). Innovation: Briquette-making				
		project helps protect women in Ugandan camp.				
		UNHCR. https://www.unhcr.org/news/makingdifference/				
		2013/8/520500559/innovation-briquette-making- project-helps-protect-women-ugandan-				
		camp.html				
		In recovery phases large scale briquetting could be implemented with proper solid waste management and briquetting machines. (Akanksha Jain)				
reening Criteria	Type and Function	Applicable for this Functional Group?	Categories [Unit]	Technology Values (Data)	Data Source / Assumptions	Internal Review
						Done?
water supply l	Performance. Categorical	FALSE	house	NA	NA	NA
water_supply	Performance, Categorical	FALSE	house yard	NA	NA	
			yard public none			NA
water_supply water_volume electricity_supply	Performance, Categorical Performance, Trapez Performance, Categorical	FALSE	yard public none [[/cap/day] electricity	NA NA (electricity = 1, intermittent = 0, no electricity = 0)	NA	
water_volume	Performance, Trapez Performance, Categorical	FALSE TRUE	yard public none [L/cap/day] electricity intermittent	NA NA	NA	NA
water_volume	Performance, Trapez	FALSE TRUE	yard public none [L/cap/day] electricity intermittent no electricity fuel	NA NA	NA	NA
water_volume electricity_supply	Performance, Trapez Performance, Categorical	FALSE TRUE FALSE	yard public none [[L/cap/day] electricity intermittent no electricity fuel no fuel	NA (electricity = 1, intermittent = 0, no electricity = 0)	NA energy required according to old library	NA NA
water_volume electricity_supply fuel_supply	Performance, Trapez Performance, Categorical Performance, Categorical	FALSE TRUE FALSE	yard public none [L/cap/day] electricity intermittent no electricity fuel no fuel	NA [electricity = 1, intermittent = 0, no electricity = 0] NA	NA energy required according to old library NA based on old library but needs a re-check A sanivation treatment plant employs 30-50	NA NA
water_volume electricity_supply fuel_supply	Performance, Trapez Performance, Categorical Performance, Categorical	FALSE TRUE FALSE	yard public none [L(cap/day) electricity intermittent no electricity fuel no fuel irregular regular	NA [electricity = 1, intermittent = 0, no electricity = 0] NA	NA energy required according to old library NA based on old library but needs a re-check	NA NA
water_volume electricity_supply fuel_supply	Performance, Trapez Performance, Categorical Performance, Categorical	FALSE TRUE FALSE	yard public none [L(cap/day) electricity intermittent no electricity fuel no fuel irregular regular	NA [electricity = 1, intermittent = 0, no electricity = 0] NA	NA energy required according to old library NA based on old library but needs a re-check A sanivation treatment plant employs 30-50 people. (Sanivation, n.d.) Need for continous work of several workers is	NA NA
water_volume electricity_supply fuel_supply	Performance, Trapez Performance, Categorical Performance, Categorical	FALSE TRUE FALSE TRUE	yard public none [L/cap/day] electricity intermittent no electricity fuel no fuel irregular regular continuous	NA [electricity = 1, intermittent = 0, no electricity = 0] NA	NA energy required according to old library NA based on old library but needs a re-check A sanivation treatment plant employs 30-50 people. (Sanivation, n.d.) Need for continous work of several workers is assumed.	NA NA
water_volume electricity_supply fuel_supply frequency_of_om	Performance, Trapez Performance, Categorical Performance, Categorical PDF, Categorical	FALSE TRUE FALSE TRUE	yard public none [L/cap/day] electricity intermittent no electricity fuel no fuel irregular regular continuous	NA [electricity = 1, intermittent = 0, no electricity = 0] NA [(irregular = 0, regular = 0, continous = 1)	NA energy required according to old library NA based on old library but needs a re-check A sanivation treatment plant employs 30-50 people. (Sanivation, n.d.) Need for continous work of several workers is assumed. Need for pipes is assumed	NA NA
water_volume electricity_supply fuel_supply frequency_of_om pipe_supply pump_supply	Performance, Trapez Performance, Categorical Performance, Categorical PDF, Categorical Performance, Categorical Performance, Categorical	FALSE TRUE FALSE TRUE TRUE TRUE	yard public none [Li/cap/day] electricity intermittent no electricity fuel no fuel irregular regular continuous no pipes difficulty available pipes no pumps difficulty available pumps	NA [electricity = 1, intermittent = 0, no electricity = 0] NA [irregular = 0, regular = 0, continous = 1] [no pipes = 0, difficultly available = 0.1, pipes = 1] [no pumps = 0, difficultly available = 0.1, pumps =	NA energy required according to old library NA based on old library but needs a re-check A sanivation treatment plant employs 30-50 people. (Sanivation, n.d.) Need for continous work of several workers is assumed. Need for pipes is assumed Need for pumps is assumed	NA NA
water_volume electricity_supply fuel_supply frequency_of_om pipe_supply	Performance, Trapez Performance, Categorical Performance, Categorical PDF, Categorical Performance, Categorical	FALSE TRUE FALSE TRUE TRUE TRUE	yard public none [L(cap/day)] electricity intermittent no electricity fuel no fuel irregular regular continuous no pipes difficulty available pipes no concrete difficulty available pumps no concrete difficulty available	NA (electricity = 1, intermittent = 0, no electricity = 0) NA (irregular = 0, regular = 0, continous = 1) (no pipes = 0, difficultly available = 0.1, pipes = 1)	NA energy required according to old library NA based on old library but needs a re-check A sanivation treatment plant employs 30-50 people. (Sanivation, n.d.) Need for continous work of several workers is assumed. Need for pipes is assumed	NA NA
water_volume electricity_supply fuel_supply frequency_of_om pipe_supply pump_supply	Performance, Trapez Performance, Categorical Performance, Categorical PDF, Categorical Performance, Categorical Performance, Categorical	FALSE TRUE FALSE TRUE TRUE TRUE	yard public none [L/cap/day] electricity intermittent no electricity fuel no fuel irregular regular continuous no pipes difficulty available pipes no pumps difficulty available pumps no concrete	NA (electricity = 1, intermittent = 0, no electricity = 0) NA (erregular = 0, regular = 0, continous = 1) (no pipes = 0, difficultly available = 0.1, pipes = 1) (no pumps = 0, difficultly available = 0.1, pumps = (no concrete = 0, difficultly available = 0.1,	NA energy required according to old library NA based on old library but needs a re-check A sanivation treatment plant employs 30-50 people. (Sanivation, n.d.) Need for continous work of several workers is assumed. Need for pipes is assumed Need for pumps is assumed	NA NA
water_volume electricity_supply fuel_supply frequency_of_om pipe_supply pump_supply concrete_supply	Performance, Trapez Performance, Categorical Performance, Categorical PDF, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical	FALSE TRUE FALSE TRUE TRUE TRUE TRUE	yard public none ([¿/cap/day] electricity intermittent no electricity fuel no fuel irregular regular continuous no pipes difficulty available pipes no pumps difficulty available pumps no concrete difficulty available concrete simple technical special no pumps difficulty available pumps no concrete difficulty available pumps pumps no concrete difficulty available concrete simple technical special no pumps difficulty available concrete simple technical special no pumps no concrete difficulty available concrete simple technical special no pumps no pumps no concrete simple technical special no pumps no pumps no concrete simple technical special no pumps no pump no	NA (electricity = 1, intermittent = 0, no electricity = 0) NA (irregular = 0, regular = 0, continous = 1) (no pipes = 0, difficultly available = 0.1, pipes = 1) (no pumps = 0, difficultly available = 0.1, pumps = (no concrete = 0, difficultly available = 0.1, concrete = 1) (simple = 0.7, technical = 0.2, special = 0.1)	NA energy required according to old library NA based on old library but needs a re-check A sanivation treatment plant employs 30-50 people. (Sanivation, n.d.) Need for continous work of several workers is assumed. Need for pipes is assumed Need for pumps is assumed Need for concrete is assumed	NA NA NA
water_volume electricity_supply fuel_supply frequency_of_om pipe_supply pump_supply concrete_supply	Performance, Trapez Performance, Categorical Performance, Categorical PDF, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Popp, Categorical Popp, Categorical PDF, Categorical	FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE FALSE FALSE FALSE FALSE	yard public mone [L/cap/day] electricity intermittent no electricity fuel no fuel irregular regular continuous no pipes difficulty available pipes no pumps difficulty available pumps no concrete difficulty available concrete simple technical special special concrete simple technical special concrete special concrete simple technical special concrete special concrete special concrete special concrete special concrete concrete concrete simple technical special concrete concre	NA (electricity = 1, intermittent = 0, no electricity = 0) NA (irregular = 0, regular = 0, continous = 1) (no pipes = 0, difficultly available = 0.1, pipes = 1) (no pumps = 0, difficultly available = 0.1, pumps = (no concrete = 0, difficultly available = 0.1, concrete = 1) (simple = 0.7, technical = 0.2, special = 0.1) NA NA	NA energy required according to old library NA based on old library but needs a re-check A sanivation treatment plant employs 30-50 people. (Sanivation, n.d.) Need for pipes is assumed Need for pumps is assumed Need for concrete is assumed from old library NA	NA NA NA NA NA
water_volume electricity_supply fuel_supply frequency_of_om pipe_supply pump_supply concrete_supply spare_parts 0 0 0	Performance, Trapez Performance, Categorical Performance, Categorical PDF, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Pof, Categorical Pof, Categorical	FALSE TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE FALSE FALSE FALSE FALSE FALSE	yard public none [L/cap/day] electricity intermittent no electricity fuel no fuel irregular regular continuous no pipes difficulty available pipes no concrete difficulty available pumps no concrete difficulty available simple technical special special special concrete simple technical special concrete simple technical special concrete concrete special concrete concret	NA (electricity = 1, intermittent = 0, no electricity = 0) NA (irregular = 0, regular = 0, continous = 1) (no pipes = 0, difficulty available = 0.1, pipes = 1) (no pumps = 0, difficulty available = 0.1, pumps =	NA energy required according to old library NA based on old library but needs a re-check A sanivation treatment plant employs 30-50 people. (Sanivation, n.d.) Need for continous work of several workers is assumed. Need for pipes is assumed Need for pumps is assumed Need for concrete is assumed from old library NA	NA NA NA NA
water_volume electricity_supply fuel_supply frequency_of_om pipe_supply concrete_supply spare_parts 0 0	Performance, Trapez Performance, Categorical Performance, Categorical PDF, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Popp, Categorical Popp, Categorical PDF, Categorical	FALSE TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE FALSE FALSE FALSE FALSE FALSE	yard public none [Li/cap/day] electricity intermittent no electricity intermittent no fuel irregular regular continuous no pipes difficulty available pipes no concrete difficulty available pumps no concrete difficulty available concrete simple technical special concrete difficulty available concrete simple technical special concrete concrete difficulty available concrete difficulty available concrete difficulty available concrete concrete difficulty available concrete concrete difficulty available concrete concrete difficulty available concrete concrete concrete difficulty available concrete concr	NA (electricity = 1, intermittent = 0, no electricity = 0) NA (irregular = 0, regular = 0, continous = 1) (no pipes = 0, difficulty available = 0.1, pipes = 1) (no pumps = 0, difficulty available = 0.1, pumps = (no concrete = 0, difficulty available = 0.1, concrete = 1) (simple = 0.7, technical = 0.2, special = 0.1) NA NA NA NA NA NA NA NA NA N	NA energy required according to old library NA based on old library but needs a re-check A sanivation treatment plant employs 30-50 people. (Sanivation, n.d.) Need for continous work of several workers is assumed. Need for pumps is assumed Need for promps is assumed Need for concrete is assumed from old library NA NA NA NA Sanivation uses innovative, low-cost solar treatment technologies to transform fecal waste	NA NA NA NA NA
water_volume electricity_supply fuel_supply frequency_of_om pipe_supply pump_supply concrete_supply spare_parts 0 0 0	Performance, Trapez Performance, Categorical Performance, Categorical PDF, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Pof, Categorical Pof, Categorical	FALSE TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE FALSE FALSE FALSE FALSE FALSE	yard public none [L/cap/day] electricity intermittent no electricity fuel no fuel irregular regular continuous no pipes difficulty available pipes no pumps difficulty available pumps no concrete difficulty available concrete simple technical special covery cold covery cold	NA (electricity = 1, intermittent = 0, no electricity = 0) NA (irregular = 0, regular = 0, continous = 1) (no pipes = 0, difficulty available = 0.1, pipes = 1) (no pumps = 0, difficulty available = 0.1, pumps =	NA energy required according to old library NA based on old library but needs a re-check A sanivation treatment plant employs 30-50 people. (Sanivation, n.d.) Need for continous work of several workers is assumed. Need for pipes is assumed Need for pripes is assumed Need for concrete is assumed from old library NA NA NA Sanivation uses innovative, low-cost solar treatment technologies to transform fecal waste into briquettes; —[J (CDC, 2017)] since the process is based on solar treatment	NA NA NA NA NA
water_volume electricity_supply fuel_supply frequency_of_om pipe_supply pump_supply concrete_supply spare_parts 0 0 0 temperature	Performance, Trapez Performance, Categorical Performance, Categorical PDF, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical PDF, Categorical PDF, Categorical O O O O Performance, Categorical	FALSE TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE FALSE FALSE FALSE FALSE TRUE	yard public none [L/cap/day] electricity intermittent no electricity fuel no fuel irregular regular continuous no pipes difficulty available pipes no pumps difficulty available pipes no concrete difficulty available yumps no concrete simple technical special C C C C C C C C C C C C C	NA (electricity = 1, intermittent = 0, no electricity = 0) NA (tirregular = 0, regular = 0, continous = 1) (no pipes = 0, difficultly available = 0.1, pipes = 1) (no pumps = 0, difficultly available = 0.1, pipes = 1) (no concrete = 0, difficultly available = 0.1, concrete = 1) (simple = 0.7, technical = 0.2, special = 0.1) NA NA NA NA NA (very cold = 0, cold = 0, temperate = 0.25, warm =	NA energy required according to old library NA based on old library but needs a re-check A sanivation treatment plant employs 30-50 peeple. (Sanivation, n.d.) Need for continous work of several workers is assumed. Need for pipes is assumed Need for pipes is assumed Need for concrete is assumed from old library NA NA Sanivation uses innovative, low-cost solar treatment technologies to transform fecal waste into briquettes [] (CDC, 2017) since the process is based on solar treatment technologies it probably runs much more efficient in hot areas with lots of sun.	NA NA NA NA NA
water_volume electricity_supply fuel_supply frequency_of_om pipe_supply pump_supply concrete_supply spare_parts 0 0 0	Performance, Trapez Performance, Categorical Performance, Categorical PDF, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Pof, Categorical Pof, Categorical	FALSE TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE FALSE FALSE FALSE FALSE TRUE	yard public none (LiCrapfday) electricity intermittent no electricity fuel no electricity fuel no fuel irregular regular continuous fuel more public fuel fuel fuel fuel fuel fuel fuel fuel	NA (electricity = 1, intermittent = 0, no electricity = 0) NA (irregular = 0, regular = 0, continous = 1) (no pipes = 0, difficulty available = 0.1, pipes = 1) (no pumps = 0, difficulty available = 0.1, pumps =	NA energy required according to old library NA based on old library but needs a re-check A sanivation treatment plant employs 30-50 people. (Sanivation, n.d.) Need for continuous work of several workers is assumed. Need for pipes is assumed Need for promise is assumed Need for concrete is assumed Need for concrete is to summer to the continuous work of several workers is assumed. Need for pumps is assumed Need for pipes is assumed Need for concrete is assumed some for concrete is assumed in the continuous work of several workers is assumed. Na Na Na Na Na Na Na Na Na Na Na Na Na	NA NA NA NA NA
water_volume electricity_supply fuel_supply frequency_of_om pipe_supply pump_supply concrete_supply spare_parts 0 0 0 temperature	Performance, Trapez Performance, Categorical Performance, Categorical PDF, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical PDF, Categorical PDF, Categorical O O O O Performance, Categorical	FALSE TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE	yard public none [LiCap/day] electricity intermittent no electricity fuel no fuel irregular regular continuous no pipes difficulty available pipes no pumps difficulty available pumps no concrete difficulty available pimps no concrete difficulty available pumps no concrete difficulty available pipes no pumps difficulty available pumps no concrete difficulty available concrete difficulty available concrete difficulty available concrete difficulty available concrete difficulty available concrete difficulty available concrete difficulty available concrete difficulty available difficulty availab	NA (electricity = 1, intermittent = 0, no electricity = 0) NA (tirregular = 0, regular = 0, continous = 1) (no pipes = 0, difficultly available = 0.1, pipes = 1) (no pumps = 0, difficultly available = 0.1, pipes = 1) (no concrete = 0, difficultly available = 0.1, concrete = 1) (simple = 0.7, technical = 0.2, special = 0.1) NA NA NA NA NA (very cold = 0, cold = 0, temperate = 0.25, warm =	NA energy required according to old library NA based on old library but needs a re-check A sanivation treatment plant employs 30-50 people. (Sanivation, n.d.) Need for continous work of several workers is assumed. Need for pipes is assumed Need for pripes is assumed Need for concrete is assumed From old library NA NA Sanivation uses innovative, low-cost solar treatment technologies to transform fecal waste into briquettes [] (CDC, 2017) since the process is based on solar treatment technologies it probably runs much more efficient in hot areas with lots of sun. For this technology the criterion "flooding" is considered to irrelevant. it should function	NA NA NA NA NA NA
water_volume electricity_supply fuel_supply frequency_of_om pipe_supply pump_supply concrete_supply spare_parts 0 0 temperature	Performance, Trapez Performance, Categorical Performance, Categorical PDF, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical PDF, Categorical PDF, Categorical PDF, Categorical PDF, Categorical PDF, Categorical PPFformance, Categorical Performance, Categorical	FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE	yard public none [L/cap/day] electricity intermittent no electricity fuel no fuel irregular regular continuous no pipes difficulty available pipes no concrete difficulty available pipes no concrete difficulty available concrete difficulty available pipes no concrete difficulty available difficulty available concrete difficulty available concrete difficulty available concrete difficulty available concrete difficulty available concrete difficulty available concrete difficulty available concrete difficulty available diffic	NA (electricity = 1, intermittent = 0, no electricity = 0) NA (irregular = 0, regular = 0, continous = 1) (no pipes = 0, difficultly available = 0.1, pipes = 1) (no pumps = 0, difficultly available = 0.1, pumps = (no concrete = 0, difficultly available = 0.1, concrete = 1) (simple = 0.7, technical = 0.2, special = 0.1) NA NA (very cold = 0, cold = 0, temperate = 0.25, warm = (flooding = 1, no flooding = 1)	NA based on old library but needs a re-check A sanivation treatment plant employs 30-50 people. (Sanivation, n.d.) Need for continous work of several workers is assumed. Need for pipes is assumed Need for pripes is assumed Need for concrete is assumed Need for concrete is to sum of the concrete is assumed. Need for pipes is assumed Need for pipes is assumed Need for pripes is assumed Need for pripes is assumed In the concrete is assumed Need for concrete is assumed Sanivation uses innovative, low-cost solar treatment technologies to transform fecal waste into briquettes [] (CDC, 2017) since the process is based on solar treatment technologies it probably runs much more efficient in hot areas with lots of sun. For this technology the criterion "floodings" is considered to irrelevant. It should function successfully (100% performance) in flood prone areas without any Issues. (Akanksha Jain)	NA
water_volume electricity_supply fuel_supply frequency_of_om pipe_supply pump_supply concrete_supply spare_parts 0 0 temperature	Performance, Trapez Performance, Categorical Performance, Categorical PDF, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Pof, Categorical O Pof, Categorical PDF, Categorical PDF, Categorical PDF, Categorical O Performance, Categorical	FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE	yard public none [Li/cap/day] electricity intermittent no electricity intermittent no fuel irregular regular continuous no pipes difficulty available pipes no concrete difficulty available pipes no concrete difficulty available permitti no pimps no concrete difficulty available permitti no pimps no concrete difficulty available concrete difficulty available concrete difficulty available concrete difficulty available concrete difficulty available concrete difficulty available concrete difficulty available concrete difficulty available concrete difficulty available concrete difficulty available concrete difficulty available concrete difficulty available concrete difficulty available concrete difficulty available concrete difficulty available difficulty difficulty fulling difficulty difficulty fulling difficulty difficulty fulling difficulty difficulty difficulty fulling difficulty diffic	NA (electricity = 1, intermittent = 0, no electricity = 0) NA (irregular = 0, regular = 0, continous = 1) (no pipes = 0, difficulty available = 0.1, pipes = 1) (no pumps = 0, difficulty available = 0.1, pumps = (no concrete = 0, difficulty available = 0.1, concrete = 1) (simple = 0.7, technical = 0.2, special = 0.1) NA NA NA NA NA (very cold = 0, cold = 0, temperate = 0.25, warm = (flooding = 1, no flooding = 1)	NA energy required according to old library NA based on old library but needs a re-check A sanivation treatment plant employs 30-50 people. (Sanivation, n.d.) Need for continous work of several workers is assumed. Need for pimps is assumed Need for pripes is assumed Need for concrete is assumed Trom old library NA NA NA NA NA NA Sanivation uses innovative, low-cost solar treatment technologies to transform fecal waste into briquettes [] (CDC, 2017) since the process is based on solar treatment technologies it probably runs much more efficient in hot areas with lots of sun. For this technology the criterion "flooding" is considered to irrelevant. it should function successfully (100% performance) in flood prone areas without any Issues. (Akantsha Jain)	NA
water_volume electricity_supply fuel_supply frequency_of_om pipe_supply pump_supply concrete_supply spare_parts 0 0 0 temperature flooding	Performance, Trapez Performance, Categorical Performance, Categorical PDF, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical PDF, Categorical PDF, Categorical PDF, Categorical PDF, Categorical PDF, Categorical PPFformance, Categorical Performance, Categorical	FALSE TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE	yard public none (LiCrapfday) electricity intermittent no electricity fuel no fuel licrapfday electricity fuel no fuel licrapfday electricity fuel no fuel licrapfday electricity fuel no fuel licrapfday electricity fuel no fuel licrapfday electricity fuel no pups difficulty available pipes no concrete difficulty available pumps no concrete difficulty available concrete simple technical special Code temperate warm hot flooding no flooding no flooding no access difficult full flooding no access difficult full flooding no flooding	NA (electricity = 1, intermittent = 0, no electricity = 0) NA (irregular = 0, regular = 0, continous = 1) (no pipes = 0, difficultly available = 0.1, pipes = 1) (no pumps = 0, difficultly available = 0.1, pumps = (no concrete = 0, difficultly available = 0.1, concrete = 1) (simple = 0.7, technical = 0.2, special = 0.1) NA NA (very cold = 0, cold = 0, temperate = 0.25, warm = (flooding = 1, no flooding = 1)	NA based on old library but needs a re-check A sanivation treatment plant employs 30-50 people. (Sanivation, n.d.) Need for continous work of several workers is assumed. Need for pipes is assumed Need for pripes is assumed Need for concrete is assumed Need for concrete is to sum of the concrete is assumed. Need for pipes is assumed Need for pipes is assumed Need for pripes is assumed Need for pripes is assumed In the concrete is assumed Need for concrete is assumed Sanivation uses innovative, low-cost solar treatment technologies to transform fecal waste into briquettes [] (CDC, 2017) since the process is based on solar treatment technologies it probably runs much more efficient in hot areas with lots of sun. For this technology the criterion "floodings" is considered to irrelevant. It should function successfully (100% performance) in flood prone areas without any Issues. (Akanksha Jain)	NA
water_volume electricity_supply fuel_supply frequency_of_om pipe_supply pump_supply concrete_supply spare_parts 0 0 0 temperature flooding vehicular_acces	Performance, Trapez Performance, Categorical Performance, Categorical PDF, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Popper Categorical Popper Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical	FALSE TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE	yard public none [L/cap/day] electricity electricity electricity electricity fuel no electricity fuel no fuel electricity fuel no fuel electricity fuel no fuel electricity fuel no fuel electricity	NA (electricity = 1, intermittent = 0, no electricity = 0) NA (irregular = 0, regular = 0, continous = 1) (no pipes = 0, difficultly available = 0.1, pipes = 1) (no pumps = 0, difficultly available = 0.1, pumps = (no concrete = 0, difficultly available = 0.1, concrete = 1) (simple = 0.7, technical = 0.2, special = 0.1) NA NA NA (very cold = 0, cold = 0, temperate = 0.25, warm = (flooding = 1, no flooding = 1)	NA energy required according to old library NA based on old library but needs a re-check A sanivation treatment plant employs 30-50 people. (Sanivation, n.d.) Need for continous work of several workers is assumed. Need for pipes is assumed Need for pripes is assumed Need for concrete is assumed from old library NA Sanivation uses innovative, low-cost solar treatment technologies to transform fecal waste into briquettes [] (CDC, 2017) since the process is based on solar treatment technologies it probably runs much more efficient in hot areas with lots of sun. For this technology the criterion "flooding" is considered to irrelevant. It should function successfully (100% performance) in flood prone areas without any issues. (Akanksha Jain) NA	NA
water_volume electricity_supply fuel_supply frequency_of_om pipe_supply pump_supply concrete_supply spare_parts 0 0 0 temperature flooding vehicular_acces	Performance, Trapez Performance, Categorical Performance, Categorical PDF, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Popper Categorical Popper Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical	FALSE TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE	yard public none [L/cap/day] electricity intermittent no electricity intermittent no fuel irregular regular continuous no pipes difficulty available pipes no concrete difficulty available pipes no concrete difficulty available simple technical special concrete simple technical special no flooding no flooding no flooding no flooding no access difficulty available pipes no concrete simple technical special no flooding no flooding no flooding no flooding no flooding no flooding no flooding no flooding no flooding no flooding no flooding years and gravel gra	NA (electricity = 1, intermittent = 0, no electricity = 0) NA (irregular = 0, regular = 0, continous = 1) (no pipes = 0, difficultly available = 0.1, pipes = 1) (no pumps = 0, difficultly available = 0.1, pumps = (no concrete = 0, difficultly available = 0.1, concrete = 1) (simple = 0.7, technical = 0.2, special = 0.1) NA NA NA (very cold = 0, cold = 0, temperate = 0.25, warm = (flooding = 1, no flooding = 1)	NA energy required according to old library NA based on old library but needs a re-check A sanivation treatment plant employs 30-50 people. (Sanivation, n.d.) Need for continous work of several workers is assumed. Need for pipes is assumed Need for pripes is assumed Need for concrete is assumed from old library NA Sanivation uses innovative, low-cost solar treatment technologies to transform fecal waste into briquettes [] (CDC, 2017) since the process is based on solar treatment technologies it probably runs much more efficient in hot areas with lots of sun. For this technology the criterion "flooding" is considered to irrelevant. It should function successfully (100% performance) in flood prone areas without any issues. (Akanksha Jain) NA	NA
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water_volume electricity_supply fuel_supply frequency_of_om pipe_supply pump_supply concrete_supply spare_parts 0 0 temperature flooding vehicular_acces slope soil_type	Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Popp, Categorical Popp, Categorical Popp, Categorical Popp, Categorical Popp, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical	FALSE TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE	yard public none [LiCap/day] electricity intermittent no electricity fuel no fuel irregular regular continuous no pipes difficulty available pipes no pumps difficulty available pipes no concrete difficulty available pipes no concrete difficulty available pipes no concrete difficulty available pipes no concrete difficulty available concrete simple technical special Cock of the pipes of the pip	NA (electricity = 1, intermittent = 0, no electricity = 0) NA (irregular = 0, regular = 0, continous = 1) (no pipes = 0, difficulty available = 0.1, pipes = 1) (no pumps = 0, difficulty available = 0.1, pumps = (no concrete = 0, difficulty available = 0.1, concrete = 1) (simple = 0.7, technical = 0.2, special = 0.1) NA NA NA (very cold = 0, cold = 0, temperate = 0.25, warm = (flooding = 1, no flooding = 1) NA NA NA NA NA NA NA NA NA N	NA energy required according to old library NA based on old library but needs a re-check A sanivation treatment plant employs 30-50 people. (Sanivation, n.d.) Need for continous work of several workers is assumed. Need for pipps is assumed Need for pripps is assumed Need for concrete is assumed Trom old library NA NA NA NA NA NA NA NA NA NA NA NA NA	NA
water_volume electricity_supply fuel_supply frequency_of_om pipe_supply pump_supply concrete_supply spare_parts 0 0 0 temperature flooding vehicular_acces slope soil_type groundwater_depth excavation	Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Popperformance, Categorical Popperformance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical	FALSE TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRUE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE	yard public none [Li/cap/day] electricity intermittent no electricity intermittent no fuel irregular regular continuous no pipes difficulty available pipes no concrete difficulty available pipes no concrete difficulty available pipes no concrete difficulty available pipes no concrete difficulty available concrete simple technical special concrete difficulty available pipes no concrete difficulty available concrete simple technical special concrete difficulty available concrete simple technical special special	NA (electricity = 1, intermittent = 0, no electricity = 0) NA (irregular = 0, regular = 0, continous = 1) (no pipes = 0, difficulty available = 0.1, pipes = 1) (no pumps = 0, difficulty available = 0.1, pumps = (no concrete = 0, difficulty available = 0.1, concrete = 1) (simple = 0.7, technical = 0.2, special = 0.1) NA NA NA (very cold = 0, cold = 0, temperate = 0.25, warm = (flooding = 1, no flooding = 1) NA NA NA NA NA NA NA NA NA N	NA based on old library but needs a re-check A sanivation treatment plant employs 30-50 people. (Sanivation, n.d.) Need for continous work of several workers is assumed. Need for pipes is assumed Need for pripes is assumed Need for concrete is assumed Need for concrete is assumed Need for concrete is assumed Need for pripes is assumed Need for pumps is assumed Need for pumps is assumed Need for pumps is assumed Need for pumps is assumed Need for concrete is assumed From old library NA Sanivation uses innovative, low-cost solar treatment technologies to transform fecal waste into briquettes [] (CDC, 2017) since the process is based on solar treatment technologies it probably runs much more efficient in hot areas with lots of sun. For this technology the criterion "flooding" is considered to irrelevant. It should function successfully (100% performance) in flood prone areas without any issues. (Akanksha Jain) NA NA NA NA NA According to Sanivation (n.d.) there is 3 - 5 acres of land space needed to build up a sanivation treatment plant that serves 10,000-2,000,000	NA NA NA NA NA NA NA NA NA NA NA NA NA N
water_volume electricity_supply fuel_supply frequency_of_om pipe_supply pump_supply concrete_supply spare_parts 0 0 0 temperature flooding vehicular_acces slope soil_type groundwater_depth excavation surface_area_onsite	Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Trapez Performance, Trapez Performance, Trapez	FALSE TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE FALSE	yard public none (L/Cap/day) electricity intermittent no electricity intermittent no fuel irregular regular continuous difficulty available pipes no pumps difficulty available pipes no concrete difficulty available experience simple technical special cold temperate warm hot flooding no flooding no flooding no flooding no flooding silt is sand gravel rock water depth [m] easy hard [m2/pots]	NA (electricity = 1, intermittent = 0, no electricity = 0) NA (irregular = 0, regular = 0, continous = 1) (no pipes = 0, difficultiy available = 0.1, pipes = 1) (no pumps = 0, difficultiy available = 0.1, pipes = 1) (no concrete = 0, difficultiy available = 0.1, concrete = 1) (simple = 0.7, technical = 0.2, special = 0.1) NA NA NA (very cold = 0, cold = 0, temperate = 0.25, warm = 1) (flooding = 1, no flooding = 1) NA NA NA NA NA NA NA NA NA N	NA NA based on old library but needs a re-check A sanivation treatment plant employs 30-50 people. (Sanivation, n.d.) Need for continous work of several workers is assumed. Need for pipes is assumed Need for pripes is assumed Need for concrete is assumed Need for concrete is assumed Need for concrete is assumed Need for pumps is assumed Need for pumps is assumed Need for pumps is assumed Need for pumps is assumed Need for concrete is assumed Need for pumps is assumed Na Na Sanivation uses innovative, low-cost solar treatment technologies to transform fecal waste into briquettes [] (CDC, 2017) since the process is based on solar treatment technologies it probably runs much more efficient in hot areas with lots of sum. For this technology the criterion "flooding" is considered to Irrelevant. It should function successfully (100% performance) in flood prone areas without any issues. (Akanksha Jain) NA NA NA NA According to Sanivation (n.d.) there is 3 - 5 acres of land space needed to build up a sanivation treatment plant that serves 100,000-2,000,000 people. NA	NA NA NA NA NA NA NA NA NA NA NA NA NA N
water_volume electricity_supply fuel_supply frequency_of_om pipe_supply pump_supply concrete_supply spare_parts 0 0 0 0 temperature flooding vehicular_acces slope soil_type groundwater_depth excavation surface_area_onsite surface_area_offsite	Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Popp, Categorical Popp, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Trapez Performance, Trapez Performance, Trapez Performance, Trapez Performance, Trapez Performance, Trapez	FALSE TRUE FALSE TRUE TRUE TRUE TRUE TRUE TRUE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE TRUE	yard public none (LiCap/day) electricity intermittent no electricity fuel no fuel liregular regular continuous (Miller and Miller an	NA (electricity = 1, intermittent = 0, no electricity = 0) NA (irregular = 0, regular = 0, continous = 1) (no pipes = 0, difficultly available = 0.1, pipes = 1) (no pumps = 0, difficultly available = 0.1, pipes = 1) (no concrete = 0, difficultly available = 0.1, concrete = 1) (simple = 0.7, technical = 0.2, special = 0.1) NA NA NA (very cold = 0, cold = 0, temperate = 0.25, warm = 1) NA NA NA NA NA NA NA NA NA N	NA energy required according to old library NA based on old library but needs a re-check A sanivation treatment plant employs 30-50 people. (Sanivation, n.d.) Need for continous work of several workers is assumed. Need for pipes is assumed Need for pumps is assumed Need for concrete is assumed from old library NA NA NA Sanivation uses innovative, low-cost solar treatment technologies to transform fecal waste into briquettes [] (CDC, 2017) since the process is based on solar treatment technologies it probably runs much more efficient in hot areas with lots of sun. For this technology the criterion "flooding" is considered to irrelevant. It should function successfully (100% performance) in flood prone areas without any issues. (Akanksha Jain) NA NA NA NA NA NA NA NA NA NA NA NA N	NA NA N

Description	drinking_water_exposure	Performance, Categorical	FALSE	Close	NA	NA	NA	
Company Comp	0	0	FALSE	Not close	NA	NA	NA	
### Management M				Ladder: unskilled skilled	(unskilled = 0, skilled = 0.5, professional = 1)	Professional construction skills are assumed to be very useful but skilled construction skills should be sufficient under certain circumstances such as very good design and good preparation	NA	
Marie	design_skills	Performance, Categorical	TRUE	unskilled skilled	(unskilled = 0, skilled = 0, professional = 1)	Professional design skills are assumed to be		
Company Comp	om_skills	Performance, Categorical	TRUE	Ladder: Unskilled Skilled	(unskilled = 0, skilled = 0.1, professional = 1)			
Company Comp	0	0	FALSE		NA .	NA .	NA	
Company Comp								
Second Company Seco	0	0	FALSE	C	NA	NA	NA	
Second Continues	cicuising_inculou	renormance, categorical	T TEST	Soft wipers				
March Production Program Production Program Production Program Production Program Production Program Production Program Production Program Production Program Production Program Production Program Production Program Production Program Production Program	0			C				
Marie				short (< 1 year)		Treatment tank, Mixer, Barrels and dolly cart all		
March Marc	speed_implement_toilet	PDF, Categorical	FALSE	long (>5 years) rapid (< 3 days)	NA .	(2018))	NA	
Indigenous Continues Indigenous Continues				slow (> 2 weeks)				
### Printmance, Origination 12 EE	speed_implement_treatment	PDF, Categorical	INUE	moderate (few weeks up to three months)	(rapid=U.5, moderate=U.5, slow=U)	deploy a toilet unit than digging a pit latrine.", "Lead time: Time required for initial system deployment, including waste processing plant, is higher than traditional solutions." (Hakspiel, D. et al. (2018)) While the appropriate container-based toilets can be implemented quickly, the treatment system itself fakes some time to set up. Patent technology (Sanivation), if materials are made available locally fast then implementation does not require much time at all. Lower probability is allotted to the category "rapid" [50%) because materials required for operation are quite specialised and therefore may be difficult to procure in a short time, i.e., less than a week.	yes	
				difficult		"The faccal sludge is collected and transported to a central processing site twice a week, where it is treated using a solar thermal treatment process. Once free of pathogens, the treated facces are combined with a high carbon co-waste product, such as charcoal dust, to make solid fuel briquettes." The implementation Guide actively promotes an expansion stage, in which more toilets can be deployed as part of the system. (Hakspiel, D. et al. (2018)) It is assumed that by a briquetting facility can be scaled up by increasing the high carbon co-waste product and collecting facees from more toilets.		
Property Property			TRUE	technical	(simple = 0.5, technical = 0.3, special = 0.2)	"The system that Sanivation uses in Kakuma heats a heating fluid that is continuously pumped through a closed circuit of pipes running through an insulated Jacket. The insulated Jacket surrounds a tank into which faecal sludge is loaded. The heating system is semi-automated with temperature sensors measuring the fluid and sludge temperatures and a controller activating a circulation pump accordingly. Safety mechanisms, including pressure relief valves and temperature larms, are incorporated into the design to maximize operator safety and to minimize the potential for user error. [] The system can be built offsite and assembled in a standard shipping container for ease of transportation and rapid deployment." (Hakspiel, D. et al. (2018)) [Manufacturing of the treatment tank and drying racki can be local (in an industrial city), whereas the grinding wheel mixer and roller press are manufactured abroad and need to be imported.] (Hakspiel, D. et al. (2018)) The treatment process requires technical parts as well as some specially manufactured parts awell as some specially manufactured parts as well as some specially manufactured parts as well as some specially manufactured parts	yes	
Med (N) 10 10 10 10 10 10 10 1			Range	Airloss	Soilloss	Waterloss		
## 100 F F F F F F F F F		1	-	0	(0		C with anivation
Time	k	100				0		
March Marc	TN		-			0	* N PA volatilizatio n is related to air	anivation
No. No.								
0.14 0.86 0 0 0 Assumption: PA Content content content briquetts 7% 0.96 0 0 0 0 0 0 0 0 0	k	25		0.07		-	PA	4
moistrue content briquetts System Carlots Carlot	H2O		-	1		0	Sa	anivation
med (R) 0.14 0-0.16 0.93 0 0 - bal. 0.07 0 0 - \$ 5 (0.14) - - - - PC with TS 0.99 - 0.01 0 0 PC with med (R) 0.99 - 0.01 0 0 Spulter ai, (202 ai,		0.14		0.86			Assumption: PA moistrue content briquetts ~5%. Dried Faeces with moisture 20% ~ 5% = TC_Airloss 0.75. FS with moisture 80% ~ 5% = TC_Airloss	
£ 5 (0.14) - - PA TS 0.99 - 0.01 0 0 PC with Sanivat San				0.93		0	-	
Sanivat med (R)	k	5				0	PA	A
med (R) 0.99 - 0.01 0 Spuhler al. (202	TS		-			0	Sa	anivation
	med (R)	0.99		0.01		0	Sp	puhler et I. (2021)
	k	100				-		

References

Gensch, R., Jennings, A., Renggli, S., & Reymond, P. (2018). Compendium of Sanitation Technologies in Emergencies . German WASH Network (GWN), Swiss Federal Institute of Aquatic Science and Technology (Eawag), Global WASH Cluster (GWC) and Sustainable Sanitation Alliance (SuSanA). Loestsher, T., & Reller, J. (2002). A decision support system for selecting sanitation systems in developing countries. Socio-Economic Planning Sciences, 36 (4), 267–290. https://doi.org/10.1016/S0038-0121(0)200007-1
Spubler, D., de Morais Lima, P., Fritsche, J., Ilmanen, K., Jain, A., van Slotten, Q. (2012). Sanitation stechnology (Eawag), Dübendorf, Switzerland. Spubler, D., & Roller, J. (2009). Sanitation technology library: Details and data sources for appropriateness profiles and transfer coefficients. Eawag - Swiss Federal Institute of Aquatic Science and Technology. Hakspiel, D., et al. (2018). Container-Based Toilets with Solid Fuel Briquettes as a Reuse Product, Best Practice Guidelines for Refuge Camps.

(COC), C. f. D. C. a. P. (2017). "Transforming Waste to Fuel and Creating Healthier Communities."

Tilley, E., Ulrich, L., Lüthi, C., Reymond, P., & Zurbrügg, C. (2014). Compendium of Sanitation Systems and Technologies—2nd revised edition . Swiss Federal Institute of Aquatic Science and Technology (EAWAG).

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Settler General Information	Values	Data Source					
FUNCTIONAL GROUP UNIQUE IDENTIFIER (ID)		-					·
DATA COMPILER	Julian Fritzsche						
INPUT PRODUCT	blackwater, transportedblackwater	Tilley, E. et al. (2014)					
	effluent, transportedeffluent, sludge,	Tilley, E. et al. (2014)					
RELATIONS	transportedsludge Input: OR	Tilley, E. et al. (2014)					
	Output: AND						
COMMENTS Pro-Eilter Criteria	Values	Data Source					
Pre-Filter Criteria applicability_level	Values (household = 0, neighbourhood = 1, city =	Tilley, E. et al. (2014)					
management level	1) (household = 0, shared = 0.5, public = 1)	Tilley, E. et al. (2014)					
capex_req_level		Spuhler, D. et al. (2021)					
opex_req_level technical_maturity	3	Spuhler, D. et al. (2021) Tilley, E. et al. (2014)					
	(acute = 0, stabilisation = 0.5,	Gensch, R. et al. (2018)					
Screening Criteria	development/recovery = 1) Type and Function	Applicable for this Functional Group?	Categories [Unit]	Technology Values (Data)	Data Source / Assumptions	Internal Review Done?	
water_supply	Performance, Categorical		house	NA	NA	NA	
			yard public				
water volume	Performance, Trapez	EALCE	none	NA	NA	NA .	
water_volume electricity_supply	Performance, Categorical		[L/cap/day] electricity	(electricity = 1, intermittent = 0.75, no	"Large primary clarifiers are often	yes	
			intermittent no electricity	electricity = 0.5)	equipped with mechanical collectors that continually scrape the settled solids		
			no creetirity		towards a sludge hopper in the base of		
					the tank, from where it is pumped to sludge treatment facilities. A sufficiently		
					sloped tank bottom facilitates sludge		
					removal. Scum removal can also be done either manually or by a collection		
					mechanism." (Compendium)		
					Settlers can be equipped with collectors that require electrical energy. The		
					performance is slightly improved if a		
					mechanical collector is installed, as it does not have to be done by hand. If		
					electric scrappers are used, 'intermittent		
					electricity' can work a bit better than 'no electricity', since one can choose to only		
					empty when electricity is available.		
fuel_supply	Performance, Categorical	FALSE	fuel	NA	NA	NA	
frequency_of_om	PDF, Categorica	TRUE	no fuel irregular	(irregular = 0, regular = 1, continuous = 0)	"In settlers that are not designed for	yes	
			regular		anaerobic processes, regular sludge		
			continuous		removal is necessary to prevent septic conditions and the build-up and release		
					of gas which can hamper the		
					sedimentation process by re-suspending part of the settled solids. Sludge		
					transported to the surface by gas bubbles		
					is difficult to remove and may pass to the next treatment stage. Frequent scum		
					removal and adequate		
					treatment/disposal, either with the sludge or separately, is also important."		
					(Compendium)		
					Regular desludging and scum removal is necessary.		
pipe_supply	Performance, Categorical	TRUE	no pipes difficultly available	(no pipes = 0.5, difficultly available = 0.75, pipes = 1)	"a good inlet and outlet construction with an efficient distribution and	yes	
			pipes	year =	collection system (baffles, weirs or T-		
					shaped pipes) is important." (Compendium)		
pump_supply	Performance, Categorica	TRUE	no pumps	(no pumps = 0.75, difficultly available =	"desludging can be done using Manual		
			difficultly available pumps	0.75, pumps = 1)	Emptying and Transport (C.1), Motorised Emptying and Transport (C.2) or by		
					gravity using a bottom outlet. []The		
					main operation and maintenance costs are related to the removal of primary		
					sludge and the cost of electricity if pumps		
					are required for discharge (in absence of a gravity flow option)." (Emersan)		
					Pumps can be required for emptying		
					depending on the design. It is assumed that building a gravity-driven		
					configuration performs worse than one		
					with pumps.		
concrete_supply	Performance, Categorical	TRUE	no concrete	(no concrete = 0.5, difficultly available =	"A Settler can be made of concrete, sand,	yes	
			difficultly available concrete	0.75, concrete = 1)	gravel,cement, steel, as well as fibreglass, PVC or plastic, and are available as		
					prefabricated units." (Emersan)		
					It is assumed that concrete has a higher performance than the other materials		
					due to the local experience with concrete.		
spare_parts	PDF, Categorica	TRUE	simple technical	(simple = 0.7, technical = 0.3, special = 0)	"A Settler can be made of concrete, sand, gravel, cement, steel, as well as	yes	
			special		fibreglass, PVC or plastic, and are		
					available as prefabricated units.", "and also on the local availability and thus		
					costs of materials (sand, gravel, cement,		
					steel) or prefabricated modules and labor costs." (Emersan)		
					Technical spare parts might be needed, if		
					it is a pre-fabricated module or if pumps		
0		FALSE		NA		NA	
0		FALSE FALSE		NA NA		NA NA	
temperature	Performance, Categorica		very cold	(very cold = 1, cold = 1, temperate = 1,	The settling efficiency of the settler does		
			cold temperate	warm = 1, hot = 1)	not particularly rely on the overall temperature, but the temperature		
			warm emperate		variations and uniformity within the tank		
			hot		({Goula, 2008 #1376}). Since the settler does not rely on		
					bacterial activity either, all temperature		
l							i i
					values are assumed to be suitable.		

				1		,
flooding	Performance, Categorical		flooding no flooding	(flooding = 0.9, no flooding = 1)	These values are allotted to all "tank" based technologies. These treatment technologies and their corresponding tanks are built to be water-tight. Additionally, their raised configurations are possible in flood prone areas. The impact of criterion flooding is therefore not considered to be as severe and only a 10% reduction in performance is allotted. (Akanksha Jain)	yes
vehicular_acces	Performance, Categorical	FALSE	no access difficult full	NA	NA	NA
slope	Performance, Categorical	FALSE	flat	NA	NA	NA
soil_type	Performance, Categorical	FALSE	not flat clay	NA	NA	NA .
			silt sand gravel			
groundwater_depth	Performance, Trapez	EALSE	rock water depth [m]	NA .	NA .	NA
excavation	Performance, Categorical		easy	(easy = 1, hard = 0.75)	Depending on the design, excavation	yes
surface_area_onsite	Performance, Trapez	FALSE	hard [m2/plot]	NA	might be necessary. NA	NA
surface_area_offsite	Performance, Trapez	TRUE	m2/pers	(a = 0.05, b = 0.05, c = 999, d = 999)	From Mang, HP. & Li, Z. (2010) on biogas settlers: "Only 0.5-1.m2 per m3 daily flow are needed, compared to 25-30 m2/m3 /d flow in aerobic ponds and constructed wetlands." We calculate the ratio of the minimum space requirements between biogas settlers and constructed wetlands: 30 m2/m3/d / 0.5 m2/m3/d = 60. The space requirements of the settler are therefore 60x smaller than the space requirements of constructed wetlands. Using our value of 3 m2/cap for constructed wetlands (from Table 1.3, Dotro et al. 2017), we calculate space requirements of 0.05 m2/cap for the	
0	0	FALSE	0	NA	biogas settler (Eawag, 2021). NA	NA .
0	0	FALSE FALSE	0	NA NA	NA NA	NA NA
drinking_water_exposure	Performance, Categorical		Close	NA NA	NA NA	NA NA
0	0	FALSE	Not close	NA	NA .	NA .
0	0	FALSE	0	NA	NA	NA
construction_skills	Performance, Categorical		Ladder: unskilled skilled professional	(unskilled = 0.5, skilled = 1, professional = 1)	"Simple and robust technology" (Compendium) There are no technical parts to be installed and the design is pretty simple. A casual labourer should be sufficient. Futhermore there are prefabricated tanks are available in fibreglass, PVC or plastic. (Emersan)	yes
design_skills	Performance, Categorical		Ladder: unskilled skilled professional	(unskilled = 0, skilled = 1, professional = 1)	"Settlers are typically designed for a hydraulic retention time of 1.5–2.5 hours. Less time is needed if the BOD level should not be too low for the following biological step. The tank should be designed to ensure satisfactory performance at peak flow. In order to prevent eddy currents and short-circuiting, as well as to retain scum inside the basin, a good inlet and outlet construction with an efficient distribution and collection system (baffles, welrs or T-shaped pipes) is important." (Emersan) The design has to be carried out in accordance with a few factors.	yes
om_skills	Performance, Categorical	TRUE	Ladder: Unskilled Skilled	(unskilled = 0.5, skilled = 1, professional = 1)	Usually no operation and maintenance is needed except regular scum and sludge	yes
0	0	FALSE	Professional	NA NA	removal.	NA .
0	0	FALSE	0	NA	NA	NA
0		FALSE FALSE		NA NA	NA NA	NA NA
cleansing_method	Performance, Categorical	FALSE	Washers Soft wipers Hard wipers	NA	NA	NA
0	0	FALSE FALSE	0	NA NA	NA NA	NA NA
lifetime	Performance, Categorical	TRUE	short (< 1 year) medium (2-5 years) long (>5 years)	(short = 1, medium = 1, long = 1)	There are different types of settlers, but in general long lifetimes are expected. For example, settlers with additional lamellae, such as tube settlers have "twenty to twenty-five year service life, provided proper maintenance is performed, land plate settlers havel longer lifespan due to material of construction." (Brentwood, 2020)	yes
speed_implement_toilet	PDF, Categorical	FALSE	rapid (< 3 days) moderate (3 days to 2 weeks) slow (> 2 weeks)	NA	NA	NA
speed_implement_treatment	PDF, Categorical	TRUE	rapid (few days to a week) moderate (few weeks up to three months) slow (> 3 months)	(rapid=0.7, moderate=0.3, slow=0)	"A Settler can be made of concrete, sand, gravel, cement, steel, as well as fibreglass, PVC or plastic, and are available as prefabricated units." (Compendium) With prefabricated structures implementation should be very quick, however, slightly lower performance allotted to category "rapid" (70%) since if concrete is to be used for construction, minimum curing time of 7 days would be needed. (Akanksha Jain)	yes

### Company of the Co									
Interest Interest				simple technical		satisfactory performance at peak flow.", "They can be independent tank or integrated into combined treatment units.", "To enhance the performance of Settlers inclined plates (lamellee) and tubes can be installed which increase the settling area, or chemical coagulants can be used." (Emersan) The settlers have been specifically designed with a certain volume for certain inputs, so one cannot simply increase their size. However, new settlers can be build and integrated into combined treatment units. Furthermore, the treatment capacity can be increased slightly by adding lamellae, tubes or chemical coagulants. "A Settler can be made of concrete, sand, gravel, cement, steel, as well as fibreglass, PVC or plastic, and are			
Page Page						(Emersan) Can be constructed from locally available material. However, we assume that some technical parts are required to pump out sludge from the tank. (Kukka			
Mark Mark	Transfer Coefficients	(copied from "Sanitation_Technologies_TC_database_202106				illianen, Lawag 2021)			ı '
	_	Sludge	Range	Effluent	Airloss	Soilloss			
March	TP	0.7	0.6 - 0.8	0.3	C	o c	0	* as TP	
No.	med (R)	0.7		0.3	0	O C	0		-
	k							<u> </u>	
Control Cont	TN	0.15	-	0.85	C	C	0	* donitrified	
Company Comp		0.43	-	0.57	C	0	0	*	
Meditional Information Meditional Informational							-	denitrified	
March Marc		0.17	-	0.83	C	C	0	* dominational	
No	med (R)	0.17	0.15 - 0.43	0.83			0	denitrified	-
Meditional Information Mask Removal [N] Mask	k	5	[0.28]						PA
Mark Companies	H20	0.04	-	0.95	0.01		0		PA
Mark Mark									
Max. Removal [N] Max. Remova	med (R)	0.04		0.95	0.01		0		-
Max. Removal [N] Max. Remova	k	5						<u> </u>	PA
Med (R)	TS	0.234	0.195 - 0.273	0.766	C	C	0		
Meditional Information		0.228	0.191 - 0.265	0.772	C	0	0		
Additional Information 34.2.1 Data from: [conradin, 2010 8973)8 Min. Removal [K]								34.2.2	2014
Additional Information 34.2.1 Data from: (Corradin, 2010 8973)8 Min. Removal [K]	med (R)			0.77	0	0	0	Souhler et	PA
Min. Removal [Ks] Max. Removal [Ks] Max. Removal [Ks] S 50 0 70 0 70 15 [Kmr TSS) 50 0 70 0 70 15 [Kmr TSS) 19.5 27.3 18.4 [Kmr TSS) 19.5 27.3 19.									
Min. Removal [K] Asia STSXTS (from 10.39 0.39 0.39 1.50 1.50 0.70 1.50 1.50 0.70 1.50 1.50 0.70 1.50 1.50 0.70 1.50 1.50 0.70 1.50 1.50 0.70 1.50 1.50 0.70 1.50 1.50 0.70 1.50 1.50 0.70 1.50 1.50 0.70 1.50 1.50 0.70 1.50 1.50 0.70 1.50 1.50 0.70 1.50 1.50 0.70 1.50 1.50 0.70 1.50 1.50 0.70 0.70 1.50 0.70 1.50 0.70 1.50 0.70 1.50 0.70 1.50 0.70 1.50 0.70 0.70 1.50 0.70 1.50 0.70 1.50 0.70 1.50 0.70 1.50 0.70 1.50 0.70 0.70 1.50 0.70 0.70 1.50 0.70 0.70 1.50 0.70 0.70 1.50 0.70 0.70 0.70 0.70 0.70 0.70 0.70 0	Additional Information	Data from: (Conradin 2010 #973)@							
Ratio TSS:TS (from 0.039 0.39 0.39 0.39 0.39 0.39 0.39 0.3			Max. Removal [%]						† l
TS (From TSS) 19.5 27.3 Min. Removal [15] Max.	TSS	50	70						
34.2.2 Data from: (Fuchs, 2014 #1421) Min. Removal [X] Max. Removal [Xs] Max. Remova									
Min. Removal [%] Max. Removal [%] 68 Ratio TSS:TS [from 0.39 0.39 0.39 horizontal wetland) TS [from TS5] 19.11 26.52 Seferences Sensch, R., Jennings, A., Benggli, S., & Reymond, P. (2018). Compendium of Somitation Technologies in Emergencies. German WASH Network (GWN), Swiss Federal Institute of Aquatic Science and Technology (Eawag), Global WASH Cluster (GWC) and Sustainable Sanitation Alliance (SuSanA). oetscher, T., & Keller, J. (2002). A decision support system for selecting sanitation systems in developing countries. Socio-Economic Planning Sciences, 36 (4), 267–290. https://doi.org/10.1016/S0038-0121(02)00007-1 gpulher, D., & Bollow, F., Fritzsche, J., Ilmanen, K., Jain, A., van Sloten, M., & Willimann, C. (2021). SaniChoice Project Team. Department Sinalation, Water and Solid Waste for Development Countries [Sandec), Swiss Federal Institute of Aquatic Science and Technology (Eawag), Dübendorf, Switzerland. Spulher, D., & Bollow, T. (2002). Smitzerland Technology (Eawag), Dübendorf, Switzerland. Spulher, D., & Roll (2010). "The SWAN TOOLORs." from Mater Testment-performance and design recommendations." Water Science and Technology (59(2): 278-285. Omnolos, E., et al. (2013). "The SWAN TOOLORs." from Mater Testment-performance and design recommendations." Water Science and Technology (59(2): 278-285. Omnolos, E., et al. (2013). "The SWAN TOOLORs." from Mater Testment-performance of simultaneous C/N/P removal WWTPs." Bioresource Technology 136: 680-688. Omnolos, E., et al. (2003). "The Settiers vs. Plats Settlers: Comparing Lamella Technologies." Value, J., et al. (2003). "The Settiers vs. Plats Settlers: Comparing Lamella Technologies." Value, J., et al. (2003). "The Certification Time in the Settler on Phosphorus Removal from Communal Wastewater (4 pp.)" Environmental Science and Pollution Research 12(5): 306-309. Value, J., et al. (2003). "The Certification Time in the Settlers Comparing Lamella Technologies." Value, J., et al. (2003). "The Certification Time in the Settlers Comparing Lamella Technolog			27.5						
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Noticental wetlands TS (from TSS) 19.11 26.52 Noticent Search, I., & Relier, J. (2002). A decision support system for selecting sanitation systems in developing countries. Socio-Economic Planning Sciences, 36 (4), 267-290. https://doi.org/10.1016/S0038-01221(02)00007-1 Sputher, D., de Morais Lima, P., Fritzsche, J., Ilmanen, K., Jain, A., van Sioten, M., & Willimann, C. (2021). SaniCholee Project Team. Department Sinatiation, Water and Solid Waste for Development Countries (Sandec), Swiss Federal Institute of Aquatic Science and Technology (Eawag), Dübendorf, Switzerland. Sputher, D., & Roller, J. (2002). Smitter (19.00). The Switzer of Switzerland rechnology Immorphy Details and deals of sucres for opportaineness profiles and transfer coefficients. Eawag – Swiss Federal Institute of Aquatic Science and Technology. Swiss Federal Institute of Aquatic Sc									
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Sensch, R., Jennings, A., Renggli, S., & Reymond, P. (2018). Compendium of Sanitation Technologies in Emergencies. German WASH Network (GWN), Swiss Federal Institute of Aquatic Science and Technology (Eawag), Global WASH Cluster (GWC) and Sustainable Sanitation systems in developing countries. Socio-Economic Planning Sciences., 36 (4), 267–290. https://doi.org/10.1016/S0038-0121(D)00007-1 Spubler, D., de Norsis Lima, P., Fritzsche, L., Ilmanen, K., Jain, A., van Slotten, M., & Willimann, C. (2021). Sanitation etchnology in the Company of th									1
Srentwood (2020). "Tube Settlers vs. Plate Settlers: Comparing Lamella Technologies." Mang, HP. and Z. Li (2010). Technology review of biogas sanitation-Biogas sanitation-	Loetscher, T., & Keller, J. (2002). A Spuhler, D., de Morais Lima, P., Fi Spuhler, D., & Roller, L. (2020). So Fuchs, S., et al. (2014). "Lamella s Conradin, K., et al. (2010). "The S' Guerrero, J., et al. (2013). "Effect	A decision support system for selecting sanitat ritzsche, J., Ilmanen, K., Jain, A., van Sloten, M unitation technology library: Details and data se ettlers for storm water treatment-performan SWM Toolbox." from http://www.sswm.info. of nitrite, limited reactive settler and plant de	ion systems in developing countries. Socio-Eco "& Willimann, C. (2021). Sanichoice Project To ources for appropriateness profiles and transfer ce and design recommendations." Water Scien sign configuration on the predicted performan	nomic Planning Sciences , 36 (4), 267–290. http am. Department Sanitation, Water and Solid V coefficients . Eawag - Swiss Federal Institute or ce and Technology 69(2): 278-285. ce of simultaneous C/N/P removal WWTPs." B	vs://doi.org/10.1016/S0038-0121(02)00007-1 Waste for Development Countries (Sandec), Suf Aquatic Science and Technology. vs. doi:10.1016/S0038-0121(02)0007-1 vs. doi:10.1016/S0038-0				
50ula, A. M., et al. (2008). "The effect of influent temperature variations in a sedimentation tank for potable water treatment—A computational fluid dynamics study." Water Research 42(13): 3405-3414.	Brentwood (2020). "Tube Settlers	s vs. Plate Settlers: Comparing Lamella Techno	logies."						l
soula, A. M., et al. (ZUXB). "The effect of influent temperature variations in a sedimentation tank for potable water treatment—A computational fluid dynamics study." Water Research 42(13): 3405-3414. filley, E., Ulrich, L., Lithi, C., Reymond, P., & Zurbrügg, C. (2014). Compendium of Sonitation Systems and Technologies—2nd revised edition. Swiss Federal Institute of Aquatic Science and Technology (EAWAG).	Mang, HP. and Z. Li (2010). Tech	nology review of biogas sanitation-Biogas san	itation for blackwater, brown water or for excr			ermany, Deutsche Gesellschaft für Internationa	le Zusammenarbeit GmbH (GIZ).		
ווופץ, ב., טוויטו, ב., בטווו, ב., הפקיווטיוט, ד., א בטוטיטקק, ב. (בטבין. בטוווףביוטיטוי טן בטווועטטו בקצוווט ווויטינעט ביווטיטעט ביווטי ביווטיטעט ביווטי ביווטיטעט (באשאט).	Goula, A. M., et al. (2008). "The e	ffect of influent temperature variations in a se	edimentation tank for potable water treatment	—A computational fluid dynamics study." Wat	er Research 42(13): 3405-3414.				
	riney, E., Ulrich, L., Luthi, C., Reyn	nonu, r., & zurbrugg, C. (2014). Compendium	uj surmation systems and Technologies—2nd ri	viseu edition . Swiss Federal Institute of Aquat	uc science and Technology (EAWAG).				

Imhoff Tark							
	Values	Data Source					
FUNCTIONAL GROUP	Т	-					
UNIQUE IDENTIFIER (ID) DATA COMPILER	imhoff_tank SaniChoice Project Team	-					
	blackwater, transportedblackwater,	Tilley, E. et al. (2014)	1				
OUTPUT BRODUCT	greywater, transportedgreywater effluent, transportedeffluent, sludge,	Tilley, E. et al. (2014)					
	transportedsludge	, (2014)					
RELATIONS	Input: OR	Tilley, E. et al. (2014)					
	Output: AND						
COMMENTS Pre-Filter Criteria	Values	Data Source					
	(household = 0, neighbourhood = 0.5,	Tilley, E. et al. (2014)					
	city = 1)						
management_level capex_req_level		Tilley, E. et al. (2014) Spuhler, D. et al. (2021)					
opex_req_level	3	Spuhler, D. et al. (2021)					
technical_maturity	(acute = 0, stabilisation = 0.5,	Tilley, E. et al. (2014) Same values allotted as for a Settler.					
development_priase	development/recovery = 1)	Emersan -> T.1 Settler (Gensch, R. et al.					
Constaling C to 1		(2018))	Cotanada Blata	Technology Vol.	Data Carrers 12	Internal Burder B. 2	
Screening Criteria water_supply	Type and Function Performance, Categorical		Categories [Unit] house	Technology Values (Data) NA	Data Source / Assumptions NA	Internal Review Done? NA	
	,		yard				
			public none				
water_volume	Performance, Trapez	FALSE	[L/cap/day]	NA	NA	NA	
electricity_supply	Performance, Categorical		electricity	(electricity = 1, intermittent = 0.75, no	Pumps for emptying are necessary and	yes	
			intermittent no electricity	electricity = 0.5)	these pumps might require electricity to work. However, if the pumps are in the		
			no crectificity		form of mobile pumps or vacuum trucks,		
					they can work without electricity. It is		
					assumed that generally, electric pumps		
					perform better, as they do not require vehicular access and can be installed at		
					the best location. If electric pumps are		
					used intermittent electricity can work a		
					bit better than no electricity, since one only empties when electricity is available.		
					If electric pumps are used, 'intermittent		
					electricity' can work a bit better than 'no		
					electricity', since one can choose to only empty when electricity is available.		
					empty when electricity is available.		
fuel_supply	Performance, Categorical	FALSE	fuel no fuel	NA	NA	NA	
frequency_of_om	PDF, Categorical	TRUE	irregular	(irregular = 0, regular = 1, continuous = 0)		yes	
			regular		possible at low cost, if trained personnel		
			continuous		are in charge. Flow paths have to be kept		
					open and cleaned out weekly, while scum in the settling compartment and		
					the gas vents has to be removed daily if		
					necessary. Stabilized sludge from the		
					bottom of the digestion compartment should be removed according to the		
					design. A minimum clearance of 50 cm		
					between the sludge blanket and the slot		
					of the settling chamber has to be ensured		
					at all times." (Compendium) Regular maintenance is required.		
					negular maintenance is required.		
pipe_supply	Performance, Categorical	TRUE	no pipes	(no pipes = 0, difficulty available = 0.5,	"T-shaped pipes or baffles are used at the	yes	
			difficultly available	pipes = 1)	inlet and the outlet to reduce velocity		
			pipes		and prevent scum from leaving the system" (Emersan)		
					"For desludging, a pipe and pump have to		
					be installed or access provided for		
					vacuum trucks and mobile pumps." (Compendium)		
					Pipes are required for this technology.		
pump_supply	Performance, Categorical	TRUE	no pumps	(no pumps = 0.5, difficulty available =	"The Imhoff tank is usually built	yes	
			difficultly available pumps	0.75, pumps = 1)	underground with reinforced concrete. It can, however, also be built above		
			F- F-		ground, which makes sludge removal		
					easier due to gravity, although it still		
					requires pumping up of the influent." (Emersan)		
					"For desludging, a pipe and pump have to		
					be installed or access provided for		
					vacuum trucks and mobile pumps."		
					(Compendium) "Sludge is ideally removed by hydraulic		
					pressure, not requiring any pumping but		
					only a sludge removal pipe controlled by		
					a valve. This is possible if a natural gradient exists, so that a head of min. 1.5		
					m at the level of the valve can be		
					achieved (Texas Water Commission,		
					1991)." (Griesauer, C. (2014)) Some type of pump is required for		
					Some type of pump is required for pumping up the influent, if the imhoff		
					tank is built (partly) above ground. In		
					other configurations the hydraulic		
					pressure is sufficient or pumping could be achieved in the form of a mobile pump		
					or a vacuum truck.		
concrete_supply	Performance, Categorical	TRUE	no concrete	(no concrete = 0, difficulty available =	"The Imhoff tank is usually built	yes	
	,5		difficultly available	0.5, concrete = 1)	underground with reinforced concrete. It		
			concrete		can, however, also be built above		
					ground, which makes sludge removal easier due to gravity, although it still		
					requires pumping up of the influent.		
					Small prefabricated Imhoff tanks are also		
					available on the market." (Compendium)		
					Concrete is assumed to be necessary.		
spare_parts	PDF, Categorical	TRUE	simple	(simple = 0.7, technical = 0.3, special = 0)	"Operation and maintenance are	yes	
	,5=		technical		possible at low cost, if trained personnel		
			special		are in charge" (Compendium)		
					"Requires expert design, but can be constructed with locally available		
					constructed with locally available material.", "Simple to construct and to		
					operate." (SSWM Toolbox)		
					Low tech spare parts are assumed,		
					however, if the pump breaks, more technical parts are necessary		
					technical parts are necessary.		
0	0	FALSE		NA	NA	NA	
0		FALSE		NA NA	NA NA	NA NA	
0	0	FALSE	1 0	NA NA	NA	NA	<u>l</u>

Martine Propose Company Comp	temperature						
### Market Company (Company 1965) ***Section 1965 ***Production Company 1965 ***Pro		Performance, Categorical	TRUE	very cold	(very cold = 0.5, cold = 0.7, temperate =	"Imhoff tanks can be used in warm and	yes
March Marc				cold	1, warm = 1, hot = 1)	cold climates.", " In colder climates	
March Profiting accordance March Profiting accordance March Profiting accordance March Profiting accordance March Profiting accordance March M				temperate		longer sludge retention time and,	
Modes Profession Control The Control				warm		therefore, a greater volume is needed."	
Martin M				hot		(Compendium)	
Publication						Lower performance for temperatures	
In the banding of the control of the							
Selection and Not Recorded for Selection and Selection a	flooding	Performance, Categorical	TRUE		(flooding = 0.9, no flooding = 1)		yes
				no flooding		be built underground if the groundwater	
Comparison Com						table is low and the location is not flood	
Book Security Se						prone." (Compendium)	
Book Security Se							
Validation Companies Validation Companies						These values are allotted to all "tank"	
Matheway Mark Mar						based technologies. These treatment	
Mathematical Action Professional Confession Mathematical Confess						technologies and their corresponding	
## Application of the processors and the processors						tanks are built to be water-tight.	
Annual Content						Additionally, their raised configurations	
						are possible in flood prone areas. The	
March Marc							
Marked and part Marked and							
## Commons Cologonal SASE 16 16 16 16 16 16 16 1							
All March						(Akanksha Jain)	
All March							
Parlie remark. Calegorian (PALE) Max							
Description Description	vehicular_acces	Performance, Categorical	PALSE		NA	NA	NA .
Max Max							
Max			E410E				
Suit Suit	siope	Performance, Categorical	FALSE		NA	NA .	NA
Second color Professional Color Professional		Dorf C-t- 1 1	EALCE		N/A	NA.	N/A
## And Particularies, Tapper (14.15)	soii_type	Performance, Categorical	FALSE		NA.	INA	INA
Production Professional State Professional St	1						
Part	1						
Best	1						
Performance, Congenies Titled Stay S	groundwater denth	Performance Transa	FALSE		NA	NA	NA
Serforce_pres_profiles							
Surface_area_crisis	excavation	r enormance, categorical			(cusy = 1, naru = 0.73)		, ,
Surface_prince_prince Performance_C Troyof TRUE		1					
### Annual Performance, Topical (M.E.) ### Intelligence area, official ### Intelligence ### Intelli		1					
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speed_implement_treatment PDF, Categorical TRUE rapid (few days to a week) moderate (few weeks up to three months) slow (> 3 months) (rapid=0.7, moderate=0.3, slow=0) "The Imhorf tank is usually built underground with reinforced concrete" "Small prefabricated inhorf tanks are also available on the market." (Compendium) With prefabricated structures implementation should be very quick, however, slightly lower performance allotted to categor "rapid" (70%) since if concrete is to the order of 7 days would be	om_skills	Performance, Categorical 0 0 0 0 Performance, Categorical 0 Performance, Categorical	FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE	skilled professional Ladder: unskilled skilled skilled skilled stelled professional Ladder: Unskilled Skilled Professional Ladder: Unskilled Skilled Professional 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	(unskilled = 0, skilled = 1, professional = 1) NA NA NA NA NA NA NA (Short = 1, medium = 1, long = 1)	"Requires expert design and construction" (Compendium) Similar to a WSP. "Operation and maintenance are possible at low cost, if trained personnel are in charge." (Compendium) Trained personnel is necessary. NA NA NA NA NA NA NA Sudge needs to be dug out every 1 to 5 years and discharged properly" (Imhoff Tank SXWM Toolbox) "For the civil works a life expectancy of 25 years is assumed. Pipework and the manhole cover are expected to last for 15 years. (Country specific assessments show that reinvestment was required every 20 to 25 years.)" (Imhoff Tank Griesauer, C. (2014)). In a study by Griesauer on the CLARA planning tool the expected litetimes for inhoff tanks were larger than 5 years.	NA NA N
moderate (few weeks up to three months) months) slow (> 3 months) also available on the market." (Compendium) With prefabricated imbody as the program of the program	om_skills	Performance, Categorical 0 0 0 0 Performance, Categorical 0 Performance, Categorical	FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE	skilled professional Ladder: unskilled skilled professional Ladder: Unskilled skilled professional Ladder: Unskilled Skilled Professional 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	(unskilled = 0, skilled = 1, professional = 1) NA NA NA NA NA NA NA (Short = 1, medium = 1, long = 1)	"Requires expert design and construction" (Compendium) Similar to a WSP. "Operation and maintenance are possible at low cost, if trained personnel are in charge." (Compendium) Trained personnel is necessary. NA NA NA NA NA NA NA Sudge needs to be dug out every 1 to 5 years and discharged properly" (Imhoff Tank SXWM Toolbox) "For the civil works a life expectancy of 25 years is assumed. Pipework and the manhole cover are expected to last for 15 years. (Country specific assessments show that reinvestment was required every 20 to 25 years.)" (Imhoff Tank Griesauer, C. (2014)). In a study by Griesauer on the CLARA planning tool the expected litetimes for inhoff tanks were larger than 5 years.	NA NA N
months) slow (> 3 months) also available on the market." (Compendium) With prefabricated structures implementation should be very quick, however, slightly lower performance allotted to categor "rapid" (70%) since if concrete is to be used for construction, minimum curing time of 7 days would be	om_skills 0 0 0 cleansing_method 0 lifetime	Performance, Categorical 0 0 0 0 Performance, Categorical 0 Performance, Categorical	FALSE FALSE FALSE FALSE FALSE FALSE TAUSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE	skilled professional Ladder: unskilled skilled skilled skilled store unskilled skilled professional Ladder: Unskilled Skilled Professional Skilled Professional 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	(unskilled = 0, skilled = 1, professional = 1) NA NA NA NA NA NA NA NA NA NA NA NA NA	"Requires expert design and construction" (Compendium) Similar to a WSP. "Operation and maintenance are possible at low cost, if trained personnel are in charge." (Compendium) Trained personnel is necessary. NA NA NA NA NA NA NA NA NA NA NA NA NA	NA NA N
slow (> 3 months) also available on the market." (Compendium) With prefabricated structures implementation should be very quick, however, slightly lower performance allotted to category "rapid" (70%) since if concrete is to be used for construction, minimum curring time of 7 days would be	om_skills 0 0 0 cleansing_method 0 lifetime	Performance, Categorical 0 0 0 0 Performance, Categorical 0 Performance, Categorical	FALSE FALSE FALSE FALSE FALSE FALSE TAUSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE	skilled professional Ladder: unskilled skilled professional Ladder: Unskilled Skilled Professional Unskilled Professional	(unskilled = 0, skilled = 1, professional = 1) NA NA NA NA NA NA NA NA NA NA NA NA NA	"Requires expert design and construction" (Compendium) Similar to a WSP. "Operation and maintenance are possible at low cost, if trained personnel are in charge." (Compendium) Trained personnel is necessary. NA NA NA NA NA NA NA NA NA NA NA NA NA	NA NA N
(Compendium) With prefabricated structures Implementation should be very quick, however, slightly lower performance allotted to reagon," rapid" (70%) since if concrete is to be used for construction, minimum curring time of 7 days would be	om_skills 0 0 0 cleansing_method 0 lifetime	Performance, Categorical 0 0 0 0 Performance, Categorical 0 Performance, Categorical	FALSE FALSE FALSE FALSE FALSE FALSE TAUSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE	skilled Jadder: unskilled skilled professional Ladder: Unskilled skilled Professional Ladder: Unskilled Skilled Skilled Professional 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	(unskilled = 0, skilled = 1, professional = 1) NA NA NA NA NA NA NA NA NA NA NA NA NA	"Requires expert design and construction" (Compendium) Similar to a WSP. "Operation and maintenance are possible at low cost, if trained personnel are in charge." (Compendium) Trained personnel is necessary. NA NA NA NA NA NA NA NA NA NA NA NA NA	NA NA N
With prefabricated structures implementation should be very quick, however, slightly lower performance allotted to category "rapid" (70%) since if concrete is to be used for construction, minimum to minimum to fa days would be	om_skills 0 0 0 cleansing_method 0 lifetime	Performance, Categorical 0 0 0 0 Performance, Categorical 0 Performance, Categorical	FALSE FALSE FALSE FALSE FALSE FALSE TAUSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE	skilled professional Ladder: unskilled skilled professional Ladder: Unskilled Skilled Professional Ladder: Unskilled Skilled Professional	(unskilled = 0, skilled = 1, professional = 1) NA NA NA NA NA NA NA NA NA NA NA NA NA	"Requires expert design and construction" (Compendium) Similar to a WSP. "Operation and maintenance are possible at low cost, if trained personnel are in charge." (Compendium) Trained personnel is necessary. NA NA NA NA NA NA NA NA NA NA NA NA NA	NA NA N
implementation should be very quick, however, slightly lower performance allotted to category "rapid" (70%) since if concrete is to be used for construction, minimum curring time of 7 days would be	om_skills 0 0 0 cleansing_method 0 lifetime	Performance, Categorical 0 0 0 0 Performance, Categorical 0 Performance, Categorical	FALSE FALSE FALSE FALSE FALSE FALSE TAUSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE	skilled professional Ladder: unskilled skilled professional Ladder: Unskilled Skilled Professional Ladder: Unskilled Skilled Professional	(unskilled = 0, skilled = 1, professional = 1) NA NA NA NA NA NA NA NA NA NA NA NA NA	"Requires expert design and construction" (Compendium) Similar to a WSP. "Operation and maintenance are possible at low cost, if trained personnel are in charge." (Compendium) Trained personnel is necessary. NA NA NA NA NA NA NA NA NA NA NA NA NA	NA NA N
however, slightly lower performance allotted to category "rapid" (70%) since if concrete is to be used for construction, minimum curing time of 7 days would be	om_skills 0 0 0 cleansing_method 0 lifetime	Performance, Categorical 0 0 0 0 Performance, Categorical 0 Performance, Categorical	FALSE FALSE FALSE FALSE FALSE FALSE TAUSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE	skilled professional Ladder: unskilled skilled professional Ladder: Unskilled Skilled Professional Ladder: Unskilled Skilled Professional	(unskilled = 0, skilled = 1, professional = 1) NA NA NA NA NA NA NA NA NA NA NA NA NA	"Requires expert design and construction" (Compendium) Similar to a WSP. "Operation and maintenance are possible at low cost, if trained personnel are in charge." (Compendium) Trained personnel is necessary. NA NA NA NA NA NA NA NA NA NA NA NA NA	NA NA N
allotted to category "rapid" (70%) since if concrete is to be used for construction, minimum to wring time of 7 days would be	om_skills 0 0 0 cleansing_method 0 lifetime	Performance, Categorical 0 0 0 0 Performance, Categorical 0 Performance, Categorical	FALSE FALSE FALSE FALSE FALSE FALSE TAUSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE	skilled professional Ladder: unskilled skilled professional Ladder: Unskilled Skilled Professional Ladder: Unskilled Skilled Professional	(unskilled = 0, skilled = 1, professional = 1) NA NA NA NA NA NA NA NA NA NA NA NA NA	"Requires expert design and construction" (Compendium) Similar to a WSP. "Operation and maintenance are possible at low cost, if trained personnel are in charge." (Compendium) Trained personnel is necessary. NA NA NA NA NA NA NA NA NA NA NA NA NA	NA NA N
concrete is to be used for construction, minimum curing time of 7 days would be	om_skills 0 0 0 cleansing_method 0 lifetime	Performance, Categorical 0 0 0 0 Performance, Categorical 0 Performance, Categorical	FALSE FALSE FALSE FALSE FALSE FALSE TAUSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE	skilled professional Ladder: unskilled skilled professional Ladder: Unskilled Skilled Professional Ladder: Unskilled Skilled Professional	(unskilled = 0, skilled = 1, professional = 1) NA NA NA NA NA NA NA NA NA NA NA NA NA	"Requires expert design and construction" (Compendium) Similar to a WSP. "Operation and maintenance are possible at low cost, if trained personnel are in charge." (Compendium) Trained personnel is necessary. NA NA NA NA NA NA NA NA NA NA NA NA NA	NA NA N
minimum curing time of 7 days would be	om_skills 0 0 0 cleansing_method 0 lifetime	Performance, Categorical 0 0 0 0 Performance, Categorical 0 Performance, Categorical	FALSE FALSE FALSE FALSE FALSE FALSE TAUSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE	skilled professional Ladder: unskilled skilled professional Ladder: Unskilled Skilled Professional Ladder: Unskilled Skilled Professional	(unskilled = 0, skilled = 1, professional = 1) NA NA NA NA NA NA NA NA NA NA NA NA NA	"Requires expert design and construction" (Compendium) Similar to a WSP. "Operation and maintenance are possible at low cost, if trained personnel are in charge." (Compendium) Trained personnel is necessary. NA NA NA NA NA NA NA NA NA NA NA NA NA	NA NA N
	om_skills 0 0 0 cleansing_method 0 lifetime	Performance, Categorical 0 0 0 0 Performance, Categorical 0 Performance, Categorical	FALSE FALSE FALSE FALSE FALSE FALSE TAUSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE	skilled professional Ladder: unskilled skilled professional Ladder: Unskilled Skilled Professional Ladder: Unskilled Skilled Professional	(unskilled = 0, skilled = 1, professional = 1) NA NA NA NA NA NA NA NA NA NA NA NA NA	"Requires expert design and construction" (Compendium) Similar to a WSP. "Operation and maintenance are possible at low cost, if trained personnel are in charge." (Compendium) Trained personnel is necessary. NA NA NA NA NA NA NA NA NA NA NA NA NA	NA NA N
needed. (Akanksha Jain)	om_skills 0 0 0 cleansing_method 0 lifetime	Performance, Categorical 0 0 0 0 Performance, Categorical 0 Performance, Categorical	FALSE FALSE FALSE FALSE FALSE FALSE TAUSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE	skilled professional Ladder: unskilled skilled professional Ladder: Unskilled Skilled Professional Ladder: Unskilled Skilled Professional	(unskilled = 0, skilled = 1, professional = 1) NA NA NA NA NA NA NA NA NA NA NA NA NA	"Requires expert design and construction" (Compendium) Similar to a WSP. "Operation and maintenance are possible at low cost, if trained personnel are in charge." (Compendium) Trained personnel is necessary. NA NA NA NA NA NA NA NA NA NA NA NA NA	NA NA N
	om_skills 0 0 0 cleansing_method 0 lifetime	Performance, Categorical 0 0 0 0 Performance, Categorical 0 Performance, Categorical	FALSE FALSE FALSE FALSE FALSE FALSE TAUSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE	skilled professional Ladder: unskilled skilled professional Ladder: Unskilled Skilled Professional Ladder: Unskilled Skilled Professional	(unskilled = 0, skilled = 1, professional = 1) NA NA NA NA NA NA NA NA NA NA NA NA NA	"Requires expert design and construction" (Compendium) Similar to a WSP. "Operation and maintenance are possible at low cost, if trained personnel are in charge." (Compendium) Trained personnel is necessary. NA NA NA NA NA NA NA NA NA NA NA NA NA	NA NA N
	om_skills 0 0 0 cleansing_method 0 lifetime	Performance, Categorical 0 0 0 0 Performance, Categorical 0 Performance, Categorical	FALSE FALSE FALSE FALSE FALSE FALSE TAUSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE	skilled professional Ladder: unskilled skilled professional Ladder: Unskilled Skilled Professional Ladder: Unskilled Skilled Professional	(unskilled = 0, skilled = 1, professional = 1) NA NA NA NA NA NA NA NA NA NA NA NA NA	"Requires expert design and construction" (Compendium) Similar to a WSP. "Operation and maintenance are possible at low cost, if trained personnel are in charge." (Compendium) Trained personnel is necessary. NA NA NA NA NA NA NA NA NA NA NA NA NA	NA NA N

Construction_parts PDF, Categorical TRUE Simple (simple = 0.8, technical = 0.2, special = 0) Requires expert design, but can be constructed with locally available material. "Simple to constructed with locally available material. "Simple to constructed in operate." (Imhorf Trank SSVM Toolbox) An imhorf tank can be constructed mostly with simple locally available material. However, we assume that some technical parts are required to pump out sludge from the tank. (Kukka ilmanen, Eawag 2021)	Comments 10 * 11.51% removal of :	
Studge Range Effluent Airfoss Soilloss Waterloss	0 * 11.51%	
med(R) 0.11 - 0.85 0 0		Reference {Ghrabi,
k 25	Tellioval of .	2011
TN 0.44 - 0.56 0 0	-	PA
		(Ghrabi, 2011
0.3 - 0.7 0 0	0 * as TN	{Ávila,
med(R) 0.37 0.3-0.44 0.63 0 0	0	2017
k 5 [0.14]		PA
H2O 0.04 - 0.95 0.01 0		PA (adapted
	-	from ABR)
med (R) 0.04 - 0.95 0.01 0	-	PA
TS 0.18 0.078 - 0.273 0.82 0 0		{Mikelonis,
0.24 0.2-0.27 0.75 0 0		2010 {McLean,
0.24 0.2-0.27 0.70 0		2009
0.25 - 0.75 0 0		(Ghrabi, 2011
0.31 0.24 - 0.38 0.69 0 0		{Ávila,
		2017
med(R) 0.25 0.078-0.38 0.75 0 0 5 (3.02)	0 Spuhler et	PA
Additional Information 32.2.1 Data from: [Mikelonis, 2010 #1406]		
Removal [%] (Min. value) Removal [%] (Max. value)		
TSS 20 70 Ratio TSS:TS (from 0.39		
horizontal wetland T5 (from TSS) 7.8 27.3		
15 ((rom 15s)		
Removal [%] (Min. value) Removal [%] (Max. value)		
155 50 70 Ratio TS:TS (from 0.39		
horizontal weetland] 15 (from 155) 19.5 27.3		
32.2.3 Data from: (Ghrabi, 2011 #1408)		
Removal [%]		
TSS 63.3		
TSS 63.3 Ratio TSS:TS (from 0.39		
TSS 63.3		
TSS 63.3 Ratio TSS:T3 (from 0.39 horizontal wetland TS (from TSS) 24.687 32.24 Data from: (Ávila, 2017 #1409)		
TSS 63.3 Ratio TSS:TS (from 0.39 horizontal wetland) 75 (from TSS) 24.687 32.2.4 Data from: [Ávila, 2017 #1409) Removal [M] [Min. value) Removal [M] [Max. value)		
TSS 63.3		
TSS 63.3 Ratio TSS:TS (from 0.39 horizontal wetland) TS (from TSS) 24.687		
TSS 63.3 Ratio TSS:TS (from 0.39 horizontal welland) 24.687 TS (from TSS) 24.687 32.24 Data from: (Avila, 2017 #1.409) Removal [K] (Min. value) Removal [K] (Max. value) TS (from TSS) 61 97 Ratio TSS:TS (from 0.39 37.83 TS (from TS) Data from: (Avila, 2017 #1.409) Iffluent Imflort Effluent Imflort Tank Removal [K] Average Removal [K]		
TSS 6.3.		
TSS 63.3 Ratio TSS:TS (from 0.39 horizontal welland) 24.687 TS (from TSS) 24.687 32.24 Data from: (Avila, 2017 #1.409) Removal [K] (Min. value) Removal [K] (Max. value) TS (from TSS) 61 97 Ratio TSS:TS (from 0.39 37.83 TS (from TS) Data from: (Avila, 2017 #1.409) Iffluent Imflort Effluent Imflort Tank Removal [K] Average Removal [K]		
TSS 63.3 Ratio TSSTS (from 0.39 horizontal wetland 15 (from TSS) 24.687 32.24 Data from: (Ávila, 2017 #1409) Removal [½] (Max. value) TSS 61 97 Ratio TSSTS (from 0.39 TS (from TSS) 23.79 37.83 32.25 Data from: (Ávila, 2017 #1409) Effluent imhoff Tank Removal [½] Average Removal [½] TN (Period III) 66 46 23.333333 TN (Period III) 66 46 23.333333 TN (Period III) 76 50 34.210568		
TSS 63.3 Ratio TSS:TS (from 0.39	zrland.	

Anaerobic Baffled Reactor							
General Information FUNCTIONAL GROUP	Values T	Data Source					
UNIQUE IDENTIFIER (ID) DATA COMPILER	abr	-					
	blackwater, transportedblackwater,	Spuhler, D. & Roller, L. (2020)					
OUTPUT PRODUCT	greywater, transportedgreywater effluent, transportedeffluent, sludge,	Spuhler, D. & Roller, L. (2020)					
RELATIONS	transportedsludge Input: OR	Spuhler, D. & Roller, L. (2020)					
	Output: AND						
COMMENTS	Malana	Data Carres	•				
Pre-Filter Criteria applicability_level	Values (household = 0.5, neighbourhood = 1,	Tilley, E. et al. (2014)					
management level	city = 0) (household = 0.5, shared = 1, public = 1)	Tilley, E. et al. (2014)					
capex_req_level opex_req_level	6	Spuhler, D. et al. (2021) Spuhler, D. et al. (2021)					
technical_maturity		Tilley, E. et al. (2014)					
	development/recovery = 1)	Gensch, R. et al. (2018)					
Screening Criteria water_supply	Type and Function Performance, Categorical		house	NA	Data Source / Assumptions NA	Internal Review Done? NA	
			yard public				
water_volume	Performance, Trapez	FAI SE	none [L/cap/day]	NA .	NA .	NA .	
electricity_supply			electricity	(electricity = 1, intermittent = 0.75, no electricity = 0.5)	"No electrical energy is required" (Compendium) "The main operation and maintenance costs are	yes	
			no electricity	electricity = 0.5)	related to the removal of primary sludge and the		
					cost of electricity if pumps are required for discharge (in the absence of a gravity flow option)." (Emersan)		
					Technology can work without electricity and it would only be required for the desludging of the ABR with a		
					fixed pump. (A vacuum truck for emptying the ABR would be an alternative option without electricity). It		
					is assumed that an installed pump using electricity		
					do perform slightly better than the gravity-driven emptying or the one with a vacuum truck. If electric		
					pumps are used, 'intermittent electricity' can work a bit better than 'no electricity', since one can choose		
					to only empty when electricity is available.		
fuel_supply	Performance, Categorical	FALSE	fuel	NA .	NA .	NA .	
frequency_of_om	PDF, Categorical		no fuel irregular		"Scum and sludge levels need to be monitored to	ves	
rrequericy_or_om	rur, categorical		regular	= 0)	ensure that the tank is functioning well. Process	,	
			continuous		operation in general is not required, and maintenance is limited to the removal of		
					accumulated sludge and scum every 1 to 3 years.", "ABR tanks should be checked from time to time to		
					ensure that they are watertight." (Compendium) Maintenance has to be done regularly but not very		
pipe_supply	Performance, Categorical	TRUE	no pipes	(no pipes = 0.5, difficultly available =	often. Inlet and outlet pipes are required (Emersan)	yes	
pipe_supply	renormance, Categorical		difficultly available	(no pipes = 0.5, difficultly available = 0.75, pipes = 1)	muce on a outlet pipes are required (Emersan)	yes	
pump_supply	Performance, Categorical	TRUE	pipes no pumps	(no pumps = 0.75, difficultly available =	"A pump might be required for discharging the	yes	
			difficultly available pumps	0.75, pumps = 1)	treated wastewater where gravity flow is not an option." (Emersan)		
					Pumps can be required for emptying depending on the design (e.g. gravity-driven emptying). It is		
					assumed that building a gravity-driven configuration		
					performs worse than one with pumps.		
concrete_supply	Performance, Categorical	TRUE	no concrete difficultly available	(no concrete = 0.5, difficultly available = 0.75, concrete = 1)	"There are many materials that can be used in the construction of an ABR. Metal, concrete, and plastic	yes	
			concrete		are primarily used depending on the setting." ({Nguyen, 2010 #1377})		
					Concrete is one of the possible materials to		
					construct an ABR. It is assumed to perform a bit better, as it can seal the ABR effectively against the		
					ground and locals have usually experience working with concrete.		
spare_parts	PDF, Categorical	TRUE	simple technical	(simple = 0.7, technical = 0.3, special = 0)	"An ABR can be made of concrete, fibreglass, PVC or plastic, and prefabricated units are available. A	yes	
			special		pump might be required for discharging the treated wastewater where gravity flow is not an option."		
					(Emersan)		
					The ABR is mechanically simple (({Nguyen, 2010 #1377}) and requires only few technical spare parts.		
					If the pump breaks, more technical parts are necessary. Technical spare parts might be needed, if		
0	n	FALSE	n	NA .	it is a pre-fabricated module. NA	NA .	
0	0	FALSE FALSE	0	NA NA	NA	NA NA	
temperature	Performance, Categorical		very cold	(very cold = 0.5, cold = 0.7, temperate =	"ABRs can be installed in every type of climate,	yes	
			cold temperate	1, warm = 1, hot = 1)	although the efficiency is lower in colder climates." (Compendium)		
			warm hot		Assumed to be similar to an Imhoff Tank.		
flooding	Performance, Categorical	TRUE	flooding no flooding	(flooding = 0.9, no flooding = 1)	"The system should have an emergency bypass system to protect against flooding during high water	yes	
					usage." (({Nguyen, 2010 #1377}) "Even though ABRs are designed to be watertight, it		
					is not recommended to construct them inareas with		
					high groundwater tables or where there is frequent flooding. Alternatively prefabricated modules can be		
					placed above ground." (Emersan) Usually, flooding can pose a problem if the ABR is		
					built underground.		
					These values are allotted to all "tank" based		
					technologies. These treatment technologies and their corresponding tanks are built to be water-tight.		
					Additionally, their raised configurations are possible in flood prone areas. The impact of criterion flooding		
					is therefore not considered to be as severe and only a 10% reduction in performance is allotted.		
vehicular_acces	Performance, Categorical	FALSE	no access	NA	(Akanksha Jain)	NA .	
			difficult full				
slope	Performance, Categorical	FALSE	flat	NA	NA .	NA	
soil_type	Performance, Categorical	FALSE	not flat clay	NA	NA .	NA	
			silt sand				
			gravel rock				
groundwater_depth excavation	Performance, Trapez Performance, Categorical		water depth [m]	NA (easy = 1, hard = 0.75)	NA " most commonly installed underground "	NA yes	
excavation	renormance, Categorical		hard	(y - 2, mara = 0.73)	"most commonly installed underground" (Compendium)	yes	
surface_area_onsite	Performance, Trapez	FALSE	[m2/plot]	NA	Excavation might be necessary. NA	NA	
surface_area_offsite	Performance, Trapez	TRUE	m2/pers	(a = 0.15, b = 0.15, c = 999, d = 999)	Expert judgement by Nanchoz Zimmermann		
0		FALSE		NA	(personal communication, April 2021) NA	NA .	
0		FALSE		NA NA	NA NA	NA NA	

0		FALSE		NA	NA	NA	I	
drinking_water_exposure			Close Not close	NA	NA	NA		
0	0	FALSE FALSE	0	NA NA	NA NA	NA NA		
construction_skills	Performance, Categorical	TRUE	Ladder: unskilled skilled professional	(unskilled = 0, skilled = 0, professional = 1)	"Requires expert design and construction" (Compendium) Similar to an Imhoff Tank.	yes		
design_skills	Performance, Categorical	TRUE	Ladder: unskilled skilled	(unskilled = 0, skilled = 0, professional = 1)	"Requires expert design and construction" (Compendium) Similar to an Imhoff Tank.	yes		
om_skills	Performance, Categorical	TRUE	professional Ladder: Unskilled Skilled	(unskilled = 0, skilled = 1, professional = 1	Operation and maintenance includes desludging and	yes		
0	0	FALSE	Professional	NA .	checking for leaks - rather easy.	NA .		
0	0	FALSE FALSE	0	NA	NA	NA	İ	
0 cleansing_method		FALSE		NA NA NA	NA NA	NA NA		
0	0	FALSE	Hard wipers	NA	NA .	NA		
0 lifetime		FALSE		NA (short = 1, medium = 1, long = 1)	NA "Long service life" (Compendium)	NA yes	Ī	
			medium (1-5 years) long (>5 years)		"For the civil works a life expectancy of 25 years is assumed. Pipes and the manhole cover are expected loast for 15 years." (ABR [Griesauer, C. (2014)]. In a study by Griesauer on the CLARA planning tool the expected lifetimes for ABRs were larger than 5 years.			
speed_implement_toilet	PDF, Categorical	FALSE	rapid (< 3 days) moderate (3 days to 2 weeks)	NA	NA	NA		
			slow (> 2 weeks)	(rapid=0, moderate=0.2, slow=0.8)				
speed_implement_treatment	PDF, Categorical	INUE	rapid (few days to a week) moderate (few weeks up to three months) slow (> 3 months)	(rapid=U_, moderate=U_, slow=U.8)	"An ABR can be made of concrete, fibreglass, PVC or plastic, and prefabricated units are available." "Roughly, an ABR for 20 households can take up to several weeks to construct. If reinforced fibre plastic ABR prefabricated modules are used to the required for construction is much less [3-4 days]. Once in operation, three to obs months (up to nine in colder climates) are needed for the biological environment to be occome established and maximum treatment efficiency to be reached. ABRs are thus not appropriate for the acute response phase and are more suitable for the stabilisation and recovery phases as a longer-term solution." To reduce start-up time, the ABR can be inoculated with anaerobic bacteria, e.g. by adding Septic Tank siduge, or cow manue." "Long start up time" (Compendium) Since a long start up time is required, probabilities are mostly allotted to category "slow" (80%) however, some probability is also allotted to moderate category to account for the improvement in speed of implementation as prefab units are available. (Kaknakha Jain)	yes		
scalability	Performance, Categorical		easy difficult	(easy = 1, difficult = 0.3)	"Scale/scalability (level 4 of 5 meaning difficult to scale): Not modular i.e. scale up only possible at design stage" (Abbott), et al. (2013) "ABRs should consist of at least four chambers as per 600 load); more than six chambers are not recommended.", "The hydraulic retention time should not be less than eight hours, and 16–20 hours is a preferred range." (Emersan) "With increasing wastewater volumes, the up-flow area has to be increased accordingly, and the total reactor volume cannot be adjusted by increasing the reactor degth, as this would lead to increased volumes would require very large, shallow tanks, which makes their construction uneconomical" (Cotterer et al., 2009) ABR are designed specifically and it is not recommended to add further chambers or increase the volume size of a chamber. However, new ABRs can be built (e.g., attached to new tollest). These require a new design and complex concrete constructions so that ABRs are assigned a scalability performance of 30%. (Kukka Ilmanen, Eawage 2021)	yes		
construction_parts	PDF, Categorical		simple technical special	(simple = 0.8, technical = 0.2, special = 0)	"An ABR can be made of concrete, fibreglass, PVC or plastic, and prefabricated units are available. A pump might be required for discharging the treated wastewater where gravity flow is not an option." (Emersan) The ABR is mechanically simple and can be constructed mostly with locally available material. However, we assume that some technical parts are required to pump out sludge from the tank. (Kukka illmanen. Ewas 2021)	yes		
	(copied from "Sanitation_Technologies_TC_database_20210622 Sludge	Range	Effluent	Airloss	Soilloss	Waterloss	Comments	Reference
TP	0.31	-	0.69	C	0	0	* TP pathways	Hamader and
	0.45	0.39 - 0.51			0	c	* TP removal, range depends on number of baffles	Javorszky (2014) Koottatep et al. (2018) Nasr et al.
							removal, depends	(2009)
med (R)	0.33	0.3-0.51	0.67				on HRT	-
med (k)	5	[0.21]			-		+ TVAI	PA Hamada
TN	0.32	-	0.68		0	C	* TKN pathways	Hamader and Javorszky (2014)
	0.28	0.15 - 0.41	0.72	c	0	c	* TKN removal, range depends on number of baffles	Koottatep et al. (2018)
	0.29	0.21 - 0.37	0.71	C	0	C	removal, depends on HRT; Ammonia concentrati	Nasr et al. (2009)
							on increases	
med (R)		[0.26]				0		PA
H2O	0.04		0.95	0.01	0	C		PA

med (R)	0.04		0.95	0.01	,	۵		
med (R)	25		0.95	0.01		0		PΔ
TS	0.57		0.43					Hamader Hamader
13	0.57	=	0.43		1			and
								Javorszky
							TC Effluent	
							TS=0.57	()
							estimated	
						,	with ratio	
							from	
							calculations	
							in 25.2.1	
	0.65	0.63 - 0.66	0.35	0)	0	Spuhler et	Koottatep
						i i	al. (2021)	et al. (2018)
	0.58	0.53 - 0.63	0.42	C C	0			Nasr et al.
								(2009)
							69 – 82%;	
							TC_Effluent TS=0.53 -	
							0.63	
							estimated	
							with ratio	
							from	
							calculations	
							in 25.2.1	
med (R)	0.58	0.53 -0.66	0.42	0	o'	0		-
k	25	[0.13]						PA
Additional Information								
25.2.1	Data from: Koottatep et al. (2018)							
	TS	TSS	Ratio TS:TSS removal					
Removal	0.66	0.86	0.77					
	0.65	0.83	0.78					
	0.55	0.71	0.77					
Median			0.77					
Calculation			Ratio = Removal TS / Removal TSS					
Additional Information								
25.2.1	Data from: Koottatep et al. (2018)							
-	TS	TSS	Ratio TS:TSS removal					
Removal	0.66		0.77					
	0.65	0.83	0.78					
	0.55							
Median			0.77					
Calculation								
References								
	S. P. Poumand D. (2019). Compandium of San	tation Tachnologias in Emergancias Gorman W	ASH Natural (GMM) Swice Endoral Institute o	F Aquatic Science and Technology (Fayrag), Glo	obal WASH Cluster (GWC) and Sustainable Sanitation Alliano	(SuSanA)		
		ion systems in developing countries. Socio-Eco			Joan WASTI Cluster (GWC) and Sustainable Sanitation Amano	(Jusana).		
					iss Federal Institute of Aquatic Science and Technology (Eaw	ag) Dühendorf Switzerland		
		urces for appropriateness profiles and transfer of			33 reactor matrice or require science and recimology (caw	og,, outeriori, switchilli.		
					eering and Water Pollution Control, University of Natural Re	ourses and Life Sciences (BOVII)		
		and Wastewater Freatment Technologies. Vien Dic Baffled Reactor Followed by a Duckweed Po			cerning and water Pollution Control, University of Natural Re	ources and tile Stierices (BUKU)		
		ralized wastewater treatment system in the tro			stralia in Fohruary			
				astewater Treatment & Recycling in Perth, Au	stralla, ili rebruary.			
		ATS) and sanitation in developing countries." B		leaster Bellef: Technology Comment Co. 1 =	Anna Outra Halland National High Commission Co. C.	(UNUCR) The UNID-6		
				isaster nelief: recnnology comparison Study."	Arup, Oxfam, United Nations High Commissioner for Refug	ees (UNTICR), The UN Ketugee Agency.		
		CLARA simplified planningtool:(water sources,						
		ater treatment process using the anaerobic ba						
Tilley, E., Ulrich, L., Lüthi, C., Reyr	mond, P., & Zurbrügg, C. (2014). Compendium o	of Sanitation Systems and Technologies—2nd rev	rised edition . Swiss Federal Institute of Aquation	Science and Technology (EAWAG).				

Upflow Anaerobic Sludge Blad General Information	nket Reactor Values	Data Source					
FUNCTIONAL GROUP	Т	-					
UNIQUE IDENTIFIER (ID) DATA COMPILER		-	1				
INPUT PRODUCT	blackwater,	Tilley, E. et al. (2014)					
	transportedblackwater, sludge, transportedsludge,						
	transportedtransferred_sludge,						
OUTDUT DRODUCT	pithumus, transportedpithumus	T'll 5 ! (2014)					
OUTPUT PRODUCT	effluent, transportedeffluent, processed_sludge,	Tilley, E. et al. (2014)					
	transportedprocessed_sludge,						
RELATIONS	biogas, transportedbiogas	Tilley, E. et al. (2014)					
RELATIONS	Output: AND	Tilley, E. et al. (2014)					
COMMENTS Pre-Filter Criteria	Values	Data Source					
	(household = 0, neighbourhood =	Tilley, E. et al. (2014)					
management level	0.5, city = 1) (household = 0, shared = 0, public	Tilley, E. et al. (2014)					
	= 1)						
capex_req_level opex_req_level		Spuhler, D. et al. (2021) Spuhler, D. et al. (2021)					
technical_maturity		Tilley, E. et al. (2014)					
development_phase	(acute = 0, stabilisation = 0,	"Long start-up time" (Tilley, E. et					
	development/recovery = 1)	al. (2014)) Rather unsuitable for acute and					
		stabilisation emergency phases,					
		complex operation, expensive					
		equipment required. (Akanksha Jain)					
Screening Criteria	Type and Function	Applicable for this Functional	Categories [Unit]	Technology Values (Data)	Data Source / Assumptions	Internal Review Done?	
water_supply	Performance, Categorical	Group? FALSE	house	NA	NA	NA	
·			yard				
			public none				
water_volume	Performance, Trapez	FALSE	[L/cap/day]	NA	NA	NA	
electricity_supply	Performance, Categorical		electricity	(electricity = 1, intermittent = 0.5,	"A constant source of electricity is	yes	
			intermittent no electricity	no electricity = 0)	required" (Compendium) "Power supply interruptions have		
			,		minimal effect" (NaWaTech		
final and of	Performance, Categorical	EALSE	fuel	NA	Compendium) NA	NA	
fuel_supply			no fuel	DO.	130	130	
frequency_of_om	PDF, Categorical	TRUE	irregular	(irregular = 0, regular = 1,		yes	
			regular continuous	continuous = 0)	monitoring and infrequent desludging. (Compendium)		
					Regular O&M required.		
pipe_supply	Performance, Categorical	TRUE	no pipes difficultly available	(no pipes = 0.75, difficultly	"Critical elements for the design of UASB reactors are the influent distribution	yes	
			pipes	available = 0.75, pipes = 1)	system, the gas-solids separator, and		
					the effluent withdrawal design."		
					(Compendium) Inlet and outlets pipes are not specifically required as other		
					inlet and outlet systems can be created,		
					but pipes might be useful before the		
					inlet and after the outlet systems.		
pump_supply	Performance, Categorical	TRUE	no pumps			yes	
			difficultly available pumps	= 0.5, pumps = 1)	up the UASB, a pump is required.		
concrete_supply	Performance, Categorical	TRUE	no concrete	(no concrete = 0, difficultly	"Commonly used construction material	yes	
			difficultly available	available = 0.5, concrete = 1)	is Reinforced Cement Concrete." (SSWM		
			concrete		Toolbox) Assuming concrete is used to build the reactor		
spare_parts	PDF, Categorical	TRUE	simple	(simple = 0.2, technical = 0.4,	"Not all parts and materials may be	yes	
			technical special	special = 0.4)	locally available ", "Critical elements for the design of UASB reactors are the		
			special		influent distribution system, the gas-		
					solids separator, and the effluent		
					withdrawal design. The gas that rises to the top is collected in a gas collection		
					dome and can be used as energy		
					(biogas)." (Compendium)		
					Technical as well as some specially manufacture spare parts for the		
					influent, effluent and gas systems are		
0	0	FALSE	() NA	required. NA	NA	
0	C	FALSE	(NA NA	NA	NA	
0 temperature		FALSE TRUF	very cold	NA (very cold = 0.5, cold = 0.7,	NA Assumed to be similar to an Imhoff Tank.	NA ves	
temperature	r errormance, Categorica		cold	(very coid = 0.5, coid = 0.7, temperate = 1, warm = 1, hot = 1)	, assumed to be similar to all illinoir (ank.	,	
			temperate				
			warm hot				
flooding	Performance, Categorical	TRUE	flooding	(flooding=0.9, no flooding=1)		yes	
			no flooding		based technologies. These treatment technologies and their corresponding		
					tanks are built to be water-tight.		
					Additionally, their raised configurations		
					are possible in flood prone areas. The impact of criterion flooding is therefore		
					not considered to be as severe and only		
					a 10% reduction in performance is allotted. (Akanksha Jain)		
vehicular_acces	Performance, Categorical		no access difficult	NA	NA	NA	
			full				
slope	Performance, Categorical	FALSE	flat	NA	NA	NA	
soil_type	Performance, Categorical	FALSE	not flat clay	NA	NA	NA	
	.,		silt				
			sand gravel				
			rock	<u> </u>			
groundwater_depth			water depth [m]	NA (easy = 1, hard = 0.75)		NA ves	
	renormance, Categorical	INGE	easy	(easy = 1, hard = 0.75)		yes	
excavation			hard		necessary.		
surface_area_onsite		FALSE	[m2/plot]	NA		NA	

surface_area_offsite	Performance, Trapez	TRUE	m2/pers	(a = 0.03, b = 0.03, c = 999, d = 999)	Requires at least 0.03 m2/cap.				
					From Table 1.3 (Dotro et al. 2017)				
0		FALSE FALSE		NA NA	NA NA	NA NA			
0	0	FALSE	0	NA	NA	NA			
drinking_water_exposure	Performance, Categorical	FALSE	Close Not close	NA	NA	NA			
0		FALSE FALSE		NA NA	NA NA	NA NA			
construction_skills			Ladder:	(unskilled = 0, skilled = 0,	"Requires expert design and	yes			
			unskilled skilled professional	professional = 1)	construction" (Compendium) High construction and design skills.				
design_skills	Performance, Categorical	TRUE	Ladder: unskilled skilled	(unskilled = 0, skilled = 0, professional = 1)	"Requires expert design and construction" (Compendium) High construction and design skills.	yes			
om_skills	Performance, Categorical	TRUE	professional Ladder:	(unskilled = 0, skilled = 0.5,	"The UASB is a Centralized Treatment	yes			
			Unskilled Skilled Professional	professional = 1)	technology that must be operated and maintained by professionals." (Compendium) High O&M skills required.				
0		FALSE FALSE		NA NA	NA NA	NA NA			
0	0	FALSE	0	NA	NA	NA			
0 cleansing_method	Performance, Categorical	FALSE FALSE	Washers	NA NA	NA NA	NA NA			
0		FALSE	Soft wipers Hard wipers	NA	NA	NA			
0	0	FALSE	0	NA	NA	NA			
lifetime	Performance, Categorical		short (< 1 year) medium (1-5 years) long (>5 years)	(short = 1, medium = 1, long = 1)	"Life time of pipes, the 3-phase separator, the inlet distribution system and the steel gratings and steps is assumed to be 10 y. [] The reactors are expected to have a life time of 25 years." (UASB Griesauer, C. (2014) In a study by Griesauer on the CLARA planning tool the expected lifetimes for UASBs were larger than 5 years.	yes			
speed_implement_toilet	PDF, Categorical	FALSE	rapid (< 3 days) moderate (3 days to 2 weeks)	NA	NA	NA			
	885 6	TOUE	slow (> 2 weeks)	frankling and the Colored	Name at a transfer of the same at				
speed_implement_treatment	PDF, Categorical	TRUE	rapid (few days to a week) moderate (few weeks up to three	(rapid=0, moderate=0, slow=1)	"Long start-up time", "A UASB is not appropriate for small or rural	yes			
			months) slow (> 3 months)		communities without a constant water supply or electricity. The technology is relatively simple to design and build, but				
					developing the granulated sludge may take several months" (Compendium) Long start up time and no prefab				
					structure, implementation can only be done corresponding to the timeframe of "slow" category. (Akanksha Jain)				
scalability	Performance, Categorical	TRUE	easy	(easy = 1, difficult = 0.5)	"Scale/scalability (level 2 of 5 meaning	yes			
			difficult		easy to scale): More settlement tanks and filters could be added in sets of three in parallel" (Upflow Filters Abbott, J. et al. (2019)) A UASB can be scaled up by building new units.				
construction_parts	PDF, Categorical	TRUE	simple	(simple = 0.2, technical = 0.4,	"Not all parts and materials may be	yes			
			technical special	special = 0.4)	locally available ", "Critical elements for the design of UASR reactors are the influent distribution system, the gassolids separator, and the effluent withdrawal design. The gas that rises to the top is collected in a gas collection dome and can be used as energy (biogas)." (Compendium) The UASR requires technical as well as some specially manufactured parts for the influent, effluent and gas systems.				
Transfer Coefficients	(copied from "Sanitation_Technologies_TC_database Processed Sludge	2_20210622.xlsm") Range	Secondary Effluent	Biogas	Airloss	Soilloss	Waterloss	Comments/Spe	Reference
TP			0.1		C	n	n	cifications * as TP	{Tian, 2015
	0.98	0.97 - 0.99				0	0	* as TP from	#1423} {Jędrzejewsk
								dairy wastewater - with steel elements	a-Cicińska, 2010 #1425}
	0.714	0.577 - 0.851	0.286	C	C	0	0	* as TP from dairy	{Jędrzejewsk a-Cicińska,
								wastewater- without steel,	2010 #1425}
	4.00	0.577 - 0.99		0			0	see 35.2.2	
med (R)	0.90	[0.413]							PA
TN			0.26		C	0	0	* as TN (annamox)	{Tian, 2015 #1423}
	0.7		0.3	O	C	0	0	* greater than	{Yokota, 2018 #1424}
	0.87		0.13	d	C	0	0	* as TN, without recirculation	t {Tang, 2010 #1426}
	0.82	-	0.18	o d	C	0	0	* as TN, without recirculation	t {Tang, 2010 #1426}
	0.79		0.21	C	C	0	0	* as TN, without recirculation	t {Tang, 2010 #1426}
	0.87		0.13	O	C	0	0	* as TN, without recirculation	t {Tang, 2010 #1426}
	0.84		0.16	C	C	0	0	* as TN, without recirculation	t {Tang, 2010 #1426}
	0.83		0.17	C	c	0	0	* as TN, without recirculation	
	0.6		0.37	0.03	C	0	0	adapted from	PA
med (R)	0.82	0.7 - 0.87	0.18	0.03	C	0		biogas_settler)	-

bal.	0.8	-	0.17	0.03	0	0	0	-
k	25	[0.17]						PA (see SBR)
H2O	0.93		0.02	0	0.05	0	0 See SBR	PA
med (R)	0.93		0.02	0	0.05		0	
mes (it)	5.55		-	:	0.03	:		PA
TS			0.65	0	0	0	0 * from 35.2	
	0.36		0.64	0	0	0	0 * from 35.2	1 {Musa, 2019
	0.37		0.63	0	0	0	0 * from 35.2	
	0.22	-	0.78	0	0	0	0 * from 35.2	
	0.17	-	0.83	0	0	0	0 * from 35.2	
	0.17	-	0.83	0	0	0	0 * from 35.2	
		-	-	0.5		-	* at least 50 of the dry matter con	al. (2013) ent
							is converter methane (C and carbon dioxide (CO	14)
		-	0.08	-	-	-	* see calculations 28.2.1; TSS: 0.13 (estimation	
	•	-	0.19	-	-	-	 * as TS reduction in wastewater 	Erni et al. (2011)
		-	-	0.4	-	-	*Organic matter combustior 90%; TS assumption	
	0.41	-	-	-	-	-	- * balances remainders adapted fro biogas_sett	
med (R)	0.35		0.65	0.45	0	0	0	-
bal.	0.2	-	0.5	0.3	0	0	0	-
k	25	[0.2]						PA
Additional Information								
	Data from: {Musa, 2019 #1422}							
Ratio TSS:TS (from								
horizontal_wetland)	0.39	0.39	0.39	0.39	0.39	0.39		
TS (from TSS)	35.1	35.88	37.05	21.84	17.16	16.77		
	Data from: {Jędrzejewska-Cicińska, 20			'		-		
	Min. Removal [%]	Max. Removal [%]						
Removal with steel	0.97							
Removal without steel								
(minimum - divided by 1.164) Removal without steel	0.833333333	0.850515464	:					
(maximum -divided by 1.681)	0.577037478	0.588935158						
Removal range without steel								
	n a UASB reactor packed with steel eler	ments was higher by 16.4–68.1% than	:					
Poforoncos	ii a ozob reactor packed with steer eler	ments was nigher by 10.4-08.1% tridit						

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ServerInformation Value Detail Source FUNCTIONAL GROUP T Server	a							
The content of the	Biogas Reactor General Information	Values	Data Source	Biogas Reactor				
March Marc								
March Marc			-					
Company Comp			Spuhler, D. & Roller, L. (2020)					
March Marc	OUTDUT DOOD: : ***		Souther D. & Pollor I. (2020)					
March Marc	OUTPUT PRODUCT		opunier, υ. & κοller, L. (2020)					
Comparison Com		transportedbiogas						
Company Comp	RELATIONS		Spuhler, D. & Roller, L. (2020)					
March Marc								
Agriculture Agriculture			Data Source					
Appendix March M								
Appendix March M	management level	(household = 1 shared = 1 public = 1)	Tilley F et al (2014)					
Description Company	capex_req_level	6						
### A Proposed Company of the Compan	opex_req_level	4						
Processing Section Company Com								
		development/recovery = 1)	appropriate for treating household					
Prince P								
Part Part								
March Control Contro								
Company Comp								
March Marc	Screening Criteria	Type and Function	Applicable for this Functional Group?	Categories [Unit]	Technology Values (Data)		Internal Review Done?	
March Marc	water_supply	Performance, Categorical	FALSE		NA	NA	NA	
Mate								
Machine Processor Processo				none				ļ
Manuscript Telegrand College T								
Market, of Primarize, Congress (No.) Tell Congress	electricity_supply	renormance, Categorical	- INOL				,	
Total Continues (Continues Continues				no electricity				ļ
PRESCRIPTION OF THE PROPERTY O	fuel_supply	Performance, Categorical	FALSE		NA .	NA	NA	
Households with the second control of the se	frequency_of_om	PDF, Categorical	TRUE	irregular	(irregular = 0, regular = 1, continuous = 0)			İ
PRP_1000 Performance_Congress NLE Services and services a				regular		be shredded and mixed with water or		
PROCESSES AND STATES A				continuous				
Information, Categorical Biol Company of the Compan						so that corrosion and leaks are		
PARA, MARIN Preferences, Categorial (TRL Open 2) Prefe								
PROF. Services, Categories (R.U.) Performance, Categories (R.								
### Print manual, Casagonial Tribut parting, 14906 Print manual, Casagonial Tribut #### Print manual, Casagonial Tribut ###################################						Regular maintenance required.		ļ
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Concrete_Lapper Performance_Categorian TRUE Incomplete Concrete_Lapper Concre	pump_supply	renormance, categorical	IRGE			No pumps required.	yes	
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power_parts POT. Categories (TOU.) Indige can be a compared to the ca	concrete_supply	Performance, Categorical	TRUE			"Biogas reactors can be brick-	yes	
The part of the pa						tanks" (Compendium)		
sections of the section of the secti								
Compression Compression C	spare_parts	PDF, Categorical	TRUE		(simple = 0.2, technical = 0.6, special = 0.2)		yes	
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waterpoor convent sold time (for sailed), we water page and filters, water page and filters, water page and filters, water page and filters, water water and page and								
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fronting support will be necessary to spice support will be necessary to spice support will be necessary to spice support will be necessary to spice support will be necessary to spice support will be necessary. Special super parts might be necessary, Special super parts might be necessary. Special super parts might be necess						reinforced fibre plastic modules, and		
Technical gaine parts with the necessary to ripotate page, whose, etc. if it was built in the processor or the processor page to rising the temperature of the prediction with might be interesting to the prediction of the predict								
replace piece, where, soci, left was built books, board support any through the project piece and the professional piece piece and piece piece and piece piece piece and piece								
on the performance of the perfor						replace pipes, valves, etc, if it was built		
Special spare parts might be required for the predistricated solutions. O O O PLASE O INA NA NA NA NA NA NA NA NA NA NA NA NA N								
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matter conversion into biogas becomes very low." (Emerana) "Biogas plants that produce gas from excrete add not function will noted temperature either because the amount of the temperature either because the amount of the temperature either because the amount of the temperature either because the amount of the temperature in the plant will drop below 5°C, fletabanc, 2019 #14002) Performance decreases from 15°C to lower temperatures. flooding Performance, Categorical TRUE flooding flood				temperate		"Biogas Reactors are less appropriate for		
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the plant will drop below \$5°C" (Leblanc, 2019 #1402] Performance decreases from 15°C to lower temperatures. flooding Performance, Categorical TRUE flooding flood								
2019 #1402 Performance decreases from 15° C to lower temperatures. Teven though Blogas Reactors are watertight, it is not recommended to construct them in areas with high groundwater tables or where there is frequent flooding." (Emersian) 18 (Ignas reactors and brick-constructed domes or prefabricated tanks, installed above or below ground" (Ignesian) old library, a=0,b=0,c=6,d=12 days per year > strongly affected. These values are allotted to all "tank" based technologies. These treatment technologies and their corresponding tanks are built to be water-tight. Additionally, their raised configurations are possible in flood prone areas. The impact of retrieon flooding is therefore not considered to be as severe and only a 10% reduction in performance is allotted. (Akanisha Jain)						the plant will drop below 5°C." {Leblanc.		
Sower temperatures. Source though Biggs Reactors are waterlight, it is not recommended to construct them in areas with high groundwater tables or where there is frequent flooding. (Emersan) "Biogas reactors can be brick-constructed domes or prefabricated tanks, installed above or below ground" (Emersan) old library: and, bn-Q, c-5, d-12 days per year - strongly affected These values are allotted to all "tank" based technologies. These treatment technologies and their corresponding tanks are built to be water-tight. Additionally, their raised configurations are possible in flood prome areas. The impact of criterion flooding is therefore not considered to be as severe and only a 10% reduction in performance is allotted. (Akanisha Jain) vehicular_acces Performance, Categorical FALSE no access NA NA NA NA						2019 #1402}		
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are possible in flood prone areas. The impact of criterion flooding is therefore not considered to be as severe and only a 10% reduction in performance is allotted. (Akanksha Jain) vehicular_acces Performance, Categorical FALSE no access NA NA NA NA						Additionally, their raised configurations		
not considered to be as severe and only a 10% reduction in performance is allotted. (Akanksha Jain) vehicular_acces Performance, Categorical FALSE no access NA NA NA NA						are possible in flood prone areas. The		
vehicular_acces Performance, Categorical FALSE no access NA NA NA NA								
vehicular_acces Performance, Categorical FALSE no access NA NA NA						10% reduction in performance is allotted.		
difficult full	vehicular_acces	Performance, Categorical	FALSE		NA	NA	NA	
1 108 1 1				difficult				
	1	1		1	1	1		1

slope soil_type	Performance, Categorical					
soil_type	renormance, categorical	FALSE	flat not flat	NA	NA	NA
	Performance, Categorical	FALSE	clay	NA	NA	NA
			silt			
			sand gravel			
			rock			
groundwater_depth	Performance, Trapez		water depth [m]	NA		NA
excavation	Performance, Categorical	TRUE	easy	(easy = 1, hard = 0.75)	"Biogas reactors can be brick-	
			hard		constructed domes or prefabricated tanks, installed above or below ground"	
					(Emersan)	
					Depending on the design (above or	
					below ground), excavation might be	
	Desferred Trans	FALCE	[m2/plot]	NA	necessary. NA	NA
surface_area_onsite	Performance, Trapez	PALSE	[mz/piot]	NA .	INA	INA
surface_area_offsite	Performance, Trapez	TRUE	m2/pers	(a = 0.4, b = 0.4, c = 999, d = 999)	About 1.2 - 1.6 m3/cap are needed for a	
					biogas reactor. Assuming a depth of max.	
					3m of smaller reactors (Eawag, 2021), we define a minimum space requirement	
					of 0.4 m2/cap.	
					"Requires minimum space of of 1.5m x	
					6m for digester" (BCG, 2014)	
					The number of users is assumed to be a minimum of 5 households upto	
					commercial use.	
0		FALSE				NA
0		FALSE				NA
0 drinking_water_exposure	Performance, Categorical	FALSE FALSE	Close	NA NA	NA NA	NA NA
as_water_exposure	remormatice, categorical		Not close		1	
0		FALSE	(NA NA		NA
0		FALSE		NA		NA
construction_skills	Performance, Categorical	TRUE	Ladder: unskilled	(unskilled = 0, skilled = 0.5, professional = 1)	"Requires expert design and skilled	yes
			skilled		construction" (Compendium)	
			professional			
design_skills	Performance, Categorical	TRUE	Ladder:	(unskilled = 0, skilled = 0, professional = 1)		yes
			unskilled skilled		construction" (Compendium)	
			professional			
om_skills	Performance, Categorical	TRUE	Ladder:	(unskilled = 0, skilled = 1, professional = 1)		yes
			Unskilled		still carries a risk of infection. Depending	
			Skilled Professional		on its end-use, further treatment might be required. There are also dangers	
			Protessional		associated with the flammable gases	
					that, if mismanaged, could be harmful to	
					human health." (Compendium)	
					"If the reactor is properly designed and	
					built, repairs should be minimal. To start the reactor, it should be inoculated with	
					anaerobic bacteria, e.g., by adding cow	
					dung or Septic Tank sludge. Organic	
					waste used as substrate should be	
					shredded and mixed with water or	
					digestate prior to feeding. Gas equipment should be carefully and regularly cleaned	
					so that corrosion and leaks are	
Į.						
					prevented. Grit and sand that have	
					prevented. Grit and sand that have settled to the bottom should be	
					settled to the bottom should be removed. Depending on the design and	
					settled to the bottom should be removed. Depending on the design and the inputs, the reactor should be emptied	
					settled to the bottom should be removed. Depending on the design and	
					settled to the bottom should be removed. Depending on the design and the inputs, the reactor should be emptied	
0	0	EAI SE		NA.	settled to the bottom should be removed. Depending on the design and the inputs, the reactor should be emptied once every 5 to 10 years." (Compendium)	No.
0 0	0	FALSE FALSE	(NA NA	settled to the bottom should be removed. Depending on the design and the inputs, the reactor should be emptied	NA NA
0	0	FALSE FALSE	(NA NA	settled to the bottom should be removed. Depending on the design and the inputs, the reactor should be emptied once every 5 to 10 years." (Compendium) NA NA NA	NA NA
0 0 0	0 0 0	FALSE FALSE FALSE		NA NA NA	settled to the bottom should be removed. Depending on the design and the inputs, the reactor should be emptied once every 5 to 10 years." (Compendium) NA NA NA NA	NA NA NA
0	0	FALSE FALSE FALSE	((() () () () () () () () ()	NA NA	settled to the bottom should be removed. Depending on the design and the inputs, the reactor should be emptied once every 5 to 10 years." (Compendium) NA NA NA	NA NA
0 0 0	0 0 Performance, Categorical	FALSE FALSE FALSE	Washers Soft wipers Hard wipers	NA NA NA NA	settled to the bottom should be removed. Depending on the design and the inputs, the reactor should be emptied once every 5 to 10 years." (Compendium) NA NA NA NA NA NA NA	NA NA NA NA
0 0 0 cleansing_method	0 0 0 Performance, Categorical	FALSE FALSE FALSE FALSE FALSE	Washers Soft wipers Hard wipers (0	NA NA NA NA	settled to the bottom should be removed. Depending on the design and the inputs, the reactor should be emptied once every 5 to 10 years." (Compendium) NA NA NA NA NA NA NA NA NA	NA NA NA NA
0 0 cleansing_method	0 0 0 Performance, Categorical 0 0	FALSE FALSE FALSE FALSE FALSE FALSE	Washers Soft wipers Hard wipers (NA NA NA NA NA	settled to the bottom should be removed. Depending on the design and the inputs, the reactor should be emptied once every 5 to 10 years." (Compendium) NA NA NA NA NA NA NA NA NA N	NA NA NA NA NA
0 0 0 cleansing_method	0 0 0 Performance, Categorical	FALSE FALSE FALSE FALSE FALSE FALSE	Washers Soft wipers Hard wipers (short (< 1 year)	NA NA NA NA	settled to the bottom should be removed. Depending on the design and the inputs, the reactor should be emptied once every 5 to 10 years." (Compendium) NA NA NA NA NA NA NA NA NA NA NA NA NA	NA NA NA NA
0 0 cleansing_method 0 0	0 0 0 Performance, Categorical 0 0	FALSE FALSE FALSE FALSE FALSE FALSE	Washers Soft wipers Hard wipers (NA NA NA NA NA	settled to the bottom should be removed. Depending on the design and the inputs, the reactor should be emptied once every 5 to 10 years." (Compendium) NA NA NA NA NA NA NA NA NA N	NA NA NA NA NA
0 0 cleansing_method 0 0	0 0 0 Performance, Categorical 0 0	FALSE FALSE FALSE FALSE FALSE FALSE	Washers Soft wipers Hard wipers (short (< 1 year) medium (1-5 years)	NA NA NA NA NA	settled to the bottom should be removed. Depending on the design and the inputs, the reactor should be emptied once every 5 to 10 years." (Compendium) NA NA NA NA NA NA NA NA NA NA NA NA NA	NA NA NA NA NA
0 0 cleansing_method 0 0	0 0 0 Performance, Categorical 0 0	FALSE FALSE FALSE FALSE FALSE FALSE	Washers Soft wipers Hard wipers (short (< 1 year) medium (1-5 years)	NA NA NA NA NA	settled to the bottom should be removed. Depending on the design and the inputs, the reactor should be emptied once every 5 to 10 years." (Compendium) NA NA NA NA NA NA NA NA NA NA NA NA NA	NA NA NA NA NA
0 0 cleansing_method 0 0	0 0 0 Performance, Categorical 0 0	FALSE FALSE FALSE FALSE FALSE FALSE	Washers Soft wipers Hard wipers (short (< 1 year) medium (1-5 years)	NA NA NA NA NA	settled to the bottom should be removed. Depending on the design and the inputs, the reactor should be emptied once every 5 to 10 years." (Compendium) NA NA NA NA NA NA NA NA NA (Compendium) NA NA NA NA (Compendium) NA NA NA NA NA NA NA NA NA NA NA NA NA	NA NA NA NA NA
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0 0 cleansing_method 0 0	0 0 0 Performance, Categorical 0 0	FALSE FALSE FALSE FALSE FALSE FALSE	Washers Soft wipers Hard wipers (short (< 1 year) medium (1-5 years)	NA NA NA NA NA	settled to the bottom should be removed. Depending on the design and the inputs, the reactor should be emptied once every 5 to 10 years." (Compendium) NA NA NA NA NA NA NA NA NA NA NA NA NA	NA NA NA NA NA
0 0 cleansing_method 0 0	0 0 0 Performance, Categorical 0 0	FALSE FALSE FALSE FALSE FALSE FALSE	Washers Soft wipers Hard wipers (short (< 1 year) medium (1-5 years)	NA	settled to the bottom should be removed. Depending on the design and the inputs, the reactor should be emptied once every 5 to 10 years." (Compendium) NA NA NA NA NA NA NA NA NA NA NA NA NA	NA NA NA NA NA
0 0 cleansing_method 0 0	0 0 0 Performance, Categorical 0 0	FALSE FALSE FALSE FALSE FALSE FALSE	Washers Soft wipers Hard wipers (short (< 1 year) medium (1-5 years)	NA	settled to the bottom should be removed. Depending on the design and the inputs, the reactor should be emptied once every 5 to 10 years." (Compendium) NA NA NA NA NA NA NA NA NA NA NA NA NA	NA NA NA NA NA
0 0 cleansing_method 0 0	0 0 0 Performance, Categorical 0 0	FALSE FALSE FALSE FALSE FALSE FALSE	Washers Soft wipers Hard wipers (short (< 1 year) medium (1-5 years)	NA	settled to the bottom should be removed. Depending on the design and the inputs, the reactor should be emptied once every 5 to 10 years." (Compendium) NA NA NA NA NA NA NA NA NA NA NA NA NA	NA NA NA NA NA
0 0 0 cleansing_method 0 0 iffetime	0 0 0 Performance, Categorical 0 Performance, Categorical	FALSE FALSE FALSE FALSE TRUSE FALSE	Washers Soft wipers Hard wipers (short (<1 year) medium (1-5 years) long (>5 years)	NA	settled to the bottom should be removed. Depending on the design and the inputs, the reactor should be emptied once every 5 to 10 years." (Compendium) NA NA NA NA NA NA NA NA NA NA NA NA NA	NA NA NA NA NA Ves
0 0 cleansing_method 0 0	0 0 0 Performance, Categorical 0 0	FALSE FALSE FALSE FALSE TRUSE FALSE	Washers Soft wipers Hard wipers Short (< 1 year) medium (1-5 years) long (>5 years) rapid (< 3 days)	NA	settled to the bottom should be removed. Depending on the design and the inputs, the reactor should be emptied once every 5 to 10 years." (Compendium) NA NA NA NA NA NA NA NA NA NA NA NA NA	NA NA NA NA NA
0 0 0 cleansing_method 0 0 iffetime	0 0 0 Performance, Categorical 0 Performance, Categorical	FALSE FALSE FALSE FALSE TRUSE FALSE	Washers Soft wipers Hard wipers (short (<1 year) medium (1-5 years) long (>5 years) rapid (< 3 days) moderate (3 days) to 2 weeks)	NA	settled to the bottom should be removed. Depending on the design and the inputs, the reactor should be emptied once every 5 to 10 years." (Compendium) NA NA NA NA NA NA NA NA NA NA NA NA NA	NA NA NA NA NA Ves
0 0 0 cleansing_method 0 lifetime speed_implement_toilet	0 0 0 Performance, Categorical 0 Performance, Categorical	FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE	Washers Soft wipers Hard wipers (short (< 1 year) medium (1-5 years) long (>5 years) rapid (< 3 days) moderate (3 days to 2 weeks) slow (> 2 weeks)	NA NA NA NA (short = 1, medium = 1, long = 1)	settled to the bottom should be removed. Depending on the design and the inputs, the reactor should be emptied once every 5 to 10 years." (Compendium) NA NA NA NA NA NA NA NA NA NA NA NA NA	NA NA NA NA NA Ves
0 0 0 cleansing_method 0 0 iffetime	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE	Washers Soft wipers Hard wipers (short (< 1 year) medium (1-5 years) long (>5 years) rapid (< 3 days) moderate (3 days to 2 weeks) show (> 2 weeks) rapid (few days to a week) moderate (few days to a week) moderate (few weeks up to three	NA	settled to the bottom should be removed. Depending on the design and the inputs, the reactor should be emptied once every 5 to 10 years." (Compendium) NA NA NA NA NA NA NA NA NA NA NA NA NA	NA NA NA NA NA NA Yes
0 0 0 cleansing_method 0 lifetime speed_implement_toilet	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE	rapid (< 3 days) moderate (3 days to 2 weeks) slow (> 2 weeks) rapid few days to a week) moderate (3 days to 2 weeks)	NA NA NA NA (short = 1, medium = 1, long = 1)	settled to the bottom should be removed. Depending on the design and the inputs, the reactor should be emptied once every 5 to 10 years." (Compendium) NA NA NA NA NA NA NA NA NA NA NA NA NA	NA NA NA NA NA NA Ves
0 0 0 cleansing_method 0 lifetime speed_implement_toilet	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE	Washers Soft wipers Hard wipers (short (< 1 year) medium (1-5 years) long (>5 years) rapid (< 3 days) moderate (3 days to 2 weeks) show (> 2 weeks) rapid (few days to a week) moderate (few days to a week) moderate (few weeks up to three	NA NA NA NA (short = 1, medium = 1, long = 1)	settled to the bottom should be removed. Depending on the design and the inputs, the reactor should be emptied once every 5 to 10 years." (Compendium) NA NA NA NA NA NA NA NA NA NA NA NA NA	NA NA NA NA NA NA Ves
0 0 0 1 cleansing_method 0 lifetime	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE	rapid (< 3 days) moderate (3 days to 2 weeks) slow (> 2 weeks) rapid few days to a week) moderate (3 days to 2 weeks)	NA NA NA NA (short = 1, medium = 1, long = 1)	settled to the bottom should be removed. Depending on the design and the inputs, the reactor should be emptied once every 5 to 10 years." (Compendium) NA NA NA NA NA NA NA NA NA NA NA NA NA	NA NA NA NA NA NA Ves
0 0 0 cleansing_method 0 lifetime speed_implement_toilet	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE	rapid (< 3 days) moderate (3 days to 2 weeks) slow (> 2 weeks) rapid few days to a week) moderate (3 days to 2 weeks)	NA NA NA NA (short = 1, medium = 1, long = 1)	settled to the bottom should be removed. Depending on the design and the inputs, the reactor should be emptied once every 5 to 10 years." (Compendium) NA NA NA NA NA NA NA NA NA NA NA NA NA	NA NA NA NA NA NA Ves
0 0 0 cleansing_method 0 lifetime speed_implement_toilet	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE	rapid (< 3 days) moderate (3 days to 2 weeks) slow (> 2 weeks) rapid few days to a week) moderate (3 days to 2 weeks)	NA	settled to the bottom should be removed. Depending on the design and the inputs, the reactor should be emptied once every 5 to 10 years." (Compendium) NA NA NA NA NA NA NA NA NA NA NA NA NA	NA N
0 0 0 cleansing_method 0 lifetime speed_implement_toilet	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE	rapid (< 3 days) moderate (3 days to 2 weeks) slow (> 2 weeks) rapid few days to a week) moderate (3 days to 2 weeks)	NA	settled to the bottom should be removed. Depending on the design and the inputs, the reactor should be emptied once every 5 to 10 years." (Compendium) NA NA NA NA NA NA NA NA NA NA NA NA NA	NA NA NA NA NA NA Ves
0 0 0 cleansing_method 0 lifetime speed_implement_toilet	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE	rapid (< 3 days) moderate (3 days to 2 weeks) slow (> 2 weeks) rapid few days to a week) moderate (3 days to 2 weeks)	NA NA NA NA (short = 1, medium = 1, long = 1) NA NA (rapid=0, moderate=0.2, slow=0.8)	settled to the bottom should be removed. Depending on the design and the inputs, the reactor should be emptied once every 5 to 10 years." (Compendium) NA NA NA NA NA NA NA NA NA NA NA NA NA	NA N
0 0 0 cleansing_method 0 lifetime speed_implement_toilet	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE	rapid (< 3 days) moderate (3 days to 2 weeks) slow (> 2 weeks) rapid few days to a week) moderate (3 days to 2 weeks)	NA NA NA NA (short = 1, medium = 1, long = 1) NA NA (rapid=0, moderate=0.2, slow=0.8)	settled to the bottom should be removed. Depending on the design and the inputs, the reactor should be emptied once every 5 to 10 years." (Compendium) NA NA NA NA NA NA NA NA NA NA NA NA NA	NA N
0 0 0 cleansing_method 0 lifetime speed_implement_toilet	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE	rapid (< 3 days) moderate (3 days to 2 weeks) slow (> 2 weeks) rapid few days to a week) moderate (3 days to 2 weeks)	NA NA NA NA (short = 1, medium = 1, long = 1) NA NA (rapid=0, moderate=0.2, slow=0.8)	settled to the bottom should be removed. Depending on the design and the inputs, the reactor should be emptied once every 5 to 10 years." (Compendium) NA NA NA NA NA NA NA NA NA NA NA NA NA	NA NA NA NA NA NA Yes
0 0 0 cleansing_method 0 lifetime speed_implement_toilet	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE	rapid (< 3 days) moderate (3 days to 2 weeks) slow (> 2 weeks) rapid few days to a week) moderate (3 days to 2 weeks)	NA NA NA (short = 1, medium = 1, long = 1) NA NA (rapid=0, moderate=0.2, slow=0.8)	settled to the bottom should be removed. Depending on the design and the inputs, the reactor should be emptied once every 5 to 10 years." (Compendium) NA NA NA NA NA NA NA NA NA NA NA NA NA	NA NA NA NA NA NA Yes
0 0 0 cleansing_method 0 lifetime speed_implement_toilet	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE	rapid (< 3 days) moderate (3 days to 2 weeks) slow (> 2 weeks) rapid few days to a week) moderate (3 days to 2 weeks)	NA	settled to the bottom should be removed. Depending on the design and the inputs, the reactor should be emptied once every 5 to 10 years." (Compendium) NA NA NA NA NA NA NA NA NA NA NA NA NA	NA NA NA NA NA NA Yes
0 0 0 1 cleansing_method 0 lifetime	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE	rapid (< 3 days) moderate (3 days to 2 weeks) slow (> 2 weeks) rapid few days to a week) moderate (3 days to 2 weeks)	NA	settled to the bottom should be removed. Depending on the design and the inputs, the reactor should be emptied once every 5 to 10 years." (Compendium) NA NA NA NA NA NA NA NA NA NA NA NA NA	NA N
0 0 0 cleansing_method 0 lifetime speed_implement_toilet	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE	rapid (< 3 days) moderate (3 days to 2 weeks) slow (> 2 weeks) rapid few days to a week) moderate (3 days to 2 weeks)	NA	settled to the bottom should be removed. Depending on the design and the inputs, the reactor should be emptied once every 5 to 10 years." (Compendium) NA NA NA NA NA NA NA NA NA NA NA NA NA	NA NA NA NA NA NA Yes
0 0 0 cleansing_method 0 lifetime speed_implement_toilet	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE	rapid (< 3 days) moderate (3 days to 2 weeks) slow (> 2 weeks) rapid few days to a week) moderate (3 days to 2 weeks)	NA	settled to the bottom should be removed. Depending on the design and the inputs, the reactor should be emptided once every 5 to 10 years." (Compendium) NA NA NA NA NA NA NA NA NA NA NA NA NA	NA NA NA NA NA NA Ves
0 0 0 cleansing_method 0 lifetime speed_implement_toilet	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE	rapid (< 3 days) moderate (3 days to 2 weeks) slow (> 2 weeks) rapid few days to a week) moderate (3 days to 2 weeks)	NA NA NA NA (short = 1, medium = 1, long = 1) NA NA (rapid=0, moderate=0.2, slow=0.8)	settled to the bottom should be removed. Depending on the design and the inputs, the reactor should be emptied once every 5 to 10 years." (Compendium) NA NA NA NA NA NA NA NA NA NA NA NA NA	NA N
0 0 0 cleansing_method 0 lifetime speed_implement_toilet	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE	rapid (< 3 days) moderate (3 days to 2 weeks) slow (> 2 weeks) rapid few days to a week) moderate (3 days to 2 weeks)	NA NA NA NA (short = 1, medium = 1, long = 1) NA NA (rapid=0, moderate=0.2, slow=0.8)	settled to the bottom should be removed. Depending on the design and the inputs, the reactor should be emptied once every 5 to 10 years." (Compendium) NA NA NA NA NA NA NA NA NA NA NA NA NA	NA NA NA NA NA NA Ves
0 0 0 cleansing_method 0 lifetime speed_implement_toilet	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE	rapid (< 3 days) moderate (3 days to 2 weeks) slow (> 2 weeks) rapid few days to a week) moderate (3 days to 2 weeks)	NA NA NA NA (short = 1, medium = 1, long = 1) NA NA (rapid=0, moderate=0.2, slow=0.8)	settled to the bottom should be removed. Depending on the design and the inputs, the reactor should be emptied once every 5 to 10 years." (Compendium) NA NA NA NA NA NA NA NA NA NA NA NA NA	NA NA NA NA NA NA Ves
0 0 0 cleansing_method 0 lifetime speed_implement_toilet	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE	rapid (< 3 days) moderate (3 days to 2 weeks) slow (> 2 weeks) rapid few days to a week) moderate (3 days to 2 weeks)	NA NA NA NA (short = 1, medium = 1, long = 1) NA NA (rapid=0, moderate=0.2, slow=0.8)	settled to the bottom should be removed. Depending on the design and the inputs, the reactor should be emptied once every 5 to 10 years." (Compendium) NA NA NA NA NA NA NA NA NA NA NA NA NA	NA NA NA NA NA NA Ves

scalability construction_parts		TRUE	easy difficult simple technical special	(easy = 1, difficult = 0.3) (simple = 0.3, technical = 0.4, special = 0.3)	"Scale/scalability (level 4 of 5 meaning difficult to scale): Not easily scalable for a decentralised model, Perfabricated digesters come in a variety of sizes but likely maximum 8m² would be efficient for "household" rype scale, otherwise you look to develop a centralised type plant; Size of biogas reactor (digester) need to be aligned with volume of influent i.e. toilet blocks not individual latrine; A 4m3 digester serves a kitchen shared by six families. This would need to be scaled accordingly" (Abbott, J. et al. (2019) building new units. This would need to with the existing spatial distribution of latrines. "A Biogas Reactor can only be upscaled by building new units. This option is limited since new biogas reactors needed to fit with the existing spatial distribution of latrines. "A Biogas Reactor can be made out of bricks, cement, steel, sand, wire for structural strength (e.g. chicken wire), water props can fittings, a valve and a	yes		
					water pipes and intings, a vaive and a prefabricated gas outlet pipe. Prefabricated solutions include geo-bags, reinforced fibre plastic modules, and router moulded units and are available from specialist suppliers." (Emersan) Simple materials, such as concrete, as well as technical parts including pipes, valve, etc. are needed to construct a local blogas reactor. Alternatively, blogas reactors can be specially manufactured and prefabricated.			
Transfer Coefficients	(copied from "Sanitation_Technologies_TC_database_202106	22.xlsm")						
Transfer Coefficients	Biogas		Processed Sludge	Airloss	Soilloss	Waterloss	Comments	Reference
TP		-	1		0	0		Bachmann
								et al. (2015)
med (R)	100	-	100	`	0	0		PA PA
TN			0.97		0	0		PA
med (R)	0.03		0.97		0	0		-
k	100	-	100					PA
H2O	0.01	-	0.99	9	9	0		PA
med (R)	0.01	-	0.99)	0	0		-
k	100		100					PA
TS	0.5	-	0.5		0		* at least	Wellinger,
							50% of the	A. et al.
	0.4	0.25 - 0.5	0.6	1	' °	0	*Organic matter	Rose et al. (2015)
	0.34		0.66			0	паттег	(2015) Minale and
	0.34	1	0.86	1	1			Worku
	0.29	0.25 - 0.33	0.71		0	0	*	Bachmann
							anaerobic	et al. (2015)
med (R)	0.34							-
bal.	0.38		0.62		0	0	Spuhler et	-
		[0.21]						

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Anaerobic Filter							
General Information	Values	Data Source					
FUNCTIONAL GROUP UNIQUE IDENTIFIER (ID)		-					
DATA COMPILER	SaniChoice Project Team	-					
INPUT PRODUCT	blackwater, transportedblackwater, greywater, transportedgreywater,	Tilley, E. et al. (2014)					
OUTPUT PRODUCT	effluent, transportedeffluent, sludge,	Tilley, E. et al. (2014)					
RELATIONS	transportedsludge	Tilley, E. et al. (2014)					
RELATIONS	Output: AND	Tilley, E. et al. (2014)					
COMMENTS							
	Values	Data Source	T				
applicability_level	(household = 0.5, neighbourhood = 1, city = 0)	Tilley, E. et al. (2014)					
	(household = 0.5, shared = 1, public = 1)						
capex_req_level opex_req_level	6	Spuhler, D. et al. (2021) Spuhler, D. et al. (2021)					
technical_maturity	3	Tilley, E. et al. (2014)					
development_phase	(acute = 0.5, stabilisation = 0.5, development/recovery = 1)	Gensch, R. et al. (2018)					
Screening Criteria	Type and Function		Categories [Unit]	Technology Values (Data)	Data Source / Assumptions	Internal Review Done?	
water_supply	Performance, Categorical	FALSE	house	NA	NA	NA	
			yard public				
			none				
water_volume electricity_supply	Performance, Trapez Performance, Categorical		[L/cap/day] electricity	NA (electricity = 1, intermittent = 0.75, no	NA "No electrical energy is required" (Emersan),	NA yes	
			intermittent	electricity = 0.5)	"The main operation and maintenance (O &		
			no electricity		M) costs are related to the removal of primary sludge and the cost of electricity if		
					pumps are required for discharge (in absence		
					of a gravity flow option)." (Emersan)		
					Electricity is required for pumps that backflush or discharge. It is possible to		
					imagine alternative solutions, e.g. a gravity		
					flow option for discharge, though this might		
					perform less well than an installed pump using electricity. If electric pumps are used,		
					'intermittent electricity' can work a bit better		
					than 'no electricity', since one can choose to only empty when electricity is available.		
					, empty when electricity is available.		
fuel_supply	Performance, Categorical	FALSE	fuel	NA	NA	NA	
	-		no fuel				
frequency_of_om	PDF, Categorical	TRUE	irregular regular	(irregular = 0, regular = 0.7, continuous = 0.3)	"Scum and sludge levels need to be monitored to ensure that the tank is		
			continuous	0.3)	functioning well. Over time, solids will clog		
					the pores of the filter. As well, the growing		
					bacterial mass will become too thick, break		
					off and eventually clog pores. When the efficiency decreases, the filter must be		
					cleaned. This is done by running the system		
					in reverse mode (backwashing) or by removing and cleaning the filter material.		
					Anaerobic filter tanks should be checked		
					from time to time to ensure that they are		
					watertight." (Compendium) Regular, almost continuous maintenance is		
					required.		
pipe_supply	Performance, Categorical	TRUE	no pipes	(no pipes = 0.5, difficultly available =	Inlet and outlet pipes are required (Emersan)	yes	
			difficultly available pipes	0.75, pipes = 1)			
pump_supply	Performance, Categorical	TRUE	no pumps	(no pumps = 0.75, difficultly available =	"The main operation and maintenance (O &	yes	
			difficultly available	0.75, pumps = 1)	M) costs are related to the removal of		
			pumps		primary sludge and the cost of electricity if pumps are required for discharge (in absence		
					of a gravity flow option)." (Emersan)		
					Pumps can be required for emptying depending on the design. It is assumed that		
					building a gravity-driven configuration		
					performs worse than one with pumps.		
concrete_supply	Performance, Categorical	TRUE	no concrete	(no concrete = 0.5, difficultly available =	"An AF can be made of concrete, sand,	yes	
			difficultly available	0.75, concrete = 1)	gravel, cement, steel, as well as fibreglass,		
			concrete		PVC or plastic, and thus can be found as a prefabricated solution." (Emersan)		
					Concrete is one of the possible materials to		
					construct an AF. It is assumed to perform a bit better, as it can seal the AF effectively		
					against the ground and locals have usually		
,	DDF C-1 1	TDIJE	simple	(cimple = 1 technical = 0 0'	experience working with concrete.	was	
spare_parts	PDF, Categorical	INOE	simple technical	(simple = 1, technical = 0, special = 0)	"An AF can be made of concrete, sand, gravel, cement, steel, as well as fibreglass,	yes	
			special		PVC or plastic, and thus can be found as a		
					prefabricated solution. Compared to an ABR, additional filter material is necessary, while a		
					pump is not used to empty the sludge.		
					(Emersan) "Filter materials commonly used		
					include gravel, crushed rocks or bricks, cinder, pumice, shredded glass or specially		
					formed plastic pieces (even crushed PVC		
					plastic bottles can be used)." (Emersan) The AF mainly requires a replacement of the		
					filter material, for which different materials		
					are suitable. It is expected that these		
	<u> </u>				materials are locally available.	<u> </u>	
0		FALSE		NA .	NA	NA	
0		FALSE FALSE		NA NA	NA NA	NA NA	
temperature	Performance, Categorical		very cold	(very cold = 0.5, cold = 0.7, temperate =	"Anaerobic filters can be installed in every	yes	
			cold temperate	1, warm = 1, hot = 1)	type of climate, although the efficiency is lower in colder climates. " (Compendium)		
			warm		Similar to an ABR.		
			hot				
flooding	Performance, Categorical	TRUE	flooding no flooding	(flooding = 0.9, no flooding = 1)	"Even though AFs are watertight, it is not recommended to construct them in areas	yes	
					with high groundwater tables or where there		
					is frequent flooding. Alternatively,		
					prefabricated modules can be placed above ground." (Emersan)		
					As the ABR, the anaerobic filter should have		
					an emergency bypass if built underground so		
					no problems with flooding occur. These values are allotted to all "tank" based		
					technologies. These treatment technologies		
					and their corresponding tanks are built to be		
					water-tight. Additionally, their raised configurations are possible in flood prone		
					areas. The impact of criterion flooding is		
					therefore not considered to be as severe and		
					only a 10% reduction in performance is allotted. (Akanksha Jain)		
vehicular_acces	Performance, Categorical	FALSE	no access	NA	NA	NA	
	Í.	I .	difficult	1	[i l	
			full				

slope Performance, Categorical FALSE flat not fl		
Soll_type Performance, Categorical FALSE Clay Sand		
Sand gravel rock Performance, Trapez FALSE Water depth [m] NA NA NA NA NA NA NA N		
groundwater_depth		
groundwater_depth		
exavation Performance, Categorical TRUE easy hard (easy = 1, hard = 0.75) Depending on the configuration, anaerobic filters are built underground and therefore require excavation. Surface_area_onsite Performance, Trapez FALSE [m2/plot] NA NA NA NA NA NA NA NA NA NA NA NA NA		
Surface_area_onsite Performance, Trapez FALSE [m2/plot] NA NA NA NA NA NA NA N		
Surface_area_onsite		
estimated to be around 0.5 m2/person." To account for uncertainties, we assume a minimum space requirement of 0.4 m2/cap here (Eawag, 2021). O		
estimated to be around 0.5 m2/person." To account for uncertainties, we assume a minimum space requirement of 0.4 m2/cap here (Eawag, 2021). O		
minimum space requirement of 0.4 m2/cap here (Eavag, 2021). NA NA NA NA NA NA NA N		
minimum space requirement of 0.4 m2/cap here (Eavag, 2021). NA NA NA NA NA NA NA N		
O O FALSE O NA NA NA NA NA NA NA		
0		
Not close		
O OFALSE ONA NA NA NA CONSTRUCTION_Skills Performance, Categorical TRUE Ladder: (unskilled = 0, skilled = 0, professional = "Requires expert design and construction" (yes unskilled 1) (Compendium)		
construction_skills Performance, Categorical TRUE Ladder: (unskilled = 0, skilled = 0, skilled = 0, professional = "Requires expert design and construction" yes (Compendium)		
skilled Similar to an ABR.		
professional		
design_skills Performance, Categorical TRUE ladder: (unskilled = 0, professional = "Requires expert design and construction" yes (unskilled = 1)		
skilled Similar to an ABR.		
orn_skills Performance, Categorical TRUE ladder: (unskilled = 1, professional = yes		
Unskilled 1)		
Skilled Similar to an ABR, but filter material also has Professional to be cleaned. A little bit more elaborate.		
0 0 FALSE 0 NA NA NA		
0 0 FALSE 0 NA NA NA NA O NA NA NA NA NA NA NA NA NA NA NA NA NA		
0 0 FALSE 0 NA NA NA		
cleansing_method Performance, Categorical FALSE Washers NA NA NA Soft wipers		
Hard wipers		
0 0 FALSE 0 NA NA NA NA O FALSE 0 NA NA NA NA		
lifetime Performance, Categorical TRUE short (<1 year) (short = 1, medium = 1, long = 1) "Long service life" (Compendium) yes		
medium (1-5 years) "An AF requires a start-up period of 6-9 long (>5 years) months to reach full treatment capacity as		
the slow growing anaerobic biomass first		
needs to be established on the filter media." (Emersan)		
The start up period suggests that a short		
lifetime might not be suitable, but this is considered in the circterion "Speed of f		
implementation for treatment".		
speed_implement_tollet PDF, Categorical FALSE rapid (< 3 days) NA NA NA NA moderate (3 days to 2 weeks)		
slow (> 2 weeks)		
speed_implement_treatment PDF, Categorical TRUE rapid (few days to a week) (rapid=0, moderate=0.2, slow=0.8) "An AF can be made of concrete, sand, yes		
moderate (few weeks up to three gravel, cement, steel, as well as fibreglass, months) PVC or plastic, and thus can be found as a		
slow (> 3 months) prefabricated solution." "AFs are not suitable		
for the acute response phase because the biological environment within the AF takes		
time to establish. The AF is more suitable for		
the stabilisation and recovery phases and as a longer-term solution. "Maintenance: An AF		
requires a start-up period of six to nine		
months to reach full treatment capacity as the slow growing anaerobic biomass first		
needs to be established on the filter media.		
To reduce start-up time, the filter can be inoculated with anaerobic bacteria, e.g. by		
spraying Septic Tank sludge onto the filter		
material." (Compendium) Since a long start up time is required,		
probabilities are mostly allotted to category		
"slow" (80%) however, some probability is also allotted to moderate category to		
account for the improvement in speed of		
implementation as prefab units are available. (Akanksha Jain)		
scalability Performance, Categorical TRUE easy (easy = 1, difficult = 0.3) "The hydraulic retention time (HRT) is the yes difficult most important design parameter influencing		
filter performance and a HRT of 12–36 hours		
is recommended." (Emersan) AFs are designed for a specific Hydraulic		
Retention Time and it is not recommended		
to add further chambers or increase the volume size of a chamber. However, new AFs		
can be built (e.g. attached to new toilets).		
These require a new design and complex concrete constructions so that AFs are		
assigned a scalability performance of 30%.		
construction_parts PDF, Categorical TRUE simple (simple = 1, technical = 0, special = 0) "An AF can be made of concrete, sand, yes		
technical gravel, cement, steel, as well as fibreglass,		
special PVC or plastic, and thus can be found as a prefabricated solution. Typical filter material		
should ideally range from 12 to 55 mm in		
diameter. The size of materials decrease from bottom to top. Filter materials		
commonly used include gravel, crushed rocks		
or bricks, cinder, pumice, shredded glass or specially formed plastic pieces (even crushed		
PVC plastic bottles can be used)." (Emersan)		
The material required to construct an AF (concrete, gravel,) is usually locally available.		
(Contacto, grave)/ a usuany usuany usuany availabile.		
Transfer Coefficients (copied from "Sanisticon, Technologies, T.C. database, 2021/08/22 Julin")		
Sludge Range Effluent Airloss Soilloss Waterloss	Comments Re	eference
TP 0.53 0.28-0.78 0.47 0 0		Ceating, 016
med (R) 0.55 0.28-0.78 0.47 0 0	0 -	
k 5 (05) TN 0.15 - 0.85 0 0	- PA 0 * as TN {Co	A Conradin,
		010 #973}
med (R) 0.15 - 0.85 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	- PA	A
H2O 0.04 - 0.99 0.01 0	0 PA	'A
		dapted om ABR)
med (R) 0.06 - 0.95 0.01 0	0 -	
TS 0.15 - 0.85 0 0	- PA 0 * from {Ka	(ang,
	38.2.1 20	003

0.12	2003 (Kang, 2003 (Kang,
0.2	{Kang, 2003 {Kang,
0.23 - 0.77 0 0 0 0 from 8.2.4 med (R) 0.15 0.12-0.23 0.85 0 0 0 0 0 bat 0.18 - 0.82 0 0 0 0 0 points	Kang,
38.24	
bal. 0.18 - 0.82 0 0 5 public	-
k 25 [0.11]	ret -
	PA
Additional Information	
38.2.1 Data from: (Kang, 2003 #1434)	
HRT [d] = 1 Min. Removal [k]	
TSS 39 Ratio TSS:TS (from	
nauro 13.51 (rom horizontal wetland) 0.39	
TS (from TS) 15.21	
38.2.2 Data from: {Kang, 2003 #1434}	
HRT [d] = 0.5 Min. Removal [%]	
TSS 30	
Ratio TSS:TS (from	
horizontal_wetland] 0.39	
TS (from TSS) 11.7	
38.2.3 Data from: (Kang, 2003 #1434)	
HRT d = 2 Min. Removal K	
ISS 52 Ratio TSS:TS (from	
horizontal wetland) 0.39	
TS (from TSS) 20.28	
38.2.4 Data from: (Kang. 2003 #1434)	
HRT [d] = 3 Min. Removal [%]	
TSS 59	
horizontal_wetland) 0.39	
TS (from TSS) 23.01	
References	
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long in .e. an. (2005). Preferenties to simile wastewater using aniestoon inter. Applied inchemistry and discretifiningly 105(1): 117-20. Conradin K, et al. (2010). The SWM Toolbox "from thirty/www.sswm.info.	
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Commencia - Dotale Document							
Sequencing Batch Reactor General Information	Values	Data Source					
FUNCTIONAL GROUP UNIQUE IDENTIFIER (ID)	sbr	-					
DATA COMPILER		- Spuhler, D. & Roller, L. (2020)					
	greywater, transportedgreywater, sludge, transportedsludge, transportedtransferred_sludge	Spanier, D. & Noller, L. (2020)					
OUTPUT PRODUCT	processed_sludge, transportedprocessed_sludge, effluent, transportedeffluent	Spuhler, D. & Roller, L. (2020)					
	Input: OR Output: AND	Spuhler, D. & Roller, L. (2020)					
COMMENTS Pre-Filter Criteria	Values	Data Source					
applicability_level	(household = 0, neighbourhood = 0.5, city = 1)	Adapted from activated sludge, since the Sequencing Batch Reactor (SBR) is a different configuration of the					
management_level	(household = 0, shared = 0, public = 1)	conventional activated sludge systems (from SSWM: https://sswm.info/step- nawatech/module-1-nawatech- basics/appropriate-technologies- 0/sequence-bath-reactor-%28sbr%29). Adapted from activated sludge, since the Sequencing Batch Reactor (SBR) is a Gedifferent configuration of the conventional activated sludge systems (from SSWM: https://sswm.info/step- nawatech/module-1-nawatech- basics/appropriate-technologies- 0/sequence-bath-reactor-%28sbr%29).					
capex_req_level	5	Spuhler, D. et al. (2021)					
opex_req_level technical_maturity	7 3 3 (acute = 0, stabilisation = 0.5,	Spuhler, D. et al. (2021) "The Sequencing Batch Reactor (SBR) process has been successfully applied to more than 1,300 plants in the U.S., Canada, and Europe within the last 25 years." From SSWM: https://sswm.info/step-awatech/module-1-nawatech-basics/appropriate-technologies-0/sequence-batch-reactor-%28sbr%29 Adapted from activated sludge, since the					
	development/recovery = 1)	Sequencing Batch Reactor (SBR) is a different configuration of the conventional activated sludge systems.					
	Type and Function		Categories [Unit]	Technology Values (Data)	Data Source / Assumptions	Internal Review Done?	
water_supply	Performance, Categorical	FALSE	house yard public	NA	NA	NA	
water_volume	Performance, Trapez			NA	NA	NA	
electricity_supply	Performance, Categorical		electricity intermittent no electricity	(electricity = 1, intermittent = 0, no electricity = 0)	"high electricity consumption (pumping and aeration", "requires continous supply of energy" (NaWaTech Compendium)	yes	
					For aeration a constant energy supply is required.		
fuel_supply	Performance, Categorical		fuel no fuel	NA	NA	NA	
frequency_of_om	PDF, Categorical	TRUE	irregular regular continuous	(rregular = 0, regular = 0, continuous = 1)	controls, automatic valves, and automatic switches, these systems may require more maintenance than a conventional activated sludge system." (EPA, 1999 #1385)	yes	
pipe_supply	Performance, Categorical	TRUE	no pipes difficultly available pipes	(no pipes = 0, difficultly available = 0.5, pipes = 1)	More O&M than activated sludge. Inlet and outlet pipes as well as connecting pipes between tanks are required	yes	
pump_supply	Performance, Categorical		no pumps difficultly available pumps	(no pumps = 0, difficultly available = 0.5, pumps = 1)	"Mechanical equipment, such as pumps, aerates and mixers" (NaWaTech Compendium) "Budget level costs include such as the blowers, diffusers, electrically operated valves, mixers, sludge pumps, decanters, and the control panel." (EPA, 1999) #1385) Desludging pumps are necessary.	yes	
concrete_supply	Performance, Categorical	TRUE	no concrete difficultly available concrete	(no concrete = 0, difficultly available = 0.5, concrete = 1)	"The SBR tank is typically constructed with steel or concrete." {EPA, 1999 #1385}	yes	
spare_parts	PDF, Categorical		simple technical special	(simple = 0.2, technical = 0.4, special = 0.4)	"Mechanical equipment, such as pumps, aerates and mixers", "costly mechanical parts", "highly mechanised equipment (control panel" (NaWaTech Compendium) Diffusers, electrically operated valves, mixers, control panels and other parts are necessary (EPA, 1999 #1385).	yes	
0		FALSE FALSE		NA NA	NA NA	NA NA	
0	0	FALSE	0	NA (very cold = 0.5, cold = 0.7, temperate =	NA	NA NA	
temperature	Performance, Categorical	INVE	very cold cold temperate warm	(very cold = 0.5, cold = 0.7, temperate = 1, warm = 1, hot = 1)	Assumed to be similar to an ABR.		
flooding	Performance, Categorical	TRUE	hot flooding	(flooding=0.9, no flooding=1)	Adapted from activated sludge, since the	yes	
			no flooding		Sequencing Batch Reactor (SBR) is a different configuration of the conventional activated sludge systems (from SSWM: https://sswm.info/step-nawatech/module-1-nawatech-basics/appropriate-technologies-Oscquence-batch-reactor-%28sbm/\$29). old library: a=0,b=0,c=6,d=60 days per year >> affected These values are allotted to all "tank" based technologies. These treatment technologies and their corresponding tanks are built to be water-tight. Additionally, their raised configurations are possible in flood prone areas. The impact of criterion flooding is therefore not considered to be as severe and only a 10% reduction in performance is allotted. (Akanksha Jain)		

vehicular_acces	Performance, Categorical	FALSE	no access difficult full	NA	NA	NA
slope	Performance, Categorical	FALSE	flat	NA	NA	NA
			not flat			
soil_type	Performance, Categorical	FALSE	clay	NA	NA	NA
			silt			
			sand			
			gravel rock			
groundwater_depth	Performance, Trapez	FALSE	water depth [m]	NA	NA	NA
excavation	Performance, Categorical	TRUE	easy	(easy = 1, hard = 0.75)	Adapted from activated sludge, since the	
		-	hard	, , , , , , , , , , , , , , , , , , , ,	Sequencing Batch Reactor (SBR) is a	,
					different configuration of the	
					conventional activated sludge systems	
					(from SSWM: https://sswm.info/step-	
					nawatech/module-1-nawatech-	
					basics/appropriate-technologies-	
					O/sequence-batch-reactor-%28sbr%29). As for other treatment technologies, the	
					configuration built underground is mostly	
					more practical because the water does	
					not need additional pumping. However,	
					we assume that it can be also built above	
					ground.	
surface_area_onsite	Performance, Trapez	FALSE	[m2/plot]	NA	NA	NA
surface_area_offsite	Performance, Trapez	TOUE	m2/pers	(a = 0.12, b = 0.12, c = 999, d = 999)	Requires at least 0.12 m2/cap.	
surrace_area_onsite	Performance, Trapez	IRUE	m2/pers	(a = 0.12, b = 0.12, c = 999, d = 999)	Requires at least 0.12 m2/cap.	
					Table 1.3 (Dotro et al. 2017)	
0		FALSE		NA NA	NA	NA
0	0	FALSE	0	NA NA	NA	NA
O deletion water assessment		FALSE		NA NA	NA NA	NA NA
drinking_water_exposure	Performance, Categorical	PALSE	Close Not close	NA	NA	NA
0	0	FALSE		NA .	NA	NA NA
0	0	FALSE		NA .	NA NA	NA NA
construction_skills	Performance, Categorical		Ladder:		Adapted from activated sludge, since the	
			unskilled		Sequencing Batch Reactor (SBR) is a	
			skilled		different configuration of the	
1			professional		conventional activated sludge systems	
					(from SSWM: https://sswm.info/step- nawatech/module-1-nawatech-	
					basics/appropriate-technologies-	
					0/sequence-batch-reactor-%28sbr%29).	
design_skills	Performance, Categorical	TRUE	Ladder:	(unskilled = 0, skilled = 0, professional = 1)	Adapted from activated sludge, since the	
			unskilled		Sequencing Batch Reactor (SBR) is a	
			skilled		different configuration of the	
			professional		conventional activated sludge systems	
					(from SSWM: https://sswm.info/step- nawatech/module-1-nawatech-	
					basics/appropriate-technologies-	
					0/sequence-batch-reactor-%28sbr%29).	
om_skills	Performance, Categorical	TRUE	Ladder:	(unskilled = 0, skilled = 0.5, professional =	Adapted from activated sludge, since the	
_			Unskilled	1)	Sequencing Batch Reactor (SBR) is a	
			Skilled		different configuration of the	
			Professional		conventional activated sludge systems	
					(from SSWM: https://sswm.info/step- nawatech/module-1-nawatech-	
					basics/appropriate-technologies-	
					0/sequence-batch-reactor-%28sbr%29).	
0	0	FALSE	0	NA NA	NA	NA
0		FALSE		NA NA	NA	NA
0	0	FALSE	0	NA	NA	NA
cleansing_method	Performance, Categorical	FALSE	Washers	NA NA	NA NA	NA NA
cleansing_method	r en ormance, categorica	TAESE	Soft wipers	NA.	NA .	NO.
			Hard wipers			
0	0	FALSE		NA NA	NA	NA
0		FALSE		NA NA	NA	NA
lifetime	Performance, Categorical	TRUE	short (< 1 year)	(short = 1, medium = 1, long = 1)	"For the civil works a life expectancy of	yes
			medium (1-5 years)		25 years is assumed. Mechanical and	
			long (>5 years)		electrical components are expected to last for 10 years." [A specific assessment	
					in Ethiopia showed a 25 year lifetime	
					before reinvestment was required.] (SBR	
					Griesauer, C. (2014)).	
1					In a study by Griesauer on the CLARA	
					planning tool the expected lifetimes for	
speed_implement_toilet	PDF, Categorical	EALSE	rapid (< 3 days)	NA	SBRs were larger than 5 years.	NA
speeu_iinpiement_toilet	PDF, Categorical	Inch	moderate (3 days to 2 weeks)	130	NA	ING.
			slow (> 2 weeks)			
speed_implement_treatment	PDF, Categorical	TRUE	rapid (few days to a week)	(rapid=0, moderate=0.5, slow=0.5)	Same as Activated Sludge Technology	yes
			moderate (few weeks up to three		since this is just a variant of the same	
			months)		(Akanksha Jain)	
scalability	Performance, Categorical	TRUE	slow (> 3 months) easy	(easy = 1, difficult = 1)	"For small treatment plants the SBR	yes
scalability	remormance, Categorical		difficult	cosy - 1, unneut - 1)	setup has the advantage of avoiding	,
					redundant system components	
					compared to conventional activated	
					sludge plants and the modular structure	
					allows for a simple upscaling of the	
					treatment plant (DWA, 2009). The possibility to change cycle times provides	
					operational flexibility without requiring	
					any constructive measures (DWA, 2009;	
					WSP, 2007). Hydraulic and organic shock	
					loads can be tolerated well (WSP, 2007),	
					because during the filling stage the SBR	
					tank itself acts as an equalisation basin	
					(US-EPA, 1999)." (Griesauer, C., (2014)) "Resistant against shock-loads and	
					applicable for a large range of organic	
					and hydraulic loading rates." (NaWaTech	
					Compendium)	
					A SBR is able to deal with higher levels of	
					organic and hydraulic loading rates and	
					therefore a small to medium increase in	
					the number of users. To scale up the operation cycle times can be adapted.	
					For larger upscaling an additional reactor	
					could be constructed. (Kukka Ilmanen,	
A Company of the Comp	İ	İ	İ	1	= 2021	1

construction_parts	PDF, Categorical PDF, Categorical		simple technical special		"Mechanical equipment, such as pumps, aerators and mixers", "costly mechanical parts", "highly mechanised equipment (control panel)" (NaWaTech Compendium) Diffusers, electrically operated valves, mixers, control panels and other parts are necessary (EPA, 1999 #1385). An SBR requires a lot of technical parts. Additionally, we assume that the controlling system might require even some parts from special manufacturers. (Kukka Ilmanen, Eawag 2021)	yes		
	Processed Sludge	Range	Effluent	Airloss	Soilloss			Reference
ТР	0.88	-	0.12	. 0	C		* pathways for PO4-P	and
								Javorszky (2014)
	0.74	-	0.26	0	C		* see calculations	Wilderer et al. (2000)
	0.73	0.44 - 0.98	0.27	0	0		in 26.2.1	Bernal-
							TC_effluent given (=1 - PO4-P	Martínez et al. (2000)
							removal)	
							see calculations	
med (R)	0.74		0.26	0	C	0	in 26.2.2	-
k TN	0.22	[0.54]	0.14	0.64		-	* pathways	PA Hamader
	0.22		0.24	0.04			for TN	and
								Javorszky (2014)
	0.26	-	0.06	0.68	C		* Effluent TC: see	Wilderer et al. (2000)
							calculations in 26.2.1;	
							other values	
							estimated based on	
							removal	
							distribution ratio in	
	0.23		0.19	0.58	C	0		Bernal-
							TC_effluent given (=1 -	Martínez et al. (2000)
							NH4-N	(2000)
							removal) see	
							calculations in 26.2.2;	
							other values	
							estimated	
							based on removal	
							distribution ration in	
	0.25		0.05	0.7	0		26.2.5 * Aerobic	Lochmatter
							granular sludge	et al. (2014)
							SBR;	
							TC_TN pathways	
	0.29	0.27 - 0.3	0.1	0.61	O		given *	Xylem
							continuous influent	(2015)
							SBR,	
							calculations see 26.2.4	
med (R) bal.	0.25 0.24		0.10 0.12					-
k H2O	0.02		0.93	0.05		- 0		PA PA
med (R)	0.02	0 - 0.05	0.93	0.05	C	0	Spuhler et al. (2021)	-
k	25							PA
TS	0.64	-	0.36	0	C		TSS to	Hamader and
							sludge: 0.82; TS	Javorszky (2014)
							estimated from ratio	
	0.75		0.25	. 0	Ö		in 26.2.6 * TSS to	Keller et al.
	0.73		0.23	U	·		sludge:	(2001)
							0.95; TS estimated	
							from ratio in 26.2.6	
	0.78							Zhu et al. (2006)
med (R)	0.75 25			0	0	0		PA PA
		(0.14)						
	Data from: Wilderer et al. (2000)							
	TN [mg/L] Influent	Effluent		Effluent	TC_Effluent TN	TP		
Min Ave	25	44320 44328	5 44418	0.6	0.18	0.12 0.26		
Max	87		17	44320	0.23	0.26		
TC Median 26.2.2	Data from: Bernal-Martínez et al. (2000)			l	0.2	0.26		
Sludge Age days	PO4-P removal [%] 0.53	NH4- N removal [%]						
6	0.44 0.95	0.48						
23	0.98	0.94						
Mean 26.2.3	Data from: Keller et al. (2001)	0.81]				
TSS	Influent [mg/L]	Effluent [mg/L]	TC_effluent 0.05	-				
TN	54		0.11					
TP	35247	0.1/	0.02 TC_Effluent= Content Effluent / Content					
Calculation 26.2.4	Data from: Xylem (2015)		Influent					
	0h		6h 0.055	Average 0.1				
TC_TN to effluent TC_TN to sludge	0.3	0.27	0.29	0.29				
TC_TN to Gas 26.2.5	0.53	0.65	0.66	0.61				
				_				1

Ratio TC_Sludge: TC_Airloss			
(for TN pathway estimations)			
Data Source	TC_Sludge	TC_Airloss	
Hamader and Javorszky (2014)	0.22	0.64	
Lochmatter et al. (2014)	0.25	0.7	
Xylem (2015)	0.29	0.61	
Mean	0.25	0.65	
Removal Distribution (%)	0.28	0.72	
26.2.6	Data from: Zhu et al. (2006)		
TS removal [%]	TSS removal [%]	Ratio	
0.782	0.995	0.786	
Calculation		Ratio= TS Removal/ TSS removal	

References
Gensch, R., Jennings, A., Rengell, S., & Reymond, P. (2018). Compendium of Sanitation Technologies in Emergencies . German WASH Network (GWN), Swiss Federal Institute of Aquatic Science and Technology (Eawag), Global WASH Cluster (GWC) and Sustainable Sanitation Alliance (SuSanA).

Loetscher, T., & Reller, J. (2002). A decision support system for selecting sanitation systems in developing countries. Socio-Eerom. Department Sanitation, Wax Water and Solid Waxer an

Tilley, E., Ulrich, L., Lüthi, C., Reymond, P., & Zurbrügg, C. (2014). Compendium of Sanitation Systems and Technologies—2nd revised edition. Swiss Federal Institute of Aquatic Science and Technology (EAWAG).

	Values	Data Source	1			
FUNCTIONAL GROUP UNIQUE IDENTIFIER (ID)	wsp	-				
DATA COMPILER INPUT PRODUCT	Julian Fritzsche transportedblackwater,	- Spuhler, D. & Roller, L. (2020)	-			
OUTPUT PRODUCT	transportedgreywater,	Spuhler, D. & Roller, L. (2020)	-			
	transportedsecondary_effluent					
RELATIONS	Input: OR Output: AND	Spuhler, D. & Roller, L. (2020)				
COMMENTS Pro Eilter Criteria		Data Source	1			
Pre-Filter Criteria applicability_level	Values (household = 0, neighbourhood = 0.5,	Tilley, E. et al. (2014)				
management_level	city = 1 (household = 0, shared = 0.5, public = 1)	Tilley, E. et al. (2014)	-			
capex_req_level opex_req_level	7	Spuhler, D. et al. (2021) Spuhler, D. et al. (2021)				
technical_maturity	3	Tilley, E. et al. (2014)				
development_phase	(acute = 0, stabilisation = 1, development/recovery = 1)	Gensch, R. et al. (2018)				
creening Criteria water supply	Type and Function Performance, Categorical	Applicable for this Functional Group?	Categories [Unit]	Technology Values (Data)	Data Source / Assumptions NA	Internal Review Done? NA
			yard			
			public none			
water volume electricity_supply	Performance, Trapez Performance, Categorical	FALSE TRUE	[L/cap/day] electricity	NA (electricity = 1, intermittent = 1, no	NA "No electrical energy is required" (Compendium/Emersan)	NA yes
			intermittent no electricity	electricity = 1)		
fuel_supply	Performance, Categorical	FALSE	fuel	NA	NA .	NA
frequency_of_om	PDF, Categorical	TRUE	no fuel irregular	(irregular = 0, regular = 1, continuous = 0)	"Scum that builds up on the pond surface should be regularly removed.	yes
			regular continuous		Aquatic plants (macrophytes) that are present in the pond should also be removed as they may provide a breeding habitat for mosquitoes and	
			Continuous		prevent light from penetrating the water column." (Compendium)	
					Regular maintenance is required.	
pipe_supply	Performance, Categorical	TRUE	no pipes difficultly available	(no pipes = 0.5, difficultly available = 0.75, pipes = 1)	Inlet and outlet pipes (Emersan)	yes
program area 1	Performance, Categorical	TRUE	pipes	(no pumps = 1, difficultly available = 1,	"No electrical energy is required", "natural wind mixing" (Emersan)	was
pump_supply	renormance, categorical		no pumps difficultly available	pumps = 1)	"Sludge can be removed using a raftmounted sludge pump, a	yes
			pumps		mechanical scraper at the bottom of the pond or by draining and dewatering the pond and removing the sludge with a front-end loader."	
					(Emersan) No pumps are needed. Sludge pumps can though be used to remove the	
					sludge. There are two other options for desludging without pumps	
					(mechanical sccraper, draining&dewatering) that are assumed to perform equally well.	
concrete_supply	Performance, Categorical	TRUE	no concrete difficultly available	(no concrete = 1, difficultly available = 1, concrete = 1)	"To prevent leaching into the groundwater, the ponds should have a liner. The liner can be made from clay, asphalt, compacted earth, or any	yes
			concrete		other impervious material." (Compendium)	
					Technology should be watertight, but the liner does not appear to be made from concrete. No concrete required.	
spare_parts	PDF, Categorical	TRUE	simple technical	(simple = 0.6, technical = 0.4, special = 0)	"To prevent leaching into groundwater, the ponds should have a liner, which can be made from clay, asphalt, compacted earth, or any other	yes
			special		impervious material.", "Facultative ponds' [] efficiency may be	
					improved with the installation of mechanical aerators.", "Sludge can be removed using a raftmounted sludge pump, a mechanical scraper at the	
					bottom of the pond or by draining and dewatering the pond and removing the sludge with a front-end loader." (Emersan)	
					Only local low tech material is required, however further aerations,	
					scrapers and pumps can be added that might need technical spare parts.	
0	0	FALSE FALSE	0	NA NA	NA NA	NA NA
0 temperature		FALSE		NA (very cold = 0.5, cold = 0.7, temperate =	NA "In the psychrophilic temperature region, digestion becomes slower	NA yes
comperature	. c.romance, categorical	-	cold	1, warm = 1, hot = 1)	when temperatures decrease below 15°C, but never stops."	
			temperate warm	1	The temperature can even be as low as -45° (G. E. ALEXIOU* AND D. D.	
			Wdffff		MARA (2003))	
			hot		MARA (2003)) It is assumed there's no change in performance for higher temperatures	
flooding	Performance, Categorical	TRUE	hot	(flooding = 0.6, no flooding = 1)	It is assumed there's no change in performance for higher temperatures "The pond system must be protected from general flooding, for ponds,	yes
flooding	Performance, Categorical	TRUE	hot	(flooding = 0.6, no flooding = 1)	It is assumed there's no change in performance for higher temperatures The pond system must be protected from general flooding, for ponds, inlet and outlet devices, and other features can be damaged or destroyed by floodwaters and accompanying debris. Floodwaters	yes
flooding	Performance, Categorical	TRUE	hot	(flooding = 0.6, no flooding = 1)	It is assumed there's no change in performance for higher temperatures "The pond system must be protected from general flooding, for ponds, inlet and outlet devices, and other features can be damaged or detroyed by floodwaters and accompanying debris. Floodwaters containing large amounts of sediments may, through deposition and	yes
flooding	Performance, Categorical	TRUE	hot	(flooding = 0.6, no flooding = 1)	It is assumed there's no change in performance for higher temperatures The pond system must be protected from general flooding, for ponds, inlet and outlet devices, and other features can be damaged or destroyed by floodwaters and accompanying debris. Floodwaters containing large amounts of sediments may, through deposition and erosion, completely destroy an inadequately protected waste stabilization pond." (WHO, 1987)	yes
flooding	Performance, Categorical	TRUE	hot	(flooding = 0.6, no flooding = 1)	It is assumed there's no change in performance for higher temperatures "The pond system must be protected from general flooding, for ponds, inlet and outlet devices, and other features can be damaged or destroyed by floodwaters and accompanying debris. Floodwaters containing large amounts of sediments may, through deposition and erosion, completely destroy an inadequately protected waste stabilization pond. ("WINU, 1987) "It should be verified whether the land is floodable and the maximum flood levels, for definition of the height of the	haz
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0	C	FALSE	0	NA .	NA .	NA		
cleansing_method	Performance, Categorica	FALSE	Washers Soft wipers	NA	NA	NA		
			Hard wipers					
0	0	FALSE FALSE		NA NA	NA NA	NA NA	-	
lifetime	Performance, Categorica		short (< 1 year) medium (1-5 years)	(short = 1, medium = 1, long = 1)	"WSPs are not suitable for the acute response phase due to the long implementation time needed and are more appropriate for the	yes		
			long (>5 years)		stabilisation and recovery phases and as a longer-term solution." (Emersan)			
					The fact that WSPs are not suitable for short lifetimes due to the long implementation time is not considered in the criterion 'Lifetime' and			
					instead part of the criterion 'Speed of Implementation'. (Kukka Ilmanen,			
					Eawag 2021) "Life time of the pump, pipes and of baffle walls is assumed to be 10 y.			
					[] The ponds are expected to have a life time of 25 years."			
					[Assessments in Ethiopia expect 20 years lifetime for most parts and the civil works associated with the pond may serve up to 40 years.] (WSP			
					Griesauer, C. (2014) In a study by Griesauer on the CLARA planning tool the expected			
					lifetimes for WSPs were larger than 5 years.			
speed_implement_toilet	PDF, Categorica	I FALSE	rapid (< 3 days) moderate (3 days to 2 weeks) slow (> 2 weeks)	NA	NA .	NA		
speed_implement_treatment	PDF, Categorica	TRUE	rapid (few days to a week)	(rapid=0, moderate=0, slow=1)	"WSPs are not suitable for the acute response phase due to the long	yes	1	
			moderate (few weeks up to three months)		implementation time needed and are more appropriate for the stabilisation and recovery phases and as a longer-term solution."			
			slow (> 3 months)		(Compendium)			
					Long start up time (anaerobic pond) and no prefab structure, implementation can only be done corresponding to the timeframe of "slow" category. (Akanksha Jain)			
scalability	Performance, Categorica	TRUE	easy difficult	(easy = 1, difficult = 0.3)	"Scale/scalability (of anaerobic lagoon is level 5 of 5 meaning difficult to scale): Centralised treatment process, scale up possible by adding new	yes		
			difficult		treatment units (e.g. anaerobic lagoons) in parallel; [] Smaller sized			
					anaerobic lagoons could be constructed according to context but the minimum scale is still a 'centralised system'; A key advantage of the			
					anaerobic lagoons is that the 1.5 year solids residence time provides			
					sufficient time to build phase 2 treatment and finish the treatment train over a period in which all waste is contained" (Abbott, J. et al. (2019))			l
					A case study on anaerobic lagoons in Cox Bazaar showed that they are			l
					very difficult to scale. These lagoons represent the first anaerobic pond in a Waste Stabilisation Pond System and WSPs are therefore very			l
					difficult to scale. It is possible to scale up the technology by adding			l
					further anaerobic, facultative and maturations ponds and using them in parallel. However, due to their size these can be difficult to excavate and			
					construct. (Kukka Ilmanen, Eawag 2021)			
construction_parts	PDF, Categorica	TRUE	simple technical	(simple = 0.6, technical = 0.4, special = 0)	"Mechanical equipment is necessary to dig ponds. To prevent leaching into groundwater, the ponds should have a liner, which can be made	yes		
			special		from clay, asphalt, compacted earth, or any other impervious material.",			
					"Facultative ponds' [] efficiency may be improved with the installation of mechanical aerators.", "Sludge can be removed using a raftmounted			
					sludge pump, a mechanical scraper at the bottom of the pond or by			
					draining and dewatering the pond and removing the sludge with a front- end loader." (Emersan)			
					Mechanical equipment required for digging and constructing the WSP.			
					Aerators, scrapers, pumps can be added to the design, which require technical parts.			
Transfer Coefficients	(copied from "Sanitation_Technologies_TC_database_20210s Sludge	622.xism*) Range	Secondary Effluent	Airloss	Soilloss	Waterloss	Comments/	/ Reference
TP	0.56	6 -	0.44	Alloss	0	0 (* TP	Hamader
	0.33	7 0.32 - 0.41	0.63		0	0 (pathways	and Xian-Hua
med (R)	0.56		0.44					(1994)
bal.		7	0.53		0	0 0		-
k TN	0.24	5 [0.24]	0.28	0.4:	-		* TN	PA Hamader
						1	pathways	and
	0.2	2	0.2	0.1	6	0	* TN removal	Conradin et al. (2010)
	0.22	2	0.33	0.4	5	0	* N	Ho et al.
	0.25	-	0.24	0.5	1	0	* Ammonia	(2017) Soares et
med (R)	0.24	4 0.2-0.25	0.28	0.4	8	0	removal	al. (1996)
bal.	0.24		0.26			0		-
k H2O	0.05	[0.05]	0.9	0.0	5		*PA	PA
med (R)			- 0.90	0.0	5	0		-
k TS	0.43		0.59		-		Spuhler et	PA Hamader
						1	removal:	and
	0.35	5	0.68	3	0	0	*TSS removal	Conradin et al. (2010)
	0.45	5	0.55	5	0	0	* TS	Alcocer et
med (R)	0.43	3 0.35 -0.45	i 0.59)	0	0 (removal	al. (1993) -
mea (K)	0.42							
bal.	0.42	2 -	0.58		0	0 (- DA
		2 -			-	D (PA

Additional Information			
29.2.1	Data from: Alcocer et al. (1993)		
	Removal Efficiency	TC_Effluent	Ratio TS:TSS removal
TS	0.45	0.55	
TSS	0.6	0.4	0.75
TDS	0.43	0.57	
Calculation		TC_Effluent = 1- Removal efficiency	Ratio= Removal TS / Removal TSS
29.2.2	Data from:Hamader and Javorszky (2014)		
	TC Sludge	TC Effluent	TC Airloss
Removal	0.24	0.28	0.48
Removal Distribution		67%	
	Removal to sludge= TC_Sludge / (TC_Sludge		Removal to airloss= TC_Airloss / (TC_Sludge
Calculation	+ TC_Airloss)		+ TC_Airloss)

References

Gensch, R., Jennings, A., Renggil, S., & Reymond, P. (2018). Compendium of Sonitation Technologies in Emergencies. German WASH Network (GWN), Swiss Federal Institute of Aqualic Science and Technology (Eawag), Global WASH Cluster (GWC) and Sustainable Sanitation Alliance (SuSanA). Loestsher, T., & Reller, J. (2002). A decision support system for selecting sanitation systems in developing countries. Scole-Comomic Planning Sciences, 36 (4), 267–250. https://doi.org/10.1016/S0038-0121(0)00007-1 Systems (Compensation of the Science and Technology). Report Science and Technology. Spainer, D., de Monta Lungshi, J. (2002). Sanitation technology. Bronzy: Details and data sources for appropriateness profiles and transfer coefficients. Eawag. Swiss Federal Institute of Aqualic Science and Technology. Harmander, K. and N. Humander, K.

	ted Wetland					
	Values	Data Source				
UNIQUE IDENTIFIER (ID)	free-water_wetland	-				
DATA COMPILER	Julian Fritzsche effluent, transportedeffluent, greywater,	- Tilley, E. et al. (2014)				
1	transportedgreywater, stormwater,	, =				
	transportedstormwater secondary_effluent,	Tilley, E. et al. (2014)				
RELATIONS	transportedsecondary_effluent	Tilley, E. et al. (2014)				
	Output: AND	, =				
COMMENTS			<u> </u>			
e-Filter Criteria	Values	Data Source				
	(household = 0.5, neighbourhood = 1, city = 1)					
management_level capex_req_level	(household = 0.5, shared = 1, public = 1)	Tilley, E. et al. (2014) Spuhler, D. et al. (2021)				
opex_req_level	3	Spuhler, D. et al. (2021)				
technical_maturity development phase	(acute = 0, stabilisation = 0.5,	Tilley, E. et al. (2014) Assumption the same values apply for free-				
	development/recovery = 1)	water wetlands. (Gensch, R. et al. (2018))				
eening Criteria	Type and Function	Applicable for this Functional Group?	Categories [Unit]	Technology Values (Data)	Data Source / Assumptions	Internal Review Done?
water_supply	Performance, Categorical	FALSE	house yard	NA	NA	NA
			public			
water_volume	Performance, Trapez	FALSE	none [L/cap/day]	NA .	NA	NA
electricity_supply			electricity	(electricity = 1, intermittent = 1, no	"No electrical energy is required"	yes
			intermittent no electricity	electricity = 1)	(Compendium)	
fuel_supply	Performance, Categorical	FALSE	fuel no fuel	NA	NA	NA
frequency_of_om	PDF, Categorical	TRUE	irregular	(irregular = 0, regular = 1, continuous = 0)	"Regular maintenance should ensure that	yes
			regular continuous		water is not short-circuiting, or backing up because of fallen branches, garbage, or	
					beaver dams blocking the wetland outlet.	
					Vegetation may have to be periodically cut back or thinned out." (Compendium)	
					Regular maintenance.	
pipe_supply	Performance, Categorical	TRUE	no pipes	(no pipes = 0.5, difficultly available = 0.75,	"Wastewater can be fed into the wetland,	yes
,			difficultly available pipes	pipes = 1)	using weirs or by drilling holes in a distribution pipe, to allow it to enter at	
			pipes		evenly spaced intervals."	
					Inlet and outlet pipes for effluent required. (Compendium)	
pump_supply	Performance, Categorical	TRUE	no pumps	(no pumps = 1, difficultly available = 1,	No pumps required.	yes
			difficultly available pumps	pumps = 1)		
concrete_supply	Performance, Categorical	TRUE	no concrete	(no concrete = 1, difficultly available = 1,	"The channel or basin is lined with an	yes
			difficultly available concrete	concrete = 1)	impermeable barrier (clay or geo-textile) covered with rocks, gravel and soil and	
					planted with native vegetation (e.g.,	
					cattails, reeds and/or rushes)." (Compendium)	
					Technology should be watertight, but the	
					liner does not appear to be made from concrete. No concrete required.	
spare_parts	PDF, Categorical	TRUE	simple	(simple = 1, technical = 0, special = 0)	"Can be built and repaired with locally	yes
			technical special		available materials" (Compendium) No technical or special parts are required.	
0		FALSE		NA	NA	NA
0	0	FALSE	0	NA	NA	NA
0 temperature		FALSE	0 very cold	NA (very cold = 0.5, cold = 0.7, temperate = 1,	NA "This technology is best suited for warm	NA yes
temperature	r en ormance, categorical		cold	warm = 1, hot = 1)	climates, but can be designed to tolerate	,
			temperate warm		some freezing and periods of low biological activity." (Compendium)	
			hot		Assumed to be comparable to a WSP.	
flooding	Performance, Categorical	TRUE	flooding no flooding	(flooding = 0.6, no flooding = 1)	Assumed to be comparable to a WSP. "Constructed wetlands are also used as a	yes
					flood protection measure." (Stefanakis,	
					2019)	
					This is a technology that is necessarily built on the ground surface and its raised	
					configuration is not possible. (e.g., all pond-	
		1			based, wetlands, drying beds etc.). Note: All pond-based/wetland/drying bed	
		1			technologies are allotted similar	
					performance values. Their functioning can be severely disrupted by flooding events.	
		1			However, it is possible that they can be	
					protected from flooding by building embankments or mounds of adequate	
					height around them. Since a flood-	
					preventive configuration of the technology is possible, it is allotted a performance of	
					50%. Process wise, flooding or entry of surface run-off can be considered to be	
					more critical for drying beds than ponds	
					and wetlands, therefore technologies of the latter two type are awarded a slightly	
					higher performance of 60% (Akanksha Jain)	
vehicular_acces	Performance, Categorical	FALSE	no access	NA	NA	NA .
			difficult			
slope	Performance, Categorical	FALSE	flat	NA	NA	NA .
			not flat	NA .	NA .	NA .
soil_type	Performance, Categorical	IODE	silt	INO.	INO.	INO.
			sand gravel			
			rock			
groundwater_depth excavation	Performance, Trapez Performance, Categorical	FALSE TRUE	water depth [m] easy	NA (easy = 1, hard = 0.5)	NA Assuming that shallow and wide excavation	NA yes
			hard		is necessary.	
surface_area_onsite	Performance, Trapez	FALSE	[m2/plot]	NA	NA	NA
surface_area_offsite	Performance, Trapez	TRUE	m2/pers	(a = 3, b = 3, c = 999, d = 999)	The same value as for the horizontal flow	
					wetland is applied here, as both "require a large land area" (Compendium) and	
l I					differences in terms of space requirements	
	1				are expected to be insignificant due to the similar nature of the technologies (Eawag,	
				1		i l
_	-	EALCE	_	NA	2021).	NA.
0	0	FALSE FALSE	0	NA NA	NA NA	NA NA
0	0	FALSE FALSE	0	NA NA	NA NA NA	NA NA
0	0 0 Performance, Categorical	FALSE FALSE	0 0 Close Not close	NA	NA NA NA NA	NA

							_
0 construction_skills	0 Performance, Categorical	TRUE	Ladder:	NA (unskilled = 0, skilled = 0.5, professional = 1)	NA "Requires expert design and construction"	yes NA	+
			unskilled skilled		(Compendium) See WSP.		
			professional				
design_skills	Performance, Categorical	TRUE	Ladder: unskilled	(unskilled = 0, skilled = 0, professional = 1)	"Requires expert design and construction" (Compendium)	yes	
			skilled		See WSP.		
and abilla	Desferons Cotton del	TRUE	professional	(contilled Of stilled 4 confessions 4)			
om_skills	Performance, Categorical	IRUE	Ladder: Unskilled	(unskilled = 0.5, skilled = 1, professional = 1)		yes	
			Skilled		O&M includes declogging and eventual		
0	0	FALSE	Professional C	NA .	cutting back of vegetation (Compendium). NA	NA	
0		FALSE		NA	NA	NA	
0		FALSE FALSE		NA NA	NA NA	NA NA	
cleansing_method	Performance, Categorical	FALSE	Washers	NA	NA	NA	
			Soft wipers Hard wipers				
0		FALSE		NA	NA	NA	
0 lifetime	Performance, Categorical	FALSE TRUE	short (< 1 year)	NA (short = 1, medium = 1, long = 1)	NA "Long service life" (Emersan)	NA yes	_
			medium (1-5 years)		A long service life similar to the horizonal		
			long (>5 years)		subsurface flow constructed wetland is assumed. (Kukka Ilmanen, Eawag 2021)		
speed_implement_toilet	PDF, Categorical	FALSE	rapid (< 3 days)	NA	NA	NA	
			moderate (3 days to 2 weeks) slow (> 2 weeks)				
speed_implement_treatment	PDF, Categorical	TRUE	rapid (few days to a week)	(rapid=0, moderate=0, slow=1)	"In principle, Constructed Wetlands can be	yes	
			moderate (few weeks up to three months) slow (> 3 months)		built using locally available material, however, availability of sand and gravel		
			Slow (2.5 mondis)		(with required grain size distribution and		
					cleanliness) is often a problem. Additional		
					materials include a liner or clay, wetland plants, and a syphon or pump for		
					intermittent loading. They are typically not		
					suit able for pre-fabrication." "Wetland		
					plants take time to become established, therefore the start-up time for Constructed		
					Wetlands is quite long. Thus this		
					technology is not suitable for the acute response phase but for the stabilisation		
					and recovery periods and as a longer-term		
					solution." (Emersan Compendium)		
					Long start up time and no prefab structure, implementation can only be done		
					corresponding to the timeframe of "slow"		
					category. (Akanksha Jain)		
scalability	Performance, Categorical	TRUE	easy	(easy = 1, difficult = 0.3)	It is assumed that new wetland beds can be	ves	
			difficult	(555)	added though it requires a long start-up	,	
					time. Similar scalability as for vertical		
construction_parts	PDF, Categorical	TRUE	simple	(simple = 1, technical = 0, special = 0)	wetlands is assumed. "Can be built and repaired with locally	yes	
_			technical		available materials" (Compendium)		
Transfer Coefficients	[copied from "Sanitation_Technologies_TC_database_20210622.	xism")	special				
Transfer Coefficients	Secondary Effluent	xism") Range	Soilloss	Airloss	Waterloss	Comments	Reference
Transfer Coefficients TP		T				Comments * as TP removal efficiency	{Vymazal,
	Secondary Effluent	Range -	Soilloss	g o			{Vymazal, 2007 #103} {Vymazal,
	Secondary Effluent 0.512 0.66	Range -		0		* as TP removal efficiency * as TP removal efficiency	{Vymazal, 2007 #103} {Vymazal, 2010 #1436}
	0.512 0.66 0.51	Range -	5.0illoss 0.488 0.488 0.34	0	C	* as TP removal efficiency * as TP removal efficiency * as TP removal efficiency	{Vymazal, 2007 #103} {Vymazal, 2010 #1436} {Vymazal, 2010 #1436}
	Secondary Effluent 0.512 0.66	Range -		0	C	* as TP removal efficiency * as TP removal efficiency	{Vymazal, 2007 #103} {Vymazal, 2010 #1436} {Vymazal, 2010 #1436} {Vymazal,
	Secondary Effluent 0.512 0.666 0.551 0.65	Range	Soilless 0.488 0.488 0.34 0.45 0.45 0.45 0.45	0	c c	* as TP removal efficiency * as TP removal efficiency * as TP removal efficiency * as TP removal efficiency	{Vymazal, 2007 #103} {Vymazal, 2010 #1436} {Vymazal, 2010 #1436} {Vymazal, 2010 #1436}
TP	Secondary Effluent 0.512 0.66 0.51 0.65 0.55 0.55 0.55 0.55 0.55 0.55 0.55	Range	Soilless 0.488 0.348 0.34 0.45 0.45 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.5 0.		c c	* as TP removal efficiency * as TP removal efficiency * as TP removal efficiency	{Vymazal, 2007 #103} {Vymazal, 2010 #1436} {Vymazal, 2010 #1436} {Vymazal,
	Secondary Effluent 0.512	Range	0.485 0.485 0.485 0.345 0.35 0.35 0.55 0.55 0.48		c c	* as TP removal efficiency * as TP removal efficiency * as TP removal efficiency * as TP removal efficiency	{Vymazal, 2007 #103} {Vymazal, 2010 #1436} {Vymazal, 2010 #1436} {Vymazal, 2010 #1436} {Vymazal,
TP med [R]	Secondary Effluent 0.512 0.66 0.51 0.65 0.55 0.55 0.55 0.55 0.55 0.55 0.55	Range	0.485 0.485 0.485 0.345 0.35 0.35 0.55 0.55 0.48		c c	* as TP removal efficiency * as TP removal efficiency * as TP removal efficiency * as TP removal efficiency	{Vymazal, 2007 #103} (Vymazal, 2010 #1436} (Vymazal, 2010 #1436} (Vymazal, 2010 #1436} (Vymazal, 2010 #1436} (Vymazal, 2010 #1436} - PA
TP med (R)	Secondary Effluent 0.512 0.66 0.51 0.65 0.51 0.65 0.55 0.55	Range	Soilloss 0.488 0.34 0.45 0.35 0.45		c c	* as TP removal efficiency * as TP removal efficiency * as TP removal efficiency * as TP removal efficiency * as TP removal efficiency * as TN removal efficiency	(Vymazal, 2010 #103) (Vymazal, 2010 #1436) (Vymazal, 2010 #1436) (Vymazal, 2010 #1436) (Vymazal, 2010 #1436)
TP med (R)	Secondary Effluent 0.512 0.66 0.51 0.65 0.55 0.55 0.55 0.55 0.588	0.5-0.66 (0.16)	Soilloss 0.488 0.34 0.45 0.45 0.45 0.46 0.41		c c	* as TP removal efficiency * as TP removal efficiency * as TP removal efficiency * as TP removal efficiency * as TP removal efficiency * as TN removal efficiency * as TN removal efficiency	(Vymazal, 2010 #1436) (Vymazal, 2010 #1436) (Vymazal, 2010 #1436) (Vymazal, 2010 #1436) (Vymazal, 2010 #1436)
TP med (R)	Secondary Effluent 0.512 0.66 0.51 0.65 0.51 0.65 0.55 0.55	0.5-0.66 (0.16)	Soilloss 0.488 0.340 0.45 0.45 0.45 0.46 0.46		c c	* as TP removal efficiency * as TP removal efficiency * as TP removal efficiency * as TP removal efficiency * as TP removal efficiency * as TN removal efficiency	(Vymazal, 2010 #103) (Vymazal, 2010 #1436) (Vymazal, 2010 #1436) (Vymazal, 2010 #1436) (Vymazal, 2010 #1436) (Vymazal, 2010 #1436) (Vymazal, 2010 #1436) (Vymazal, 2010 #1436) (Vymazal, 2010 #1436) (Vymazal, 2010 #1436) (Vymazal, 2010 #1436) (Vymazal, 2010 #1436)
TP med (R)	Secondary Effluent 0.512 0.66 0.51 0.65 0.55 0.55 0.55 0.55 0.588	0.5-0.66 (0.16)	Soilloss 0.488 0.34 0.45 0.45 0.45 0.46 0.41			* as TP removal efficiency * as TP removal efficiency * as TP removal efficiency * as TP removal efficiency * as TP removal efficiency * as TN removal efficiency * as TN removal efficiency	(Vymazal, 2010 #103) (Vymazal, 2010 #103) (Vymazal, 2010 #1436) (Vymazal, 2010 #1436) (Vymazal, 2010 #1436) (Vymazal, 2010 #1436) (Vymazal, 2010 #1436) (Vymazal, 2010 #1436) (Vymazal, 2010 #1436) (Vymazal, 2010 #1436) (Vymazal, 2010 #1436) (Vymazal, 2010 #1436)
TP med (R)	Secondary Effluent 0.512 0.66 0.51 0.65 0.55 0.55 0.55 0.55 0.55 0.55 0.55 0.55	0.5-0.66 (0.16)	Soilloss 0.488 0.34 0.45 0.45 0.45 0.45 0.41 0.45			* as TP removal efficiency * as TP removal efficiency * as TP removal efficiency * as TP removal efficiency * as TP removal efficiency * as TN removal efficiency * as TN removal efficiency * as TN removal efficiency * as TN removal efficiency * as TN removal efficiency * as TN removal efficiency	(Vymazal, 2010 #1436) (Vymazal, 2010 #1436) (Vymazal, 2010 #1436) (Vymazal, 2010 #1436) (Vymazal, 2010 #1436) (Vymazal, 2010 #1436) (Vymazal, 2010 #1436) (Vymazal, 2010 #1436) (Vymazal, 2010 #1436) (Vymazal, 2010 #1436) (Vymazal, 2010 #1436) (Vymazal, 2010 #1436)
TP	Secondary Effluent 0.512 0.66 0.51 0.65 0.55 0.55 0.55 0.53 0.59 0.42	0.5-0.66 (0.16)	Soilloss 0.488 0.34 0.45 0.45 0.45 0.41 0.45 0.41 0.44 0.43			* as TP removal efficiency * as TP removal efficiency * as TP removal efficiency * as TP removal efficiency * as TP removal efficiency * as TN removal efficiency * as TN removal efficiency * as TN removal efficiency * as TN removal efficiency	(Vymazal, 2010 #103) (Vymazal, 2010 #103) (Vymazal, 2010 #1436) (Vymazal, 2010 #1436) (Vymazal, 2010 #1436) (Vymazal, 2010 #1436) (Vymazal, 2010 #1436) (Vymazal, 2010 #1436) (Vymazal, 2010 #1436) (Vymazal, 2010 #1436) (Vymazal, 2010 #1436) (Vymazal, 2010 #1436)
TP med (R)	Secondary Effluent 0.512 0.66 0.51 0.65 0.55 0.55 0.55 0.59 0.59 0.42 0.42	0.5-0.666 (0.15)	Soilloss 0.488 0.34 0.45 0.55 0.45 0.41 0.41 0.45 0.41			* as TP removal efficiency * as TP removal efficiency * as TP removal efficiency * as TP removal efficiency * as TP removal efficiency * as TN removal efficiency * as TN removal efficiency * as TN removal efficiency * as TN removal efficiency * as TN removal efficiency * as TN removal efficiency	(Vymazal, 2007 #103) (Vymazal, 2010 #1436) (Vyma
TP	Secondary Effluent 0.512 0.666 0.51 0.65 0.55 0.55 0.51 0.53 0.59 0.42 0.55 0.42	0.5-0.66 (0.16)	Soilloss 0.488 0.34 0.45 0.45 0.45 0.41 0.41 0.41 0.41 0.45			* as TP removal efficiency * as TP removal efficiency * as TP removal efficiency * as TP removal efficiency * as TP removal efficiency * as TN removal efficiency * as TN removal efficiency * as TN removal efficiency * as TN removal efficiency * as TN removal efficiency * as TN removal efficiency	Oymazal, 2007 #103 Oymazal, 2007 #103 Oymazal, 2010 #1436
med (R)	Secondary Effluent 0.512 0.66 0.51 0.65 0.55 0.55 0.55 0.58 0.58 0.59 0.42 0.52 0.88	0.5 - 0.66 (0.16) (0.17	Soilloss 0.488 0.488 0.45 0.45 0.45 0.45 0.41 0.412 0.441 0.45 0.45 0.45	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		* as TP removal efficiency * as TP removal efficiency * as TP removal efficiency * as TP removal efficiency * as TP removal efficiency * as TN removal efficiency * as TN removal efficiency * as TN removal efficiency * as TN removal efficiency * as TN removal efficiency * as TN removal efficiency * Adapted from "horizontal_wetland"	(Vymazal, 2007 #103) (Vymazal, 2010 #1436) (Vyma
med (R)	Secondary Effluent 0.512 0.666 0.51 0.55 0.55 0.55 0.55 0.58 0.58 0.59 0.42 0.55 0.88 0.82 0.82	0.5-0.66 (0.15) 0.42-0.59 (0.17) 0.95-0.73	Soilloss 0.488 0.498 0.45 0.45 0.45 0.45 0.412 0.45 0.45 0.45 0.45 0.45	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		* as TP removal efficiency * as TP removal efficiency * as TP removal efficiency * as TP removal efficiency * as TP removal efficiency * as TN removal efficiency	Oymazal, 2007 #103 Oymazal, 2007 #103 Oymazal, 2010 #1436
med (R) med (R) k TN med (R) med (R)	Secondary Effluent 0.512 0.66 0.51 0.55 0.55 0.55 0.55 0.55 0.55 0.55 0.55 0.55 0.55 0.55 0.58	0.5-0.66 [0.16] 0.42-0.59 [0.17] 0.75-0.97	Soilloss 0.488 0.498 0.45 0.45 0.45 0.45 0.41 0.45 0.41 0.45 0.45 0.45 0.46 0.47 0.48	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		* as TP removal efficiency * as TP removal efficiency * as TP removal efficiency * as TP removal efficiency * as TP removal efficiency * as TP removal efficiency * as TN removal efficiency * as TN removal efficiency * as TN removal efficiency * as TN removal efficiency * as TN removal efficiency * as TN removal efficiency Adapted from "horizontal_wetland" Adapted from "horizontal_wetland" Adapted from "horizontal_wetland" Adapted from "horizontal_wetland"	(Vymazal, 2007 #103) (Vymazal, 2010 #1436) (Vyma
med (R)	Secondary Effluent 0.512 0.666 0.51 0.55 0.55 0.55 0.55 0.58 0.58 0.59 0.42 0.55 0.88 0.82 0.82	0.5-0.66 [0.16] 0.42-0.59 [0.17] 0.75-0.97	Soilloss 0.488 0.349 0.45 0.45 0.45 0.45 0.412 0.45 0.45 0.45 0.45 0.45 0.45 0.45 0.45 0.45 0.45	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		* as TP removal efficiency * as TP removal efficiency * as TP removal efficiency * as TP removal efficiency * as TP removal efficiency * as TP removal efficiency * as TN removal efficiency * as TN removal efficiency * as TN removal efficiency * as TN removal efficiency * as TN removal efficiency * as TN removal efficiency Adapted from "horizontal_wetland" Adapted from "horizontal_wetland" Adapted from "horizontal_wetland" Adapted from "horizontal_wetland"	Oymazal, 2007 #103,
med (R) & TN med (R) & A H2O med (R) & Ball Med (R)	Secondary Effluent 0.512 0.66 0.51 0.52 0.53 0.53 0.53 0.59 0.42 0.55 0.88 0.88 0.88 0.88	0.5-0.66 (0.16) 0.42-0.59 (0.87) 0.95-0.73	Soilloss 0.488 0.349 0.45 0.45 0.45 0.45 0.412 0.45 0.45 0.45 0.45 0.45 0.45 0.45 0.45 0.45 0.45	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		* as TP removal efficiency * as TP removal efficiency * as TP removal efficiency * as TP removal efficiency * as TP removal efficiency * as TP removal efficiency * as TN removal efficiency * as TN removal efficiency * as TN removal efficiency * as TN removal efficiency * as TN removal efficiency * as TN removal efficiency Adapted from "horizontal_wetland" Adapted from "horizontal_wetland" Adapted from "horizontal_wetland" Adapted from "horizontal_wetland"	Oymazal, 2007 #103 Oymazal, 2007 #103 Oymazal, 2010 #1436
med (R) med (R) fin med (R) med (R) med (R) med (R)	Secondary Effluent 0.512 0.66 0.51 0.55 0.55 0.55 0.55 0.53 0.59 0.42 0.55 0.88 0.88 0.82 0.88 0.88 0.88 0.88 0.88 0.89 0.90 0.9	0.5-0.66 0.16 0.42-0.59 0.42-0.59 0.47-0.97 0.75-0.97	Soilloss 0.488 0.34 0.45 0.45 0.45 0.41 0.44 0.44 0.44 0.45 0.55 0.45 0.40 0.50 0.65	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		* as TP removal efficiency * as TP removal efficiency * as TP removal efficiency * as TP removal efficiency * as TP removal efficiency * as TN removal efficiency *	(Vymazal, 2007 #103) (Vymazal, 2010 #1436) (Vyma
med (R) med (R) med (R) med (R) med (R)	Secondary Effluent 0.512 0.66 0.51 0.65 0.55 0.55 0.58 0.58 0.58 0.59 0.42 0.59 0.42 0.55 0.8 0.81 0.81 0.81 0.81 0.81 0.81 0.81 0.81	0.5 - 0.66 [0.16] 0.42 - 0.59 [0.57] 0.75 - 0.97 [0.74]	Soilloss 0.488 0.34 0.45 0.45 0.45 0.41 0.45 0.41 0.44 0.45	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		* as TP removal efficiency * as TP removal efficiency * as TP removal efficiency * as TP removal efficiency * as TP removal efficiency * as TN removal efficiency *	Oymazal, 2007 #103 Oymazal, 2007 #103 Oymazal, 2010 #1436
med (R) med (R) fin med (R) med (R) med (R) med (R)	Secondary Effluent 0.512 0.66 0.51 0.55 0.55 0.55 0.55 0.55 0.55 0.58 0.55 0.59 0.42 0.59 0.42 0.59 0.42 0.55 0.50 0.50 0.72 0.735	0.5-0.66 [0.16] 0.42-0.59 [0.17] 0.75-0.97	Soilloss 0.488 0.34 0.45 0.45 0.45 0.46 0.41 0.41 0.41 0.45 0.41 0.41 0.45 0.40 0.41 0.41 0.45 0.40 0.41 0.41 0.41 0.42 0.41 0.42	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		* as TP removal efficiency * as TP removal efficiency * as TP removal efficiency * as TP removal efficiency * as TP removal efficiency * as TN removal efficiency *	(Vymazal, 2007 #103) (Vymazal, 2010 #1436) (Vyma
med (R) med (R) med (R) med (R) med (R) med (R) med (R)	Secondary Effluent 0.512 0.66 0.51 0.65 0.55 0.55 0.58 0.58 0.58 0.59 0.42 0.59 0.42 0.55 0.8 0.81 0.81 0.81 0.81 0.81 0.81 0.81 0.81	0.5-0.66 [0.16] 0.42-0.59 [0.17] 0.75-0.97	Soilloss 0.488 0.34 0.45 0.45 0.45 0.46 0.41 0.41 0.41 0.45 0.41 0.41 0.45 0.40 0.41 0.41 0.45 0.40 0.41 0.41 0.41 0.42 0.41 0.42	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		* as TP removal efficiency * as TP removal efficiency * as TP removal efficiency * as TP removal efficiency * as TP removal efficiency * as TN removal efficiency *	Oymazal, 2007 #103 Oymazal, 2007 #103 Oymazal, 2010 #1436 Oymazal
med (R)	Secondary Effluent 0.512 0.66 0.51 0.55 0.55 0.55 0.59 0.42 0.55 0.88 0.55 0.88 0.88 0.88 0.81 0.81 0.81 0.83 0.83 0.83 0.83 0.83	0.5-0.66 (0.15) 0.42-0.59 (0.47) 0.5-0.73 (0.75-0.97) (0.24)	Soilloss 0.488 0.33 0.45 0.45 0.45 0.41 0.41 0.41 0.41 0.45	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		* as TP removal efficiency * as TP removal efficiency * as TP removal efficiency * as TP removal efficiency * as TP removal efficiency * as TN removal efficiency *	Oymazal, 2007 #103 Oymazal, 2010 #1436
med (R) med (R) med (R) med (R) solution and the solu	Secondary Effluent 0.512 0.66 0.51 0.55 0.55 0.55 0.55 0.53 0.59 0.42 0.55 0.82 0.82 0.82 0.82 0.82 0.83 0.81 0.82 0.83 0.81 0.82 0.83 0.83 0.84 0.85 0.8	0.5-0.66 (0.15) 0.42-0.59 (0.47) 0.5-0.73 (0.75-0.97) (0.24)	Soilloss 0.488 0.33 0.45 0.45 0.45 0.41 0.41 0.41 0.41 0.45	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		* as TP removal efficiency * as TP removal efficiency * as TP removal efficiency * as TP removal efficiency * as TP removal efficiency * as TN removal efficiency *	Oymazal, 2007 #103 Oymazal, 2010 #1436 Oymazal, 2010 #143
med (R) med (R) med (R) med (R) solution and the solu	Secondary Effluent 0.512 0.66 0.51 0.55 0.55 0.55 0.55 0.53 0.59 0.42 0.55 0.80 0.81 0.82 0.82 0.83 0.83 0.82 0.83 0.83 0.83 0.83 0.83 0.83 0.83 0.83 0.83 0.84 0.85 0.8	0.5-0.66 (0.15) 0.42-0.59 (0.47) 0.5-0.73 (0.75-0.97) (0.24)	Soilloss 0.488 0.33 0.45 0.45 0.45 0.41 0.41 0.41 0.41 0.45	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		* as TP removal efficiency * as TP removal efficiency * as TP removal efficiency * as TP removal efficiency * as TP removal efficiency * as TN removal efficiency *	Oymazal, 2007 #103 Oymazal, 2010 #1436 Oymazal, 2010 #143
med (R) med (R) med (R) med (R) huse med (R) med (R) k TS med (R) k Additional Information Usually the removal efficiency sta	Secondary Effluent 0.512 0.66 0.51 0.55 0.55 0.55 0.55 0.58 0.59 0.42 0.55 0.59 0.42 0.72 0.82 0.82 0.82 0.82 0.82 0.82 0.82 0.82 0.83 0.84 0.81 0.81 0.81 0.81 0.82 0.83 0.84 0.85 0.85 0.86 0.87 0.87 0.77 0.77 0.73 0.74 0.74 0.75 0.75 0.77 0.7	0.5-0.66 (0.15) 0.42-0.59 (0.47) 0.5-0.73 (0.75-0.97) (0.24)	Soilloss 0.488 0.33 0.45 0.45 0.45 0.41 0.41 0.41 0.41 0.45	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		* as TP removal efficiency * as TP removal efficiency * as TP removal efficiency * as TP removal efficiency * as TP removal efficiency * as TN removal efficiency *	Oymazal, 2007 #103 Oymazal, 2010 #1436
med (R) med (R) med (R) from the first the	Secondary Effluent 0.512 0.66 0.51 0.55 0.55 0.55 0.55 0.58 0.59 0.42 0.55 0.59 0.42 0.72 0.82 0.82 0.82 0.82 0.82 0.82 0.82 0.82 0.83 0.84 0.81 0.81 0.81 0.81 0.82 0.83 0.84 0.85 0.85 0.86 0.87 0.87 0.77 0.77 0.73 0.74 0.74 0.75 0.75 0.77 0.7	0.5-0.66 (0.15) 0.42-0.59 (0.47) 0.5-0.73 (0.75-0.97) (0.24)	Soilloss 0.488 0.33 0.45 0.45 0.45 0.41 0.41 0.41 0.41 0.45	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		* as TP removal efficiency * as TP removal efficiency * as TP removal efficiency * as TP removal efficiency * as TP removal efficiency * as TN removal efficiency *	Oymazal, 2007 #103 Oymazal, 2010 #1436
med (R)	Secondary Effluent 0.512 0.66 0.51 0.55 0.55 0.55 0.55 0.59 0.42 0.59 0.42 0.55 0.70 0.70 0.735 0.77 0.735 0.77 0.736 0.78 0.78 0.78 0.78 0.78 0.78 0.78 0.78 0.78 0.78 0.78 0.78 0.78 0.78 0.79 0.79 0.79 0.79 0.79 0.735 0.77 0.735 0.77 0.735 0.77 0.736	0.5 - 0.66 0.16 0.17 0.75 - 0.97 0.75 - 0.97 0.75 - 0.97	Soilloss 0.488 0.33 0.45 0.45 0.45 0.41 0.41 0.41 0.41 0.45	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		* as TP removal efficiency * as TP removal efficiency * as TP removal efficiency * as TP removal efficiency * as TP removal efficiency * as TN removal efficiency *	Oymazal, 2007 #103 Oymazal, 2010 #1436
med (R) med (R) med (R) from the first transfer of the first tr	Secondary Effluent 0.512 0.66 0.51 0.55 0.55 0.55 0.55 0.59 0.42 0.55 0.59 0.42 0.55 0.70 0.735 0.77 0.735 0.77 0.735 0.77 0.736 0.78 0.78 0.79	0.5 - 0.66 0.16 0.17 0.75 - 0.97 0.73 - 0.97 0.74 0.75 - 0.97 0.75 - 0.97 0.75 - 0.97	Soilloss 0.488 0.33 0.45 0.45 0.45 0.41 0.41 0.41 0.41 0.45	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		* as TP removal efficiency * as TP removal efficiency * as TP removal efficiency * as TP removal efficiency * as TP removal efficiency * as TN removal efficiency *	Oymazal, 2007 #103 Oymazal, 2010 #1436
med (R) med (R) med (R) from the first transfer of the first tr	Secondary Effluent 0.512 0.66 0.51 0.55 0.55 0.55 0.55 0.58 0.58 0.58 0.59 0.42 0.55 0.80 0.42 0.55 0.70 0.73	0.5 - 0.66 0.16 0.17 0.75 - 0.97 0.73 - 0.97 0.74 0.75 - 0.97 0.75 - 0.97 0.75 - 0.97	Soilloss 0.488 0.33 0.45 0.45 0.45 0.41 0.41 0.41 0.41 0.45	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		* as TP removal efficiency * as TP removal efficiency * as TP removal efficiency * as TP removal efficiency * as TP removal efficiency * as TN removal efficiency *	Oymazal, 2007 #103 Oymazal, 2010 #1436
med (R) med (R) f TN med (R) le H20 med (R) bal. k TS med (R) Additional information Usually the removal efficiency sta 40.2.2 HLR [cm/d] TS(rom TSS) Ratio TSS-TS (from horizontal_vetland) TS (rom TS) 40.2.3 HLR [cm/d]	Secondary Effluent 0.512 0.66 0.51 0.55 0.55 0.55 0.55 0.58 0.59 0.42 0.55 0.88 0.88 0.82 0.99 0.42 0.55 0.88 0.81 0.82 0.81 0.83 0.84 0.85 0.8	0.5 - 0.66 0.16 0.17 0.75 - 0.97 0.73 - 0.97 0.74 0.75 - 0.97 0.75 - 0.97 0.75 - 0.97 0.75 - 0.97 0.75 - 0.97 0.75 - 0.97	Soilloss 0.488 0.33 0.45 0.45 0.45 0.41 0.41 0.41 0.41 0.45	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		* as TP removal efficiency * as TP removal efficiency * as TP removal efficiency * as TP removal efficiency * as TP removal efficiency * as TN removal efficiency *	Oymazal, 2007 #103 Oymazal, 2010 #1436
med (R) ### Med (Secondary Effluent 0.512 0.66 0.51 0.55 0.55 0.55 0.55 0.58 0.59 0.42 0.55 0.88 0.55 0.88 0.55 0.70 0.735 0.88 0.81 0.82 0.82 0.83 0.81 0.81 0.81 0.81 0.81 0.83 0.81 0.83 0.83 0.83 0.84 0.85 0.77 0.735 0	0.5 - 0.66 0.16 0.42 - 0.59 0.42 - 0.59 0.75 - 0.73 0.75 - 0.97 0.73 - 0.97 0.74 0.75 - 0.97 0.75 - 0.97 0.75 - 0.97 0.75 - 0.97	Soilloss 0.488 0.33 0.45 0.45 0.45 0.41 0.41 0.41 0.41 0.45	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		* as TP removal efficiency * as TP removal efficiency * as TP removal efficiency * as TP removal efficiency * as TP removal efficiency * as TN removal efficiency *	Oymazal, 2007 #103 Oymazal, 2010 #1436
med (R) med (R) med (R) med (R) MACA med (R) MACA MED (R) Additional information Usually the removal efficiency sta MACA MACA MACA MACA MACA MACA MACA TS Ratio TSS:TS (from horizontal_wetland) TS (from TSS) A0.2.3 MAI [cm/d]	Secondary Effluent 0.512 0.66 0.51 0.55 0.55 0.55 0.55 0.53 0.59 0.42 0.55 0.53 0.59 0.42 0.55 0.70 0.735 0.80 0.81 0.81 0.81 0.81 0.81 0.81 0.82 0.83 0.81 0.83 0.81 0.83 0.84 0.85 0.77 0.735 0.735 0.735 0.735 0.735 0.735 0.736 0.735 0.736 0.735 0.736 0.735 0.736 0.736 0.735 0.736 0.737 0.736 0.736 0.736 0.737 0.736 0.736 0.736 0.736 0.737 0.736 0.737 0.736 0.737 0.736 0.737 0.737 0.737 0.737 0.738	0.5 - 0.66 0.16 0.42 - 0.59 0.42 - 0.59 0.75 - 0.73 0.75 - 0.97 0.73 - 0.97 0.74 0.75 - 0.97 0.75 - 0.97 0.75 - 0.97 0.75 - 0.97	Soilloss 0.488 0.33 0.45 0.45 0.45 0.41 0.41 0.41 0.41 0.45	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		* as TP removal efficiency * as TP removal efficiency * as TP removal efficiency * as TP removal efficiency * as TP removal efficiency * as TN removal efficiency *	Oymazal, 2007 #103 Oymazal, 2010 #1436
med (R) ### Med (Secondary Effluent 0.512 0.66 0.51 0.55 0.55 0.55 0.55 0.53 0.59 0.42 0.55 0.53 0.59 0.42 0.55 0.70 0.735 0.80 0.81 0.81 0.81 0.81 0.81 0.81 0.82 0.83 0.81 0.83 0.81 0.83 0.84 0.85 0.77 0.735 0.735 0.735 0.735 0.735 0.735 0.736 0.735 0.736 0.735 0.736 0.735 0.736 0.736 0.735 0.736 0.737 0.736 0.736 0.736 0.737 0.736 0.736 0.736 0.736 0.737 0.736 0.737 0.736 0.737 0.736 0.737 0.737 0.737 0.737 0.738	0.5 - 0.66 0.16 0.42 - 0.59 0.42 - 0.59 0.75 - 0.73 0.75 - 0.97 0.73 - 0.97 0.74 0.75 - 0.97 0.75 - 0.97 0.75 - 0.97 0.75 - 0.97	Soilloss 0.488 0.33 0.45 0.45 0.45 0.41 0.41 0.41 0.41 0.45	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		* as TP removal efficiency * as TP removal efficiency * as TP removal efficiency * as TP removal efficiency * as TP removal efficiency * as TN removal efficiency *	Oymazal, 2007 #103 Oymazal, 2010 #1436 Oymazal, 2010 #143
med (R) med (R) med (R) med (R) med (R) med (R) med (R) med (R) strict (R) med (R)	Secondary Effluent 0.512 0.66 0.51 0.51 0.55 0.55 0.55 0.58 0.59 0.42 0.59 0.42 0.82 0.82 0.82 0.82 0.82 0.82 0.82 0.83 0.82 0.82 0.83 0.83 0.82 0.83 0.83 0.84 0.85 0.85 0.86 0.87 0.87 0.87 0.77 0.73 0.7	0.5 - 0.66 0.16 0.17 0.75 - 0.97 0.73 - 0.97 0.73 - 0.97 0.74 - 0.75 0.75 - 0.75 0.75 - 0.75 0.75 - 0.75 0.75 - 0.75 0.75 - 0.75 0.75 - 0.75	Soilloss 0.488 0.49 0.41 0.45 0.41 0.41 0.41 0.45 0.41 0.41 0.45 0	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	C C C C C C C C C C C C C C C C C C C	* as TP removal efficiency * as TP removal efficiency * as TP removal efficiency * as TP removal efficiency * as TP removal efficiency * as TN removal efficiency *	(Vymazal, 2007 #103) (Vymazal, 2010 #1436) (Vyma

Gensch, R., Dennings, A., Renggli, S., & Reymond, P. (2018). Compendium of Sanitation Technologies in Emergencies. German WASH Network (GWN), Swiss Federal Institute of Aquatic Science and Technology (Eawag), Global WASH Cluster (GWC) and Sustainable Sanitation Alliance (SuSanA). Loetscher, T., & Keller, J. (2002). A decision support system for selecting sanitation systems in developing countries. Socio-Economic Planning Sciences, 36 (4), 267–290. https://doi.org/10.1016/S0038-0121(02)00007-1
Spubler, D., de Morais Lima, P., Fritzsche, J., Ilimanen, K., Jain, A., van Stoten, M., & Willimann, C. (2021). SanitChoice Project Team. Department Sanitation, Water and Solid Waste for Development Countries (Sandec), Swiss Federal Institute of Aquatic Science and Technology (Eawag), Dübendorf, Switzerland. Spubler, D., & Robeller, L. (2020). Solidal Master of Development Countries (Sandec), Swiss Federal Institute of Aquatic Science and Technology. Swiss Federal Institute of Aquatic Science and Technology. Vymazal, J. (2010). "Constructed Wetlands for Wastewater Treatment." Water 25.
Tilley, E., Ulrich, L., Lüthi, C., Reymond, P., & Zurbrügg, C. (2014). Compendium of Sanitation Systems and Technologies—2nd revised edition. Swiss Federal Institute of Aquatic Science and Technology (EAWAG).

	Values	Data Source				
FUNCTIONAL GROUP UNIQUE IDENTIFIER (ID)	horizontal_wetland	-				
DATA COMPILER INPUT PRODUCT	Julian Fritzsche blackwater, transportedblackwater,	- Spuhler, D. & Roller, L. (2020)				
	effluent, transportedeffluent, greywater, secondary_effluent,	Spuhler, D. & Roller, L. (2020)				
	transportedsecondary_effluent					
RELATIONS	Input: OR Output: AND	Spuhler, D. & Roller, L. (2020)				
COMMENTS		Date Carres				
	Values (household = 0.5, neighbourhood = 1, city =	Tilley, E. et al. (2014)				
management level	0.5) (household = 0.5, shared = 1, public = 1)	Tilley, E. et al. (2014)				
capex_req_level opex_req_level	8	Spuhler, D. et al. (2021) Spuhler, D. et al. (2021)				
technical_maturity	3	Tilley, E. et al. (2014)				
	(acute = 0, stabilisation = 0.5, development/recovery = 1)	Gensch, R. et al. (2018)				
Screening Criteria water_supply	Type and Function Performance, Categorical	Applicable for this Functional Group? FALSE	Categories [Unit]	Technology Values (Data) NA	Data Source / Assumptions NA	Internal Review Done? NA
			yard public			
			none			
water_volume electricity_supply	Performance, Trapez Performance, Categorical		[L/cap/day] electricity	NA (electricity = 1, intermittent = 1, no	NA "No electrical energy is required"	NA yes
			intermittent no electricity	electricity = 1)	(Compendium)	
fuel_supply	Performance, Categorical	FALSE	fuel	NA	NA	NA
frequency_of_om	PDF, Categorical	TRUE	no fuel irregular	(irregular = 0, regular = 1, continuous = 0)	"During the first growing season, it is	yes
			regular continuous		important to remove weeds that can compete with the planted wetland	
					vegetation. With time, the gravel will become clogged with accumulated solids	
					and bacterial film. The filter material at the	
					inlet zone will require replacement every 10 or more years. Maintenance activities	
					should focus on ensuring that primary treatment is effective at reducing the	
					concentration of solids in the wastewater	
					before it enters the wetland. Maintenance should also ensure that trees do not grow	
					in the area as the roots can harm the liner." (Compendium)	
					Regular maintenance.	
pipe_supply	Performance, Categorical	TRUE	no pipes	(no pipes = 0.5, difficultly available = 0.75,	"A wide inlet zone should be used to evenly	yes
			difficultly available pipes	pipes = 1)	distribute the flow. A well-designed inlet that allows for even distribution is	
					important to prevent short-circuiting. The	
					outlet should be variable so that the water surface can be adjusted to optimize	
					treatment performance." Inlet and outlet pipes for effluent required. (Compendium)	
pump_supply	Performance, Categorical	TRUF	no pumps	(no pumps = 1, difficultly available = 1,	No pumps required	yes
Panth-anhhia	r crioance, categorital		difficultly available	pumps = 1)	. ,,	,
concrete_supply	Performance, Categorical	TRUE	no concrete	(no concrete = 1, difficultly available = 1,	"The bed should be lined with an	yes
			difficultly available concrete	concrete = 1)	impermeable liner (clay or geotextile) to prevent leaching.", "Small,	
					round, evenly sized gravel is most	
					commonly used to fill the bed" (Compendium)	
					Technology should be watertight, but the liner does not appear to be made from	
spare_parts	PDF, Categorical	TRUE	simple	(simple = 1, technical = 0, special = 0)	concrete. No concrete required. "Can be built and repaired with locally	yes
spare_parts	PDF, Categorical	IKUE	technical	(simple = 1, technical = 0, special = 0)	available materials and local labourers"	yes
			special		(Horizontal subsurface flow CW SSWM Toolbox)	
					No technical or special parts are required.	
0		FALSE		NA	NA	NA
0	0	FALSE FALSE		NA	NA NA	NA NA
temperature	Performance, Categorical	TRUE	very cold cold	(very cold = 0.5, cold = 0.7, temperate = 1, warm = 1, hot = 1)	"This technology is best suited for warm climates, but	yes
,			temperate	, =/	can be designed to tolerate some freezing	
			warm hot		and periods of low biological activity." (Compendium)	
					Assumed to be comparable to a WSP.	
flooding	Performance, Categorical	TRUE	flooding	(flooding = 0.6, no flooding = 1)	Assumed to be comparable to a WSP.	yes
	i		no flooding	İ	"Constructed wetlands are also used as a	
					flood protection measure." (Stefanakis,	
					2019)	
					2019) This is a technology that is necessarily built	
					2019) This is a technology that is necessarily built on the ground surface and its raised configuration is not possible. (e.g., all pond-	
					2019) This is a technology that is necessarily built on the ground surface and its raised	
					2019) This is a technology that is necessarily built on the ground surface and its raised configuration is not possible. (e.g., all pondbased, wetlands, drying beds etc.). Note: All pond-based/wetland/drying bed technologies are allotted similar	
					2019) This is a technology that is necessarily built on the ground surface and its raised configuration is not possible. (e.g., all pond-based, wetlands, drying beds etc.). Note: All pond-based/wetland/drying beds technologies are allotted similar performance values. Their functioning can be severely disrupted by flooding events.	
					2019) This is a technology that is necessarily built on the ground surface and its raised configuration is not possible. (e.g., all pond-based, wetlands, drying beds etc.). Note: All pond-based/wetland/drying bed technologies are allotted similar performance values. Their functioning can be severely disrupted by flooding events.	
					2019) This is a technology that is necessarily built on the ground surface and its raised configuration is not possible. (e.g., all pond-based, wetlands, drying beds etc.). Note: All pond-based/wetland/drying bed technologies are allotted similar performance values. Their functioning can be severely disrupted by flooding events. However, it is possible that they can be protected from flooding by building embankments or mounds of adequate	
					2019) This is a technology that is necessarily built on the ground surface and its raised configuration is not possible. (e.g., all pond-based, wetlands, drying beds etc.). Note: All pond-based/wetland/drying beds etc.). Note: All pond-based/wetland/drying beds technologies are allotted similar performance values. Their functioning can be severely disrupted by flooding events. However, it is possible that they can be protected from flooding by building embankments or mounds of adequate height around them. Since a flood-preventive configuration of the technology	
					This is a technology that is necessarily built on the ground surface and its raised configuration is not possible. (e.g., all pond-based, wetlands, drying beds etc.). Note: All pond-based/wetland/drying beds etc.) Note: All pond-based/wetland/drying beds etc.) Note: Description of the property of the	
					2019) This is a technology that is necessarily built on the ground surface and its raised configuration is not possible, (e.g., all pond-based, wetlands, drying beds etc.). Note: All pond-based/wetland/drying bed technologies are allotted similar performance values. Their functioning can be severely disrupted by flooding events. However, it is possible that they can be protected from flooding by building embankments or mounds of adequate height around them. Since a flood-preventive configuration of the technology is possible, it is allotted a performance of 50%. Process wise, flooding or entry of surface run-off can be considered to be	
					2019) This is a technology that is necessarily built on the ground surface and its raised configuration is not possible. (e.g., all pond-based, wetlands, drying beds etc.). Note: All pond-based/wetland/drying beds etc.). Note: All pond-based/wetland/drying beds technologies are allotted similar performance values. Their functioning can be severely disrypted by flooding events. However, it is possible that they can be protected from flooding by building embankments or mounds of adequate height around them. Since a flood-preventive configuration of the technology is possible, it is allotted a performance of SOM. Process wise, flooding or entry of surface run-off can be considered to be more critical for drying beds than ponds and wetlands, therefore technologies of	
					This is a technology that is necessarily built on the ground surface and its raised configuration is not possible. (e.g., all pond-based, wetlands, drying beds etc.). Note: All pond-based/wetland/drying bed technologies are allotted similar performance values. Their functioning can be severely disrupted by flooding events. However, it is possible that they can be protected from flooding by building embankments or mounds of adequate height around them. Since a flood-preventive configuration of the technology is possible, it is allotted a performance of 50%. Process wise, flooding or entry of surface run-off can be considered to be more critical for drying beds than ponds	
unhleder een-	Berformann Calentaire	FAISE	no arress	NA NA	This is a technology that is necessarily built on the ground surface and its raised configuration is not possible (e.g., all pond-based, wetlands, drying beds etc.). Note: All pond-based/wetland/drying bed technologies are allotted similar performance values. Their functioning can be severely disrupted by flooding events. However, it is possible that they can be protected from flooding by building embaniments or mounds of adequate height around them. Since a flood-preventive configuration of the technology is possible, it is allotted a performance of 50%. Process wise, flooding or entry of surface run-off can be considered to be more critical for drying beds than ponds and wetlands, therefore technologies of the latter two type are awarded a slightly higher performance of 60% (Akanisha Jain)	NA.
vehicular_acces	Performance, Categorical	FALSE	no access difficult	NA.	This is a technology that is necessarily built on the ground surface and its raised configuration is not possible. (e.g., all pond-based, wetlands, drying beds etc.). Note: All pond-based/wetland/drying bed technologies are allotted similar performance values. Their functioning can be severely disrupted by flooding events. However, it is possible that they can be protected from flooding by building embankments or mounds of a dequate height around them. Since a floodop reventive configuration of the technology is possible, it is allotted a performance of 50%. Process wise, flooding or entry of surface run-off can be considered to be more critical for drying beds than ponds and wetlands, therefore technologies of the latter two type are awarded a slightly	NA.
vehicular_acces stope	Performance, Categorical Performance, Categorical		difficult full flat	NA NA	This is a technology that is necessarily built on the ground surface and its raised configuration is not possible (e.g., all pond-based, wetlands, drying beds etc.). Note: All pond-based/wetland/drying bed technologies are allotted similar performance values. Their functioning can be severely disrupted by flooding events. However, it is possible that they can be protected from flooding by building embaniments or mounds of adequate height around them. Since a flood-preventive configuration of the technology is possible, it is allotted a performance of 50%. Process wise, flooding or entry of surface run-off can be considered to be more critical for drying beds than ponds and wetlands, therefore technologies of the latter two type are awarded a slightly higher performance of 60% (Akanisha Jain)	NA NA
slope	Performance, Categorical	FALSE	difficult full flat not flat	NA .	This is a technology that is necessarily built on the ground surface and its raised configuration is not possible. (e.g., all pond-based, wetlands, drying beds etc.). Note: All pond-based/wetland/drying bed technologies are aliotted similar performance values. Their functioning can be severely disrupted by flooding events. However, it is possible that they can be protected from flooding by building embankments or mounds of a dequate height around them. Since a floodop reventive configuration of the technology is possible, it is allotted a performance of 50%. Process wise, flooding or entry of surface run-off can be considered to be more critical for drying beds than ponds and wetdands, therefore technologies of the latter two type are awarded as lightly higher performance of 60% (Akanisha Jain) NA	NA .
		FALSE	difficult full flat not flat clay silt		This is a technology that is necessarily built on the ground surface and its raised configuration is not possible. (e.g., all pond-based, wetlands, drying beds etc.). Note: All pond-based/wetlands/drying bed technologies are allotted similar performance values. Their functioning can be severely disrupted by flooding events. However, it is possible that they can be protected from flooding by building embankments or mounds of a dequate height around them. Since a flood-preventive configuration of the technology is possible, it is allotted a performance of 50%. Process wise, flooding or entry of surface run-off can be considered to be more critical for drying beds than ponds and wetlands, therefore technologies of the latter two type are awarded as lightly higher performance of 60% (Akanksha Jain)	
slope	Performance, Categorical	FALSE	difficult full flat not flat clay silt sand gravel	NA .	This is a technology that is necessarily built on the ground surface and its raised configuration is not possible. (e.g., all pond-based, wetlands, drying beds etc.). Note: All pond-based/wetland/drying bed technologies are aliotted similar performance values. Their functioning can be severely disrupted by flooding events. However, it is possible that they can be protected from flooding by building embankments or mounds of a dequate height around them. Since a floodop reventive configuration of the technology is possible, it is allotted a performance of 50%. Process wise, flooding or entry of surface run-off can be considered to be more critical for drying beds than ponds and wetdands, therefore technologies of the latter two type are awarded as lightly higher performance of 60% (Akanisha Jain) NA	NA .
slope soil_type	Performance, Categorical Performance, Categorical	FALSE	difficult flat flat not flat clay silt sand gravel rock	NA NA	This is a technology that is necessarily built on the ground surface and its raised configuration is not possible. (e.g., all pond-based, wetlands, drying beds etc.). Note: All pond-based/wetland/drying bed technologies are aliotted similar performance values. Their functioning can be severely disrupted by flooding events. However, it is possible that they can be protected from flooding by building embankments or mounds of a dequate height around them. Since a floodop reventive configuration of the technology is possible, it is allotted a performance of 50%. Process wise, flooding or entry of surface run-off can be considered to be more critical for drying beds than ponds and wetdands, therefore technologies of the latter two type are awarded as lightly higher performance of 60% (Akanisha Jain) NA	NA .
slope	Performance, Categorical	FALSE FALSE	difficult full flat not flat clay silt sand gravel	NA .	This is a technology that is necessarily built on the ground surface and its raised configuration is not possible. (e.g., all pond-based, wetlands, drying beds etc.). Note: All pond-based/wetlands/drying bed technologies are aliotted similar performance values. Their functioning can be severely disrupted by flooding events. However, it is possible that they can be protected from flooding by building embankments or mounds of a dequate height around them. Since a flood-preventive configuration of the technology is possible, it is allotted a performance of 50%. Process wise, flooding or entry of surface run-off can be considered to be more critical for drying beds than ponds and wetlands, therefore technologies of the latter two type are awarded as lightly higher performance of 60% (Akanksha Jain) NA	NA NA

surface_area_offsite	Performance, Trapez	FALSE	[m2/plot]	NA	NA	NA	
	Performance, Trapez	TRUE	m2/pers	(a = 3, b = 3, c = 999, d = 999)	Requires at least 3 m2/cap.		
					From Table 1.3 (Dotro et al. 2017)		
0		FALSE FALSE			NA NA	NA NA	1
0		FALSE	0	NA	NA NA	NA NA	1
drinking_water_exposure			Not close				
0	0	FALSE FALSE			NA NA	NA NA	1
construction_skills	Performance, Categorica	TRUE	Ladder: unskilled	(unskilled = 0, skilled = 0, professional = 1)	"Requires expert design and construction" (Compendium)	yes	
			skilled		The construction is slightly more elaborate		
design_skills	Performance, Categorica	TRUE	professional Ladder:	(unskilled = 0, skilled = 0, professional = 1)	than a free-water wetland. "Requires expert design and construction"	yes	İ
			unskilled skilled		(Compendium) The construction is slightly more elaborate		
om_skills	Performance, Categorica	TRUE	professional Ladder:	(unskilled = 0.5, skilled = 1, professional = 1)	than a free-water wetland. "Regular maintenance	yes	-
			Unskilled Skilled	,	should ensure that water is not short- circuiting, or backing up because of fallen		
			Professional		branches, garbage, or beaver		
			1		dams blocking the wetland outlet. Vegetation may have		
					to be periodically cut back or thinned out." (Compendium)		
0		FALSE	0	NA	For maintenance, low skills suffice. NA	NA	1
0	C	FALSE	0	NA	NA	NA	1
0	C	FALSE FALSE	0	NA	NA NA	NA NA	1
cleansing_method	Performance, Categorica		Washers Soft wipers	NA	NA	NA	
0			Hard wipers	NA.	NA .	NA .	
0	C	FALSE FALSE	0	NA	NA	NA NA	1
lifetime	Performance, Categorica	TRUÉ	short (< 1 year) medium (1-5 years)	(short = 1, medium = 1, long = 1)	"Long service life" (Emersan) "Some constructed wetlands have now	yes	
			long (>5 years)		been in continuous operation for over 20 years and these plants are still producing		
					good treatment results" (Hoffmann et al. (2011))		
					"Life expectancy for the pumps and pump		
					equipment is assumed to be 10 y. [] All other items such as filter material, plant		
					cover, liner, drain pipes in the filter, manholes, piping between the beds and		
					the pump station are expected to last for 25 years." [Assessments in Ethiopia expect		
					20 years lifetime, in Kenia 20-25 years and		
					a study in Morocco suggests a replacement of the filter material every 8-15 years.]		
					(HFCW Griesauer, C. (2014) In a study by Griesauer on the CLARA		
					planning tool the expected lifetimes for HFCWs were larger than 5 years.		
			<u> </u>				ļ
speed_implement_toilet	PDF, Categorica	FALSE	rapid (< 3 days) moderate (3 days to 2 weeks)	NA	NA	NA	
speed_implement_treatment	PDF, Categorica	TRUE	slow (> 2 weeks) rapid (few days to a week)	(rapid=0, moderate=0, slow=1)	"In principle, Constructed Wetlands can be	ves	1
	,		moderate (few weeks up to three months) slow (> 3 months)		built using locally available material, however, availability of sand and gravel	,	
			slow (> 3 months)		(with required grain size distribution and		
					cleanliness) is often a problem. Additional materials include a liner or clay, wetland		
			1		plants, and a syphon or pump for intermittent loading. They are typically not		
			1		suit able for pre-fabrication." "Wetland plants take time to become established,		
					therefore the start-up time for Constructed		
					Wetlands is quite long. Thus this technology is not suitable for the acute		
			1		response phase but for the stabilisation and recovery periods and as a longer-term		
					solution." (Emersan Compendium) Long start up time and no prefab structure,		
			1				
			ļi		implementation can only be done		
					implementation can only be done corresponding to the timeframe of "slow" category. (Akanksha Jain)		
scalability	Performance, Categorica	TRUE	easy	(easy = 1, difficult = 0.3)	corresponding to the timeframe of "slow"	yes	
scalability	Performance, Categorica		easy difficult	(easy = 1, difficult = 0.3)	corresponding to the timeframe of "slow" category. (Akanksha Jain) "The design of a horizontal subsurface flow constructed wetland depends on the	yes	
scalability	Performance, Categorica			(easy = 1, difficult = 0.3)	corresponding to the timeframe of "slow" category. (Akanksha Jain) "The design of a horizontal subsurface flow constructed wetland depends on the treatment target and the amount and quality of the influent. It includes decisions	yes	
scalability	Performance, Categorica			(easy = 1, difficult = 0.3)	corresponding to the timeframe of "slow" category. (Akanksha Jain) "The design of a horizontal subsurface flow constructed wetfand depends on the treatment target and the amount and quality of the influent. It includes decisions about the amount of parallel flow paths and compartmentation. The removal	yes	
scalability	Performance, Categorica			(easy = 1, difficult = 0.3)	corresponding to the timeframe of "slow" category. (Akanksh Jain) "The design of a horizontal subsurface flow constructed wetland depends on the treatment target and the amount and quality of the influent. It includes decisions about the amount of parallel flow paths	yes	
scalability	Performance, Categorica			(easy = 1, difficult = 0.3)	corresponding to the timeframe of "slow" category. (Akanksha Jain) The design of a horizontal subsurface flow constructed wetland depends on the treatment target and the amount and quality of the influent. It includes decisions about the amount of parallel flow paths and compartmentation. The removal efficiency of the wetland is a function of the surface area (length multiplied by width), while the cross-sectional area	yes	
scalability	Performance, Categorica			(easy = 1, difficult = 0.3)	corresponding to the timeframe of "slow" category. (Akanksha Jain) The design of a horizontal subsurface flow constructed wetland depends on the treatment target and the amount and quality of the influent. It includes decisions about the amount of parallel flow paths and compartmentation. The removal efficiency of the wetland is a function of the surface area (length multiplied by width), while the cross-sectional area (width multiplied by depth) determines the maximum possible flow." (Compendium)	yes	
scalability	Performance, Categorica			(easy = 1, difficult = 0.3)	corresponding to the timeframe of "slow" category, (Akanksha Jain) The design of a horizontal subsurface flow constructed wetland depends on the treatment target and the amount and quality of the influent. It includes decisions about the amount of parallel flow paths and compartmentation. The removal efficiency of the wetland is a function of the surface area (length multiplied by width), while the cross-sectional area (width multiplied by detph) determines the maximum possible flow." (Compendium) It is assumed that new wetland beds can be added though it requires a long start-up	yes	
scalability	Performance, Categorica			(easy = 1, difficult = 0.3)	corresponding to the timeframe of "slow" category. (Akanksh Jain) The design of a horizontal subsurface flow constructed wetland depends on the treatment target and the amount and quality of the influent. It includes decisions about the amount of parallel flow paths and compartmentation. The removal efficiency of the wetland is a function of the surface area (length multiplied by width), while the cross-sectional area (width multiplied by depth) determines the maximum possible flow." (Compendium) It is assumed that new wetland beds can be added though it requires a long start-up time and needs to be designed well. Similar	yes	
scalability	Performance, Categorica			(easy = 1, difficult = 0.3)	corresponding to the timeframe of "slow" category, (Akanksha Jain) The design of a horizontal subsurface flow constructed wetland depends on the treatment target and the amount and quality of the influent. It includes decisions about the amount of parallel flow paths and compartmentation. The removal efficiency of the wetland is a function of the surface area (length multiplied by width), while the cross-sectional area (width multiplied by detph) determines the maximum possible flow." (Compendium) It is assumed that new wetland beds can be added though it requires a long start-up	yes	
scalability scalability	Performance, Categorica Poper Categorica	TRUE	difficult	(easy = 1, difficult = 0.3) (simple = 1, technical = 0, special = 0)	corresponding to the timeframe of "slow" category. (Akanksh Jain) The design of a horizontal subsurface flow constructed wetland depends on the treatment target and the amount and quality of the influent. It includes decisions about the amount of parallel flow paths and compartmentation. The removal efficiency of the wetland is a function of the surface area (length multiplied by width), while the cross-sectional area (width multiplied by depth) determines the maximum possible flow." (Compendium) It is assumed that new wetland beds can be added though it requires a long start-up time and needs to be designed well. Similar scalability as for vertical wetlands is assumed. "Can be built and repaired with locally	yes	
		TRUE	difficult	(easy = 1, difficult = 0.3) (simple = 1, technical = 0, special = 0)	corresponding to the timeframe of "slow" category. (Akanksha Jain) The design of a horizontal subsurface flow constructed wetland depends on the treatment target and the amount and quality of the influent. It includes decisions about the amount of parallel flow paths and compartmentation. The removal efficiency of the wetland is a function of the surface area (length multiplied by width), while the cross-sectional area (width multiplied by depth) determines the maximum possible flow." (Compendium) it is assumed that new wetland beds can be added though it requires a long start-up time and needs to be designed well. Similar scalability as for vertical wetlands is assumed. "Can be built and repaired with locally available materials and local labourers" (Horizontal subsyrface flow CVP I SSVM)		
construction_parts	PDF, Categorica	TRUE	simple technical	(easy = 1, difficult = 0.3) (simple = 1, technical = 0, special = 0)	corresponding to the timeframe of "slow" category. (Akanksh Jain) The design of a horizontal subsurface flow constructed wetland depends on the treatment target and the amount and quality of the influent. It includes decisions about the amount of parallel flow paths and compartmentation. The removal efficiency of the wetland is a function of the surface area (length multiplied by width), while the cross-sectional area (width multiplied by depth) determines the maximum possible flow." (Compendium) It is assumed that new wetland beds can be added though it requires a long start-up time and needs to be designed well. Similar scalability as for vertical wetlands is assumed. "Can be built and repaired with locally available materials and local labourers"		
construction_parts Transfer Coefficients	PDF, Categorica [coped fron "Santation_Technologies_TC_database_20216827 Secondary Effluent	TRUE	simple technical special	(easy = 1, difficult = 0.3) (simple = 1, technical = 0, special = 0)	corresponding to the timeframe of "slow" category. (Akanksh Jain) The design of a horizontal subsurface flow constructed wetland depends on the treatment target and the amount and quality of the influent. It includes decisions about the amount of parallel flow paths and compartmentation. The removal efficiency of the wetland is a function of the surface area (length multiplied by width), while the cross-sectional area (width multiplied by depth) determines the maximum possible flow." (Compendium) It is assumed that new wetland beds can be added though it requires a long start-up time and needs to be designed well. Similar scalability as for vertical wetlands is assumed. "Can be built and repaired with locally available materials and local labourers" (Horizontal subsurface flow CW SSWM Toolbox)	yes Comments/	Reference
construction_parts Transfer Coefficients	PDF, Categorica (coped from "autholic Technologies Tc_database 2021662) Secondary Effluent 0.585	TRUE	simple technical special	(easy = 1, difficult = 0.3) (simple = 1, technical = 0, special = 0)	corresponding to the timeframe of "slow" category. (Akanksh Jain) The design of a horizontal subsurface flow constructed wetland depends on the treatment target and the amount and quality of the influent. It includes decisions about the amount of parallel flow paths and compartmentation. The removal efficiency of the wetland is a function of the surface area (length multiplied by width), while the cross-sectional area (width multiplied by depth) determines the maximum possible flow." (Compendium) it is assumed that new wetland beds can be added though it requires a long start-up time and needs to be designed well. Similar scalability as for vertical wetlands is assumed. "Can be built and repaired with locally available materials and local labourers" (Horizontal subsurface flow CW SSWM Toolbox)	yes Comments/ * as TP removal efficiency	(Vymazal, 2007 #103
construction_parts Transfer Coefficients	PDF, Categorica [coped fron "Santation_Technologies_TC_database_20216827 Secondary Effluent	TRUE	simple technical special	(easy = 1, difficult = 0.3) (simple = 1, technical = 0, special = 0)	corresponding to the timeframe of "slow" category. (Akanksh Jain) The design of a horizontal subsurface flow constructed wetland depends on the treatment target and the amount and quality of the influent. It includes decisions about the amount of parallel flow paths and compartmentation. The removal efficiency of the wetland is a function of the surface area (length multiplied by width), while the cross-sectional area (width multiplied by depth) determines the maximum possible flow." (Compendium) it is assumed that new wetland beds can be added though it requires a long start-up time and needs to be designed well. Similar scalability as for vertical wetlands is assumed. "Can be built and repaired with locally available materials and local labourers" (Horizontal subsurface flow CW SSWM Toolbox)	yes Comments/	{Vymazal, 2007 #103 {Vymazal, 2010
construction_parts Transfer Coefficients TP med (R)	PDF, Categorica [copied from "samitation Technologies_TC_database_20210622 Secondary Effluent 0.586 0.5	TRUE	simple technical special	(easy = 1, difficult = 0.3) (simple = 1, technical = 0, special = 0) Airloss 0	corresponding to the timeframe of "slow" category. (Akanksh Jain) "The design of a horizontal subsurface flow constructed wetfand depends on the treatment target and the amount and quality of the influent. It includes decisions about the amount of parallel flow paths and compartmentation. The removal efficiency of the wetland is a function of the surface area (length multiplied by width), while the cross-sectional area (width multiplied by depth) determines the maximum possible flow." (Compendium) It is assumed that new wetland beds can be added though it requires a long start-up time and needs to be designed well. Similar scalability as for vertical wetlands: "Can be built and repaired with locally available materials and local abources" (Horizontal subsurface flow CW SSWM Toolbox) Waterloss	yes Comments/ * as TP removal efficiency * as TP removal efficiency	{Vymazal, 2007 #103 {Vymazal, 2010 #1436}
construction_parts Transfer Coefficients	PDF, Categorica [coped from "santation_Technologies_Te_database_2021662] Secondary Effluent 0.588 0.58	TRUE	Simple technical special Soilloss 0.411 0.5	(easy = 1, difficult = 0.3) (simple = 1, technical = 0, special = 0) Airloss 0	corresponding to the timeframe of "slow" category. (Akanksh Jain) "The design of a horizontal subsurface flow constructed wetfand depends on the treatment target and the amount and quality of the influent. It includes decisions about the amount of parallel flow paths and compartmentation. The removal efficiency of the wetland is a function of the surface area (length multiplied by width), while the cross-sectional area (width multiplied by depth) determines the maximum possible flow." (Compendium) It is assumed that new wetland beds can be added though it requires a long start-up time and needs to be designed well. Similar scalability as for vertical wetlands: "Can be built and repaired with locally available materials and local abources" (Horizontal subsurface flow CW SSWM Toolbox) Waterloss	yes Comments/ * as TP removal efficiency * as TP removal efficiency	{Vymazal, 2007 #103 {Vymazal, 2010
construction_parts Transfer Coefficients TP med (R)	PDF, Categorica [cosed from "anniation Technologies TC detabase 2021602. Secondary Effluent 0.586 0.5	TRUE	simple technical special Soilloss 0.411 0.5	(easy = 1, difficult = 0.3) (simple = 1, technical = 0, special = 0) Airioss 0 0	corresponding to the timeframe of "slow" category. (Akanksh Jain) The design of a horizontal subsurface flow constructed wetland depends on the treatment target and the amount and quality of the influent. It includes decisions about the amount of parallel flow paths and compartmentation. The removal efficiency of the wetland is a function of the surface area (length multiplied by width), while the cross-sectional area (width multiplied by depth) determines the maximum possible flow." (Compendium) It is assumed that new wetland beds can be added though it requires a long start-up time and needs to be designed well. Similar scalability as for vertical wetlands is assumed. "Can be built and repaired with locally available materials and local labourers" (Horizontal subsurface flow CW SSWM Toolbox) Waterloss 0 0 0 0	yes Comments/ * as TP removal efficiency * as TP removal efficiency	{Vymazal, 2007 #103 {Vymazal, 2010 #1436} - PA
construction_parts Transfer Coefficients TP med (R)	PDF, Categorica [cooled from "anniation Technologies TC detables 2021602. Secondary Effluent 0.586 0.5 0.577	TRUE	simple technical special Soilloss 0.411 0.5 0.442 0.423	(easy = 1, difficult = 0.3) (simple = 1, technical = 0, special = 0) Airioss 0 0	corresponding to the timeframe of "slow" category. (Akanksh Jain) The design of a horizontal subsurface flow constructed wetland depends on the treatment target and the amount and quality of the influent. It includes decisions about the amount of parallel flow paths and compartmentation. The removal efficiency of the wetland is a function of the surface area (length multiplied by width), while the cross-sectional area (width multiplied by depth) determines the maximum possible flow." (Compendium) It is assumed that new wetland beds can be added though it requires a long start-up time and needs to be designed well. Similar scalability as for vertical wetlands is assumed. "Can be built and repaired with locally available materials and local labourers" (Horizontal subsurface flow CW SSWM Toolbox) Waterloss 0 0 0 0	yes Comments/ * as TP removal efficiency * as TN removal efficiency * as TN removal efficiency	{Vymazal, 2007 #103 {Vymazal, 2010 #1436} - PA {Vymazal, 2007 #103 {Vymazal, 2010 {Vymazal, 2010 }
construction_parts Transfer Coefficients TP med (R)	PDF, Categorica [cooled from "anniation Technologies TC detables 2021602. Secondary Effluent 0.586 0.5 0.577	TRUE	simple technical special Soilloss 0.411 0.5 0.442 0.423	(easy = 1, difficult = 0.3) (simple = 1, technical = 0, special = 0) Airloss 0 0 0	corresponding to the timeframe of "slow" category, (Akanksh Jain) The design of a horizontal subsurface flow constructed wetland depends on the treatment target and the amount and quality of the influent. It includes decisions about the amount of parallel flow paths and compartmentation. The removal efficiency of the wetland is a function of the surface area (length multiplied by width), while the cross-sectional area (width multiplied by depth) determines the maximum possible flow." (Compendium) It is assumed that new wetland beds can be added though it requires a long start-up time and needs to be designed well. Similar scialability as for vertical wetlands is assumed. **Can be built and repaired with locally available materials and local labourers" (Horizontal subsurface flow CW SSWM Toolbox) **Waterloss** **One of the compensation of the compen	yes Comments/ * as TP removal efficiency * as TN removal efficiency * as TN removal efficiency	{Vymazal, 2007 #103 {Vymazal, 2010 #1436} - PA {Vymazal, 2007 #103 {Vymazal, 2010 #1436} {Vymazal, 2010 #1436} {Vymazal, 2010 #1436}
construction_parts Transfer Coefficients TP med (R)	PDF, Categorica [copied from "santation, Technologies, TC, Gatabase, 20216622 Secondary Effluent 0.585 0.57 0.57 0.57	TRUE	simple technical special Soilloss 0.411 0.5 0.46 0.43 0.43	(easy = 1, difficult = 0.3) (simple = 1, technical = 0, special = 0) Alrioss 0 0 0	corresponding to the timeframe of "slow" category. (Akanksh Jain) The design of a horizontal subsurface flow constructed wetland depends on the treatment target and the amount and quality of the influent. It includes decisions about the amount of parallel flow paths and compartmentation. The removal efficiency of the wetland is a function of the surface area (length multiplied by width), while the cross-sectional area (width multiplied by depth) determines the maximum possible flow." (Compendium) It is assumed that new wetland beds can be added though it requires a long start-up time and needs to be designed well. Similar scalability as for vertical wetlands is assumed. "Can be built and repaired with locally available materials and local labourers" (Horizontal subsurface flow CW SSWM Toolbox) Waterloss	yes Comments/ * as TP removal efficiency * as TP removal efficiency * as TN removal efficiency * as TN removal efficiency * as TN removal efficiency	{Vymazal, 2007 #103 {Vymazal, 2010 #1436} PA {Vymazal, 2010 #1436} Quite PA {Vymazal, 2007 #103 {Vymazal, 2010 #1436} }
construction_parts Transfer Coefficients TP med (R) k TN	PDF, Categorica [copied from *samitation_Technologies_16_database_20210622 Secondary Effluent 0.586 0.5 0.577 0.577	TRUE Name Range 0.5 - 0.589 (0.689)	simple technical special Soilloss 0.411 0.5 0.46 0.423 0.43 0.43	(easy = 1, difficult = 0.3) (simple = 1, technical = 0, special = 0) Airloss 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	corresponding to the timeframe of "slow" category. (Akanksh Jain) The design of a horizontal subsurface flow constructed wetland depends on the treatment target and the amount and quality of the influent. It includes decisions about the amount of parallel flow paths and compartmentation. The removal efficiency of the wetland is a function of the surface area (length multiplied by width), while the cross-sectional area (width multiplied by depth) determines the maximum possible flow." (Compendium) It is assumed that new wetland beds can be added though it requires a long start-up time and needs to be designed well. Similar scalability as for vertical wetlands is assumed. "Can be built and repaired with locally available materials and local labourers" (Horizontal subsurface flow CW SSWM Toolbox) Waterioss 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	yes Comments/ * as TP removal efficiency * as TP removal efficiency * as TN removal efficiency * as TN removal efficiency * as TN removal efficiency * as TN removal efficiency * NH3 volatilization of CW treating swine manure	{Vymazal, 2007 #10:3 {Vymazal, 2010 #1436} - PA {Vymazal, 2010 #10:3 {Vymazal, 2007 #10:3 {Vymazal, 2010 #1436} {Vymazal, 2010 2010 #1436}
construction_parts Transfer Coefficients TP med (R) med (R) bal.	PDF, Categorica [copied from "Sanitation_Technologie_TC_database_20210622 Secondary Effluent 0.586 0.5 0.577 0.57 0.67	TRUE Sition*) Range	simple technical special Soilloss 0.411 0.5 0.46 0.43 0.43	(easy = 1, difficult = 0.3) (simple = 1, technical = 0, special = 0) Airloss 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	corresponding to the timeframe of "slow" category. (Akanksh Jain) "The design of a horizontal subsurface flow constructed wetland depends on the treatment target and the amount and quality of the influent. It includes decisions about the amount of parallel flow paths and compartmentation. The removal efficiency of the wetland is a function of the surface area (length multiplied by width), while the cross-sectional area (width multiplied by depth) determines the maximum possible flow." (Compendium) It is assumed that new wetland beds can be added though it requires a long start-up time and needs to be designed well, Similar scalability as for vertical wetlands is assumed. "Can be built and repaired with locally available materials and local labourers" (Horizontal subsurface flow CW SSWM Toolbox) Waterloss 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	yes Comments/ * as TP removal efficiency * as TP removal efficiency * as TN removal efficiency * as TN removal efficiency * as TN removal efficiency * NHS wolatilization of CW treating swine manure	{Vymazal, 2007 #103 (Vymazal, 2010 #1436} - PA (Vymazal, 2007 #103 (Vymazal, 2010 #1436) + 1436} Poach et al. (2002)
construction_parts Transfer Coefficients TP med (R.)	PDF, Categorica (copied from "sanitation_Technologies_TC_database_2021062) Secondary Effluent 0.588 0.5 0.57 0.57 0.57	TRUE Range 0.5 - 0.589 0.089 0.07 - 0.67	Simple technical special Sollioss 0.411 0.5 0.423 0.433 0.43	(easy = 1, difficult = 0.3) (simple = 1, technical = 0, special = 0) Airloss 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	corresponding to the timeframe of "slow" category. (Akanksh Jain) "The design of a horizontal subsurface flow constructed wetfand depends on the treatment target and the amount and quality of the influent. It includes decisions about the amount of parallel flow paths and compartmentation. The removal efficiency of the wetland is a function of the surface area (length multiplied by width), while the cross-sectional area (width multiplied by depth) determines the maximum possible flow." (Compendium) It is assumed that new wetland beds can be added though it requires a long start-up time and needs to be designed well. Similar scalability as for vertical wetlands is assumed. "Can be built and repaired with locally available materials and local labourers" (Horizontal subsurface flow CW SSWM Toolbox) Waterloss 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	yes Comments/ * as TP removal efficiency * as TP removal efficiency * as TN removal efficiency * as TN removal efficiency * as TN removal efficiency * NHS wolatilization of CW treating swine manure	{Vymazal, 2007 #103 (Vymazal, 2010 #1436} PA (Vymazal, 2010 #1436} (Vymazal, 2010 #1436) (Vymazal, 2010 #1436) Poach et

						_	
	0.82	0.75 - 0.97	0	0.15		* ET rates given	Consoli et
							al. (2018)
	-		0.03				PA
med (R)	0.81	0.73 - 0.97	0.03	0.16	(Spuhler et
							al. (2021)
bal.	0.81	-	0.03	0.16	(-
k		[0.24]					
TS	0.66		0.34	0	(* TSS removal = 80 - 95 %, TS estimated from	Conradin
						ratio in 30.2.1	et al. (2010)
	0.71	-	0.29	0		* TSS removal 75%; TS estimated from ratio	(Vymazal,
						in 30.2.1	2010
							#1436}
med (R)	0.69	0.66 - 0.71	0.32	0)	-
bal.	0.68		0.32	0)	-
k		[0.05]					PA

Additional Information

Usually the removal efficiency stands for the fraction of the substance retained in the sludge. However, since constructed wetlands do not carry sludge as an output product (but biomass), the removal rate represents the soil loss. It has to be taken into account that if the resulting biomass of a wetland is used for alternative products,

30.2.1	Data from Chandrakanth et al. (2016)				
	lation TS - TSS - TDS in lab scale Ratio to TS				
	experiment CW				
Removal TS	0.1563				
Removal TSS	0.4	0.39			
Removal TDS	0.1111	1.41			

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rtical Flow Constructed We						
	Values	Data Source				
FUNCTIONAL GROUP UNIQUE IDENTIFIER (ID)			+			
DATA COMPILER	Julian Fritzsche					
INPUT PRODUCT	blackwater, transportedblackwater, effluent, transportedeffluent, greywater,	Tilley, E. et al. (2014)				
OUTPUT PRODUCT	effluent, transportedeffluent, greywater, secondary_effluent, transportedsecondary_effluent	Tilley, E. et al. (2014)				
RELATIONS		Tilley, E. et al. (2014)				
COMMENTS Filter Criteria	Values	Data Source				
		Tilley, E. et al. (2014)				
capex_req_level		Spuhler, D. et al. (2021)				
opex_req_level technical_maturity	3	Spuhler, D. et al. (2021) Tilley, E. et al. (2014) Gensch, R. et al. (2018)				
	development/recovery = 1)		Cotonomics (their)	Tarker day (Malaya (Data)	Data Source / Assumptions	Internal Berline Berna
ening Criteria water_supply	Type and Function Performance, Categorical	Applicable for this Functional Group? FALSE	Categories [Unit] house	Technology Values (Data) NA	NA	Internal Review Done? NA
			yard public			
water_volume	Performance, Trapez	FALSE	none [L/cap/day]	NA .	NA	NA .
electricity_supply	Performance, Categorical		electricity intermittent no electricity	(electricity = 1, intermittent = 0, no electricity = 0)	"Because of the mechanical dosing system, this technology is most appropriate where trained maintenance staff, constant power supply, and spare parts are available."	
					(Compendium) Constant power supply should be provided.	
fuel_supply	Performance, Categorical	FALSE	fuel no fuel	NA	NA	NA NA
frequency_of_om	PDF, Categorical	TRUE	irregular regular	(irregular = 0.3, regular = 0.7, continuous = 0)	"Less clogging than in a Horizontal Subsurface Flow	yes
			continuous		Constructed Wetland" (Compendium) Clogging and therefore maintenance should happen less often than for a Horizontal Subsurface Flow Constructed Wetland.	
pipe_supply	Performance, Categorical	TRUE	no pipes difficultly available pipes	(no pipes = 0.5, difficultly available = 0.75, pipes = 1)	"A ventilation pipe connected to the drainage system can contribute to aerobic conditions in the filter." Inlet and outlet drainage pipes for effluent are required. (Compendium) Additionally ventilation pipes might be	yes
pump_supply	Performance, Categorical		no pumps difficultly available pumps		necessary. "In vertical filter beds wastewater is intermittently applied (either by pump or self-acting syphon device)", "Therefore, vertical filters always need pumps or at least siphon pulse loading, whereas horizontal flow constructed wetlands can be operated without pumps (if topography alwos)," "Electricity pumps may be necessary", "Even distribution on a filter bed requires a well-functioning pressure distribution with pump or siphon." (SSWM Toolbox) The mechanical dosing system does not necessarily require a pump, however a pump will perform better than as syphon device.	yes
concrete_supply	Performance, Categorical	TRUE	no concrete difficultly available concrete		"Each filter should have an impermeable iner and an effluent collection system." (Compendium) Technology should be watertight, but it is not stated that the liner is made from concrete. It is assumed that similar to the other wetland technologies, no concrete is required.	yes
spare_parts	PDF, Categorical	TRUE	simple technical special			yes
0		FALSE	0	NA		NA
0	0	FALSE	0	NA	NA	NA
0 temperature		FALSE TRUE	very cold cold temperate warm hot	warm = 1, hot = 1)	NA The performance depending on the temperature is assumed to be comparable to other wetlands. However, less space is required for warmer climates (annual average >20° C) (SSWM Toolbox) "Not very tolerant to cold climates," i'n cold climates (annual average < 10°C), an area of 4 m2/p.e. is necessary. In warmer climates (annual average > 20°C), 1.2 m2/p.e. is enough, if the filter is designed correctly (HOFFMANN et al. 2011)." (SSWM Toolbox)	NA yes

flooding	Performance, Categorical	TRUE	flooding no flooding	(flooding = 0.6, no flooding = 1)	Assumed to be comparable to a WSP. "Constructed wetlands are also used as a flood protection measure." (Stefanakis, 2019) This is a technology that is necessarily built on the ground surface and its raised configuration is not possible, (e.g., all pond-based, wetlands, drying beds etc.). Note: All pond-based, wetlands, drying beds etc.). Note: Honologies are allotted similar performance values. Their functioning can be severely disrupted by flooding events. However, it is possible that they can be protected from flooding by building embankments or mounds of adequate height around them. Since a flood-preventive configuration of the technology is possible, it allotted a performance of 50%. Process wise, flooding or entry of surface run-off can be considered to be more critical for drying beds than ponds and wetlands, therefore technologies of the latter two type are awarded as lightly higher performance of 60% (Akanksha Jain)	yes
vehicular_acces	Performance, Categorical	FALSE	no access difficult	NA	NA	NA
slope	Performance, Categorical	FALSE	full	NA	NA	NA
soil_type	Performance, Categorical		not flat clay	NA .	NA	NA .
soii_type	. Ferrormance, categorical	1 / New York	silt			1975
			sand gravel			
			rock			
groundwater_depth excavation			water depth [m] easy	NA (easy = 1, hard = 0.5)	NA Assuming that shallow and wide excavation	NA yes
			hard		is necessary.	
surface_area_onsite	Performance, Trapez	FALSE	[m2/plot]	NA	NA	NA
surface_area_offsite	Performance, Trapez	TRUE	m2/pers	(a = 1.2, b = 1.2, c = 999, d = 999)	Requires at least 1.2 m2/cap.	
					From Table 1.3 (Dotro et al. 2017)	
0		FALSE	0	NA NA	NA	NA
0		FALSE FALSE		NA NA	NA NA	NA NA
drinking_water_exposure	Performance, Categorical	FALSE	Close Not close	NA	NA	NA
0	0	FALSE		NA .	NA .	NA .
Construction skills		FALSE		NA	NA "Requires expect design and construction	NA vec
construction_skills	Performance, Categorical	IKUE	Ladder: unskilled	(unskilled = 0, skilled = 0, professional = 1)	"Requires expert design and construction, particularly, the dosing system"	yes
			skilled professional		(Compendium)	
			professional		High construction and design skills necessary.	
design_skills om_skills			Ladder: unskilled skilled professional	(unskilled = 0, skilled = 0, professional = 1) (unskilled = 0.5, skilled = 1, professional = 1)	"Requires expert design and construction, particularly, the dosing system" (Compendium) High construction and design skills necessary.	yes
			Unskilled Skilled Professional		The operation and maintenance is not very elaborate.	
0		FALSE FALSE	0	NA NA	NA NA	NA NA
0	0	FALSE		NA NA		NA NA
cleansing_method		FALSE	Washers 0	NA NA	NA NA	NA NA
cleansing_method	renormance, categorical	TAGE	Soft wipers	NA .	NA .	NA .
0	0	FALSE	Hard wipers	NA .	NA	NA
0	0	FALSE	0	NA	NA	NA NA
lifetime	Performance, Categorical		short (c 1 year) medium (1-5 years) long (>5 years)	(short = 1, medium = 1, long = 1)	"Long service life" (Emersan) "Life expectancy for the pumps and pump equipment and for the siphon is assumed to be 10 y. [] All other Items such as filter material, plant cover, liner, drain pipes in the filter, manholes, piping between the beds and the pump station are expected to last for 25 years." [Assessments in Ethiopia expect 20 years [lettlem, in Kenia 20-25 years and a study in Morocco suggests a replacement of the filter material every 8- 15 years.] (VFCW Griesauer, C. (2014) in a study by Gresauer on the CLARA planning tool the expected lifetimes for VFCWs were larger than 5 years.	yes
speed_implement_toilet	t PDF, Categorical	FALSE	rapid (< 3 days) moderate (3 days to 2 weeks)	NA	NA	NA
speed_implement_treatment	PDF, Categorical	TRUF	slow (> 2 weeks) rapid (few days to a week)	(rapid=0, moderate=0, slow=1)	"In principle, Constructed Wetlands can be	ves
			moderate (few weeks up to three months) slow (> 3 months)		built using locally available material, however, availability of 3 and and gravel (with required grain size distribution and cleanliness) is often a problem. Additional materials include a liner or clay, wetland plants, and a syphon or pump for intermittent loading. They are typically not suit able for pre-fabrication." "Wetland plants take time to become established, therefore the start-up time for Constructed Wetlands is quite long. Thus this technology is not suitable for the acute response phase but for the stabilisation and recovery periods and as a longer-term solution." (Energan Compendium)	

scalability							
construction_parts	Performance, Categorical PDF, Categorical		easy difficult simple technical special		"Scale/Scalability: CW have a relatively large footprint area per volume treated; The CW technology can be scaled up to municipal scale however the area required will be the limiting factor; Care is need at larger scale to ensure good distribution of influent and avoid short circuiting; targe-scale CW are normally made up of smaller CW beds with attenating use" (Abbott, J. et al. (2019)) It is assumed that new wetland beds can be added though it requires a long start-up time and needs to be designed well (avoid sort-circuiting." Not all parts and materials may be locally avoid to the control of the	yes	
	(copied from "Sanitation_Technologies_TC_database_20210622					,	
	Secondary Effluent	Range	Soilloss	Airloss	Waterloss	Comments	Reference
TP	0.405	-	0.595	0		* as TP removal efficiency	{Vymazal, 2007 #103}
	0.44			0		* as TP removal efficiency	{Vymazal, 2010 #1436}
med (R)	0.42	0.405 - 0.44		0	C	·	2010 #1436}
med (R)	0.42 100	0.405 - 0.44		0		·	2010
med (R) k TN	0.42 100 0.554	0.405 - 0.44	0.58 0.446	0	c	* as TN removal efficiency	2010 #1436} - PA {Vymazal, 2007 #103}
k TN	0.42 100 0.554 0.57	0.405 - 0.44 (0.035)	0.58 	0	c c	* as TN removal efficiency * as TN removal efficiency	2010 #1436} - PA {Vymazal,
k	0.42 100 0.554 0.57	0.405 - 0.44 [0.035]	0.58 0.446	0	c	* as TN removal efficiency * as TN removal efficiency	2010 #1436} - PA {Vymazal, 2007 #103} {Vymazal, 2010 #1436}
R med (R)	0.425 1007 0.554 0.57 0.56	0.405 - 0.445 (0.035) - - - - - - - - - - - - - - - - - - -	0.58 	0	c c	* as TN removal efficiency * as TN removal efficiency	2010 #1436} - PA {Vymazal, 2007 #103} {Vymazal, 2010 #1436} -
k TN	0.42 100 0.554 0.57 0.56 100	0.405 - 0.44 (0.035) 	0.58 	0	c c	* as TN removal efficiency * as TN removal efficiency	2010 #1436} - PA {Vymazal, 2007 #103} {Vymazal, 2010 #1436}
R med (R)	0.425 1007 0.554 0.57 0.56	0.405 - 0.44 (0.035) 	0.58 	0	c c	* as TN removal efficiency * as TN removal efficiency	2010 #1436} - PA {Vymazal, 2007 #103} {Vymazal, 2010 #1436} -
# TN med {R}	0.42 1000 0.554 0.55 0.55 1000 0.8	0.405 - 0.44 (0.035) - - - - - - - - - - - - - - - - - - -	0.58 	0 0 0 0.16 0.15	c c	* as TN removal efficiency * as TN removal efficiency Adapted from "horizontal_wetland"	2010 #1436} - PA (Vymazal, 2007 #103} (Vymazal, 2010 #1436} - PA
# TN med (R) # H2O med (R) # H2O	0.42 200 0.554 0.57 0.56 1000 0.82	0.405 - 0.44 (0.035) 	0.58 0.446 0.43 0.44	0 0 0.16 0.15 -		* as TN removal efficiency * as TN removal efficiency Adapted from "horizontal_wetland" Adapted from "horizontal_wetland" Adapted from "horizontal_wetland"	2010 #1436} PA {Vymazal, 2007 #103} {Vymazal, 2010 #1436} PA PA
# TN med {R}	0.42 1000 0.554 0.55 0.55 1000 0.8	0.405 - 0.446 [0.035] 	0.58 	0 0 0.16 0.15 -	c c	* as TN removal efficiency * as TN removal efficiency Adapted from "horizontal_wetland" Adapted from "horizontal_wetland" Adapted from "horizontal_wetland"	2010 #1436) PA {Vymazal, 2007 #103} {Vymazal, 2010 #1436} PA PA PA
# TN med {R} # H2O med {R} # bal.	0.42 100 0.554 0.57 0.56 100 0.8 0.82	0.405 - 0.44 (0.035) 	0.58 0.446 0.43 0.44 0.44 0.03 0.03	0 0 0.16 0.15 -		* as TN removal efficiency * as TN removal efficiency * as TN removal efficiency Adapted from "horizontal_wetland" Adapted from "horizontal_wetland" Adapted from "horizontal_wetland"	2010 #1436) - - PA (Vymazal, 2007 #103) (Vymazal, 2010 #1436) - PA PA PA PA
## TN med (R) ## ## ## ## ## ## ## ## ## ## ## ## ##	0.42 1000 0.554 0.55 1000 0.81 0.82 0.83 0.83 0.83	0.405 - 0.44 (0.035) 0.554 - 0.57 (0.016) 0.95 - 0.73 0.75 - 0.97 0.73 - 0.97	0.58 	0 0 0.16 0.15 0.16 0.16		* as TN removal efficiency * as TN removal efficiency * as TN removal efficiency Adapted from "horizontal_wetland" Adapted from "horizontal_wetland" Adapted from "horizontal_wetland" * from 39.2.2	2010 #1436) PA {Vymazal, 2007 #103} {Vymazal, 2010 #1436} PA PA PA
# TN med {R} # H2O med {R} # bal.	0.42 100 0.554 0.57 0.56 100 0.8 0.82	0.405 - 0.44 (0.035) 0.554 - 0.57 (0.016) 0.95 - 0.73 0.75 - 0.97 0.73 - 0.97	0.58 0.446 0.43 0.44 0.44 0.03 0.03	0 0 0.16 0.15 0.16 0.16		* as TN removal efficiency * as TN removal efficiency * as TN removal efficiency Adapted from "horizontal_wetland" Adapted from "horizontal_wetland" Adapted from "horizontal_wetland" * from 39.2.2	2010 #1436)
## TN med (R) ## ## ## ## ## ## ## ## ## ## ## ## ##	0.42 1000 0.554 0.55 1000 0.81 0.82 0.83 0.83 0.83	0.405 - 0.44 (0.035) 0.554 - 0.57 (0.016) 0.95 - 0.73 0.75 - 0.97 0.73 - 0.97	0.58 	0 0 0.16 0.15 0.16 0.16		* as TN removal efficiency * as TN removal efficiency * as TN removal efficiency Adapted from "horizontal_wetland" Adapted from "horizontal_wetland" Adapted from "horizontal_wetland" * from 39.2.2	2010 #1436} - - - - - - - - - - - - - - - - - - -

Additional Information

Usually the removal efficiency stands for the fraction of the substance retained in the sludge. However, since constructed wetlands do not carry sludge as an output product (but biomass), the removal rate represents the soil loss. It has to be taken into account that if the resulting biomass of a wetland is used for alternative products,

30.7.2 | Data Score - Dumascal - 2010 #1436|

33.2.2	Data Iroin. (vyinazai, 2010 #1450)
	Removal [%]
TSS	89
Ratio TSS:TS (from	
horizontal_wetland)	0.39
TS (from TSS)	34.71

Reference, R., Jennings, A., Rengell, S., & Reymond, P. (2018). Compendium of Sanitation Technologies in Emergencies. German WASH Network (GWN), Swiss Federal Institute of Aquatic Science and Technology (Eawag), Global WASH Cluster (GWC) and Sustainable Sanitation systems in developing countries. Socio-Ceromic Planning Science, 3-6 (4), 267–290. https://doi.org/10.1016/S0038-0121(02)00007-1
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Aerated Pond							
General Information	Values	Data Source					
FUNCTIONAL GROUP UNIQUE IDENTIFIER (ID)	T	-					
DATA COMPILER	Julian Fritzsche	<u> </u>					
	transportedblackwater,	Tilley, E. et al. (2014)					
OUTPUT PRODUCT	transportedgreywater, transportedsludge,	Tilley, E. et al. (2014)					
	transportedsecondary_effluent						
RELATIONS	Output: AND	Tilley, E. et al. (2014)					
COMMENTS Pro Filter Critoria		Data Source					
	Values (household = 0, neighbourhood = 0.5,	Data Source Tilley, E. et al. (2014)					
	city = 1)						
management_level capex_req_level	(household = 0, shared = 0.5, public = 1)	Tilley, E. et al. (2014) Spuhler, D. et al. (2021)					
opex_req_level	4	Spuhler, D. et al. (2021)					
technical_maturity	(acute = 0, stabilisation = 1,	Tilley, E. et al. (2014) Adapted from Waste stabilisation ponds					
acveropment_pnase	development/recovery = 1)	(WSP), since the configuration is similar					
		to a large extent. (Akanksha Jain based					
Screening Criteria	Type and Function	on Gensch, R. et al. (2018)) Applicable for this Functional Group?	Categories [Unit]	Technology Values (Data)	Data Source / Assumptions	Internal Review Done?	
water_supply	Performance, Categorical		house	NA	NA	NA	
			yard public				
			none				1
water_volume electricity_supply	Performance, Trapez Performance, Categorical	FALSE TRUF	[L/cap/day] electricity	NA (electricity = 1, intermittent = 0, no	NA "High energy consumption, a constant	NA yes	†
electricity_supply	renormance, categorical		intermittent	electricity = 1, intermittent = 0, no electricity = 0)	source of electricity is required"	,	
	Dankarana o	ENICE	no electricity		(Compendium)	NA.	1
fuel_supply	Performance, Categorical	FALSE	fuel no fuel	NA	NA	NA	
frequency_of_om	PDF, Categorical	TRUE	irregular	(irregular = 0, regular = 0.5, continuous =	"Permanent, skilled staff is required to	yes	Ī
			regular continuous	0.5)	maintain and repair aeration machinery and the pond must be desludged every 2		
					to 5 years." (Compendium)		
					Regular to continuous maintenance is		
					required.		
pipe_supply	Performance, Categorical	TRUE	no pipes	(no pipes = 0.5, difficultly available =	In- and outlet pipes are required.	yes	İ
			difficultly available pipes	0.75, pipes = 1)			
pump_supply	Performance, Categorical	TRUE	no pumps	(no pumps = 1, difficultly available = 1,	No pumps are necessary.	yes	†
,			difficultly available	pumps = 1)			
concrete_supply	Performance, Categorical	TRUE	pumps no concrete	(no concrete = 1, difficultly available = 1,	"To prevent leaching, the pond should	yes	†
			difficultly available	concrete = 1)	have a liner. This can be made from clay,		
			concrete		asphalt, compacted earth, or any other impervious material. A protective berm		
					should be built around the pond, using		
					the fill that is excavated, to protect it		
					from runoff and erosion." (Compendium) Technology should be watertight, but the		
					liner does not appear to be made from		
					concrete. No concrete required.		
spare_parts	PDF, Categorical	TRUE	simple	(simple = 0.6, technical = 0.4, special = 0)	"Not all parts and materials may be	yes	†
<u>-</u>	, ===goricu		technical		locally available", "To prevent leaching,		
			special		the pond should have a liner. This can be		
					made from clay, asphalt, compacted earth, or any other impervious		
					material.", "Mechanical aerators provide		
					oxygen and keep the aerobic organisms suspended and mixed with water to		
					achieve a high rate of organic		
					degradation.", " It is especially important that electricity service is uninterrupted		
					and that replacement parts are available		
					to prevent extended downtimes that		
					may cause the pond to turn anaerobic." (Compendium)		
					Technical spare parts are required and		
					should be accessible quickly. Some simple spare parts might also be required.		
					Simple spare parts might also be required.		
		FALCE			ALA.	NA.	1
0		FALSE FALSE		NA NA	NA NA	NA NA	†
0	0	FALSE	0	NA	NA	NA	‡
temperature	Performance, Categorical		very cold	(very cold = 0.7, cold = 0.9, temperate =	"Aerated lagoons can function in a larger	yes	
			cold temperate	1, warm = 1, hot = 1)	range of climates than Waste Stabilization Ponds (T.5) ", " As well,		
			warm		because oxygen is introduced by the		
			hot		mechanical units and not by light-driven		
					photosynthesis, the ponds can function in more northern climates"		
					(Compendium)		
					Performance in lower temperatures is assumed to be higher than the		
					performance of a WSP.		1
flooding	Performance, Categorical	TRUE	flooding	(flooding = 0.6, no flooding = 1)	It is assumed that aerated ponds are as	yes	
			no flooding		prone to flooding as WSPs.		
					This is a technology that is necessarily		
					built on the ground surface and its raised		
					configuration is not possible. (e.g., all pond-based, wetlands, drying beds etc.).		
					Note: All pond-based/wetland/drying		
					bed technologies are allotted similar performance values. Their functioning		
					can be severely disrupted by flooding		
					events. However, it is possible that they		
					can be protected from flooding by building embankments or mounds of		
					adequate height around them. Since a		
					flood-preventive configuration of the		
					technology is possible, it is allotted a performance of 50%. Process wise,		
					flooding or entry of surface run-off can		
					be considered to be more critical for		
					drying beds than ponds and wetlands, therefore technologies of the latter two		
					type are awarded a slightly higher		
					performance of 60% (Akanksha Jain)		
vehicular_acces	Performance, Categorical	FALSE	no access	NA	NA	NA	†
			difficult				
slope	Performance, Categorical	FALSE	full	NA	NA	NA	†
	I		not flat	I .	1	İ	ĺ
			not nat	ļ	-		1

soil_type	Performance, Categorical	FALSE	clay	NA	NA	NA	Ī	ĺ
			silt					
			sand gravel					
			rock					
groundwater_depth excavation	Performance, Trapez Performance, Categorical		water depth [m] easy	NA (easy = 1, hard = 0.5)	NA Assuming that shallow and wide	NA ves		
excavation			hard	(easy = 1, nard = 0.5)	excavation is necessary.	yes		
surface_area_onsite	Performance, Trapez	FALSE	[m2/plot]	NA	NA	NA		
surface_area_offsite	Performance, Trapez		m2/pers	(a = 1.5, b = 1.5, c = 999, d = 999)	From European Commission (2001).			
0		FALSE FALSE		NA NA	NA NA	NA NA		
0		FALSE		NA NA	NA NA	NA NA		
drinking_water_exposure	Performance, Categorical	FALSE	Close	NA	NA	NA		
0	0	FALSE	Not close	NA	NA	NA		
0	0	FALSE	0	NA	NA	NA		
construction_skills	Performance, Categorical	TRUE	Ladder: unskilled	(unskilled = 0, skilled = 0.5, professional = 1)	"Requires expert design and construction" (Compendium)	yes		
			skilled	•	Construction and design is slightly more			
design_skills	Performance, Categorical	TRUF	professional Ladder:	(unskilled = 0, skilled = 0, professional = 1)	elaborate than for a WSP. "Requires expert design and	yes		
8-2			unskilled	, , , , , , , , , , , , , , , , , , ,	construction" (Compendium)	,		
			skilled professional		Construction and design is slightly more elaborate than for a WSP.			
om_skills	Performance, Categorical	TRUE	Ladder:	(unskilled = 0, skilled = 1, professional = 1)		yes		
			Unskilled Skilled		"Requires operation and maintenance by skilled personnel" (Compendium)			
			Professional		O&M is more elaborate than for a WSP.			
0		FALSE FALSE		NA NA	NA NA	NA NA		
0	0	FALSE	0	NA	NA	NA		
0 cleansing_method	0 Performance, Categorical	FALSE	Washers	NA NA	NA NA	NA NA		
cieansing_metilod	r enormatice, categorical		Soft wipers					
0		FALSE	Hard wipers	NA NA	NA .	NA .	1	
0	0	FALSE	0	NA NA	NA	NA		
lifetime	Performance, Categorical		short (< 1 year)	(short = 1, medium = 1, long = 1)	"Pond must be desludged every 2 to 5	yes		
			medium (1-5 years) long (>5 years)		years" (Emersan) The large desludging rate suggests that			
					the technology is meant for a long			
speed_implement_toilet	PDF, Categorical	FALSE	rapid (< 3 days)	NA .	service life. NA	NA .		
-p-sap.c.menc_tollet	7 DI , Categorical		moderate (3 days to 2 weeks)					
speed_implement_treatment	PDF, Categorical	TRUF	slow (> 2 weeks) rapid (few days to a week)	(rapid=0, moderate=1, slow=0)	"Not all parts and materials may be	yes		
speed_implement_treatment	PDF, Categorical	INDE	moderate (few weeks up to three	(rapid=0, moderate=1, slow=0)	locally available" "An aerated pond is a	yes		
			months)		large, mixed, aerobic reactor."			
			slow (> 3 months)		(Compendium) Construction simple however, since			
					bricks and/or concrete is used for			
					construction, minimum 7 days curing is required- and since no prefab units are			
					available, probability is allotted only to			
					moderate category and not rapid. (Akanksha Jain)			
scalability	Performance, Categorical	TRUE	easy	(easy = 1, difficult = 0.5)	"Requires expert design and	yes		
			difficult		construction", "Resistant to organic and			
					hydraulic shock loads" (Compendium) To scale up the technology for a larger			
					number of new users further ponds can			
					be built and used in parallel, if sufficient land is available. Compared to waste			
					stabilization pond systems, they need			
					fewer ponds which need to be dug less			
					deep (2-5m). This allows easier upscaling. (Kukka Ilmanen, Eawag 2021)			
					(
construction_parts	PDF, Categorical	TRUE	simple	(simple = 0.6, technical = 0.4, special = 0)	"Not all parts and materials may be	yes		
	,		technical	(locally available", "To prevent leaching,	,		
			special		the pond should have a liner. This can be made from clay, asphalt, compacted			
					earth, or any other impervious			
					material.", "Mechanical aerators provide			
					oxygen and keep the aerobic organisms suspended and mixed with water to			
					achieve a high rate of organic			
					degradation.", "It is especially important that electricity service is uninterrupted			
					and that replacement parts are available			
					to prevent extended downtimes that			
					may cause the pond to turn anaerobic." (Compendium)			
					A liner is required for an aerated pond			
					and can be built with locally available material. Mechanical equipment			
					required for digging and constructing the			
					Aerated Pond. Aerators and pumps will require technical parts.			
Transfer C ff - l- :	(copied from "Sanitation_Technologies_TC_database_202106	22 xlsm")						
Transfer Coefficients	Sludge	, ' '	Secondary Effluent	Airloss	Soilloss	Waterloss	Comments	Reference
TP	0.494	-	0.506	C	0	0	* as TP	{Kakiichi,
	0.864	-	0.136	C	0	0	* as TP	1990 {Kakiichi,
								1990
	0.891		0.109				* as TP	{Kakiichi, 1990
	0.19		0.81	C	0	0	* as TP	(Hannah, 1986
med (R)	0.68		0.32	C	0	0		-
k TN	0.68	[0.701]	0.32				* as TKN	PA {Del Nery,
"					0	0		2002
			0.5	C	0	0	* as TKN	(Oleszkiewi cz, 1986
	0.5	-						
	0.5	-	0.57	C	0	0	* as TN	{Koottatep,
	0.43	-				0		1993
	0.43	-	0.348	C	0		* as TN	1993 {Kakiichi, 1990
	0.43	-		C	0			1993 {Kakiichi,
	0.43	-	0.348	C	0		* as TN	1993 {Kakiichi, 1990 {Kakiichi, 1990 {Kakiichi,
	0.452 0.652 0.908	-	0.348 0.092 0.058	C	0		* as TN * as TN * as TN	1993 (Kakiichi, 1990 (Kakiichi, 1990
	0.43 0.652 0.908 0.942	-	0.348 0.092 0.058	c	0		* as TN * as TN	1993 {Kakiichi, 1990 {Kakiichi, 1990 {Kakiichi, 1990
med (R)	0.452 0.652 0.908	0.02 - 0.942	0.348 0.092 0.058	c	0		* as TN * as TN * as TN * as TN * as TKN	1993 {Kakiichi, 1990 {Kakiichi, 1990 {Kakiichi, 1990 {Hannah,
	0.43 0.652 0.908 0.942 0.02 0.655	-	0.348 0.092 0.058	c	0	0	* as TN * as TN * as TN * as TN Spuhler et adapted	1993 {Kakiichi, 1990 {Kakiichi, 1990 {Kakiichi, 1990 {Hannah,
k	0.43 0.652 0.908 0.942 0.02 0.655	0.02 - 0.942	0.348 0.092 0.058 0.98	c	0	0	* as TN * as TN * as TN * as TN Spuhler et	1993 {Kakiichi, 1990 {Kakiichi, 1990 {Kakiichi, 1990 {Hannah,
k	0.43 0.652 0.908 0.942 0.02 0.655	0.02 - 0.942	0.348 0.092 0.058 0.98	C	0	0	* as TN * as TN * as TN * as TKN Spuhler et adapted from "activated"	1993 {Kakiichi, 1990 {Kakiichi, 1990 {Kakiichi, 1990 {Hannah,
k H2O	0.43 0.652 0.908 0.942 0.02 0.655 0.001	0.02 - 0.942	0.348 0.092 0.058 0.98 0.35	C	0	0	* as TN * as TN * as TN * as TKN Spuhler et adapted from "activated"	1993 (Kakiichi, 1990 (Kakiichi, 1990 (Kakiichi, 1990 (Hannah, 1986
k	0.43 0.652 0.908 0.942 0.02 0.655 0.001	0.02 - 0.942	0.348 0.092 0.058 0.98 0.35	C		0 0 0	* as TN * as TN * as TN * as TKN * as TKN Spuhler et adapted from "activated	1993 (Kakiichi, 1990 (Kakiichi, 1990 (Kakiichi, 1990 (Hannah, 1986

k	0.5	[0.99]					PA
TS	0.33	-	0.67	0	0	0 * from	{Hannah,
						36.2.1	1986
	0.22	0.21 - 23	0.78	0	0	0 * from	{Abdel-
						36.2.2	Shafy, 2011
med (R)	0.28	0.21 - 0.33	0.72	0	0	0	
k	25	[0.12]					PA
Additional Information							
	Data from: {Hannah, 1986 #1431}						
	Min. Removal [%]						
TSS	85						
Ratio TSS:TS (from							
horizontal_wetland)	0.39						
TS (from TSS)	33.15						
	Data from: {Abdel-Shafy, 2011 #1432}						
		Max. Removal [%]					
TSS Ratio TSS:TS (from	53.1	57.8					
	2007	2007					
horizontal_wetland) TS (from TSS)	39% 20.709	39% 22.542					
13 (110111 133)	20.709	22.342					
References							
	S., & Reymond, P. (2018), Compendium of Sani	tation Technologies in Emergencies . German W.	ASH Network (GWN). Swiss Federal Institute of Aquat	ic Science and Technology (Eawag), Global WASH Cluste	r (GWC) and Sustainable Sanitation Alliance (SuSanA).		Т
			omic Planning Sciences , 36 (4), 267-290. https://doi.o		, , , , , , , , , , , , , , , , , , , ,		
				r Development Countries (Sandec), Swiss Federal Institu	te of Aquatic Science and Technology (Eawag), Dübend	orf. Switzerland	
			coefficients . Eawag - Swiss Federal Institute of Aquation			,	
		wastewater treatment and restricted reuse." Jou					
		stewater Treatment Processes." Journal (Water					
			waste water." Japanese Journal of Zootechnical Science	re 61(6): 527-532			
		Aerated Lagoon." Water Science and Technology					
		ng piggery wastes." Agricultural Wastes 16(3): 1					
		d-facultative pond at a poultry slaughterhouse.					
		ment Processes. Luxembourg, Office of official p					
			rised edition . Swiss Federal Institute of Aquatic Science	e and Technology (FAWAG).			
	,, (2014). Compendian	, and the state of	and an incident of Addition Services				

0.5

stabilities fillers						
	Values	Data Source				
FUNCTIONAL GROUP UNIQUE IDENTIFIER (ID)			_			
DATA COMPILER	Julian Fritzsche					
INPUT PRODUCT	transportedblackwater, transportedgreywater,	Tilley, E. et al. (2014)				
OUTPUT PRODUCT	transportedsludge,	Tilley, E. et al. (2014)				
RELATIONS	transportedsecondary_effluent	Tilley, E. et al. (2014)	_			
	Output: AND	Tilley, L. et al. (2014)				
COMMENTS						
e-Filter Criteria applicability_level	Values (household = 0, neighbourhood = 0.5,	Data Source Tilley, E. et al. (2014)				
	city = 1)					
management_level capex_req_level	(household = 0, shared = 0, public = 1)	Tilley, E. et al. (2014) Spuhler, D. et al. (2021)	-			
opex_req_level	7	Spuhler, D. et al. (2021)				
technical_maturity development phase	(acute = 0, stabilisation = 0.5,	Tilley, E. et al. (2014) Gensch, R. et al. (2018)	-			
	development/recovery = 1)					
reening Criteria water_supply	Type and Function Performance, Categorical	Applicable for this Functional Group? FALSE	Categories [Unit] house	Technology Values (Data) NA	NA NA	Internal Review Done? NA
			yard			
			public none			
water_volume			[L/cap/day]	NA		NA
electricity_supply	Performance, Categorical	IRUE	electricity intermittent	(electricity = 1, intermittent = 0, no electricity = 0)	"Requires a constant source of electricity and constant wastewater flow", "A low-	yes
			no electricity		energy (working with gravity) trickling	
					system can be designed, but in general, a continuous supply of power and	
					wastewater is required." (Emersan)	
fuel_supply	Performance, Categorical	FALSE	fuel	NA	NA	NA
			no fuel			
frequency_of_om	PDF, Categorical	TRUE	irregular regular	(irregular = 0, regular = 0.7, continuous = 0.3)	" A skilled operator is required to monitor the filter and repair the pump in	yes
			continuous		case of problems. The sludge that	
					accumulates on the filter must be periodically washed away to prevent	
					clogging and keep the biofilm thin and	
					aerobic. High hydraulic loading rates (flushing doses) can be used to flush the	
					filter. Optimum dosing rates and flushing	
					frequency should be determined from the field operation. The packing must be	
					kept moist. This may be problematic at	
					night when the water flow is reduced or	
					when there are power failures. Snails grazing on the biofilm and filter flies are	
					well known problems associated with	
					trickling filters and must be handled by backwashing and periodic flooding."	
					(Compendium)	
					Regular up to continuous maintenance required.	
pipe_supply	Performance, Categorical	TRUÉ	no pipes difficultly available	(no pipes = 0, difficultly available = 0.5, pipes = 1)	A feed pipe and other pipes are necessary (Compendium).	yes
			pipes			
pump_supply	Performance, Categorical	TRUE	no pumps difficultly available	(no pumps = 0, difficultly available = 0.5, pumps = 1)	"Energy is required to operate the pumps feeding the Trickling Filter." (Emersan)	yes
			pumps		Pumps for backflushing as well as to feed	
					the trickling filter are required.	
concrete_supply	Performance, Categorical	TRUE	no concrete	(no concrete = 0, difficultly available =		yes
			difficultly available concrete	0.5, concrete = 1)	filters, consists of v- shaped or half round channels, cast in the concrete floor	
					during its construction. These drains are	
					covered by the concrete blocks." (Sengupta)	
					The surrounding reactor and especially	
					the floor with the underdrainage system are usually made from concrete.	
					Concrete is considered as necessary for	
					this technology. Further crushed concrete can be used as filter material,	
					but since other filter materials perform	
					equally well, concrete is not considered a requirement for the filter material.	
spare_parts	PDF, Categorical	TRUE	simple technical	(simple = 0.3, technical = 0.5, special = 0.2)	"monitor the filter and repair the pump in case of problems." (Emersan)	yes
			special	5.21	"Not all parts and materials may be	
					locally available " (Compendium)	
					The filter material can either be made from local materials as rocks or gravel, or	
					from special pre-formed plastic filter	
					media. Technical spare parts are needed for the dosing system, the pumps and the	
					drainage system. Some specially	
					manufactured parts might be required for the dosing system. (Kukka Ilmanen,	
					Eawag 2021)	
0		FALSE FALSE		NA NA		NA NA
0	0	FALSE	0	NA	NA	NA NA
temperature	Performance, Categorical	INUÉ	very cold cold	(very cold = 0.5, cold = 0.7, temperate = 1, warm = 1, hot = 1)	The performance depending on the temperature (in F°) is represented by a	
			temperate		slope between 0.34 up to 0.62, but the	
			warm hot		performance is primarily depending on the wastewater temperature and only	
					secondarily on the ambient temperature.	
					{Schroepfer, 1952 #1379}	
					Assumed to be comparable to an imhoff tank.	
flooding	Performance, Categorical	TRUE	flooding	(flooding=0.9, no flooding=1)	These values are allotted to all "tank"	yes
			no flooding		based technologies. These treatment technologies and their corresponding	
					tanks are built to be water-tight.	
					Additionally, their raised configurations are possible in flood prone areas. The	
					impact of criterion flooding is therefore	
					not considered to be as severe and only a	
	1	İ	I		10% reduction in performance is allotted. (Akanksha Jain)	
unhiquiar acc	Darfarmanca Catagoniani	ΕΔISF	no access	NΔ		NΔ
vehicular_acces	Performance, Categorical	FALSE	no access difficult	NA	NA	NA
vehicular_acces	Performance, Categorical Performance, Categorical			NA NA		NA

Second S	and Arma	Desference Cottonidad	I FALCE	Later:	Tava	la i a	NA.		
March Marc	soil_type	Performance, Categorical	FALSE	clay silt	NA	NA	NA		
March Marc									
### PATHOLOGICAL P				rock					
Ministry Ministry									
Marie Mari	surface area onsite	Performance, Trapez	FALSE		NA .	necessary.	NA .		
1							100		
Marie	surface_area_offsite	Performance, Trapez	TRUE	m2/pers	(a = 0.15, b = 0.15, c = 999, d = 999)	Requires at least 0.15 m2/cap.			
Part	0		EALSE	0	NA .		NA.		
STORY AND AN	0	C	FALSE	0	NA	NA	NA		
	drinking_water_exposure								
Color Colo				Not close					
Marie	0	C	FALSE	0	NA	NA	NA .		
Mary Mary	construction_skills	Performance, Categorical	TRUE		(unskilled = 0, skilled = 0, professional = 1)	"Requires expert design and construction, particularly, the dosing	yes		
March Marc				skilled		system" (Compendium)			
Marie Mari				professional					
Column	design_skills	Performance, Categorical	TRUE		(unskilled = 0, skilled = 0, professional = 1)		yes		
Marie				skilled		system" (Compendium)			
Contact Cont				professional					
Part	om_skills	Performance, Categorica	TRUE		(unskilled = 0, skilled = 1, professional = 1)	"Requires operation and maintenance by	yes		
1				Skilled		skilled personnel" (Compendium)			
1	0	C	FALSE		NA		NA		
Marie		C	FALSE	0	NA	NA	NA		
Professional Content		C	FALSE			NA			
March Marc	cleansing_method			Washers					
State 19/20 19/2			FALCE	Hard wipers	AVA	ALA.	N/A		
Marco	0								
March Marc	lifetime			short (< 1 year)		"It is a viable solution during the			
POS. CENSOR POS. CENSOR						emergency when a longer-term solution			
Part Part	speed implement toilet	PDF. Categorica	FALSE		NA .		NA .		
Prof. Categorial Pace Pa	-p-13_mprement_collect	r Di , Categorica		moderate (3 days to 2 weeks)					
Indicators (Time works) and part of the works of protocols Section 2016 Sec	speed_implement_treatment	PDF, Categorica	TRUE	rapid (few days to a week)	(rapid=0, moderate=0.5, slow=0.5)	"Not all parts and materials may be	yes		
				moderate (few weeks up to three		locally available" "A Trickling Filter is			
Professional Controlled Professional Con									
Application Professional Configure Profe									
Parlon name, Catagorial Policy Parlon name, Catagorial Policy						solution during the stabilisation and			
Parformance, Canagonical Third Service									
PDF, Categories Table Security Table Secu						(Emersan)			
Marie Mari	scalability	Performance, Categorical	TRUE		(easy = 1, difficult = 0.5)		yes		
Post Categoria Table									
Post Continue Con						filter media, ambient temperature, and			
Post Catalogical Part Post Catagorical Part Post Catagorical Part Post Catagorical Part Post Catagorical Part Post Catagorical Part Post Catagorical Part Post Catagorical Part Post Catagorical Part Post						discharge requirements.", "Can be operated at a range of organic and			
POF, Categorial Thuj						hydraulic loading rates" (Emersan)			
Poly Content Continue									
PPF, Categorical PRF,						easily be replicated. However, they can			
Transfer Certificial parts and materials may be such parts and materials may be such parts and materials may be such parts and materials may be such parts and materials may be such parts and materials may be such parts and materials may be such parts and materials may be such parts and materials may be such parts and materials may be such parts and materials may be such parts and materials may be made to make the made to make t						some degree and therefore a slight			
POP, Categories POP, Categ									
Security Security						minuter, cowed 2021)			
Security Security	construction parts	PDF, Categorica	I TRUE	simple	(simple = 0.4, technical = 0.5, special =	"Not all parts and materials may be	yes		
Application Application		,		technical		locally available", "A skilled operator is	,		
Tender Coefficients Part				special					
Frame Fram									
Testinate plants are needed for the pumps and the disheage yethern. Some surpose of the disheage yethern.						from local materials as rocks or gravel, or			
Technical parts are necessfor or the pumps and the definitings system. Some specially manufactured parts might be required from the dening system. Some specially manufactured parts might be required from the dening system. Some specially manufactured parts might be required from the dening system. Some specially manufactured parts might be required from the dening system. Some specially manufactured parts might be required from the dening system. Some specially manufactured parts might be required from the dening system. Some specially manufactured parts might be required from the dening system. Some specially manufactured parts might be required from the dening system. Some specially manufactured parts might be required from the dening system. Some specially manufactured parts might be required from the dening system. Some specially manufactured parts might be required from the specially manufactured parts might be required from the specially manufactured parts might be required from the specially manufactured parts might be required from the specially manufactured parts might be required from the specially manufactured parts might be required from the specially manufactured parts might be required from the specially manufactured parts might be required from the specially manufactured parts might be required from the special parts manufactured parts might be required from the special parts manufactured parts might be required from the special parts manufactured parts might be required from the special parts manufactured parts might be required from the special parts might be required from the special parts might be required from the special parts might be required from the special parts might be required from the special parts might be required from the special parts might be required from the special parts might be required from the special parts might be required from the special parts might be required from the special parts might be required from the special parts might be required from the special parts									
						Technical parts are needed for the			
Parallel Parallel						specially manufactured parts might be			
Surge Surg			1						
1	Transfer Coefficients					IIIIIdileii, Edwag 2021)			Pofe
0.15				Secondary Effluent	Airloss		Waterinss	Commonts	
10		Sludge	Range		Airloss 0			*TP	
0.15		Sludge 0.13	Range 0.1 - 0.15	0.87	0		0	*TP removal	2010 #973}
1967 1978 1979		Sludge 0.13 0.15	Range 0.1 - 0.15	0.87	0	Soilloss 0	0	*TP removal *as PO4-P	2010 #973} {Vacker, 1967
0.17 0.88 0 0 0 0 0 9 90-49 1957 195		0.13 0.15 0.22	Range 0.1 - 0.15	0.87 0.85 0.78	0	Soitless 0	0	*TP removal *as PO4-P	2010 #973} {Vacker, 1967 {Vacker, 1967
0.02		0.13 0.15 0.22	Range 0.1 - 0.15	0.87 0.85 0.78	0	Soitless 0	0	*TP removal *as PO4-P *as PO4-P	2010 #973} {Vacker, 1967 {Vacker, 1967 {Vacker,
0.17		0.13 0.15 0.22	8ange 0.1-0.15	0.87 0.85 0.78	0	Soitloss 0 0 0 0	0	*TP removal *as PO4-P *as PO4-P	2010 #973) {Vacker, 1967 {Vacker, 1967 {Vacker, 1967 {Vacker, 1967 {Vacker,
0.22		Sludge 0.13 0.15 0.22 0.15	8ange 0.1-0.15	0.87 0.85 0.78 0.85	0	Soitloss 0 0 0 0	0 0	*TP removal *as PO4-P *as PO4-P *as PO4-P *as PO4-P	2010 #973} {Vacker, 1967 {Vacker, 1967 {Vacker, 1967 {Vacker, 1967 {Vacker, 1967 {Vacker,
0.21		Sludge 0.13 0.15 0.22 0.15 0.27 0.17	8ange 0.1-0.15	0.87 0.85 0.78 0.85 0.83	0 0	Soilloss 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0	*TP removal *as PO4-P *as PO4-P *as PO4-P *as PO4-P *as PO4-P *as PO4-P	2010 #973} {Vacker, 1967 {Vacker, 1967 {Vacker, 1967 {Vacker, 1967 {Vacker, 1967 {Vacker, 1967 {Vacker,
1967 1968 0 0 0 1967 19		Sludge 0.13 0.15 0.22 0.15 0.27 0.17 0.02	Range 0.1-0.15	0.87 0.85 0.78 0.85 0.83 0.98	0 0 0 0 0	Soilloss 0 0 0 0 0 0 0 0 0	0 0	*TP removal *as PO4-P *as PO4-P *as PO4-P *as PO4-P *as PO4-P *as PO4-P	2010 #973} (Vacker, 1967 (Vacker, 1967 (Vacker, 1967 (Vacker, 1967 (Vacker, 1967 (Vacker, 1967
0.14		Sludge 0.13 0.15 0.22 0.15 0.27 0.17 0.02 0.17 0.02	Range 0.1-0.15	0.87 0.85 0.78 0.85 0.83 0.98 0.83	0 0 0 0	Soilloss 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0	*TP removal *as PO4-P *as PO4-P *as PO4-P *as PO4-P *as PO4-P *as PO4-P *as PO4-P *as PO4-P *as PO4-P *as PO4-P *as PO4-P *as PO4-P	2010 #973} (Vacker, 1967 (Vacker, 1967 (Vacker, 1967 (Vacker, 1967 (Vacker, 1967 (Vacker, 1967 (Vacker, 1967
0.14		Sludge 0.13 0.15 0.22 0.17 0.07 0.07 0.07 0.07 0.07 0.07 0.07	Range 0.1-0.15	0.87 0.85 0.78 0.85 0.83 0.98 0.83 0.78		Soilloss 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	*TP removal *as PO4-P *as	2010 #973] (Vacker, 1967 (Vacker, 1967 (Vacker, 1967 (Vacker, 1967 (Vacker, 1967 (Vacker, 1967 (Vacker, 1967 (Vacker, 1967
0.17		Sludge 0.13 0.15 0.22 0.17 0.07 0.07 0.07 0.07 0.07 0.07 0.07	Range 0.1-0.15	0.87 0.85 0.78 0.85 0.83 0.98 0.83 0.78		Soilloss 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	*TP removal *as PO4-P *as	2010 #973] (Vacker, 1967 (Vacker, 1967 (Vacker, 1967 (Vacker, 1967 (Vacker, 1967 (Vacker, 1967 (Vacker, 1967 (Vacker, 1967 (Vacker, 1967 (Vacker,
0.09		Sludge 0.13 0.15 0.22 0.17 0.07 0.07 0.07 0.07 0.07 0.07 0.07	Range 0.1-0.15	0.87 0.85 0.78 0.85 0.83 0.98 0.83 0.78		Soilloss 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	*TP removal *as PO4-P *as	2010 #973] (Vacker, 1967 (Vack
0.16		Sludge 0.13 0.15 0.22 0.17 0.07 0.07 0.07 0.07 0.07 0.02 0.17 0.02 0.17	Range 0.1-0.15	0.87 0.85 0.78 0.85 0.85 0.83 0.98 0.33 0.78 0.79 0.88		Soilloss 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	*TP removal *as PO4-P	2010 9973) (Vacker, 1967 (Vack
1967 1967		Sludge 0.15 0.15 0.22 0.17 0.07 0.07 0.07 0.17 0.02 0.17 0.17 0.17 0.17 0.17 0.17 0.18 0.19 0.19 0.19 0.10 0.10 0.10 0.10 0.11	Range 0.1-0.15	0.87 0.85 0.78 0.85 0.85 0.83 0.98 0.78 0.79 0.88 0.79 0.88		Soilloss 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	*TP removal *TP re	2010 #973] (Vacker, 1967 (Vack
0.14		Sludge 0.13 0.15 0.22 0.15 0.17 0.02 0.17 0.17 0.22 0.21 0.12 0.14 0.17 0.05	Range 0.1-0.15	0.87 0.85 0.78 0.85 0.83 0.83 0.79 0.79 0.88 0.66 0.83		Soilloss 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	*TP removal *as PO4-P *as	2010 4973] (Vacker, 1967 (Vacker, 1967 (Vacker, 1967 (Vacker, 1967 (Vacker, 1967 (Vacker, 1967 (Vacker, 1967 (Vacker, 1967 (Vacker, 1967 (Vacker, 1967 (Vacker, 1967 (Vacker, 1967 (Vacker, 1967 (Vacker, 1967 (Vacker, 1967 (Vacker, 1967 (Vacker, 1967 (Vacker, 1967
0.14 - 0.86 0 0 0 0 4° as PO4-P (Vacker, 1967) 0.18 - 0.82 0 0 0 0 0 4° as PO4-P (Vacker, 1967) 0.15 - 0.85 0 0 0 0 0 a* as PO4-P (Vacker, 1967) 0.15 - 0.85 0 0 0 0 0 8° as PO4-P (Vacker, 1967)		Sludge 0.13 0.15 0.22 0.15 0.17 0.02 0.17 0.17 0.22 0.21 0.21 0.21 0.22 0.23 0.21 0.24 0.25 0.25 0.26 0.27 0.27 0.28	Range 0.1-0.15	0.87 0.85 0.78 0.85 0.83 0.83 0.98 0.83 0.78 0.79 0.88 0.86 0.83 0.86		Soilloss 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	*TP removal removal *TP remova	2010 4973) (Vacker, 1967 (Vack
0.18 0.82 0 0 0 "as PO4-P Vacker, 1967 0.15 0.85 0 0 0 *as PO4-P Vacker, 1967 Vacker,		Sludge 0.13 0.15 0.22 0.15 0.17 0.02 0.17 0.17 0.22 0.21 0.21 0.21 0.22 0.23 0.21 0.24 0.25 0.25 0.26 0.27 0.27 0.28	Range 0.1-0.15	0.87 0.85 0.78 0.85 0.83 0.83 0.98 0.83 0.78 0.79 0.88 0.86 0.83 0.86		Soilloss 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	*TP removal *as PO4-P *as PO4-P *as PO4-P *as PO4-P *as PO4-P *as PO4-P *as PO4-P *as PO4-P *as PO4-P *as PO4-P *as PO4-P *as PO4-P *as PO4-P *as PO4-P *as PO4-P *as PO4-P	2010 #973] (Vacker, 1967 (Vack
0.15 - 0.85 0 0 0 0*as PO4-P (Vacker,		Sludge		0.87 0.85 0.78 0.85 0.83 0.83 0.98 0.83 0.78 0.79 0.88 0.66 0.83 0.91 0.84		Soilloss 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0	*TP removal *as PO4-P	2010 #973] (Vacker, 1967 (Vack
1967		Sludge 0.13 0.15 0.22 0.15 0.17 0.02 0.17 0.02 0.17 0.17 0.17 0.17 0.17 0.18 0.18 0.19 0.19 0.19 0.19 0.19 0.19 0.19 0.19	0.1-0.15	0.87 0.85 0.78 0.85 0.83 0.83 0.98 0.83 0.78 0.79 0.88 0.86 0.83 0.86		Soilloss 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	*TP removal *as PO4-P	2010 #973] (Vacker, 1967 (Vack
		Sludge 0.13 0.15 0.22 0.15 0.17 0.02 0.17 0.02 0.17 0.17 0.17 0.17 0.17 0.18 0.18 0.19 0.19 0.19 0.19 0.19 0.19 0.19 0.19	Range 0.1-0.15	0.87 0.85 0.78 0.85 0.83 0.83 0.83 0.98 0.83 0.78 0.79 0.88 0.88 0.88 0.88 0.88 0.88 0.88		Soilloss 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	*TP removal *as PO4-P	2010 #973] (Vacker, 1967 (Vack

	0.14		0.86	0	(0		(Vacker, 1967
	0.13	-	0.87	0	(0	*as PO4-P {	{Vacker, 1967
med (R)	0.15	0.02 - 0.22	0.85	. 0		0		-
k	25	[0.2]	:				F	PA
TN				0				(Forbis-
	0.18	0 - 0.35	0.82	2 0		0	*TN {	Stokes, {Conradin
	0.67	-	0.33	0		0	* from {	2010 #973 {Dai, 2013 #1383}
med (R)	0.63	0 - 0.67	0.37	0		0	-	-
		[0.67]					F	PA
H2O	0.02	! 0 - 0.05	0.93	0.05		0		PA (see SBR)
med (R)	0.15	0.02 - 0.22	0.85	0	(0	-	
k	25	[0.2]					F	PA
TN	0.63	-	0.37	0	({Forbis- Stokes,
	0.18	0 - 0.35	0.82	. 0				{Aslam,
	0.67		0.33					{Aslam,
med (R)			0.37				-	-
k	5	[0.36]					F	PA
	-	Ç. 1.37						
ional Information								
	Data from: {Forbis-Stokes, 2018 #1380}							
	Influent trickling filter	Effluent trickling filter	TC Effluent	Removal [%]	Relation Turbidity - TSS	Ratio TSS:TS		
Turbidity [NTU]			0.01326531					
TSS (from formula)				986734694				
	1506			986734694 985391766				
TS			0.01460823	985391766				
TS Calculation		22		985391766 384302789 Removal = (1-TC_Effluent)*100		0.39		
Calculation		22	0.01460823 TC_Effluent = effluent_trickling_filter/influent_trickling	985391766 384302789 Removal = (1-TC_Effluent)*100	In (TSS)=0.979 In (Turb)+0.574 (Al-Yaseri,			
Calculation		22	0.01460823 TC_Effluent = effluent_trickling_filter/influent_trickling	985391766 384302789 Removal = (1-TC_Effluent)*100	In (TSS)=0.979 In (Turb)+0.574 {Al-Yaseri, 2013 #1381}			
Calculation	Data from: (Dai, 2013 #1383) Influent [mg/l]	22 Effluent [mg/l]	0.01460823 TC_Effluent = effluent_trickling_filter/influent_trickling_filt er TC Effluent	985391766 384302789 Removal = (1-TC_Effluent)*100	In (TSS)=0.979 In (Turb)+0.574 {Al-Yaseri, 2013 #1381}			
Calculation 31.2.2 TN Calculation	Data from: (Dai, 2013 #1383) Influent [mg/l] 84	22 Effluent [mg/l]	0.01460823 TC_Effluent = effluent_trickling_filter/influent_trickling_filter TC Effluent 0.33333333	985391766 384302789 Removal = (1-TC_Effluent)*100	In (TSS)=0.979 In (Turb)+0.574 {Al-Yaseri, 2013 #1381}			
Calculation 31.2.2 TN Calculation	Oata from: (Dai, 2013 #1383) Influent (mg/l) 84 Data from: (Aslam, 2017 #1384)	Effluent [mg/l] 28 TC_Effluent = (Effluent/Influent)*100	0.01460823 TC_Effluent = effluent_trickling_filter/influent_trickling_filter TC Effluent 0.33333333	985391766 384302789 Removal = (1-TC_Effluent)*100 Removal [%] 0.66666667	In (TSS)=0.979 In (Turb)+0.574 {Al-Yaseri, 2013 #1381}			
Calculation 31.2.2 TN Calculation	Data from: (Dai, 2013 #1383) Influent [mg/l] 84	22 Effluent [mg/l] 28	0.01460823 TC_Effluent = effluent_trickling_filter/influent_trickling_filter TC Effluent 0.33333333	985391766 384302789 Removal = (1-TC_Effluent)*100 Removal [%] 0.66666667	In (TSS)=0.979 In (Turb)+0.574 {Al-Yaseri, 2013 #1381}			
Calculation 31.2.2 TN Calculation 31.2.3	Data from: {Dai, 2013 #1383} Influent [mg/l] 84 Data from: {Aslam, 2017 #1384} Removal [%] (Min. value)	Effluent [mg/I] TC_Effluent = (Effluent/Influent)*100 Removal [%] (Max. value)	0.01460823 TC_Effluent = effluent_trickling_filter/influent_trickling_filter TC Effluent 0.33333333	985391766 384302789 Removal = (1-TC_Effluent)*100 Removal [%] 0.66666667	In (TSS)=0.979 In (Turb)+0.574 {Al-Yaseri, 2013 #1381}			
Calculation 31.2.2 TN Calculation 31.2.3 TSS	Data from: {Dai, 2013 #1383} Influent [mg/l] 84 Data from: {Aslam, 2017 #1384} Removal [%] (Min. value) 38	Effluent [mg/I] TC_Effluent = (Effluent/Influent)*100 Removal [%] (Max. value)	0.01460823 TC_Effluent = effluent_trickling_filter/influent_trickling_filter TC Effluent 0.33333333	985391766 384302789 Removal = (1-TC_Effluent)*100 Removal [%] 0.66666667	In (TSS)=0.979 In (Turb)+0.574 {Al-Yaseri, 2013 #1381}			
Calculation 31.2.2 TN Calculation 31.2.3 TSS TDS Ratio TSS:TS (from	Data from: {Dai, 2013 #1383} influent {mg/l} 84 Data from: {Aslam, 2017 #1384} Removal [14] {Min. value} 38	Effluent [mg/l] Z8 TC_Effluent = (Effluent/Influent)*100 Removal [%] (Max. value) 56 36	0.01460823 TC_Effluent = effluent_trickling_filter/influent_trickling_filter TC Effluent 0.33333333	985391766 384302789 Removal = (1-TC_Effluent)*100 Removal [%] 0.66666667	In (TSS)=0.979 In (Turb)+0.574 {Al-Yaseri, 2013 #1381}			
Th Calculation 31.2.2 Th M Calculation 31.2.3 TSS TDS Ratio TSS:T S(TOS) Ratio TSS:T S(TOS)	Data from: (Dai, 2013 #1383) Influent [mg/l] 84 Data from: (Aslam, 2017 #1384) Removal [%] (Min. value) 38 20	22	0.01460823 TC_Effluent = effluent_trickling_filter/influent_trickling_filter TC Effluent 0.33333333	985391766 384302789 Removal = (1-TC_Effluent)*100 Removal [%] 0.66666667	In (TSS)=0.979 In (Turb)+0.574 {Al-Yaseri, 2013 #1381}			
Calculation 31.2.2 TN Calculation 31.2.3 TSS TDS Ratio TSS:TS (from	Data from: {Dai; 2013 #1383} Influent [mg/l] 84 Data from: {Asiam, 2017 #1384} Removal [%] (Min. value) 38 0.33 14.82	Effluent [mg/l] 28 TC_Effluent = (Effluent/Influent)*100 Removal [%] (Max. value) 56 36 21.84	0.01460823 TC_Effluent = effluent_trickling_filter/influent_trickling_filter TC Effluent 0.33333333	985391766 384302789 Removal = (1-TC_Effluent)*100 Removal [%] 0.66666667	In (TSS)=0.979 In (Turb)+0.574 {Al-Yaseri, 2013 #1381}			

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Activated Sludge							
eneral Information	Values	Data Source					
FUNCTIONAL GROUP UNIQUE IDENTIFIER (ID)	activated_sludge	-					
DATA COMPILER I INPUT PRODUCT I	Julian Fritzsche transportedblackwater,	- Tilley, E. et al. (2014)					
OUTPUT PRODUCT 1	transportedgreywater,	Tilley, E. et al. (2014)					
1	transportedsecondary_effluent						
RELATIONS I	Input: OR Output: AND	Tilley, E. et al. (2014)					
COMMENTS							
		Data Source Tilley, E. et al. (2014)					
	city = 1)	Tilley, E. et al. (2014)					
capex_req_level	8	Spuhler, D. et al. (2021)					
opex_req_level technical_maturity		Spuhler, D. et al. (2021) Tilley, E. et al. (2014)					
development_phase ((acute = 0, stabilisation = 0.5,	Gensch, R. et al. (2018)					
			Categories [Unit]	Technology Values (Data)	Data Source / Assumptions	Internal Review Done?	
water_supply	Performance, Categorical	FALSE	house yard	NA	NA	NA	
			public				
water_volume	Performance, Trapez	FALSE	none [L/cap/day]	NA	NA	NA	
electricity_supply	Performance, Categorical	TRUE	electricity intermittent	(electricity = 1, intermittent = 0, no electricity = 0)	"High energy consumption, a constant source of electricity is required"	yes	
			no electricity		(Compendium)		
fuel_supply	Performance, Categorical		fuel no fuel	NA	NA	NA	
frequency_of_om	PDF, Categorical	TRUE	irregular	(irregular = 0, regular = 0.2, continuous = 0.8)	"The mechanical equipment (mixers,	yes	
			regular continuous	0.01	aerators and pumps) must be constantly maintained. As well, the influent and		
					effluent must be constantly monitored and the control parameters adjusted, if		
					necessary, to avoid abnormalities that		
					could kill the active biomass and the development of detrimental organisms		
					which could impair the process (e.g., filamentous bacteria)." (Compendium)		
					O&M is almost a full-time job.		
pipe_supply	Performance, Categorical	TRUE	no pipes	(no pipes = 0, difficultly available = 0.5,	Pipes are necessary for aeration.	yes	
F-hc_subbit			difficultly available	pipes = 1)	Pipes are needed for inlet, outlet and for		
pump_supply	Performance, Categorical	TRUE	no pumps	(no pumps = 0, difficultly available = 0.5,	return activated sludge For recirculation a pump will be required.	yes	
			difficultly available pumps	pumps = 1)			
concrete_supply	Performance, Categorical	TRUE	no concrete	(no concrete = 0.5, difficultly available =	"Usually the Activated Sludge reactor is	yes	
			difficultly available concrete	0.75, concrete = 1)	made of plastic or concrete." (Emersan) Assuming concrete performs better than		
					plastic due to its lifetime and local		
					experience with construction with concrete.		
spare_parts	PDF, Categorical	TRUE	simple technical	(simple = 0.2, technical = 0.7, special = 0.1)	"Not all parts and materials may be locally available ", "Usually the Activated	yes	
			special	0.2,	Sludge reactor is made of plastic or		
					concrete. The aerators consist of stainless steel or plastic and a membrane		
					of rubber seal. For the potential		
					subsequent membrane process either ceramic, polymeric, or composite		
					membranes can be used. The material		
					used has an impact on fouling propensity in IMBRs. Different pre-fabricated		
					models are available." (Emersan) Technical spare parts are required.		
					Specially manufactured aeration or		
					monitoring equipment is assumed to be rarely necessary.		
0	0	FALSE FALSE	0	NA NA	NA NA	NA NA	
0 temperature	0 Performance, Categorical	FALSE TRUE	very cold	NA (very cold = 0.5, cold = 0.7, temperate =	NA Assumed to be similar to an Imhoff Tank.	NA yes	
temperature	Similare, edegorical	-	cold	1, warm = 1, hot = 1)	"Activated Sludge processes are	,	
			temperate warm		appropriate in almost every climate, but treatment capacity is reduced in colder		
			hot		environments." (Emersan)		
flooding	Performance, Categorical	TRUE	flooding	(flooding=0.9, no flooding=1)	"An activated sludge process is only	yes	
			no flooding		appropriate for a Centralized Treatment facility with a well-trained staff, constant		
					electricity and a highly developed		
					management system that ensures that the facility is correctly operated and		
					maintained. Because of economies of		
					scale and less fluctuating influent characteristics, this technology is more		
					effective for the treatment of large		
					volumes of flows." (Compendium)		
					These values are allotted to all "tank"		
					based technologies. These treatment technologies and their corresponding		
					tanks are built to be water-tight.		
					Additionally, their raised configurations are possible in flood prone areas. The		
					impact of criterion flooding is therefore not considered to be as severe and only a		
					10% reduction in performance is allotted.		
					(Akanksha Jain)		
vehicular_acces	Performance, Categorical	FALSE	no access difficult	NA	NA	NA	
			full				
slope	Performance, Categorical	FALSE	flat not flat	NA	NA	NA	
soil_type	Performance, Categorical	FALSE	clay	NA	NA	NA	
			silt sand				
			gravel				
	Performance, Trapez	FALSE	rock water depth [m]	NA	NA	NA	
groundwater depth			easy	(easy = 1, hard = 0.75)	Depending on the design, excavation is	yes	
groundwater_depth excavation	Performance, Categorical				necessary.		
	Performance, Categorical Performance, Trapez		hard [m2/plot]	NA	NA	NA	
excavation surface_area_onsite	Performance, Trapez	FALSE	[m2/plot]			NA	
excavation		FALSE		NA (a = 0.12, b = 0.12, c = 999, d = 999)	Requires at least 0.12 m2/cap.	NA .	
excavation surface_area_onsite	Performance, Trapez Performance, Trapez	FALSE	[m2/plot] m2/pers			NA NA	
excavation surface_area_onsite surface_area_offsite	Performance, Trapez Performance, Trapez 0 0	FALSE TRUE	[m2/plot] m2/pers	(a = 0.12, b = 0.12, c = 999, d = 999)	Requires at least 0.12 m2/cap. From Table 1.3 (Dotro et al. 2017) NA NA		

	daladia .		raics	Class	lava	la.a	lava.	ī	
Comparison	drinking_water_exposure				NA NA	NA NA	NA NA		
Part	0	0	FALSE	0	NA	NA	NA		
Column	construction_skills	Performance, Categorical		unskilled skilled	(unskilled = 0, skilled = 0, professional = 1)	construction" (Compendium)	yes		
March Marc	design_skills	Performance, Categorical	TRUE	Ladder: unskilled	(unskilled = 0, skilled = 0, professional = 1)	construction" (Compendium)	yes		
Part	om_skills	Performance, Categorical		Ladder: Unskilled		"Highly trained staff is required for	yes		
Control Cont				Professional		(Compendium)			
Company	0	0	FALSE	0	NA	NA	NA		
Property Property	0	0	FALSE	0	NA	NA	NA		
Part				Soft wipers Hard wipers					
March Marc									
Manual M	lifetime	Performance, Categorical		medium (1-5 years)	(short = 1, medium = 1, long = 1)	in wastewater treatment plants around the world and have usually a lifetime of more than 5 years. (Kukka Ilmanen,	yes		
Part Part	speed_implement_toilet	PDF, Categorical		moderate (3 days to 2 weeks)	NA		NA		
Marie Mari	speed_implement_treatment	PDF, Categorical	TRUE	rapid (few days to a week)	(rapid=0, moderate=0.5, slow=0.5)		yes		
PPC CARGONIC PPC				months)		so quick to deploy (2 weeks to set up); Commissioning takes time (30days?) to introduce sludge and get process (microorganisms) functioning (Abbott, J. et al. (2019)) "Several weeks are needed to establish the microorganisms required for a stable biological process" (Emersan) and that is after the reactors have been built and the aeration system has been built and the aeration system has been built." "Not all parts and materials may be locally available" (Compendium) Prefab units improve the speed of implementation however, since several weeks are required for microbial communities to establish, probabilities are allotted to both categories			
Part Part	scalability	Performance, Categorical	TRUE	easy	(easy = 1, difficult = 0.8)		yes		
Interference Part				difficult		All treatment units are in prefabricated, so layout is flexible [] Additional tanks can be added in parallel" (Abbott, J. et al. (2019)) Activated Sludge Plants can be scaled up			
Mary Mary	Constitution_parts	, Langui en		technical		locally available." (Compendium) "Usually the Activated Sludge reactor is made of plastic or concrete. The aerators consist of stainless steel or plastic and a membrane of rubber seal. For the potential subsequent membrane process either ceramic, polymeric, or composite membranes can be used. The material used has an impact on fouling propensity in IMBRs. Different pre-fabricated models are available." (Emersan) An Activated Sludge System requires a lot of technical parts. Additionally, we assume that the controlling system and the membrane process might require even some parts from special manufacturers. (Kukka Ilmanen, Eawag	yes		
To Company	Transfer Coefficients			5 d 510 d		E-11			
Martin M			range .		MII 1022	0		* 77.4% TP	{Hsu, 1998
Comment Comm		0.92	-	0.08	0	0	0	* 92.4% TP	{Thomas,
Meter Mete		0.8	-	0.2	0	0	0		{Commission
The content of the				0.2	0	0	0		-
Mater Mate			[0.15]	0.33	0	0	0		{Hsu, 1998
Mate Mate		0.9	-	0.1	O	0	0		{Samiotis,
H2O		0.79		0.21	0	0	0		-
Mater Mate		0.0011	[0.23]	0.9989	0	0			{EDWIGE,
Mate_volume_influent[m3/d] Mate Mate_volume_influent[m3/d] Mate Mate_volume_influent[m3/d] Mate Mate_volume_influent[m3/d] Mate Mate volume_influent[m3/d] Mate volume_inf									#1415}
Removal [N] Ratio TSS/TS (From horizontal system) Ratio TSS/TS (From horizontal system) Ratio TSS/TS (From horizontal system) Ratio TSS/TS (From horizontal system) Ratio TSS/TS (From horizontal system) Ratio TSS/TS (From horizontal system) Ratio TSS/TS (From horizontal system) Ratio TSS/TS (From horizontal system) Ratio TSS/TS (From horizontal system) Ratio TSS/TS (From horizontal system) Ratio TSS/TS (From horizontal system) Ratio TSS/TS (From horizontal system) Ratio TSS/TS (From TS) Ratio TSS/TS (From horizontal system) Ratio TSS/TS (From horizontal system) Ratio TSS/TS (From horizontal system) Ratio TSS/TS (From TS) Ratio TSS/TS (From horizontal system) Ratio TSS/TS (From TS) Ratio TSS/TS (F			-		0.00015	0		33.2.4 (1/2	(Wanner, 2004
Mater_volume_influent [m3/d] Mater_volume_influent [m3/d]	k	2	-				-	* fu	PA
Mater_volume_influent [m3/d] Mater_volume_influent [m3/d]	TS		-		0	0		33.2.1	2019
Removal [K] Sal Sa			-		0	0		al. (2021)	{Hsu, 1998 #1410}
Additional Information 33.2 Data from: (Goven, 2019 #1417) Removal [V6]				0.64	0	0			PA
33.1 Data from: (Giuven, 2019 #1417) Removal (K)		100	[0.03]						
TSS SB Ratio TSS.TS (from horizontal weetland) 0.39	33.2.1								
Morticontal_wetland 0.39	TSS								
TS (from TS) 34.32 Oata from: (EDWIGE, 2015 #1415)	Ratio TSS:TS (from	0.39							
2010 2011 2012 2013 Average Calculation		34.32						т	
1081.58	TS (from TSS)	Data from: {EDWIGE, 2015 #1415}							
water_volume_studge [m3/d] 1.38 1.21 1.12 1.27 1.245	33.2.2	Data from: {EDWIGE, 2015 #1415}					Calculation		
	33.2.2 Water_volume_influent [m3/d]	2010	1096.82	1179.3	1171.03	1132.1825	Calculation		

TC_H20_sludge [%]		0.110318922	0.094971593	0.108451534	0.1099646	TC_H2O_Sludge = Water_volume_sludge/water_volume_influe
	0.127591117					nt
33.2.3	Data from: {Hsu, 1998 #1410}					
	Removal [%]					
TSS	94					
Ratio TSS:TS (from						
horizontal_wetland)	0.39					
TS (from TSS)	36.66					
33.2.4	Data from: {Wanner, 2004 #1418}					
aporation of water [kg/m3]	0.15					
ssumption: 1000kg H2O = 1						
m3 H2O						
aporation of water [m3/m3]	0.00015					

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Wanner, O. (2004). Warmeriokegevinuing aus Abavasesystemen, Schlubsericht. Heat Receiver from Wastewater Systems. T. Kortleng, Perro, Switzerland, Forschungsprogramm UAW, Abteilung Umgebungswärme, WKK, Kälte, Bundesamt für Energie (BFE).

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1842. T. C. (1938). "Nutrient removal Frod Processes for Municipal Wastewater of Frod Waste Addition and Hydraulic Limits of the System." Environmental Science and Pollution Research 26(2): 1770-1780.

1842. T. C. (1938). Innovativ

Tilley, E., Ulrich, L., Lüthi, C., Reymond, P., & Zurbrügg, C. (2014). Compendium of Sanitation Systems and Technologies—2nd revised edition . Swiss Federal Institute of Aquatic Science and Technology (EAWAG).

Lactic Acid Fermentation						
General Information FUNCTIONAL GROUP	Values T	Data Source				
UNIQUE IDENTIFIER (ID)	lactic_acid_fermentation	-				
DATA COMPILER INPUT PRODUCT	SaniChoice Project Team stored_faeces, transportedstored_faeces, blackwater, transportedblackwater, sludge, transportedsludge,	- Gensch, R. et al. (2018)				
	transportedtransferred_sludge stabilized_sludge , transportedstabilized_sludge	Gensch, R. et al. (2018)				
RELATIONS	Input: OR Output: AND	Gensch, R. et al. (2018)				
		Data Source				
applicability_level	(household = 0, neighbourhood = 1, city = 0) (household = 0, shared = 0, public = 1)	Gensch, R. et al. (2018) Gensch, R. et al. (2018)				
capex_req_level	4	Spuhler, D. et al. (2021)				
opex_req_level		Spuhler, D. et al. (2021)				
technical_maturity development_phase	(acute = 1, stabilisation = 0.5,	Gensch, R. et al. (2018) Gensch, R. et al. (2018)				
	development/recovery = 0)	Applicable for this Functional Group?	Categories [Unit]	Technology Values (Data)	Data Source / Assumptions	
water_supply	Type and Function Performance, Categorical		house	NA	NA NA	Internal Review Done? NA
			yard public			
water_volume	Performance, Trapez	FALSE	none [L/cap/day]	NA .	NA .	NA
electricity_supply	Performance, Categorical	TRUE	electricity intermittent no electricity	(electricity = 1, intermittent = 0.3, no electricity = 6	"To achieve a homogeneous mix within the vessel a recirculation pump is required. The type of pump depends on the thickness of the studge. For liquid studge, a diaphragm pump may be sued, whereas thicker studge may need a screw pump or a vacuum pump." (Emersan) Mixing can also be done manual, but therefore is much more effort needed and the performance could still not be the same as if done electrical.	yes
fuel_supply	Performance, Categorical	FAISE	fuel	NA NA	NA	NA .
			no fuel			
frequency_of_om	PDF, Categorical	TRUE	irregular regular continuous	(irregular = 0, regular = 1, continous = 0)	"Regular maintenance of pumps is required, especially due to the corrosive nature of the treated sludge." (Emersan)	
pipe_supply	Performance, Categorical	TRUE	no pipes difficultly available	(no pipes = 1, difficultly available = 1, pipes = 1)	No need for pipes.	yes
	Dorfor C-t- ' '	TRUE	pipes	(no numns = 0.25, difficultly available = 0.5	"To achieve a homogropour mis-within the	wes
pump_supply	Performance, Categorical	INCE	no pumps difficulty available pumps	(no pumps = 0.25, difficultly available = 0.5, pump	vessel a recirculation pump is required. The type of pump depends on the thickness of the sludge. For liquid sludge, a disphragm pump may be used, whereas thickers sludge may need a screw pump or a vacuum pump." (Emersian) Mixing can also be done manually, but therefore is much more effort needed and the performance would be worse without pumps, so that 'difficulty' available' is chosen to be 50% (pump required) and 'no pumps' is set to an	yvo
concrete_supply	Performance, Categorical	TRUE	no concrete	(no concrete = 0.5, difficultly available = 0.75,	especially low value of 25% performance. "AF Treatment needs a vessel, preferably	yes
			difficulty available concrete	concrete = 1)	sealable as LAB are most efficient under an aerolic conditions. However, LAB are aero- tolerant and therefore open tanks can be used if no sealed wessel is available." (Emero) the There is no information found what type of material the vessel could be made of, but since the vessel needs to be sealed it could be concrete. It is assumed that alternative vessels need to either be imported (metal), have shorter lifetimes (plastix, wood) and that locals have	
spare_parts	PDF, Categorical	TAUE	şimple technical special	(simple = 0.5, technical = 0.5, special = 0)	Insperience working with concrete. "LAF Treatment needs a vessel, preferably sealable as LAB are most efficient under an aerotic condition. However, LAB are aero-tolerant and therefore open tanks can be used if no sealed wessel savailable. To achieve homogeneous mix within the vessel a homogeneous mix within the vessel a recruciation pump is required. The type of pump depends on the thickness of the sludge. For liquid skudge, a dalprarap pump may be used, whereas thicker sludge may need a screw pump or a vacuum pump. In addition, an intalia supply	yes
0	0	FALSE		NA	of milk and a probiotic drink is needed to prepare the LAB molasses. To monitor the pH level and pathogens in the vessel a water testing kt is needed." "Simple process within uses readily available material: molasses and LAB" (Emersan) To repair and replace the pumps technical parts might be required. To maintain the vessel locally assalable materials, might be required.	NA NA
0		FALSE FALSE	0		NA NA	NA NA
temperature	0 Performance, Categorical		very cold cold temperate warm hot	(very cold = 1, cold = 1, temperate = 1, warm = 1, t		
flooding	Performance, Categorical		floading no floading	(Rooding = 0.9, no flooding = 1)	This recommended that the LAF process is carried out under both conditions in sealed vessels (container or bladder). "Itemsan if constructed with a sealed vessel the technology should be watertight, what means that there should be watertight, what means that there should be no risk in area prone to flooding. These values are allotted to all "tank" based technologies. These treatment technologies and their corresponding tanks are built to be water- tight. Additionally, their raked configurations are possible in flood prone areas. The impact of criterion flooding is therefore not considered to be as severe and only a 10% reduction in performance is allotted. (Akanisha Jain)	Yes
vehicular_acces	Performance, Categorical	FALSE	no access difficult	NA	NA	NA
slope	Performance, Categorical	FALSE	full flat	NA	NA	NA
soil_type	Performance, Categorical		not flat clay	NA .	NA .	NA
Jon_vype	· crosmance, categorical		cialy silt sand gravel rock			
groundwater_depth	Performance, Trapez	FALSE	water depth [m]		NA	NA
excavation	Performance, Categorical	TRUE	easy hard	(easy = 1, hard = 0.75)	There is no information on need for excavation for the technology. Excavation might be	yes
surface_area_onsite	Performance, Trapez	FALSE	[m2/plot]	NA	necessary (one configuration). NA	NA
surface_area_offsite	Performance, Trapez	TRUE	m2/pers	(a = 0.007, b = 0.007, c = 999, d = 999)	It is recommended that the LAF process is carried out under batch conditions in sealed vessels (container or bladder) (Emersan). The same value as for hydrated lime treatment is used as it follows the same operating principle (adding treatment solution to a tank and mixing it Isanichoic eraam 2021: Best Guess).	
0		FALSE	0	NA	NA	NA
0		FALSE FALSE		NA NA	NA NA	NA NA
drinking_water_exposure	Performance, Categorical		Close	NA NA	NA NA	NA
0	^	FALSE	Not close 0	NA .	NA .	NA
0		FALSE			NA NA	NA NA

March Marc								
### A PART OF THE	construction_skills	Performance, Categorica	TRUE	unskilled	(unskilled = 0, skilled = 1, professional = 1)	construction should be possible with basic skills	yes	
March Marc	design_skills	Performance, Categorica	ITRUE	professional Ladder:	(unskilled = 0, skilled = 0, professional = 1)	"It is recommended that the LAF process is	yes	
Married Marr				skilled		vessels (container or bladder). The vessel size		
Part Part				professional				
Management Man				1		an inoculum before being added to the fresh		
Company Comp				1				
Processing the control of the cont				1		example, Yakult (0.02 %) that has been mixed		
March 1				1				
Part Part				1		be used as an inoculum. For the biological		
March Marc				1		process, the inoculum is initially added to the		
Part Part				I				
April Apri				1				
Marie Mari				I				
The continue of the continue				I		monitoring the pH daily to ensure a sanitised		
Part Part				1		"For each new batch of faecal sludge an initial		
March Marc				1		amount of sludge from the previous batch		
Marie				1				
				I		(Emersan)		
Second	om_skills	Performance, Categorica	TRUE	Ladder:	(unskilled = 0, skilled = 1, professional = 1)	"Molasses, milk or the LAB do not pose any	yes	
Production Pro								
Part						considered when handling the treated sludge as		
Part				İ				
				İ		of pump is required" (Emersan).		
	n		FALSE	-	NA .	NA .	NA .	1
Marine M	0	(FALSE	0	NA	NA	NA	1
Monther Mont								1
Marchand Marchand				Washers				1
Marie								
Reference Refe	0			0				1
Marchaell Marc								1
Prof. Control Prof. Control Prof. Control Prof. Control Prof. Control Prof. Control Prof. Control Prof. Control Prof. Control Prof. Control Prof. Control Prof. Control Prof. Prof. Control Prof. Prof. Control Prof.	ctille	r cromance, edtegorica		medium (1-5 years)	-,g - 1/	(Emersan)		
Sect of State of State Sta				long (>5 years)				
Second Continues Part Pa				İ		that no data on its longevity is available, but it is		
PRIOR PRIO				1				
motivate (a first to 2 weeks) Prof. Implement Treatment FOY, Caregorial TRUE Purfamenta, Caregorial				<u> </u>				
Martin Parenter	speed_implement_toilet	PDF, Categorica	FALSE		NA	NA.	NA	
PFF_Companied TME			<u> </u>	slow (> 2 weeks)		<u> </u>		
Solid P Tendents	speed_implement_treatment	PDF, Categorica	TRUE		(rapid=1, moderate=0, slow=0)		yes	
Act Act								
Section Sect				1				
### STATE OF PRINTED PRINTS AND THE COL				I				
### STATE OF PRINTED PRINTS AND THE COL	scalahility	Performance Categorica	TRUE	and the second s	(easy = 1 difficult = 1)	"[I actic acid fermentation] I AF Treatment needs	Mas	
All are serve others and off benefits open tanks, consistent and designed version is possible. May pursuable for the serve of the first of the transfer of version is possible. May pursuable for the serve of the first of the transfer of personal plane due to it is not be transfer for personal plane due to it is not	,	retromance, eategories		difficult	(, -,	a vessel, preferably sealable as LAB are most		
Construction_path POF_Categorical TRUE				1				
POF, Categories Note Not				I				
Supplied Continuence				1				
Table Continues Post Categorical TRUE Indicate Post Categorical TRUE Indicate Post Categorical TRUE Indicate Post Categorical TRUE Indicate Post Categorical Post Post Categorical Post Post Categorical Post P				1		its short treatment time (around 2 weeks), a		
				1				
Construction_parts				1		If a LAF vessel is designed large enough, one		
Construction_parts				İ				
Sealing Source Seal			Î.	I		needs to simply increase the amount of LAF to		
Second Coefficients						needs to simply increase the amount of LAF to scale up the technology. (Kukka Ilmanen, Eawag		
Transfer Cefficients	construction parts	PDF Categorica	TRUE	simple	(simple = 0.7, technical = 0.3, special = 0)	needs to simply increase the amount of LAF to scale up the technology. (Kukka Ilmanen, Eawag 2021)	ves	
Totaler Coefficients	construction_parts	PDF, Categorica	TRUE	technical	(simple = 0.7, technical = 0.3, special = 0)	needs to simply increase the amount of LAF to scale up the technology. (Kukka Ilmanen, Eawag 2021) "LAF Treatment needs a vessel, preferably sealable as LAB are most efficient under an	yes	
Transfer Coefficients	construction_parts	PDF, Categorica	TRUE	technical	(simple = 0.7, technical = 0.3, special = 0)	needs to simply increase the amount of LAF to scale up the technology. (Kukka Ilmanen, Eawag 2021) "LAF Treatment needs a vessel, preferably sealable as LAB are most efficient under an aerobic conditions. However, LAB are aero-	yes	
Statistic Coefficients	construction_parts	PDF, Categorica	TRUE	technical	(simple = 0.7, technical = 0.3, special = 0)	needs to simply increase the amount of LAF to scale up the technology. (Kukka Ilmanen, Eawag 2021) "LAF Treatment needs a vessel, preferably sealable as LAB are most efficient under an aerobic conditions. However, LAB are aerobic tools not not a consider the control of the c	yes	
Sample Coefficients Sample	construction_parts	PDF, Categorica	TRUE	technical	(simple = 0.7, technical = 0.3, special = 0)	needs to simply increase the amount of IAF to scale up the technology, (Kukka Ilmanen, Ewag 2021) "IAF Treatment needs a vessel, preferably scalable as IAB are most efficient under an aerobic conditions. However, IAB are aero- tolerant and therefore open tanks can be used if no scaled vessel is available. To achieve a homogeneous mix within the vessel in	yes	
Transfer Coefficients	construction_parts	PDF, Categorica	TRUE	technical	(simple = 0.7, technical = 0.3, special = 0)	needs to simply increase the amount of IAF to scale up the technology, (Kukka Ilmanen, Eawag 2021) "LAF Treatment needs a vessel, preferably "LAF are most efficient under an aerobic conditions. However, IAB are aero- tolerant and therefore open tanks can be used if no sealed vessel is available. To achieve a homogeneous mix within the vessel a recirculation pump is required. The type of pump depends on the thickness of the sludge. For	yes	
Transfer Coefficients Transfer Standard Stan	construction_parts	PDF, Categorica	TRUE	technical	(simple = 0.7, technical = 0.3, special = 0)	needs to simply increase the amount of IAF to scale up the technology. (Kukka Ilmanen, Ewag 2021) "LAF Treatment needs a vessel, perferably estable as LAB are most efficient under an aerobic conditions. However, LAB are aero- toler and and therefore open tanks can be used if no scaled wessel available. To achieve a homogeneous mix within the vessel a recirculation pump is required. The type of pump depends on the thickness of the sludge. For liquid sludge, a diphyrae pump may be used,	yes	
Transfer Coefficients Substitives Substitutes Substitives Substitutes Subs	construction_parts	PDF, Categorica	ÎTRUE	technical	(simple = 0.7, technical = 0.3, special = 0)	needs to simply increase the amount of IAF to scale up the technology. (Kukka Ilmanen, Ewag 2021) "LAF Treatment needs a vessel, perferably scalable as LAB are most efficient under an aerobic conditions. However, LAB are aero- tolerant and therefore open tanks can be used if no scaled wessel available. To achieve a homogeneous mix within the vessel a recrubation pump is required. The type of pump depends on the thickness of the sludge. For liquid skudge, a diaphragn pump may be used, whereast thicker sludge may need a screw pump or a vacuum pump. ("Emersian)	yes	
Sabilized Studge	construction_parts	PDF, Categorica	TRUE	technical	(simple = 0.7, technical = 0.3, special = 0)	needs to simply increase the amount of IAF to scale up the technology, (Kukka Ilmanen, Eawag 2021) "IAF Treatment needs a vessel, preferably seasible as IAB are most efficient under an aerobic conditions. However, IAB are aero-tolerant and therefore open tanks can be used if no sealed vessel is available. To achieve a homogeneous mix within the vessel are recrustation pump is required. The type of pump depends on the thickness of the sludge, For liquid sludge, and sludge, and subject and the screw pump or a vacuum pump. "(Emersan) To construct the vessel simple locally available	yes	
As the fermentation is performed in sealed (Scheinemann et a containers, there should be no change in surfient content, nor added value of the studge			TRUE	technical	(simple = 0.7, technical = 0.3, special = 0)	needs to simply increase the amount of IAF to scale up the technology. (Kukka Ilmanen, Ewag 2021) "LAF Treatment needs a vessel, perferably scaleble as LIAB are most efficient under an aerobic conditions. However, IAB are aero- tolerant and therefore open tanks can be used if no sealed vessel is available. To achieve a homogeneous mix within the vessel a necirculation pump in required. The type of pump depends on the thickness of the sludge. For leguid skidge, a dalpriagn pump may be used, whereast thicker sludge may need a screw pump or a vaccumu pump. ("Emersan) To construct the vessel simple locally available	yes	
1	Transfer Coefficients	Cospied from "Santacon, Technologies, T.C., Antalous, 2022-022-2-10")		technical special		needs to simply increase the amount of IAF to scale up the technology, (Kukka Ilmanen, Ewag 2021) "IAF Treatment needs a vessel, preferably seable as IAB are most efficient under an aerobic conditions. However, IAB are aero-tolerant and therefore open tanks, can be used if no sealed vessel is available. To achieve a homogeneous mix within the vessel are recircustion pump is required. The type of pump depends on the thickness of the studge, For liquid sladge, a diaphragm pump may be used, to a section pump. (Emersan) To construct the vessel simple locally available materials should be enough. Technical parts are required to provide pumps for mixing.		Reference
Medical Medi	Transfer Coefficients	Cospied from "Santacon, Technologies, T.C., Antalous, 2022-022-2-10")		technical special		needs to simply increase the amount of IAF to scale up the technology, (Kukka Ilmanen, Ewag 2021) "IAF Treatment needs a vessel, preferably seable as IAB are most efficient under an aerobic conditions. However, IAB are aero-tolerant and therefore open tanks, can be used if no sealed vessel is available. To achieve a homogeneous mix within the vessel are recircustion pump is required. The type of pump depends on the thickness of the studge, For liquid sladge, a diaphragm pump may be used, to a section pump. (Emersan) To construct the vessel simple locally available materials should be enough. Technical parts are required to provide pumps for mixing.	Comments As the fermentation is performed in sealed	(Scheinemann et al.
No. No.	Transfer Coefficients	Cospied from "Santacon, Technologies, T.C., Antalous, 2022-022-2-10")		technical special		needs to simply increase the amount of IAF to scale up the technology, (Kukka Ilmanen, Ewag 2021) "IAF Treatment needs a vessel, preferably seable as IAB are most efficient under an aerobic conditions. However, IAB are aero-tolerant and therefore open tanks, can be used if no sealed vessel is available. To achieve a homogeneous mix within the vessel are recircustion pump is required. The type of pump depends on the thickness of the studge, For liquid sladge, a diaphragm pump may be used, to a section pump. (Emersan) To construct the vessel simple locally available materials should be enough. Technical parts are required to provide pumps for mixing.	Comments As the fermentation is performed in sealed containers, there should be no change in uniferent content, nor added value of the	{Scheinemann et al. 2015}
É 25 10,31	Transfer Coefficients	Cospied from "Santacon, Technologies, T.C., Antalous, 2022-022-2-10")		technical special		needs to simply increase the amount of IAF to scale up the technology, (Kukka Ilmanen, Ewag 2021) "IAF Treatment needs a vessel, preferably seable as IAB are most efficient under an aerobic conditions. However, IAB are aero-tolerant and therefore open tanks, can be used if no sealed vessel is available. To achieve a homogeneous mix within the vessel are recircustion pump is required. The type of pump depends on the thickness of the studge, For liquid sladge, a diaphragm pump may be used, to a section pump. (Emersan) To construct the vessel simple locally available materials should be enough. Technical parts are required to provide pumps for mixing.	Comments As the fermentation is performed in sealed containers, there should be no change in uniferent content, nor added value of the	(Scheinemann et al.
É 25 10,31	Transfer Coefficients	Coursel from "Sentation, Technologies, T.; database, 35230522 view"] Stabilized Shudge	Range	technical special Autoss	Soilless	needs to simply increase the amount of IAF to scale up the technology, (Kukka Ilmanen, Ewag 2021) "IAF Treatment needs a vessel, preferably seable as IAB are most efficient under an aerobic conditions. However, IAB are aero-tolerant and therefore open tanks, can be used if no sealed vessel is available. To achieve a homogeneous mix within the vessel are recircustion pump is required. The type of pump depends on the thickness of the studge, For liquid sladge, a diaphragm pump may be used, to a section pump. (Emersan) To construct the vessel simple locally available materials should be enough. Technical parts are required to provide pumps for mixing.	Comments As the fermentation is performed in sealed containers, there should be no change in uniferent content, nor added value of the	{Scheinemann et al. 2015}
Comparison Com	Transfer Coefficients	towed from "Australians Technologies, T. database, 20210622 clam"] Stabilized Studge	Range	Aurtoss Out	Soilloss	needs to simply increase the amount of IAF to scale up the technology, (Kukka Ilmanen, Eawag 2021) "LAF Treatment needs a vessel, preferably seableb as IAB are most efficient under an aerobic conditions. However, IAB are aero-tolerant and therefore open tanks can be used if no sealed vessel is available. To achieve a homogeneous mix within the vessel are recirculation pump is required. The type of pump depends on the thickness of the sludge, For liquid sludge, a diaphragm pump may be used, whereast thicker sludge may need a crever pump or a vacuum pump. "(Emersan) To construct the vessel simple locally available materials should be enough. Technical parts are receuted to provide pumps for mixing. Wateriors	Comments As the fermentation is performed in sealed containers, there should be no change in nutrient content, nor added value of the sludge	{Scheinemann et al. 2015} McConville et al. (2020)
Med (R)	Transfer Coefficients TP med (R)	Cospiel from "Santacon, Bednodiques, TC, database, 20220622-shim") Stabilized Shudge : : 0.95	Range	Aurtoss Out	Soilloss	needs to simply increase the amount of IAF to scale up the technology, (Kukka Ilmanen, Eawag 2021) "LAF Treatment needs a vessel, preferably seableb as IAB are most efficient under an aerobic conditions. However, IAB are aero-tolerant and therefore open tanks can be used if no sealed vessel is available. To achieve a homogeneous mix within the vessel are recirculation pump is required. The type of pump depends on the thickness of the sludge, For liquid sludge, a diaphragm pump may be used, whereast thicker sludge may need a crever pump or a vacuum pump. "(Emersan) To construct the vessel simple locally available materials should be enough. Technical parts are receuted to provide pumps for mixing. Wateriors	Comments As the fermentation is performed in sealed containers, there should be no change in nutrient content, nor added value of the sludge	{Scheinemann et al. 2015} McConville et al. (2020) Spuhler et al. (2022)
Name Name	Transfer Coefficients TP med (R)	Stabilized Studge Stabilized Studge G 99 0 99	Range	Alrioss Out Out Out Out Out Out Out Out Out Ou	Sailloss	needs to simply increase the amount of IAF to scale up the technology, (Kukka Ilmanen, Eawag 2021) "IAF Treatment needs a vessel, preferably seasons are sensible as IAB are most efficient under an aerobic conditions. However, IAB are aero-tolerant and therefore open tanks can be used if no sealed vessel is available. To achieve a homogeneous mix within the vessel are included, refuge from the sensibility of the properties of the properties of the thickness of the sludge, For liquid sludge, and sludge, and supply any pror a vacuum pump. "(Emersan) To construct the vessel simple locally available materials should be enough. Technical parts are rescuired to provide pumps for mixing. Waterloss	Comments As the fermentation is performed in sealed containers, there should be no change in matrient content, nor added value of the sludge	(Scheinemann et al. 2015) McConville et al. (2020) Spuhler et al. (2022)
0.5	Transfer Coefficients TP med (R) T TN		Range	Artoss O01 O22 O23 O23	Soilloss	needs to simply increase the amount of IAF to scale up the technology, (Kukka Ilmanen, Ewag 2021) "IAF Treatment needs a vessel, preferably seable be at IAB are most efficient under an aerobic conditions. However, IAB are aero-tolerant and therefore open tanks, can be used if no sealed vessel is available. To achieve a homogeneous mix within the vessel are recirculation pump is required. The type of pump depends on the thickness of the studge. For liquid shalps, a diaphragm pump may be used, whereas thicker slodge may need a screen pump To construct the vessel simple locally available materials should be enough. Technical parts are required to provide pumps for mixine. Waterloss 0 0 0	Comments As the fermentation is performed in sealed containers, there should be no change in nursient content, nor added value of the sludge	{Scheinemann et al. 2015} McConville et al. (2020) Spuhler et al. (2022)
med (R) 0.97 0.03 0.00 0.00	Transfer Coefficients TP med (P.) ** ** ** ** ** ** ** ** **		Range	Arioss 0.01 0.02 0.03 0.05	Soilloss	needs to simply increase the amount of IAF to scale up the technology, (Kukka Ilmanen, Ewag 2021) "IAF Treatment needs a vessel, preferably seable as IAB are most efficient under an aerobic conditions. However, IAB are aero-tolerant and therefore open tanks, can be used if no sealed vessel is available. To achieve a homogeneous mix within the vessel are recirculation pump is required. The type of pump depends on the thickness of the sludge, for liquid sludge, a diaphragin pump may be used, whereas thicker sludge may need a screen pump. To construct the vessel simple locally available materials should be enough. Technical parts are required to provide pumps for mixing. Waterloss 0 0 0 0.00	Comments As the fermentation is performed in sealed containers, there should be no change in notifient content, nor added value of the sludge	(Scheinemann et al. 2015) McConville et al. (2020) Spuhler et al. (2022) PA from Dorothee Kelova et al. (2021)
k 25 (0,03) - </td <td>Transfer Coefficients TP med (P.) ** ** ** ** ** ** ** ** **</td> <td> Coapiel Stom *Santacom_Nechoologess_TC_database_20220622.nbm*] Stabilized Shadge </td> <td>Range 1 0.99-1 (0.85-0.97 0.85-0.97 0.85-0.97 0.85-0.97 0.85-0.97</td> <td>Airloss Airloss 0.01 0.01 0.02 0.03 0.05 0.05 0.05 0.05</td> <td> Soilloss</td> <td>needs to simply increase the amount of IAF to scale up the technology, (Kukka Ilmanen, Eawag 2021) "IAF Treatment needs a vessel, preferably season to the control of the</td> <td>Comments As the fermentation is performed in sealed containers, there should be no change in nutrient content, nor added value of the sludge</td> <td>(scheinemann et al. 2015) McConville et al. (2020) Spuhler et al. (2022) PA from Dorothee Kelova et al. (2021) PA from Dorothee</td>	Transfer Coefficients TP med (P.) ** ** ** ** ** ** ** ** **	Coapiel Stom *Santacom_Nechoologess_TC_database_20220622.nbm*] Stabilized Shadge	Range 1 0.99-1 (0.85-0.97 0.85-0.97 0.85-0.97 0.85-0.97 0.85-0.97	Airloss Airloss 0.01 0.01 0.02 0.03 0.05 0.05 0.05 0.05	Soilloss	needs to simply increase the amount of IAF to scale up the technology, (Kukka Ilmanen, Eawag 2021) "IAF Treatment needs a vessel, preferably season to the control of the	Comments As the fermentation is performed in sealed containers, there should be no change in nutrient content, nor added value of the sludge	(scheinemann et al. 2015) McConville et al. (2020) Spuhler et al. (2022) PA from Dorothee Kelova et al. (2021) PA from Dorothee
0.9 0.1 0 0 Spulher et al. (202 0.94 0.05 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Transfer Coefficients TP med (B) k TN med (R) REQ (R)		Range	Artoss 0.01 0.02 0.03 0.05 0.05	Soilloss C C C C C C C C C C C C C C C C C C	needs to simply increase the amount of IAF to scale up the technology, (Kukka Ilmanen, Ewag 2021) "IAF Treatment needs a vessel, preferably seable as IAB are most efficient under an aerobic conditions. However, IAB are aero-tolerant and therefore open tanks, can be used if no sealed vessel is available. To achieve a homogeneous mix within the vessel are recirculation pump is required. The type of pump depends on the thickness of the sludge, for liquid sludge, a diaphragin pump may be used, whereas thicker sludge may need a screen pump. To construct the vessel simple locally available materials should be enough. Technical parts are required to provide pumps for mixine. Waterloss 0 0 0.00	Comments As the fermentation is performed in sealed containers, there should be no change in notinent content, nor added value of the sludge	(Scheinemann et al. 2015) McConville et al. (2020) Spuhler et al. (2022) PA from Dorothee Kelova et al. (2021)
0.94 0.06 0 0 0 1 1 0 0 0 1 0 1 0 1 0 1 0 1 0 1	Transfer Coefficients TP med (R) k TN med (R) med (R) med (R) RECO med (R)	Subditive Subditive National Nationa	Range	Artoss 0.01 0.02 0.03 0.05 0.05 0.00	Soilloss C C C C C C C C C C C C	needs to simply increase the amount of IAF to scale up the technology, (Kukka Ilmanen, Ewag 2021) "IAF Treatment needs a vessel, preferably seable be st.AB are most efficient under an aerobic conditions. However, IAB are aero-tolerant and therefore open tanks, can be used if no sealed vessel is available. To achieve a homogeneous mix within the vessel are recirculation pump is required. The type of pump depends on the thickness of the subge, for liquid shalps, a diaphragin pump may be used, whereas thicker slodge may need a screen pump. To construct the vessel simple locally available materials should be enough. Technical parts are required to provide pumps for mixine. Waterloss 0 0 0.00	Comments As the fermentation is performed in sealed containers, there should be no charge in notinent content, nor added value of the studge	[Scheinemann et al. 2015] McConville et al. (2020) Spuhler et al. (2022) - PA from Dorothee Kelova et al. (2021) - PA from Dorothee Kelova et al. (2021) - PA from Dorothee Kelova et al. (2021)
1 0 0 0 VSS Kelova et al. (2021 med (R) 0.95 0,9-0,1 0.06 0.00 0.00 -	Transfer Coefficients TP med (R) k TN med (R) med (R) med (R) RECO med (R)	Subditive Subditive National Nationa	Range	Artoss 0.01 0.02 0.03 0.05 0.05 0.00	Soilloss C C C C C C C C C C C C	needs to simply increase the amount of IAF to scale up the technology, (Kukka Ilmanen, Ewag 2021) "IAF Treatment needs a vessel, preferably seable be st.AB are most efficient under an aerobic conditions. However, IAB are aero-tolerant and therefore open tanks, can be used if no sealed vessel is available. To achieve a homogeneous mix within the vessel are recirculation pump is required. The type of pump depends on the thickness of the subge, for liquid shalps, a diaphragin pump may be used, whereas thicker slodge may need a screen pump. To construct the vessel simple locally available materials should be enough. Technical parts are required to provide pumps for mixine. Waterloss 0 0 0.00	Comments As the fermentation is performed in sealed containers, there should be no charge in notinent content, nor added value of the studge	(scheinemann et al. 2015) McConville et al. (2020) Spuhler et al. (2022) PA from Dorothee Kelova et al. (2021) PA from Dorothee
med (R) 0.95 0,9-0,1 0.06 0.00 0.00 -	Transfer Coefficients TP med (R) k TN med (R) med (R) med (R) RECO med (R)	Stabilized Studge 1	Range 0.99-1 0.85-0.37 0.85-0.37 0.85-0.37	Alrioss Alrioss 0.01 0.01 0.02 0.1 0.05 0.09 0.05 0.05 0.05	Soilloss	needs to simply increase the amount of IAF to scale up the technology, (Kukka Ilmanen, Ewag 2021) "IAF Treatment needs a vessel, preferably season to the control of the co	Comments As the fermentation is performed in sealed containers, there should be no change in nutrient content, nor added value of the sludge	[Scheinemann et al. 2015] McConville et al. (2020) Spuhler et al. (2022) - PA from Dorothee Kelova et al. (2021) - PA from Dorothee Kelova et al. (2021) - PA from Dorothee Kelova et al. (2021)
k 25 (0.1)	Transfer Coefficients TP med (R) k TN med (R) med (R) med (R) RECO med (R)	Submitted Shudge	Range 0 0.99-1 0.95-0.97 0.85-0.97 0.82-0.97 0.93-0.97	Artoss 0.01 0.02 0.03 0.05 0.03 0.05 0.01 0.05 0.05 0.05 0.01 0.06 0.06	Soliloss C C C C C C C C C C C C C C C C C C	needs to simply increase the amount of IAF to scale up the technology, (Kukka Ilmanen, Ewag 2021) "LAF Treatment needs a vessel, preferably seableb as IAB are most efficient under an aerobic conditions. However, IAB are aero-tolerant and therefore open tanks, can be used if no sealed vessel is available. To achieve a homogeneous mix within the vessel are recircuistion pump is required. The type of pump depends on the thickness of the subge, for liquid shalge, a diuphragm pump may be used, whereas thickes studge may need a screer pump or a vacuum pump. "Emersan' Construct the vessel simple locally available materials should be enough. Technical parts are rescuried to provide ourms for mixing. Waterloss Waterloss 0 0 0.00 0.00	Comments As the fermentation is performed in sealed containers, there should be no change in nuclinest content, nor added value of the sludge	Scheinemann et al. 202015 McConville et al. (2020) Spuhler et al. (2022)
	Transfer Coefficients TP med (R) med (R) med (R) RO med (R) TN McO med (R)	Submitted Shudge	Range 0 0.99-1 0.09-1 0.09-1 0.85-037 0.81-037	Arioss Arioss 0.01 0.02 0.03 0.05 0.01 0.05 0.01 0.05 0.00 0.00 0.00 0.00	Soilloss C C C C C C C C C C C C	needs to simply increase the amount of IAF to scale up the technology, (Kukka Ilmanen, Eawag 2021) "LAF Treatment needs a vessel, preferably "LAF Treatment needs a vessel, preferably seasible as LAB are most efficient under an aerobic conditions. However, IAB are aero-tolerant and therefore open tanks can be used if no sealed vessel is available. To achieve a homogeneous mix within the vessel are recirculation pump is required. The type of pump depends on the tinchease of the sludge, For liquid sludge, a diaphragm pump may be used, whereast thicker sludge may need a screw pump or a vacuum pump. "(Emersan) To construct the vessel simple locally available materials should be enough. Technical parts are resulted to provide pumps for mixing. Wateriors Wateriors 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Comments As the fermentation is performed in sealed containers, there should be no change in nutrient content, nor added value of the sludge	Scheinemann et al. 2015) McConville et al. (2020) Spuhler et al. (2022) - PA from Dorothee Kelova et al. (2021) PA from Dorothee Kelova et al. (2021) PA from Dorothee

References
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doep, E. A., L., Z., Zhou, X., Yan, Y. (2018). Ecolis production and accordance in Feeal shudge, Dumand 18, 198-880s. https://doi.org/10.1016/j.Gepep...02180.02.276
Kelova et al. (2021) Small-scale - on-site treatment of feeal matter comparison of Treatments for resource recovery and sanitization. Feen Small Small-scale and Pollution Research, 28:63945-63966. https://doi.org/10.1017/j.j.1006-07/j.0017/j.1017/j.00

Caustic Soda Treatment							
	Values T	Data Source					
UNIQUE IDENTIFIER (ID)	caustic_soda_treatment SaniChoice Project Team	-					
INPUT PRODUCT	stored_faeces,	Gensch, R. et al. (2018)					
1	transportedstored_faeces, blackwater, transportedblackwater, sludge, transportedsludge, transportedtransferred_sludge						
OUTPUT PRODUCT 9	stabilized_sludge , transportedstabilized_sludge, effluent, transportedeffluent	Gensch, R. et al. (2018)					
	Input: OR Output: AND	Gensch, R. et al. (2018)					
	Values (household = 0, neighbourhood = 1, city = 0)	Data Source Gensch, R. et al. (2018)					
management_level (capex_req_level	(household = 0, shared = 0, public = 1)	Gensch, R. et al. (2018) Spuhler, D. et al. (2021)					
opex_req_level		Spuhler, D. et al. (2021)					
technical_maturity development_phase ((acute = 1, stabilisation = 0.5,	Gensch, R. et al. (2018) Gensch, R. et al. (2018)					
	development/recovery = 0) Type and Function	Applicable for this Functional Group?	Categories [Unit]	Technology Values (Data)	Data Source / Assumptions	Internal Review Done?	
water_supply	Performance, Categorical	FALSE	house yard public	NA	NA	NA	
water_volume	Performance, Trapez	FALSE		NA		NA	
electricity_supply	Performance, Categorical	TRUE	electricity intermittent no electricity	(electricity = 1, intermittent = 0.3, no elect	in the tank it is mixed into the sludge either manually or using a mixing pump. The type of pump required depends on the consistency of the sludge. A separate pump is needed for removing the treated effluent from the tank and a shovel or vacuum pump for the removal of solid material." Effect for Caustic	yes	
					soda] can be enhanced by ensuring complete mixing (Temeran) Mixing can be done manually, but performance is far better with electric mixing so that intermittent electricity is assigned a value of 0.3. At least intermittent electricity for mixing intermittent electricity for pumping the treated effluent is required.		
fuel_supply	Performance, Categorical	FALSE		NA .	NA	NA	
frequency_of_om	PDF, Categorical	TRUE	no fuel irregular regular continuous	(irregular = 0, regular = 1, continuous = 0)	"Caustic Soda is corrosive due to its high alkalinity, therefore a regular maintenance of pumps is required. During storage, caustic soda must be kept dry at all times because it absorbs and reacts with water." (Emersan)		
pipe_supply	Performance, Categorical	TRUE	no pipes	(no pipes = 1, difficultly available = 1, pipe	Regular maintenance required. No need for pipes.	yes	
pump_supply	Performance, Categorical		difficultly available pipes no pumps		"For an even distribution of caustic soda		
			difficultly available pumps		in the tank it is mixed into the sludge either manually or using a mixing pump. The type of pump required depends on the consistency of the sludge. A separate pump is needed for removing the treated effluent from the tank and a shovel or vacuum pump for the removal of solid material.* (Emersan)		
concrete_supply	Performance, Categorical	TRUE	no concrete difficultly available concrete	(no concrete = 0.5, difficultly available = 0.75, concrete = 1)	reactor vessel that can either be an above ground tank (between 1–30m3)	yes	
					or a pit below ground with trapaulin lining." (Emersal) There is no information found what type of material the vessel could be made of, but since the vessel needs to be sealed it could be concrete. It is assumed that atternative vessels need to either be imported (metal), have shorter lifetimes (plastic, wood) and that locals have experience working with concrete.		
spare_parts	PDF, Categorical	TRUE	simple technical	(simple = 0.5, technical = 0.5, special = 0)	"For an even distribution of caustic soda in the tank it is mixed into the sludge	yes	
			special		either manually or using a mixing pumpon. The type of pump required depends on the consistency of the sludge. A separate pump is needed for removing the treated effluent from the tank and a shovel or vacuum pump for the removing of solid material.", "In addition a water testing kit] personal protective equipment (PPE) [], steady supply of caustic sods is also required.", "Simple process which uses a material that is available in most countries" (Emersan) To repair and replace the pumps technical parts might be required. To maintain the vessel or provide testing kits and PPE locally available might be required.		
0	0	FALSE FALSE	0	NA NA	NA	NA NA	
0 temperature	0 Performance, Categorical	FALSE TRUE	very cold cold	NA (very cold = 1, cold = 1, temperate = 1, wa		NA	
flooding	Performance, Categorical	TRUE	temperate warm hot flooding no flooding	(flooding = 0.9, no flooding = 1)	"Caustic Soda Treatment can either take place above ground in a separate tank or below ground. In areas with a high groundwate level or in flood prone areas it is recommended to always use	yes	
					above ground tanks.", "Sealable container/wess" (Emersan) If constructed with a sealed vessel the technology should be watertight, what means that there should be malertight, what means that there should be minimal risk in area prone to flooding. These values are allotted to all "tank" based technologies. These treatment technologies and their corresponding tanks are built to be water-tight. Additionally, their raised configurations are possible in flood prone areas. The impact of criterion flooding is therefore not considered to be as severe and only a 10% reduction in performance is allotted. (Akankha Jain)		
vehicular_acces	Performance, Categorical	FALSE		NA .		NA .	
vehicular_acces	Performance, Categorical	FALSE	difficult	NA .		NA .	
vehicular_acces slope	Performance, Categorical Performance, Categorical		difficult full flat	NA NA	NA .	NA NA	
		FALSE	difficult full		NA .		

Transfer Coefficients	(organ from "Sentation Technologies, TC_database_202262: Stabilized Studge 0.65	Range 0,4-0,9	Effluent 0.21		pumps are used for mixing and emptying, technical parts are required. Soilloss	Waterloss 0	TCs from hydrated lime treatment	Reference PA Longo et al (2015)
Transfer Coefficients	Stabilized Sludge	Range			pumps are used for mixing and emptying, technical parts are required. Soilloss			
Transfer Coefficients	(copied from "Sanitation Technologies, TC database, 2021002	Zaken")			pumps are used for mixing and			
					lining. An additional smaller container is needed for the preparation of the caustic ode solution (e.g. 200 l plastic drum). For an even distribution of caustic ode solution (e.g. 200 l plastic drum). For an even distribution of caustic ode in the tank it is mixed into the sludge either manually or using a mixing pump. The type of pump required depends on the consistency of the sludge. A separate pump is needed for removing the treated effluent from the tank and a showel or vacuum pump for the removal of solid material." (Emersan) To construct the vessel simple locally available materials should be enough. If			
construction_parts	PDF, Categorical	TRUE	simple technical special	(simple = 0.7, technical = 0.3, special = 0)	"Caustic Soda Treatment needs a reactor vessel that can either be an above ground tank (between 1–30 m3) or a pit below ground with tarpaulin	yes		
					materials," "its effect can be enhanced by ensuring complete mixing, a longer contact time and a higher dosage of caustic soda". (Emersan) To scale up more sludge/blackwater needs to be treated and simply the amount of available caustic soda should be increased. It needs to be made sure that even though a larger amount of input material is treated, sufficient mixing and a long enough contact time are achieved. (Kukka Ilmanen, Eawag 2021)			
scalability	Performance, Categorical	TRUE	easy difficult	(easy = 1, difficult = 1)	(Akanksha Jain) "Caustic Soda Treatment is particularly suitable for the rapid response phase due to its short treatment time, simple process and use of readily available	yes		
content	· Ur, sategorical		moderate (few weeks up to three months) slow (> 3 months)	, , , , , , , , , , , , , , , , , , ,	ample process winch uses a material that is available in most countries" (Emersan Compendium) Implementation very quick since only a vessel and caustic soda is required, both of which are generally locally available			
speed_implement_treatment	PDF, Categorical		rapid (< 3 days) moderate (3 days to 2 weeks) slow (> 2 weeks) rapid (few days to a week)	(rapid=1, moderate=0, slow=0)	"Simple process which uses a material	ves		
speed_implement_toilet	PDF, Categorical	FALSE	rapid (< 3 days)	NA NA	Declease Cowtons return at Isbulary within 24 hours." (Elmersan) Due to the short treatment time a lifetime of less than 1 year is possible. Emerging technology, so that no data on the sold of the short of the same sassumed that the concept of treatment with caustic soda can also be applied in the long-term. (Kukka Ilmanen, Eawag 2021)	NA NA		
0 lifetime	Performance, Categorical	FALSE TRUE	short (< 1 year) medium (1-5 years) long (>5 years)	NA (short = 1, medium = 1, long = 1)	NA "The Caustic Soda Treatment process should be undertaken as a batch process and can be used to treat both solid and liquid sludge. After treatment, pH decrease towards neutral usually within	NA yes		
0		FALSE		NA.	NA NA	NA NA		
0 cleansing_method		FALSE	Washers	NA NA	NA NA	NA NA		
0	0	FALSE FALSE	C	NA NA NA	NA NA NA NA	NA NA		
om_skills	Performance, Categorical	TRUE	Ladder: Unskilled Skilled Professional	(unskilled = 0, skilled = 1, professional = 1)	[Emersan]. "Regular maintenance of pumps is required. During storage, caustic soda must be kept dry at all times because it absorbs and reacts with water. Due to potential health risks when handling caustic soda [see blevby] skilled and trained personnel must follow respective health and safety protocols and wear proner PEP ("Emersan).	yes		
			unsamed skilled professional		"The optimum dosage to reach the recommended pH of 12 is around 26 g of soda per little of faecal sludge. The exact amount, however, depends on the characteristics of blackwater or sludge. Its effect can be enhanced by ensuring complete musing, a longer contact time and a higher dosage of caustic soda"			
design_skills	Performance, Categorica	TRUE	professional Ladder: unskilled	(unskilled = 0, skilled = 0, professional =	"Caustic Soda Treatment can either take place above ground in a separate tank or below ground. In areas with a high groundwater level or in flood prone areas it is recommended to always use above ground tanks. Separate tanks may be needed for the preparation of the soda solution slurry and for the post-neutralisation of the treated effluent respectively" (Emersan). Requires expertise.	yes		
0 construction_skills		FALSE		NA (unskilled = 0, skilled = 1, professional = 1)	NA Relatively basic tanks/containers for batch process required. Pumps require basic knowledge for installation.	NA yes		
drinking_water_exposure		FALSE		NA NA	NA NA	NA NA		
0 0	0	FALSE FALSE FALSE	0	NA NA NA	drum)* (Emersan). The same value as for hydrated lime treatment is used as it follows the same operating principle (adding treatment solution to a tank and mixing it) (SaniChoice Team 2021: Best Guess). NA NA NA	NA NA NA		
surface_area_offsite	Performance, Trapez	TRUE	m2/pers	(a = 0.007, b = 0.007, c = 999, d = 999)	"Caustic Soda Treatment needs a reactor vessel that can either be an above ground tank (between 1–30 m3) or a pit below ground with tarpaulin lining. An additional smaller container is needed for the preparation of the caustic soda solution (e.g. 2001 plastic			
surface_area_onsite	Performance, Trapez		hard	NA NA	reactor vessel that can either be an above ground tank (between 1–30 m3) or a pit below ground with tarpaulin lining" (Emersan). We assume that the technology works perfectly in above ground tank and excavation therefore is not a limiting factor. NA	NA NA		
excavation	Performance, Categorical	FALSE TRUE	water depth [m] easy	NA (easy = 1, hard = 1)	NA "Caustic Soda Treatment needs a	NA yes		

	0.775		0.1	0.1		tertiary treatment analysis done on 24hr composite trickling filter effluent	Al-Rehaili and Misbahuddin (2001), PA
med (R)	0.675		0.2	0.1	0.025	0	-
k	2		-	-		-	PA
TN	0.28		0.52	0.2	0		Nurul Hanira et al. (2015), PA
	0.33		0.57	0.1			Longo et al (2015), PA
med (R)	0.305		0.545	0.15	0	0	-
k	5		-	-		-	PA
H2O	0.145	0,04-0,25	0.8	0.03	0.025	0 TC from hadrated lime treatment	PA
med (R)	0.145	-	0.8	0.03	0.025	0	-
k	5		-	-		-	PA
TS	0.4	-	0.4	0.15	0.05	0	PA
	0.72	·	0.28	0			Longo et al (2015)
	0.47		0.53			Spuhler et al. (2021)	Al-Rehaili and Misbahuddin (2001)
med (R)	0.47	0,4-0,72	0.4	0.1	0.03	0	
k	5	[0,32]					

References

Gensch, R., Jennings, A., Renggli, S., & Reymond, P. (2018). Compendium of Sonitation Technologies in Emergencies. German WASH Network (GWN), Swiss Federal Institute of Aquatic Science and Technology (Ewag), Gibbal WASH Cluster (GWC) and Sustainable Sonitation Alliance (SuSanA).

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Strong, E. (Estoor, Salamis, N., Frinor, D., Rett), F. Falter (Spirits Sciences), Selecting Hallands (Spirits Hallands), Selecting Hallands (Spirits Hallands), Selecting Hallands (Spirits Hallands), Selecting Hallands (Spirits Hallands), Selecting Hallands (Spirits Hallands), Selecting Hallands (Spirits Hallands), Selecting Hallands (Spirits Hallands), Selecting Hallands (Spirits Hallands), Selecting Hallands (Spirits Hallands), Selecting Hallands (Spirits Hallands), Selecting Hallands (Spirits Hallands), Selecting Hallands (Spirits Hallands), Selecting Hallands (Spirits Hallands), Selecting Hallands (Spirits Hallands), Selecting Hallands (Spirits Hallands), Selecting

Harris Transferred		Hara Tarabasan				
Urea Treatment General Information	Values	Urea Treatment Data Source				
FUNCTIONAL GROUP UNIQUE IDENTIFIER (ID)	urea_treatment					
	SaniChoice Project Team stored_faeces, transportedstored_faeces,	- Gensch, R. et al. (2018)				
	blackwater, transportedblackwater, sludge, transportedsludge, transportedtransferred_sludge					
OUTPUT PRODUCT	stabilized_sludge , transportedstabilized_sludge	Gensch, R. et al. (2018)				
RELATIONS	Input: OR Output: AND	Gensch, R. et al. (2018)				
COMMENTS Pre-Filter Criteria	Values	Data Source				
applicability_level		McConville, J. et al. (2020)				
capex_req_level	4	McConville, J. et al. (2020) Spuhler, D. et al. (2021)				
opex_req_level technical_maturity	3	Spuhler, D. et al. (2021) McConville, J. et al. (2020)				
	(acute = 1, stabilisation = 0, development/recovery = 0)	Gensch, R. et al. (2018)				
Screening Criteria	Type and Function	Applicable for this Functional Group?	Categories [Unit]	Technology Values (Data)	Data Source / Assumptions	Internal Review Done?
water_supply	Performance, Categorical	FALSE	house yard	NA	NA	NA
			public none			
water_volume electricity_supply	Performance, Trapez Performance, Categorical		[L/cap/day] electricity	NA (electricity = 1, intermittent = 0, no electricity = 0)	NA "Urea Treatment needs a lockable vessel (e.g. a	NA yes
			intermittent no electricity		closed tank or portable bladder) and a recirculation pump to achieve a homogeneous sludge- urea mix. For liquid sludge, a diaphragm pump may be used, whereas thicker sludge may need a screw pump or a vacuum pump."	
		FALCE.	E. al		(Emersan) Continous electricity supply is necessary.	N/A
fuel_supply	Performance, Categorical		fuel no fuel		NA .	NA
frequency_of_om	PDF, Categorical	TRUE	irregular regular	(irregular = 0, regular = 1, continous = 0)	"Regular maintenance of pumps used for mixing is required." (Emersan)	
pipe_supply	Performance, Categorical	TRUE	continuous no pipes difficultly available	(no pumps = 1, difficultly available = 1, pumps = 1)	No need for pipes. (Eawag own judgement, 2021)	yes
pump_supply	Performance, Categorical	TRUE	pipes no pumps difficultly available pumps	(no pumps = 0, difficultly available = 0.5, pumps = :	"A pump is used to circulate the sludge within the storage vessel to ensure adequate contact between the urea and sludge", "Urea Treatment needs a lockable vessel (e.g. a closed tank or portable bladder) and a recirculation pump to achieve a homogeneous sludge- urea mix. For liquid sludge, a diaphragm pump may be used, whereas thicker sludge may need a screw pump or a vacuum pump." (Emersan) Pump supply is necessary.	yes
concrete_supply	Performance, Categorical	TRUE	no concrete difficultly available concrete	(no concrete = 0.5, difficultly available = 0.75, concrete = 1)	"Urea Treatment needs a lockable vessel (e.g. a closed tank or portable bladder)" (Emersan) There is no information found what type material the vessel could be made of, but it could be concrete. It is assumed that alternative vessels need to either be imported (metal), have shorter lifetimes (plastic, wood) and that locals have experience working with concrete.	yes
spare_parts	PDF, Categorical	TRUE	simple technical special		"Urea Treatment needs a lockable wessel (e.g. a closed tank or portable bladder) and a recirculation pump to achieve a homogeneous sludge- urea mix. For liquid sludge, a diaphragm pump may be used, whereas thicker sludge may need a screw pump or a vacuum pump. In addition, a steady supply of urea is needed. Urea is a conventional, widely used and affordable chemical fertilizer that should be available in most local contexts. In addition, a water testing kit (particularly for pH and £. coll) is needed to control pH levels in the urea sludge mix and to test the level of treatment efficacy." (Emersan) "[] urea are required and urea is generally available and affordable."	yes
0		FALSE			NA	NA
0	0	FALSE	0	NA	NA NA	NA NA
temperature flooding	Performance, Categorical Performance, Categorical		very cold cold temperate warm hot flooding no flooding	(flooding = 0.9, no flooding = 1)	Nordin A. & Vinnerás B. (2015) Nordin, A. et al. (2015) Nordin, A. et al. (2009) (1) Nordin, A. et al. (2009) (2) Vinnerás B. t. al. (2009) "It is recommended that treatment is undertaken in a sealed vesse! []" (Emersan) "Potential health risks if not handled properly" (Emersan) It seems like there is a small health risk if the technology is constructed in an area prone to flooding. However, if the technology is constructed completely watertight there should be no problem with flooding.	yes
					These values are allotted to all "tank" based technologies. These treatment technologies and their corresponding tanks are built to be water-tight. Additionally, their raised configurations are possible in flood prone areas. The impact of criterion flooding is therefore not considered to be as severe and only a 10% reduction in performance is allotted. (Akanksha Jain)	
vehicular_acces	Performance, Categorical	FALSE	no access difficult	NA	NA	NA
slope	Performance, Categorical	FALSE	full flat	NA .	NA .	NA
soil_type	Performance, Categorical		not flat clay	NA NA	NA .	NA
			silt sand			
			gravel rock			
groundwater_depth excavation	Performance, Trapez Performance, Categorical		rock water depth [m] easy hard	NA (easy = 1, hard = 1)	NA Expert judgement (Nordin, A. (2021))	NA
surface_area_onsite	Performance, Trapez	FALSE	[m2/plot]	NA	NA	NA
<u> </u>	<u> </u>		ı	I.	I	

audan** ·	D	TRUE	m3/noss	(a=0.2 h=0.4 a=000 ± 000)	defined by the flow to be treated the control of	1	1
surface_area_offsite			m2/pers	(a = 0.2, b = 0.4, c = 999, d = 999)	defined by the flow to be treated thus related to the dilution with flush water, collection time and storage time where the latter is temeprature and dosage dependent. Figures given here cover the range from undiluted human excreta to using \$1. flush water per day, and gives values assuming treating waste collected per month at a storage time of less than 1 month, assuming a square cubicle. Area can be decreased further by changing with to height ratio of cubicle. (Nordin, A. (2021))		
0		FALSE FALSE		NA NA	NA NA	NA NA	
0	0	FALSE	0	NA	NA	NA	
drinking_water_exposure			Close Not close	NA	NA	NA	
0		FALSE FALSE		NA NA	NA NA	NA NA	
construction_skills			Ladder: unskilled	(unskilled = 0, skilled = 1, professional = 1)	"Urea Treatment needs a lockable vessel (e.g. a closed tank or portable bladder) and a	yes	
			skilled professional		recirculation pump to achieve a homogeneous sludge- urea mix. For liquid sludge, a diaphragm pump may be used, whereas thicker sludge may need a screw pump or a vacuum pump." (Emersan) "Urea may be hazardous when it comes on contact with skin or eyes (irritant), ingestion or inhalation and may be combustible at high temperatures." (Emersan) The installation of technical components might require a skilled labourer. Further is a propper construction highly recommended since there might be serious health risks if now health		
design_skills	Performance, Categorical	TRUE	Ladder: unskilled	(unskilled = 0, skilled = 0, professional = 1)	"The process depends on temperature and partial pressures of ammonia gas above the	yes	
om_skills	Performance, Categorical	TRUE	Ladder: Unskilled Skilled Professional	(unskilled = 0, skilled = 1, professional = 1)	liquid. Hence, ventilation and head space also influences the process conditions. It is recommended that treatment is undertaken in a sealed vessel to minimise the amount of ammonia gas that escapes and to force the equilibrium towards soluble ammonia. The treatment should be done as a batch process to ensure consistent santistation in the sludge." (Emersan) "Urea is usually added at a ratio of 2 % of the overall sludge wet weight. Urea is initially placed in the storage vessel (e.g. bladder/closed tank) and then faecal sludge is pumped into the vessel. The size of the vessel may vary depending on the amount and frequency of the sludge to be treated. A pump is used to circulate the sludge within the storage vessel to ensure adequate contact between the urea and sludge. Urea decomposition requires a minimum of 4 days, hence a retention time in the closed vessel of approximately 1 week is recommended." (Emersan) "Une to potential health risks when handling urea (see below) the process requires skilled personnel following health and safety protocols and wearing proper personal protective equipment (PPE)." (Emersan) "Urea may be needed when removing sludge from the tank. PPE (for example masks, gloves, aprons and long-sleeved clothing must be worm when handling must be worm when handling urea to prevent irritation to eyes, skin, and the respiratory system." (Emersan)		-
					moderate OM skills are recommended.		
0		FALSE FALSE		NA NA	NA NA	NA NA	
0	0	FALSE		NA NA	NA NA	NA NA	
cleansing_method	Performance, Categorical	FALSE	Washers	NA NA	NA NA	NA	
			Soft wipers Hard wipers				
0		FALSE FALSE	0	NA NA	NA NA	NA NA	
lifetime			short (< 1 year)	(short = 1, medium = 1, long = 1)	"Treatment time ≈ 1 week (4–8 days)" (Emersan)	yes	1
			medium (1-5 years) long (>5 years)		Due to the short treatment time a lifetime of less than 1 year is possible. Emerging technology, so that no data on its longevity is available, but it is assumed that the concept of treatment with urea can also be applied in the long-term. (Kukka Ilmanen, Eawag 2021)		
speed_implement_toilet	PDF, Categorical	FALSE	rapid (< 3 days) moderate (3 days to 2 weeks)	NA	NA	NA	
speed_implement_treatment	PDF, Categorical	TOLLE	slow (> 2 weeks) rapid (few days to a week)	(rapid=1, moderate=0, slow=0)	"Ammonia sanitisation may be a suitable	ves	
			moderate (few weeks up to three months) slow (> 3 months)		treatment option both for emergency situations and established treatment systems, due to its short treatment time, relatively simple process and the use of locally available materials" (SLU Compendium) implementation very quick since only a closed vessel and urea is required, both of which are generally locally available (Akanisha Jain)		_
scalability	Performance, Categorical	TRUE	easy difficult	(easy = 1, difficult = 1)	"Urea Treatment may be a suitable treatment option for the acute emergency phase due to its	yes	
construction_parts	PDF, Categorical	TRUE	simple technical special	(simple = 0.5, technical = 0.5, special = 0)	option for the acute emergency phase due to its short treatment time (around 1 week), a relatively simple process and use of readily available materials' (Emersan). If a urea treatment vessel is designed large enough, one needs to simply increase the amount of urea to scale up the technology. (Kukka Ilmanen, Eawag 2021) "Urea Treatment needs a lockable vessel (e.g. a closed tank or portable bladder) and a recirculation pump to achieve a homogeneous studge- urea mix. For liquid sludge, a diaphragm pump may be used, whereas thicker sludge may need a screw pump or a vacuum pump. In addition, a steady supply of urea is needed. Urea is a conventional, widely used and affordable chemical fertilizer that should be available in most local contexts." (Emersan) To construct the vessel simple locally available materials should be enough. If a pumping system is used for mixing, technical parts are required.	yes	_
Transfer Coefficients	(copied from "Sanitation_Technologies_TC_database_20210622.xism")						
	Stabilized Sludge	Range	Airloss	Soilloss	Waterloss	Comments	Reference

TP	1	-	0	0	0	A. Nordin
						(2021)
med (R)	1	-	0	0	0	-
k	2		-	-		PA
TN	0.96		0.04	0	0	A. Nordin
						(2021)
med (R)	0.96	-	0.04	0	0	-
k	2			-		PA
H2O	0.98	-	0.02	0	0	A. Nordin
						(2021)
med (R)	0.98		0.02	0	0	-
k	5					PA
TS	1	-	0	0	0	A. Nordin
						(2021)
med (R)	1		0	0	0	-
k	1			-		PA

References

References

Gensch, R., Jennings, A., Rengil, S., & Reymond, P. (2018). Compendium of Sonitation Technologies in Emergencies . German WASH Network (GWN), Swiss Federal Institute of Aquatic Science and Technology (Eawag), Global WASH Cluster (GWC) and Sustainable Sanitation Alliance (SuSanA).

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Hydrated Lime Treatment General Information	Values	Data Source					
FUNCTIONAL GROUP	T hydrated lime treatment	-					
DATA COMPILER INPUT PRODUCT	SaniChoice Project Team stored_faeces, transportedstored_faeces, blackwater, transportedblackwater, sludge,	- Gensch, R. et al. (2018)					
OUTPUT PRODUCT	transportedsludge, transportedtransferred_sludge stabilized_sludge, transportedstabilized_sludge, secondary_effluent,	Gensch, R. et al. (2018)					
RELATIONS	transportedsecondary_effluent	Gensch, R. et al. (2018)					
COMMENTS							
	Values (household = 0, neighbourhood = 1, city = 0.5) (household = 0, shared = 0, public = 1)	Data Source McConville, J. et al. (2020) McConville, J. et al. (2020)					
capex req level	4	Spuhler, D. et al. (2021)					
opex req level technical maturity	3	Spuhler, D. et al. (2021) McConville, J. et al. (2020)					
development_phase	(acute = 1, stabilisation = 0.5, development/recovery = 0)	Gensch, R. et al. (2018)					
Screening Criteria water_supply	Type and Function Performance, Categorical	Applicable for this Functional Group? FALSE	Categories [Unit]	Technology Values (Data) NA	Data Source / Assumptions NA	Internal Review Done? NA	
			yard public none				
water volume electricity_supply	Performance, Trapez Performance, Categorical		[L/cap/day] electricity	NA (electricity = 1, intermittent = 0.9, no	NA "For an even distribution of hydrated lime	NA yes	
			intermittent no electricity	electricity = 0.7)	throughout the sludge, constant mixing is required (either manually or with a mixing pump). The type of pump required depends on the consistency of the sludge. A separate pump is needed to remove the treated effluent from the tank and a shovel or vacuum pump to remove the solid material." (Imersan) Depending on the configuration electricity is needed.		
fuel_supply	Performance, Categorical	FALSE	fuel	NA	NA NA	NA	
frequency_of_om	PDF, Categorical	TRUE	no fuel irregular regular continuous	(irregular = 0, regular = 0.6, continous = 0.4)	If there are no machines running the process it could be quite labour intensive. If the system is automatized with machines such as pumps the process gets less abour intensive but then maintenance of the machines is required. In both cases regular to continous OM is assumed.		
pipe_supply	Performance, Categorical		no pipes difficultly available pipes	(no pumps = 1, difficultly available = 1, pumps = 1)	No need for pipes.	yes	
pump_supply	Performance, Categorical	TRUE	no pumps difficulty available pumps	(no pumps = 0.5, difficultly available = 0.75, pumps = 1)	For an even distribution of hydrated lime throughout the sludge, constant mixing is required (either manually or with a mixing pump). The type of pump required depends on the consistency of the sludge. A separate pump is needed to remove the treated effluent from the tank and a shovel or vacuum pump to remove the solid material." (Emersan) Depending on the configuration a pump is needed.	yes	
concrete_supply	Performance, Categorical	TRUE	no concrete difficulty available concrete	(no concrete = 0.5, difficultly available = 0.75, concrete = 1)	"stydrated time Treatment needs a reactor vessel. A smaller additional container is needed to prepare the lime slurry (e.g. a 200 L plastic drum)." (Emersan) There is no information found what type of material the vessel could be made of, but it could be concrete it is assumed that alternative vessels need to either be imported (metal), have shorter lifetimes (plastic, wood) and that locals have experience working with concrete.	láez .	
spare_parts	PDF, Categorical	TRUE	simple technical special	(simple = 0.5, technical = 0.5, special = 0)	'Simple process which uses commonly available material' (Emersan) "A smaller additional container is needed to prepare the lime slurry (e.g. a 200 L justic drum). For a new destinduction of hydrated lime throughout the sludge, constant mixed is required (either manually or with a mixed pump). The type of pump required depends on the consistency of the sludge. A separate pump is needed to remove the treated effluent from the tank and a showed or vacuum pump to remove the solid material. In addition a water testing hit (particularly for pHz. Ecol, total suspended solids and turbidity) is needed as well as personal protective equipment (PPE) including masks, gloves, boots, apron or suit and respective the endingent (presents) and the protective equipment (PPE) including masks, gloves, boots, apron or suit and respective the endingent (hydrated lime, magnesium sulphate if needed)." (Emersan)	yes	
0		FALSE FALSE		NA NA	NA NA	NA NA	
0 temperature	0 Performance, Categorical	FALSE		NA (very cold = 1, cold = 1, temperate = 1,	NA Assumed to be appropriate for all temperatures.	NA	
temperature			cold temperate warm hot	warm = 1, hot = 1)			
flooding	Performance, Categorical		flooding no flooding	(flooding = 0.9, no flooding = 1)	"If the tank is located below ground, care should be taken to nearwest is aboutely water tight to avoid the leakage of highly alkaline effluent into the soil. In areas with high groundwater level or in food prone seas it is recommended to use above ground tanks." (Emersan) These values are allotted to all "tanin" based technologies. These treatment technologies and their corresponding tanks are built to be waiter, Additionally, their raised configurations are possible in flood prone areas. The impact of criterion flooding is therefore not considered to be as severe and only a 10% reduction in performance is allotted. (Akanskha Jain)		
vehicular_acces	Performance, Categorical	I ALIE	no access difficult	NA	NA	NA	
slope	Performance, Categorical	FALSE	full flat	NA	NA	NA	
soil_type	Performance, Categorical	FALSE	not flat clay silt sand gravel	NA	NA	NA	
groundwater depth	Performance, Trapez	FALSE	rock water depth [m]	NA	NA NA	NA	

excavation	Performance, Categorical	TRUE	easy hard	(easy = 1, hard = 0.75)	"Hydrated Lime Treatment should be carried out in a leak-proof cistern or tank, if the tank is located below ground, care should be taken to ensure it is absolutely water tight to avoid the leakage of highly alkaline effuent into the soil. In areas with high groundwater level or in flood prone areas it is recommended to use above ground tanks." (Emersan)		
					Excavation might be needed but is mostly not necessary needed.		
surface_area_onsite surface_area_offsite	Performance, Trapez Performance, Trapez		[m2/plot] m2/pers	NA (a = 0.007, b = 0.007, c = 999, d = 999)	NA Based on calculations (SaniChoice Team 2021) that are based on technical drawings from a	NA	
0		FALSE				NA	
0	0	FALSE FALSE	(NA NA	NA	NA NA	
drinking_water_exposure	Performance, Categorical		Close Not close	NA	NA	NA	
0 0 construction_skills		FALSE FALSE TRUE		NA NA (unskilled = 0, skilled = 1, professional = 1)		NA NA γes	
design_skills	Performance, Categorical	TRUE	Ladder: unskilled skilled	(unskilled = 0, skilled = 0, professional = 1)	neutralisation of the treated effluent respectively." (Emersan) Since it is a technology with a complex design it is important that it is properly constructed. At least moderate construction skills are recommended. "Hydrated Lime Treatment should be carried out in a leak-proof cistern or tank, if the tank is located below ground, care should be taken to	yes	-
			professional		ensure it is absolutely water tight to avoid the leakage of highly alkaline effuent into the soil. In areas with high groundwater level or in flood prone areas it is recommended to use above ground tanks. Separate tanks may be needed for preparation of the lime slurry and for post- neutralisation of the treated effuent respectively." (Emersan) "Hydrated lime is a powder and corrosive to skin, eyes and lungs. Therefore, adequate PPE must be worn when handling hydrated lime to prevent irritation to eyes, skin, respiratory system, and gastrointestinal tract. Protection from fire and moisture must also be ensured. Lime is an alkaline material that reacts strongly with moisture." (Emersan)		
om_skills		FALSE	Ladder: Unskilled Skilled Professional	(unskilled = 0, skilled = 1, professional = 1) NA	and regular maintenance of the pumps used for mixing will be required. Due to the potential health risks when handling hydrated lime, skilled staff are required who follow appropriate health and safety protocols." (Emersan)	yes NA	
0	0	FALSE FALSE	(NA NA	NA	NA NA	
0 cleansing_method	0 Performance, Categorical	FALSE FALSE	Washers	NA NA		NA NA	-
			Soft wipers Hard wipers				
0	0	FALSE FALSE	(NA NA	NA	NA NA	
lifetime	Performance, Categorical		short (< 1 year) medium (1-5 years) long (>5 years)	(short = 1, medium = 1, long = 1)	"Short treatment time (s log removal of E-coli in < 1day i.e. pathogen count is 1 million times smaller)" (Emersan) Due to the short treatment time a lifetime of less than 1 year is possible. It is assumed that the concept of sanitisation with hydrated lime can also be applied in the long-term. (Kukka limanen, Eawag 2021)	yes	
speed_implement_toilet	PDF, Categorical	FALSE	rapid (< 3 days) moderate (3 days to 2 weeks)	NA	NA	NA	
speed_implement_treatment	PDF, Categorical		slow (> Z weeks) rapid (few days to a week) moderate (few weeks up to three months) slow (> 3 months)	(rapid=1, moderate=0, slow=0)	"Lime sanitisation is a simple process and uses readily available materials." (SLU Compendium) Implementation very quick since only a vessel and lime is required, both of which are generally locally available (Akanksha Jain)	yes	
scalability construction_parts	Performance, Categorical PDF, Categorical		easy difficult	(easy = 1, difficult = 1) (simple = 0.7, technical = 0.3, special = 0)	"Hydrated Lime Treatment is particularly suitable for the rapid response phase due to its short treatment time, simple process and use of readily available materials." (Emersan) "Scale/Scalability (for lagoons): Easily replicable simple excavated lagoons; Scale up could be achieved by installing additional treatment units in parallel. However, this site must have space for increasing capacity," "Scale/scalability (for concrete tanks): Scale up could be achieved by installing treatment units in parallel; Structures are concrete so are less simple to scale up than excavated lagoons", "Scale up of in-barrel' mixing is simple and will not require much more area. Barrels can also be stacked" (Abbott, J. et al. (2019) if the mixing happens in lagoons or in barrels it is simple to extend the treatment capacity. In case of concrete tanks upscaling requires building more of these. To scale up more studge/blackwater needs to be treated and simply the amount of available lime should be increased. (Kukka Ilmanen, Eawag 2021) "Simple process which uses commonly available	yes	
Transfer Coefficients	(copied from "sinkaton Technologie, TC, database, 20110	52.36m ⁻)	technical special		material" (Emersan) "A smaller additional container is needed to prepare the lime slurry (e.g. a 200 L plastic drum). For an even distribution of hydrated lime throughout the sludge, constant mixing is required (either manually or with a mixing pump). The type of pump required depends on the consistency of the sludge. A separate pump is needed to remove the treated effluent from the tank and a shovel or vacuum pump to remove the solid material." (Emersan) Simple construction parts are required to build the reactor. Additional containers for the lime slurry need to be provided or constructed. If pumps are used for mixing and emptying, technical parts are required.		
TP	Stabilized Sludge 0.6		Secondary Effluent 0.:	Airloss 0.25		Waterloss 0	Comments Reference PA Parker et al (1075)
	0.65 0.68	0,6-0,77	0.33			0	Parker et al (1975) Mazlum and Ikizoglu (2018)
med (R)	0.65 2	0,4-0,9		0.125	0.025	0	PA

					1		
TN	0.3	-	0.3	0.35	0.05	0	PA
	0.6		0.2	0.2	0		Mazlum and Ikizoglu (2018), , Puijenbroek, Beusenand Bouwman (2019)
med (R)	0.45	0,3-0,6	0.25	0.275	0.025	0	-
k	5	[0,3]	-	-	-	-	PA
H2O	0.25	-	0.65	0.05	0.05	0	PA
	0.04	-	0.95	0.01	0	0	PA (adapted from ABR)
med (R)	0.145	0,04-0,25	0.8	0.03	0.025	0	-
k	5	[0,21]	-	-	-	-	PA
TS	0.45		0.3	0.2	0.05		PA
	0.65	0.45-0.9	0.35	0	0	al. (2021)	Parker et al (1975)
	0.75	0.6-0.93	0.25	0	0	0 TSS reduction	Gold et al. (2016)
med (R)	0.65	0,45-0,9	0.3	0.05	0	0	-
k		[0,45]					PA

References
Gensch R., Jennings, A., Rengoll, S., & Reymond, P. (2018). Compendium of Sontation Technologies in Emergencies. German WASH Network (GWN), Swiss Federal Institute of Aquatic Science and Technology (Eawag), Global WASH Cluster (GWC) and Sustainable Sanitation Alliance (SuSanA).
Anderson of al. (2015) Locks Acid Fernenstation, Urea and Line Addition. Promising Faces Sudge Sanitating Methods for Emergency Sanitation. Int. 1. Environ. Res. Public Health, 12, 13871-13885. doi:10.3380/jerph121113871
hypierborks, Research and Boournam (2019) Global strongs and phosphorus in Latava waste water based on the Shared Scio-cocomic pathware and Boournam (2019) Global articing and phosphorus in Latava waste water based on the Shared Scio-cocomic pathware and Boournam (2019) Global articing and phosphorus in Latava waste water based on the Shared Scio-cocomic pathware and Boournam (2013) Global articing and phosphorus in Latava waste water based on the Shared Scio-cocomic pathware and Management 2, 13, 464–456. https://doi.org/10.1016/j.jenvman.2018.10.048
Gold, Met al (2016) Iocally produced natural conditioners for devatering of Secal Sudge. Environmental Technology, 37-21, 2802-2814, DOI: 10.1080/09593333.2016.1165/293
Anderell, von Sperling and Fernandes (2007) Biological Wastewater Treatment Series: Volume 6 Sludge Treatment and Disposal. WA Publishing, London, UK
Leetscher, T., & Keller, J. (2002). A decision support system for selecting annitation systems in developing countries. Scio-Economic Planning Sciences, 36(4), 267–290. https://doi.org/10.1016/5038-0121(02)00007-1

Microbial Fuel Cell		Microbial Fuel Cell				
FUNCTIONAL GROUP	Values T	Data Source -				
UNIQUE IDENTIFIER (ID) DATA COMPILER	microbial_fuel_cell SaniChoice Project Team	•				
	transportedurine, transportedeffluent, transportedgreywater	McConville, J. et al. (2020)				
	transportedsecondary_effluent	McConville, J. et al. (2020) McConville, J. et al. (2020)				
	Output: NA	Micconvine, J. et al. (2020)				
Pre-Filter Criteria		Data Source				
management_level	(household = 0.5, shared = 1, public = 1)	McConville, J. et al. (2020) McConville, J. et al. (2020)				
capex_req_level opex_req_level	7	Spuhler, D. et al. (2021) Spuhler, D. et al. (2021)				
technical_maturity development_phase	(acute = 0, stabilisation = 0,	McConville, J. et al. (2020) "MFCs are applicable in many settings due to				
	development/recovery = 1)	their ambient operating conditions and the possibility of integration with existing treatment technologies. MFCs can be integrated into other treatment technologies at all levels, including domestic, centralised or industrial treatment." "At a domestic scale, the MFCs can be incorporated into existing septic tranks." "Possibility of integration with other existing wastewater treatment technologies." "Low operation and maintenance costs." (McConville, L. et al. (2020)) ("MFCs are an expensive technology due to electrode and membrane materials." (McConville, L. et al. (2020)) (MCconville, L. et al. (2020)) (The cost alternatives are present but not tested. This technology has low technical maturity and is not well established, however, it shows promise since it can integrated well with existing technologies to achieve better pollutant removal (i.e., with septic tanks). And since its expensive as				
		well- therefore, it can be considered rather unsuitable in the acute and stabilisation phases-				
Secondary Coltanta	Tune and Function	but good option for recovery phases. (Akanksha Jain)	Catagorias [Unit]	Tashualam Value (Data)	Data Saurea / Ass.	Internet
Screening Criteria	Type and Function	Applicable for this Functional Group?	Categories [Unit]	Technology Values (Data)	Data Source / Assumptions	Internal Review
water_supply	Performance, Categorical	FALSE	house yard public none	NA	NA	Done? NA
water_volume electricity_supply	Performance, Trapez Performance, Categorical		[L/cap/day] electricity	NA (electricity = 1, intermittent = 1, no electricity = 1)	NA Rather than requiring electricity, MFCs produce	NA
	•		intermittent no electricity		electricity:	
					"MFCs can produce clean electricity directly from organic matter in wastewater" (SLU).	
fuel_supply	Performance, Categorical		fuel no fuel	NA	NA	NA
frequency_of_om	PDF, Categorical		irregular regular continuous	(irregular = 1, regular = 0, continous = 0)	Santoro, C. et al. (2017)	
pipe_supply	Performance, Categorical		no pipes difficultly available pipes	(no pipes = 0, difficultly available = 0, pipes = 1)	Palanisamy, G. et al. (2019)	
pump_supply	Performance, Categorical	TRUE	no pumps difficultly available pumps	(no pumps = 1, difficultly available = 1, pumps = 1)	Włodarczyk, P. & Włodarczyk, B. (2018)	
concrete_supply	Performance, Categorical	TRUE	no concrete difficultly available concrete	(no concrete = 1, difficultly available = 1, concrete = 1)	Expert Judgement (McConville, J. 2021)	
spare_parts	PDF, Categorical	TRUE	simple technical special	(simple = 0.3, technical = 0.4, special = 0.3)	Expert Judgement (McConville, J. 2021)	
0		FALSE FALSE	0	NA NA	NA NA	NA NA
0	0	FALSE	0	NA	NA	NA NA
temperature	Performance, Categorical	IKUE	very cold cold	(very cold = 0, cold = 0.2, temperate = 1, warm = 1, hot = 0.5)	Feng, Q. et al. (2016); Gonzalez-Martínez, A. et al. (2018); Tkach, O. et al (2017)	
			temperate warm			
flooding	Performance, Categorical	TRUE	flooding	(flooding = 1, no flooding = 1)	Expert Judgement (McConville, J. 2021)	
vehicular_acces	Performance, Categorical	FALSE	no flooding no access difficult	NA NA	NA NA	NA
slope	Performance, Categorical		full flat	NA NA	NA .	NA
soil_type	Performance, Categorical		not flat clay	NA	NA	NA
,			silt sand			
			gravel rock			
groundwater_depth excavation	Performance, Trapez Performance, Categorical		water depth [m]	NA (easy = 1, hard = 1)	NA Expert Judgement (McConville, J. 2021)	NA
surface_area_onsite	Performance, Trapez		hard [m2/plot]	NA	NA	NA
surface_area_offsite	Performance, Trapez		m2/pers	(a = 0.00025, b = 0.00045, c = 999, d = 999)	Expert Judgement: It varies depending on the	
surface_area_onsice	renormance, Hopez	INCE	mz/pers	(a = 0.0002.5, b = 0.0004.5, c = 335, d = 335)	capet rougement. It was suggested in the more of the capet ments used anode with a surface area of 30 cm2, while 15 cm2 for the cathode. Others that has volume of 200 mL used each with a surface area of 25 cm2. (McConville, J. 2021)	
0		FALSE FALSE		NA NA	NA NA	NA NA
0 drinking_water_exposure		FALSE	0	NA NA	NA NA	NA NA
urinking_water_exposure		FALSE	Not close	NA NA		NA NA
0 construction_skills		FALSE		NA (unskilled = 0, skilled = 1, professional = 1)	NA "The simplest MFC is composed of single cathode	NA NA
Construction_StillS	r en o mance, categorical	···	unskilled skilled professional	- O, Smileu = 1, professionidi = 1)	and anode compartment separated by a cation exchange membrane with graphite/platinum electrodes" (SLU).	
design_skills	Performance, Categorical	TRUE	Ladder: unskilled skilled professional	(unskilled = 0, skilled = 0, professional = 1)	Installation requires skilled electricians. 'The main design parameters are the number of chambers, wastewater composition and the selection of electrode material. The performance of MFCs depends on parameters such as pH, temperature, substrate, type of bacteria and internal resistance. Depending on choice of integration, the optimum design factors can vary. Adequate attention should be given to matching the MFC to the local conditions' (SLU). Requires expertise.	

om_skills	Performance, Categorical	TRUE	Ladder: Unskilled Skilled Professional	(unskilled = 0, skilled = 1, professional = 1)	"Operators should ensure that organic loading rate and microbial activity are kept at optimal levels for efficient functioning of the MFC components. Monitoring the feedstock concentration and feeding rate, as well as the power generation is crucial" (SLU).		
					Requires skilled workers who understand MFCs.		
0	0	FALSE	C	NA	NA	NA	
0		FALSE		NA		NA	
0	0	FALSE	C	NA	NA	NA	
0	0	FALSE	C	NA	NA	NA	
cleansing_method	Performance, Categorical		Washers Soft wipers Hard wipers	NA	NA	NA	
0		FALSE		NA	NA	NA	
0		FALSE		NA	NA	NA	
lifetime	Performance, Categorical	TRUE	short (c 1 year) medium (1-5 years) long (>5 years)	(short = 1, medium = 1, long = 1)	In a study on Single Chamber Microbial Fuel Cells a lifetime of 10 years was assumed. (Christgen, B. et al. (2015) Based on this study it can be assumed that the lifetime of Microbial Fuel cells exceed 5 years. Even if the electrodes should fall before 5 years have passed, they can be replaced and the technology can continue to function.	yes	
speed_implement_toilet	PDF, Categorical	FALSE	rapid (< 3 days) moderate (3 days to 2 weeks) slow (> 2 weeks)	NA	NA	NA	
speed_implement_treatment	PDF, Categorical	TRUE	Tapid (few days to a week) moderate (few weeks up to three months) slow (> 3 months)	(rapid=0.5, moderate=0.5, slow=0)	Does not require much- Anode Cathode and membrane materials, can be integrated with other technologies really well and easily. Should be able to be implemented fast, however, the limiting factor could be the local availability of such materials and therefore the probability allotted to "rapid" category is reduced (50%) (Akanksh Jain, based on text from SLU Compendium)	yes	
scalability	Performance, Categorical		easy difficult	(easy = 1, difficult = 1)	"[Microbial Fuel Cells] [MFCs] can be integrated into other treatment technologies at all levels, including domestic, centralised or industrial treatment. At a domestic scale, the MFCs can be incorporated into existing septic tanks." (Microbial Fuel Cell StU Compendium) MFCs can be integrated into other treatment technologies to reduce the energy requirements and remove wastewater pollutants. The scalability depends on the technology it is integrated into. It is assumed that the MFCs themselves can be upscaled by increasing the number of electrodes and membranes inbetween compartments. (Kukka Ilmanen, Eawag 2021)	yes	
construction_parts	PDF, Categorical PDF, Categorical (copied from "Solitation_Technologies_TC_database_20210022.stom")	TRUE	simple technical special	(simple = 0, technical = 0, special = 1)	"The simplest MFC is composed of single cathode and anode compartment separated by a cathon exchange membrane with graphite/platinum electrodes. The single-compartment MFC removes the need for the cathodic chamber by exposing the cathode directly to air." (Microbial Fuel Cell SLU Compendium) MFCs mainly consists of electrodes and membranes, which probably need to be imported and the membranes will need to be specially manufactured.	yes	
		Range	Airloss	Soilloss	Waterloss	Comments	Reference
ТР	0.1		C	0.	0	Comments	Munoz- Cupa et al. (2020)
med (R)	0.1						-
liled (K)	100				, and the second		PA
TN	0.4		0	0.	0		Fischer et
					<u> </u>		al. (2011)
med (R)	0.4		O.		0		-
k	100	[0.2]					PA
H2O	1	- ()	C		0		Palanisamy et al. (2019)
med (R)	1	-	0		0		-
k TS	100 0.1		0.1	0.			PA Palanisamy
med (R)	0.1		0.1				et al. (2019)
k	100	[0.1]					PA

References
Gensch, R., Jennings, A., Rengells, S., & Reymond, P. (2018). Compendium of Sonitation Technologies in Emergencies . German WASH Network (GWN), Swiss Federal Institute of Aquatic Science and Technology (Eawag), Global WASH Cluster (GWC) and Sustainable Sanitation Alliance (SuSanA). Loestsher, T., & Reller, J. (2002). A decision support system for selecting sanitation systems in developing countries. Socio-Economic Planning Sciences, 36 (4), 267–290. https://doi.org/10.1016/S0038-0121(00)200007-1.
Spubler, D., & Roller, L. (2002). Annitation technology (Eawag), Dibendorf, Switzerland. Spubler, D., & Roller, L. (2003). Sanitation sterinology (Eawag), Dibendorf, Switzerland. Spubler, D., & Roller, L. (2003). Sanitation sterinology (Eawag), Dibendorf, Switzerland. Spubler, D., & Roller, L. (2003). Sanitation sterinology (Eawag), Dibendorf, Switzerland. Spubler, D., & Roller, L. (2001). Sunitation technology (Eawag), Dibendorf, Switzerland. Spubler, D., & Roller, L. (2001). Sunitation sterinology (Eawag), Dibendorf, Switzerland. Spubler, D., & Roller, L. (2001). Sunitation sterinology (Eawag), Dibendorf, Switzerland. Spubler, D., & Roller, L. (2001). Sunitation sterinology (Eawag), Dibendorf, Switzerland. Spubler, D., & Roller, L. (2001). Sunitation sterinology (Eawag), Dibendorf, Switzerland. Spubler, D., & Roller, L. (2001). Sunitation sterinology (Eawag), Dibendorf, Switzerland. Spubler, D., & Roller, L. (2001). Sunitation sterinology (Eawag), Dibendorf, Switzerland. Spubler, D., & Roller, L. (2001). Sunitation sterinology (Eawag), Dibendorf, Switzerland. Spubler, L. (2001). Report sterinology (Eawag), Dibendorf, Switzerland. Spubler, L. (2001). Report sterinology (Eawag), Dibendorf, Switzerland. Spubler, L. (2001). Report sterinology (Eawag), Dibendorf, Switzerland. Spubler, L. (2001). Report sterinology (Eawag), Dibendorf, Switzerland. Spubler, L. (2001). Report sterinology (Eawag), Dibendorf, Switzerland. Spubler, L. (2001). Report sterinology (Eawag), Dibendorf, Switzerland. Spubler, L. (2001). Rep

Internation Process							
West West	Algae Cultivation General Information	Values	Data Source				
SCORPERS SCORPERS SCORPE	FUNCTIONAL GROUP UNIQUE IDENTIFIER (ID)	T algae cultivation	-				
Ministration Mini	DATA COMPILER	Julian Fritzsche	- McConville I et al /2020'	1			
Column C		transportedblackwater,					
Part							
March Marc			,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,				
Table Tabl	Pre-Filter Criteria		Data Source				
According Control of Control			McConville, J. et al. (2020)				
Section Sect	management_level		McConville, J. et al. (2020)				
March Marc							
Total Continues	technical_maturity		McConville, J. et al. (2020)	1			
### Description of Company of DEC Secription of DEC Secription of Company		development/recovery = 1)	operation and maintenance costs." (SLU)				
March Marc		Type and Function Performance Categorical	Applicable for this Functional Group?				
Management Man	water_supply	renomance, categorical	T/LUE	yard	NA .		INA
### AND PROPERTY OF THE PROPER							
Automation Aut		Performance, Trapez	FALSE				NA
Part Part	electricity_supply	Performance, Categorical	IRUE				
Professor College Prof				no electricity			
March Marc						require an energy source for artificial	
March Marc						lighting" (SLU).	
Personal Content							
March Marc							
Programmer of Companies Proc. Contegoring Text	fuel_supply	Performance, Categorical	FALSE		NA		NA
PRI-1997 Priferences Categorial VEX	frequency_of_om	PDF, Categorical	TRUE		(irregular = 0.7, regular = 0.2, continous	Expert Judgement (Ruas, G. & Serejo, M.	
Performance Companied Table Performance Companied Table Performance Companied Table Performance Companied Table Performance Companied Table Performance Companied Performance		· -		regular			
Control Cont	pipe_supply	Performance, Categorical	TRUE	no pipes			
Performance, Congress Time Performance, Congress Performance, Congress		-					
March Marc	pump_supply	Performance, Categorical	TRUE	no pumps			
Control Cont					0.9, pumps = 1)	L. (2021))	
Concess	concrete_supply	Performance, Categorical	TRUE	no concrete			
STOPLE STOPLE Stopped STOPLE Stopped					0.9, concrete = 1)	L. (2021))	
Section Sect	spare_parts	PDF, Categorical	TRUE	simple	(simple = 0.6, technical = 0.4, special = 0)		
1				special			
O O PASS Very control Pass		0	FALSE FALSE	C			
Column	0	0	FALSE	C	NA NA	NA	
	temperature	Performance, Categorical	TRUE				
Tricoding Performance, Categorical ToUE No. No. No. No. No. No. No. No. No. No.				temperate	,,		
Preformance, Categorical TMUE Reading Classifier							
## White Call agreed Performance, Categorial PASE	flooding	Performance, Categorical	TRUE	flooding	(flooding = 0.25, no flooding = 1)		
A	vehicular_acces	Performance, Categorical	FALSE		NA		NA
Super Performance, Categorial FASE	_			difficult			
Solit Space Performance, Categorical PASE Space Sp	slope	Performance, Categorical	FALSE	flat	NA	NA	NA
State Stat	soil tunn				NA NA	NA .	NA .
grand groundstater (eds) Reference, Topos (FASE color	30.1_t4be	·		silt			
Performance, Traper: PALE Oxford Performance, Cappered PALE Oxford Performance, Cappered PALE Oxford Performance, Cappered PALE Oxford Performance, Cappered PALE Oxford Performance, Cappered PALE Oxford Performance, Cappered PALE Oxford Performance, Cappered PALE Oxford PALE							
Secretarion Performance, Categorical PINUE easy (easy = 1, hard = 0.5) (a. 10.0000) (b. 10.0000)	groundwater denth	Performance Transa	FALSE	rock	NA NA	NA .	NA .
Surface_ane_office Performance, Trapper PASE Image Pass				easy		Expert Judgement (Ruas, G. & Serejo, M.	
1	surface area onsite	Performance, Transa	FALSE		NA		NA
D							
O O PASE O NA NA NA NA NA NA NA	surrace_area_offsite					Best Guess (Spuhler, D. et al. 2021)	
O PASS ONA NA NA NA NA NA NA NA NA NA NA NA NA N						NA	
O PALSE SON DIVIDED IN THE STATE OF THE SAME OF THE SA	0	0	FALSE	C	NA NA	NA	NA
O O FASS	drinking_water_exposure	Performance, Categorical	FALSE		NA	NA	NA
construction_skills Performance, Categorical TRUE unskilled = 1 skilled = 0, skilled = 0, skilled = 0, skilled = 0, skilled or systems are used. Skilled workers could systems are used. Skilled workers could systems are used. Skilled workers could systems are used. Skilled workers could systems are used. Skilled workers could systems are used. Skilled workers could systems. The selection of the most appropriate unskilled skilled professional professional are used. the geographical professional workers could skilled and professional are used. The geographical professional are used. The geographical professional are used. The geographical professional are used. The geographical professional are used. The geographical professional are used to the most appropriate unskilled and phosphorus concentrational and selection of the microalgae strain used, the geographical professional are used to the geographical professional are used to the most appropriate used to skilled a selection of the microalgae strain used, the geographical professional are used to select the microalgae species (e.g., Spirulina species, and phosphorus concentrational part unskilled and phosphorus concentrational and phosphorus concentrational and selection of the microalgae species (e.g., Spirulina species, and phosphorus concentrational and phosphorus concentrational and phosphorus concentrational and phosphorus concentrational are used. The geographical professional are unskilled and phosphorus concentrational and phosphorus concentrational and phosphorus concentrational are unskilled and phosphorus concentrational are used. The geographical professional are unskilled and phosphorus concentrational are used. The geographical professional are used to see the microalgae species (e.g., Spirulina species are critical in restort delicing and phosphorus concentrational and phosphorus concentrational are used. The geographical professional are unskilled and phosphorus concentrational are used. The geographical professional are unskilled and phospho	0			C	NA		
winklied systems are used. Stilled oversers outd systems are used. Stilled oversers outd systems. design_skills Performance, Categorical TRUE Ladder: unskilled professional In the desired product (SUJ) Efficiency and besired product (SUJ) Efficiency and phosphous concentrations (SLU). Successful operation requires skilled personal efficiency of the systems are unabled to the product of the micropal phosphous concentrations and phosphous concentrations and phosphous concentrations (SLU). Successful operation requires skilled personal efficiency of the micropal phosphous concentrations (SLU). Successful operation requires skilled personal efficiency of the micropal phosphous concentrations (SLU). Successful operation requires skilled personal efficiency of the micropal phosphous concentrations (SLU). Successful operation requires skilled personal efficiency of the micropal phosphous concentrations (SLU). Successful opera	0 construction skills						NA .
design_skills Performance, Categorical TRUE Ladder: unskilled skilled professional Stilled professional Unskilled = 0, professional 1) Ladder: unskilled = 0, professional Ladder: unskilled = 0, professional 1) Ladder: unskilled = 0, professional Ladder: unskilled = 0, professional Ladder: unskilled = 0, professional Ladder: Unski	_ '			unskilled		system and whether open or closed	
design_skills				professional		suffice in simpler, open systems.	
skilled professional professional professional professional professional professional location and the desired proteins' (SLU). "Effluent characteristics (such as turbidity, chemical oxygen demand (COD/RDD) and nitrogen and phosphorus concentrations) and selection of the microaligae species (e.g., Spirilina spp., cyanobacteria or naturally occurring species) are critical in reactor design and operations' (SLU). Performance, Categorical TRUE Ladder: Unskilled Skilled Skilled Skilled 1) Unskilled 1) Professional Professional O FAISE O NA NA NA NA NA NA NA	design_skills				(unskilled = 0, skilled = 0, professional =		
"Effluent characteristics (such as turbidity, chemical oxygen demand (COD/ROD) and nitrogen and phosphorus concentrations) and selection of the microslage species (e.g., Spirulina spp., cyanobacteria or naturally occurring species) are critical in reactor design and operations" (SLU). Requires expertise. Performance, Categorical TRUE Ladder: Unskilled Vinski	1	Performance, Categorical	TRUE				
turbidity, chemical oxygen demand/biochemical oxygen demand (COD/BOD) and nitrogen and phosphorus concentrations) and selection of the microalgae species (e.g., Spirulma spp., cyanobacteria or naturally occurring species) are critical in reactor design and operations" (SLU). Requires expertise. Performance, Categorical TRUE Ladder: Unskilled 1) Linckilled 1) Professional Linckilled 1) Professional Unskilled 1) Professional Discrepance (Categorical TRUE) Ladder: Unskilled 1) Professional Professional Discrepance (Categorical True) Available of the system is enhanced by optimising operating parameters such as hydraulic retention time, temperature, mixing, CO2 availabling and cultivation mode. At times, fertiliser addition may be required to boox the nitrogen and phosphorus concentrations' (SLU). Successful operation requires skilled personnell, even when deploying simpler systems. Discrepance (Supplementations) Available of NA NA NA NA NA NA NA NA NA NA		Performance, Categorical	TRUE	unskilled skilled		cultivation system should consider the microalgae strain used, the geographical	
C(COI/SRO) and nitrogen and phosphorus concentrations) and selection of the microaligae species (e.g., Spirulina spp., Cyanobacteria or naturally occurring species) are critical in reactor design and operations" (SLU). Performance, Categorical TRUE Ladder: Unskilled Unskilled 1) County		Performance, Categorical	TRUE	unskilled skilled		cultivation system should consider the microalgae strain used, the geographical location and the desired product" (SLU).	
phosphorus concentrations) and selection of the microalgae species (e.g., spiriulina spp., cyanobacteria or naturally occurring species) are critical in rector design and operations" (SLU). Requires expertise. Om_skills Performance, Categorical TRUE Ladder: Unskilled Unskilled 1) Viskilled Professional Viskilled Professional O		Performance, Categorical	TRUE	unskilled skilled		cultivation system should consider the microalgae strain used, the geographical location and the desired product" (SLU). "Effluent characteristics (such as turbidity, chemical oxygen	
Spirulina spp., cyanobacteria or naturally occurring species) are critical in reactor design and operations" (SLU). Requires expertise. Om_skills Performance, Categorical TRUE Ladder: Unskilled Unskilled Skilled Professional Unskilled 1) Ladder: Unskilled 1, professional "Efficiency of the system is enhanced by optimising operating parameters such as hydralic retention time, temperature, mixing, CO2 availability and cultivation mode. At time, fertiliser addition any be required to boost the nitrogen and phosphorus concentrations" (SLU). Successful operation requires skilled personell, even when deploying simpler systems. Description of the professional operation requires skilled personell, even when deploying simpler systems. Description of the professional operation requires skilled personell, even when deploying simpler systems. Description requires skilled personell, even when deploying simpler systems. Description requires skilled personell, even when deploying simpler systems. Description requires skilled personell, even when deploying simpler systems. Description requires skilled personell, even when deploying simpler systems. Description requires skilled personell, even when deploying simpler systems. Description requires skilled personell, even when deploying simpler systems. Description requires skilled personell, even when deploying simpler systems. NA NA NA NA NA NA NA NA NA NA NA NA NA N		Performance, Categorical	TRUE	unskilled skilled		cultivation system should consider the microalgae strain used, the geographical location and the desired product" (SLU). "Effluent characteristics (such as turbidity, chemical oxygen demand/biochemical oxygen demand	
occurring species) are critical in reactor design and operations" (SLU). Requires expertise. Om_skills Performance, Categorical TRUE Ladder: Unskilled Unskilled Unskilled Skilled Professional Professional In the professional of the system is enhanced by optimising operating parameters such as hydraulic retention time, temperature, mixing, CO2 availability and cultivation mode. At times, fertiliser addition may be required to boost the nitrogen and phosphorus concentrations" (SLU). Successful operation requires skilled personelle, even when deploying simpler systems. O		Performance, Categorical	TRUE	unskilled skilled		cultivation system should consider the microalgae strain used, the geographical location and the desired product" (SLU). "Effluent characteristics (such as turbidity, chemical oxygen demand/biochemical oxygen demand (COD/BOD) and nitrogen and phosphorus concentrations) and	
Requires expertise. Om_skills Performance, Categorical TRUE Ladder: Unskilled Unskilled Skilled Professional Indicate (unskilled = 0, skilled = 1, professional = 0, prof		Performance, Categorical	TRUE	unskilled skilled		cultivation system should consider the microalgae strain used, the geographical location and the desired product" (SLU). "Effluent characteristics (such as turbidity, chemical oxygen demand/biochemical oxygen demand (COO/80D) and introgen and phosphorus concentrations) and selection of the microalgae species (e.g.,	
om_skills Performance, Categorical TRUE Ladder: Unskilled Unskilled Skilled Professional Professional Name, Categorical Unskilled Unskilled Unskilled 1) Professional Professional Professional Name, Categorical Professional O		Performance, Categorical	TRUE	unskilled skilled		cultivation system should consider the incroalgue strain used, the geographical location and the desired product" (SLU). "Effuent characteristics (such as turbidity, chemical oxygen demand (IcO)BOD) and nitrogen and phosphorus concentrations) and selection of the microalgue species (e.g., Spirulina spp., cyanobacteria or naturality courring species) are critical in reaction	
Unskilled Sk		Performance, Categorical	TRUE	unskilled skilled		cultivation system should consider the increaliges strain used, the geographical location and the desired product "GLU). "Effluent characteristics (such as turbidity, chemical oxygen demand (COD/BOD) and nitrogen and phosphorus concentrations) and selection of the microaligae species (e.g., Spirulina spp., cyanobacteria or naturally occurring species) are critical in reactor design and operations" (SLU).	
Skilled Professional Professio		Performance, Categorical	TRUE	unskilled skilled		cultivation system should consider the increaliges strain used, the geographical location and the desired product "GLU). "Effluent characteristics (such as turbidity, chemical oxygen demand (COD/BOD) and nitrogen and phosphorus concentrations) and selection of the microaligae species (e.g., Spirulina spp., cyanobacteria or naturally occurring species) are critical in reactor design and operations" (SLU).	
Professional	om_skills			unstilled skilled professional	(unskilled = 0, skilled = 1, professional =	cultivation system should consider the incroalges strain used, the geographical location and the desired product" (SLU). "Effluent characteristics (such as turbidity, chemical oxygen demand/biochemical oxygen demand (COO/BOD) and throgen and phosphorus concentrations) and selection of the microalgea species (e.g., Spirulina spp., cyanobacteria or naturally occurring species) are critical in reactor design and operations" (SLU). Requires expertise. "Efficiency of the system is enhanced by "Efficiency of the system is enhanced by	
be required to boost the nitrogen and phosphorus concentrations" (SLU).	om_skills			unstilled skilled professional Ladder: Unskilled	(unskilled = 0, skilled = 1, professional =	cultivation system should consider the increaliges strain used, the geographical location and the desired product" (SLU). "Effluent characteristics (such a sturbidity, chemical oxygen demand (COD/80D) and nitrogen and phosphorus concentrations) and selection of the microaligae species (e.g., Spirulina spp., cyanobacteria or naturally occurring species) are critical in reactor design and operations" (SLU). Requires expertise. "Efficiency of the system is enhanced by optimising operating parameters such as	
phosphorus concentrations" (SLU).	om_skills			unskilled skilled professional Ladder: Unskilled Skilled	(unskilled = 0, skilled = 1, professional =	cultivation system should consider the microalgue strain used, the geographical location and the desired product "GLU). "Effluent characteristics (such as turbidity, chemical coygen demand (COD/80D) and nitrogen and phosphorus concentrations) and selection of the microalgae species (e.g., Spirulina spp., cyanobacteria or naturally occurring species) are critical in reactor design and operations" (SLU). Requires expertise. "Efficiency of the system is enhanced by optimising operating parameters such as hydraulic retention time, temperature, mixing, CO2 availability and cultivalibility and children in the construction of mixing. CO2 availability and cultivalibility and mixing. CO2 availability and cultivalibility and mixing. CO2 availability and cultivalibility and mixing. CO2 availability and cultivalibility and mixing. CO2 availability and cultivalibility and mixing. CO2 availability and cultivalibility and mixing. CO2 availability and cultivalibility and mixing. CO2 availability and cultivalibility and mixing. CO2 availability and cultivalibility and mixing. CO2 availability and cultivalibility and mixing. CO2 availability and cultivalibility and mixing. CO2 availability and cultivalibility and mixing. CO2 availability and mixing.	
personell, even when deploying simpler systems. 0	om_skills			unskilled skilled professional Ladder: Unskilled Skilled	(unskilled = 0, skilled = 1, professional =	cultivation system should consider the incroalgae strain used, the geographical location and the desired product" (SLU). Effluent characteristics (such as turbidity, chemical oxygen demand (COD/80D) and nitrogen and phosphorus concentrations) and selection of the microalgae species (e.g., Spirulina spp., cyanobacteria or naturally occurring species) are critical in reactor design and operations" (SLU). Requires expertise. "Efficiency of the system is enhanced by optimising operating parameters such as hydraulic retention time, temperature, mixing, CO2 availability and cultivation mode. At times, fertiliser addition may	
personell, even when deploying simpler systems. 0	om_skills			unskilled skilled professional Ladder: Unskilled Skilled	(unskilled = 0, skilled = 1, professional =	cultivation system should consider the increalgue strain used, the geographical location and the desired product "GLU). "Effluent characteristic (such as turbidity, chemical oxygen demand/ location and introgen and phosphorus concentrations) and selection of the microagae species (e.g., Spirulina spp., cyanobacteria or naturally occurring species) are critical in reactor design and operations" (SLU). Requires expertise. "Efficiency of the system is enhanced by optimising operating parameters such as hydraulic retention time, temperature, mixing, CO2 availability and cultivation mode. At times, fertiliser addition may be required to boost the nitrogen are	
0	om_skills			unskilled skilled professional Ladder: Unskilled Skilled	(unskilled = 0, skilled = 1, professional =	cultivation system should consider the increalges strain used, the geographical location and the desired product" (SLU). "Effuent characteristics (such as turbidity, chemical oxygen demand/biochemical oxygen demand/biochemical oxygen demand (ICO)80Di) and nitrogen and phosphorus concentrations) and selection of the microalgae species (e.g., Spirulina spp., cyanobacteria or naturally occurring species) are critical in reactor design and operations" (SLU). Requires expertise. "Efficiency of the system is enhanced by optimising operating parameters such as hydraulic retention time, temperature, mixing, CO2 availability and cultivation mode. At times, lertiliser addition may be required to boost the nitrogen and phosphorus concentrations" (SLU). Successful operation requires skilled	
0 0 FALSE 0 NA NA NA 0 0 FALSE 0 NA NA NA 0 0 FALSE 0 NA NA NA 1 0 0 FALSE NA NA NA NA 1 0 Performance, Categorical FALSE Washers NA NA NA NA 1 0 Performance, Categorical FALSE Washers NA NA NA NA NA NA NA NA NA NA NA NA NA	om_skills			unskilled skilled professional Ladder: Unskilled Skilled	(unskilled = 0, skilled = 1, professional =	cultivation system should consider the increalges strain used, the geographical location and the desired product" (SLU). "Effluent characteristics (such as turbidity, chemical oxygen demand/biochemical oxygen demand (ICO)/80D) and introgen and phosphorus concentrations) and selection of the microalgae species (e.g., Spirulina spp., cyanobacteria or naturally occurring species) are critical in reactor design and operations" (SLU). Requires expertise. "Efficiency of the system is enhanced by optimising operating parameters such a hydraulic retention time, temperature, mixing, CO2 availability and cultivation mode. At times, fertiliser addition may be required to boost the nitrogen and phosphorus concentrations" (SLU). Successful operation requires skilled personell, even when deploying simpler	
0 0 FALSE 0 NA NA NA NA 0 0 FALSE 0 NA NA NA NA cleansing_method Performance, Categorical FALSE Washers Soft wipers Hard wipers NA NA NA 0 0 FALSE 0 NA NA NA NA		Performance, Categorical	TRUE	unstilled skilled professional Ladder: Unstilled Skilled Professional	(unskilled = 0, skilled = 1, professional = 1)	cultivation system should consider the incroalges strain used, the geographical location and the desired product" (SLU). "Effluent characteristics (such as turbidity, chemical oxygen demand/biochemical oxygen demand (ICO)/80D) and introgen and phosphorus concentrations) and selection of the microalgae species (e.g., Spirulina spp., cyanobacteria or naturally occurring species) are critical in reactor design and operations" (SLU). Requires expertise. "Efficiency of the system is enhanced by optimising operating parameters such a hydraulic retention time, temperature, mixing, CO2 availability and cultivation mode. At times, fertiliser addition may be required to boost the nitrogen and phosphorus concentrations" (SLU). Successful operation requires skilled personell, even when deploying simpler systems.	
cleansing_method Performance, Categorical FALSE Washers Soft wipers 0 0 1 FALSE 0 NA NA NA NA NA NA NA NA NA NA NA NA NA	0	Performance, Categorical	TRUE	unstilled skilled professional Ladder: Unskilled Skilled Professional	(unskilled = 0, skilled = 1, professional = 1)	cultivation system should consider the increalize strain used, the geographical location and the desired product" (SLU). "Effluent characteristics (such as turbidity, chemical oxygen demand/biochemical oxygen demand (ICO)80D) and nitrogen and phosphorus concentrations) and selection of the microalize speeds (e.g., Spirulina spp., cyanobacteria or naturally occurring speeds) are critical in reactor design and operations" (SLU). Requires expertise. "Efficiency of the system is enhanced by optimising operating parameters such as hydraulic retention time, temperature, mixing. CO2 availability and cultivation may be required to boost the nitrogen and phosphorus concentrations" (SLU). Successful operation requires skilled personel, even when deploying simpler systems.	NA NA
Soft wipers Hard wipers 0 0 FALSE 0 NA NA NA	0 0 0	Performance, Categorical O O	TRUE FALSE FALSE FALSE FALSE	unstilled skilled professional Ladder: Unskilled Skilled Professional	(unskilled = 0, skilled = 1, professional = 1) NA NA NA NA	cultivation system should consider the increalige strain used, the geographical location and the desired product "(SLU). "Effluent characteristics (such as turbidity, chemical coygen demand/biochemical coygen demand/biochemical coygen demand (COD/BOD) and nitrogen and phosphorus concentrations) and selection of the microaligae species (e.g., Spirulina spp., cyanobacteria or naturally occurring species) are critical in reactor design and operations" (SLU). Requires expertise. "Efficiency of the system is enhanced by optimising operating parameters such as hydraulic retention time, temperature, mixing, CO2 availability and cultivation mode. At times, fertiliser addition may be required to boost the nitrogen and phosphorus concentrations" (SLU). Successful operation requires skilled personell, even when deploying simpler systems. NA NA	NA NA
0 0 FALSE 0 NA NA NA	0 0 0	Performance, Categorical O O	TRUE FALSE FALSE FALSE FALSE FALSE FALSE	unstilled skilled professional Ladder: Unstilled Skilled Professional	(unskilled = 0, skilled = 1, professional = 1) NA NA NA NA NA	cultivation system should consider the incroalgae strain used, the geographical location and the desired product" (SLU). Effluent characteristics (such as turbidity, chemical oxygen demand/biochemical oxygen demand/biochemical oxygen demand (ICO)8001) and introgen and phosphorus concentrations) and selection of the microalgae species (e.g., Spirulina spp., cyanobacteria or naturally occurring species) are critical in reactor design and operations" (SLU). Requires expertise. 'Efficiency of the system is enhanced by optimising operating parameters such as hydraulic retention time, temperature, mixing, CO2 availability and cultivation mode. At times, fertiliser addition may be required to boost the nitrogen and phosphorus concentrations" (SLU). Successful operation requires skilled personell, even when deploying simpler systems. NA NA	NA NA NA
	0 0 0	Performance, Categorical O O	TRUE FALSE FALSE FALSE FALSE FALSE FALSE	unstilled skilled professional Ladder: Unskilled Skilled Professional C C Washers Soft wipers	(unskilled = 0, skilled = 1, professional = 1) NA NA NA NA NA	cultivation system should consider the incroalgae strain used, the geographical location and the desired product" (SLU). Effluent characteristics (such as turbidity, chemical oxygen demand/biochemical oxygen demand/biochemical oxygen demand (ICO)8001) and introgen and phosphorus concentrations) and selection of the microalgae species (e.g., Spirulina spp., cyanobacteria or naturally occurring species) are critical in reactor design and operations" (SLU). Requires expertise. 'Efficiency of the system is enhanced by optimising operating parameters such as hydraulic retention time, temperature, mixing, CO2 availability and cultivation mode. At times, fertiliser addition may be required to boost the nitrogen and phosphorus concentrations" (SLU). Successful operation requires skilled personell, even when deploying simpler systems. NA NA	NA NA NA
	0 0 0 0 cleansing_method	Performance, Categorical 0 0 0 Performance, Categorical	TRUE FALSE FALSE FALSE FALSE FALSE FALSE FALSE	unskilled skilled professional Ladder: Unskilled Skilled Professional C C Washers Soft wipers Hard wipers	(unskilled = 0, skilled = 1, professional = 1) NA NA NA NA NA NA	cultivation system should consider the increaliges strain used, the geographical location and the desired product" (SLU). "Effluent characteristics (such as turbidity, chemical oxygen demand/blochemical oxygen demand/blochemical oxygen demand (COD/BOD) and nitrogen and phosphorus concentrations) and selection of the microaligae species (e.g., Spirulina spp., cyanobacteria or naturally occurring species) are critical in reactor design and operations" (SLU). Requires expertise. "Efficiency of the system is enhanced by optimising operating parameters such as hydraulic retention time, temperature, mixing, CO2 availability and cultivation mode. At times, fertiliser addition may be required to boost the nitrogen and phosphorus concentrations" (SLU). Successful operation requires skilled personell, even when deploying simpler systems. NA NA NA NA NA NA NA NA NA NA NA NA NA	NA NA NA NA

lifetime	Performance, Categorical	TRUE	short (< 1 year) medium (1-5 years) long (>5 years)	(short = 1, medium = 1, long = 1)	In a study by the Oak Ridge National Laboratory a lifetime of approximately 30 years is assumed for an engineering and cost analysis. (Schoenung, S.M et al.	yes		
					(2018)) Based on this it can be assumed that the lifetime of the algae ponds are larger than 5 years.			
speed_implement_toilet	PDF, Categorical	FALSE	rapid (< 3 days) moderate (3 days to 2 weeks)	NA	NA	NA		
speed_implement_treatment	PDF, Categorical	TRUE	slow (2 2 weeks) rapid (few days to a week) moderate (few weeks up to three months) slow (> 3 months)	(rapid=0.3, moderate=0.7, slow=0)	Open systems (Ponds) and closed systems possible (tubular photo-bioreactors, fall palet reactors and bag systems.) Ponds would entail typical civil engineering construction works of digging and concrete, Photobioreactors would be preliberiated and thus could be implemented faster. Since the more commonly adopted option is to have ponds, and this would require profabilities are allotted to moderate category (curing time min 7 days). Some probability is also allotted to rapid in the	yes		
scalability	Performance, Categorical	TRUE	easy	(easy = 1, difficult = 0.5)	event that prefab units are used. (Akanksha Jain) It is assumed that an algae pond can be	yes		
			difficult		easily extended by increasing the size of the pond and adding more algae. Extending the pond requires some digging that might limit the upscaling. They are assumed to have similar scalability values to arerated ponds. Furthermore, the scalability depends on how easily new algae can be sourced or their number multiplied. (Kukka Ilmanen, Eawar 2021)			
construction_parts	PDF, Categorical	TRUE	simple technical special	(simple = 0.4, technical = 0.6, special = 0)	"There are two major types of large- scale algae culture systems, open ponds and closed photo-bioreactors. Algae are cultivated in suspension or on attached systems like algal turf scrubbers.[] There are three types of closed systems: tubular photo-bioreactors, flat plate reactors and bag systems.[] Common harvesting methods include sedimentation, flocculation, centrifugation and filtration. Dying of microalgae can be done by centrifuge Cultivation SUL Compendium) Open systems are assumed to require smilar materials to acetated ponds. Closed systems require an energy source and can be more complex, requiring more technical parts. Furthermore, the harvesting and drying of algae requires more complex technical parts. It is assumed that the algae	yes		
Transfer Coefficients	[copied from "Sanitation_Technologies_TC_database_20210522	.xism")			themselves are locally available.			
	Effluent 0.32	Range	Organics 0.46	Airloss	Soilloss 0.022	Waterloss	Comments	Reference Ruas (2018), Ruas
	0.643		0.88				TDD	(2020), Serejo Bhatia et al. (2022)
	0.12 0.9 0.27		0.00				TDP removal soluble P removal	Ji et al. (2018), Acie Ferrari Silveira et a Xu et al. (2017)
med (R)	0.29 0.305		0.675	5	0.00		PO4-P removal	Usha et al. (2016)
k TN	2 0.17	[0.52]	0.3					Ruas (2018), Ruas
	0.5		-	-				(2020), Serejo Bhatia et al. (2022)
	0.2 0.18						TDP removal	Ji et al. (2018) Xu et al. (2017)
	0.25 0.35						TKN removal NO3-N removal	Ferrari Silveira et a Usha et al. (2016)
med (R)	0.23		0.76 0.53					Acién et al. (2018)
k H2O	5	[0.33]	0.05					Krustok (2016), PA
med (R)	0.939 0.9245) (Spuhler et al. (202
k TS	25	[0.1]						Krustok (2016), PA
	0.64		0.14				TSS in mircoalgae	Acién et al. (2018),
med (R)			0.14					
	23	[0.2]						
References Sensch, R., Jennings, A., Renggli, S	S., & Reymond, P. (2018). Compendium of Sani	tation Technologies in Emergencies . German W	ASH Network (GWN), Swiss Federal Institute o	of Aquatic Science and Technology (Eawag), Glo				
med (R)		[0.1]						
TS	0.6 0.64		0.2 0.14				TSS in mircoalgae	
med (R)			0.17					
	25	[0.2]						
Ku et al. (2017) Effects of influe Usha et al. (2016) Removal of r	ent C/N ratios and treatment technologies	tation Technologies in Emergencies. German W on integral biogas upgrading and pollutants oulp and paper mill effluent by microalgae in Using Microalgae	removal from synthetic domestic sewages	Sci. Rep., 7 (2017), p. 10897, 10.1038/s415	98-017-11207-y	cation Alliance (SuSanA).		

Membrane Filtration		Membrane Filtration				
General Information	Values	Data Source				
FUNCTIONAL GROUP UNIQUE IDENTIFIER (ID)	membrane_filtration	-				
	SaniChoice Project Team transportedurine					
OUTPUT PRODUCT RELATIONS		McConville, J. et al. (2020) McConville, J. et al. (2020)				
COMMENTS						
Pre-Filter Criteria	Values (household = 0, neighbourhood = 0.5, city = 1)	Data Source McConville, J. et al. (2020)				
management_level	(household = 0, shared = 0.5, public = 1)	McConville, J. et al. (2020)				
capex_req_level opex_req_level		Spuhler, D. et al. (2021) Spuhler, D. et al. (2021)				
technical_maturity development_phase	(acute = 0, stabilisation = 0, development/recovery = 1)	McConville, J. et al. (2020) The to the high technical complexity and capital investments of current membrane technology, it is most applicable at higher management levels in centralised systems. "When membranes eventually foul costly replacements and/or hazardous regeneration chemicals will be necessary." (McCoville, J. et al. (2020))				
		Given above, this technology is not considered to be very appropriate for emergency situations. Membrane Filtration is considered only appropriate for development projects or the				
creening Criteria	Type and Function	recovery phase of an emergency. (Akanksha Jain) Applicable for this Functional Group?	Cotogories [Unit]	Technology Values (Data)	Data Saurea / Assumutions	Internal
creening Criteria	Type and Function	Applicable for this runctional Group?	Categories [Unit]	Technology Values (Data)	Data Source / Assumptions	Review
water_supply	Performance, Categorical	FALSE	house	NA	NA	Done?
			yard public none			
water_volume	Performance, Trapez		[L/cap/day]	NA	NA	NA
electricity_supply	Performance, Categorical	TRUE	electricity intermittent no electricity	(electricity = 1, intermittent = 1, no electricity = 1)	"The osmotic process of the FO membranes is a naturally occurring phenomenon that does not require any external energy provided the draw solute is available without energy input. Depending on the physical driving forces used in other membrane processes (e.g., pressure, heat or electricity), the operation of membranes may require a considerable amount of energy input." (SLU).	
					Electricity requirements therefore depend on the deployed system.	
fuel_supply	Performance, Categorical		fuel no fuel	NA	NA	NA
frequency_of_om	PDF, Categorical	TRUE	irregular regular	(irregular = 0.2, regular = 0.8, continous = 0)	PA by Matthias van Sloten and proven by Priscila de Morais Lima.	
pipe_supply	Performance, Categorical	TRUE	continuous no pipes	(no pipes = 0.5, difficultly available = 0.5, pipes =	Expert judgement (McConville, J. 2021)	
	Defenses Colondal	TOUR	difficultly available pipes	1)	Emark Indoorse (McConville 1 2024)	
pump_supply	Performance, Categorical	TRUE	no pumps difficultly available pumps	(no pumps = 0.8, difficultly available = 0.8, pumps = 1)	Expert judgement (McConville, J. 2021)	
concrete_supply	Performance, Categorical	TRUE	no concrete difficultly available	(no concrete = 1, difficultly available = 1, concrete = 1)	Expert judgement (McConville, J. 2021)	
spare_parts	PDF, Categorical	TRUE	concrete simple	(simple = 0, technical = 0.5, special = 0.5)	PA by Matthias van Sloten and proven by Priscila	
			technical special		de Morais Lima.	
0		FALSE FALSE		NA NA		NA NA
0 temperature		FALSE		NA (very cold = 0.5, cold = 0.7, temperate = 1, warm		NA
			cold temperate	= 1, hot = 1)		
			warm hot			
flooding	Performance, Categorical	TRUE	flooding no flooding	(flooding = 0.8, no flooding = 1)	Should be possible to be built waterproof what means that flooding should not be a problem but maybe could cause some more effort to build.	
vehicular_acces	Performance, Categorical	FALSE	no access difficult	NA	(PA by Matthias van Sloten) NA	NA
dene	Performance, Categorical	ruer.	full	110		
slope soil_type	Performance, Categorical		flat not flat clay	NA NA	NA NA	NA NA
			silt sand gravel			
groundwater_depth	Performance, Trapez	FALSE	rock water depth [m]	NA .	NA NA	NA
excavation	Performance, Categorical		easy	(easy = 1, hard = 1)	Expert judgement (McConville, J. 2021)	· ·
surface_area_onsite	Performance, Trapez	FALSE	hard [m2/plot]	NA NA	NA	NA
surface_area_offsite	Performance, Trapez	TRUE	m2/pers	(a = 0.5, b = 1, c = 999, d = 999)	This depends on the wastewater flow of course. For a single household with not many people, it could be less than 1 m3. These are very rough estimates - it of course in also a function of the depth of the filter as much	
0	n	FALSE	n	NA .	as the surface ares. (McConville, J. 2021)	NA
0	0	FALSE	C	NA	NA	NA
0 drinking_water_exposure	Performance, Categorical	FALSE FALSE	Close	NA NA	NA NA	NA NA
0	0	FALSE	Not close	NA NA	NA NA	NA
0 construction_skills		FALSE		NA (unskilled = 0, skilled = 0.5, professional = 1)	NA Depends on the complexity of the implemented system, but requires highly skilled workers to	NA
design_skills	Performance, Categorical	TRUE	skilled professional Ladder: unskilled	(unskilled = 0, skilled = 0, professional = 1)	construct the highly technical systems. "The main design aspects of membranes include the feed and draw solutions, draw solute	
			skilled professional		recovery process, membrane material, orientation and placement within the treatment process" (SLU). High technical complexity. Requires expertise.	
om_skills	Performance, Categorical	TRUE	Ladder: Unskilled	(unskilled = 0, skilled = 1, professional = 1)	Depends on the complexity of the implemented system, but requires skilled workers to handle	
			Skilled Professional		the high technical complexity.	
0		FALSE FALSE	C	NA NA		NA NA
0	0	FALSE FALSE	C	NA NA	NA	NA NA
cleansing_method			Washers Soft wipers	NA NA	NA NA	NA
0	0	FALSE	Hard wipers	NA	NA	NA

Nettone	0	0	FALSE	C	NA	NA	NA	1
Speed_properment_protein	lifetime			short (< 1 year) medium (1-5 years)		"nigh technical complexity and capital investments of current membrane technology" (Membranes SLU Compendium) It is assumed that due to the high capital investment costs membranes are implemented as long-term solutions. Therefore, even though membranes can have lifetimes of 3 or less years, It is assumed that old membranes can be replaced and the technology itself has a lifetime of more than 5 years. (Kulka limanen, Eawag of more than 5 years. (Kulka limanen, Eawag		
red, implement, yearhened. POF, Categorical TRUE and file or days to a week) propriete (file or weeks up to three months) All file or file	speed_implement_toilet	PDF, Categorical	FALSE	moderate (3 days to 2 weeks)	NA		NA	
Scalability Performance, Categorical TRUE say official = 0.5) Membrane sterhology is widely applicable to a number of vestigate sterams and cause style integrated rich existing restative options as a number of vestigate sterams and cause style integrated rich existing restative options as a number of vestigate sterams and cause style integrated rich existing restative options as a number. Operanding on the models can be difficult. (Issais Imman, Fazage 2021) one models are a models for the tearnest membrane restative statements are models are a models for the tearnest membrane restative statements are models are a model for the overall system adding further models are considered the tearnest membrane restative. (Issais Imman, Fazage 2021) one models are considered the overall system adding further models are considered the overall system adding further models are considered the overall system adding further models are considered the feed and discussion steriline. In the main design appetr of membranes include the feed and discussion steriline. In the main design appetr of membranes include the feed and discussion steriline. In the main design appetr of membranes include the feed and resolutions, or as souther recovery process, membrane material, orientation and adjacement within the transment process. "Thelly technical complexity" and the feed and resolutions, or as souther recovery process, membrane material, orientation and adjacement within the transment process." Thelly technical complexity." **Section** **Section** **Pof. Categorical**	speed_implement_treatment	PDF, Categorical	TRUE	rapid (few days to a week) moderate (few weeks up to three months)	(rapid=0.5, moderate=0.5, slow=0)	number of waste streams and can easily be integrated into existing treatment options as discussed above." Does not require much- Draw Solution and membrane materials, can be integrated with other technologies really well and easily. Should be able to be implemented fast, however, the limiting factor could be the local availability of such materials and therefore the probability allotted to "rapid" category is reduced (50%) (kkanksha Jain, based on text from SLU	yes	
technical special spec	scalability	Performance, Categorical	TRUE		(easy = 1, difficult = 0.5)	"Membrane technology is widely applicable to a number of waste streams and can easily be integrated into existing treatment options as discussed above." (Membranes S.U. Compendium) Membranes often exist in compact modules that are added as an additional step to other treatment processes. As long as sufficient membrane modules are available the treatment capacity can be increased by increasing their number. Depending on the module types and how these modules are connected to the overall system adding further modules can be difficult.	yes	
Concentrated Urine			TRUE	technical	(simple = 0, technical = 0.4, special = 0.6)	the feed and draw solutions, draw solute recovery process, membrane material, orientation and placement within the treatment process.", "highly technical complexity" (Membranes SLU Compendium) Membrane filtration requires special membranes as well as technical parts. (Kukka limanen, Eawag	yes	
TP 03 02-04 0 0 07 0 McCC mdd(R) 03 0.2-04 0 0 0.7 0 0 1.22 TN 03 0.1-05 0.05 0.05 0.65 0 McC med(R) 03 0.1-05 0.05 0.05 0.65 0 0 .1.22 med(R) 03 0.1-05 0.05 0.05 0.05 0 0 .1.22 ### 2	Transier coemicients							
Med (R)		Concentrated Urine	Range				Comments	Reference McConville,
TN 03 0.1-05 0.05 0.65 0 McC med (R) 03 0.1-05 0.05 0.65 0 k 2 0 (0.4) H20 0.95 0.9-1 0.05 0 0 0 McC med (R) 0.95 0.9-1 0.05 0 0 0 K 5 0.01 TS 0.15 0.15 0.03 0.1 0.75 0 McC med (R) 0.15 0.03 0.1 0.75 0 McC med (R) 0.15 0.03 0.1 0.75 0 McC med (R) 0.15 0.03 0.1 0.75 0 McC MCC MCC MCC MCC MCC MCC MCC								J. (2021)
Med (R)	k							17A
## 2								McConville, J. (2021)
	k	2	[0.4]					PA
K 5 [0.1] - PA TS 0.15 0-03 0.1 0.75 0 McCcc med (R) 0.15 0-03 0.1 0.75 0 - K 1 [0.3] - - - - PA						0		McConville, J. (2021)
TS 0.15 0-03 0.1 0.75 0 McC 1.20 1.20 1.20 1.20 1.20 1.20 1.20 1.20		0.95				0		-
k 1 [0.3] - PA			0 - 0.3	0.1				McConville, J. (2021)
	med (R)	0.15			0.79	0		
References	k	1	[0.3]					PA
	References							

References

Gensch, R., Jennings, A., Renymond, P. (2018). Compendium of Sonitation Technologies in Emergencies . German WASH Network (GWN), Swiss Federal Institute of Aquatic Science and Technology (Eawag), Global WASH Cluster (GWC) and Sustainable Sanitation Alliance (SuSanA). Lotescher, T., & Relegil, T., (2023). Adecision support system for selecting sanitation systems in developing countries. Socio-Economic Planning Sciences, 36 (4), 267–290. https://doi.org/10.1016/50038-0121(02)00007-1

Spubler, D., de Morais Lima, P., Fritzsche, J., Imanen, K., Jain, A., van Soten, M., & Willimann, C. (2021). SaniChoice Project Team. Department Sanitation, Water and Solid Waste for Development Countries (Sandac), Swiss Federal Institute of Aquatic Science and Technology. (Eawag), Dübendorf, Switzerland. Spubler, D., & Roller, L. (2020). Sonitation technology library: Details and data sources for oppropriateness profiles and transfer coefficients. Eswag - Swiss Federal Institute of Aquatic Science and Technology.

Micronille, J., et al. (2020). "Guide to Sanitation Resource Recovery Products & Technologies: a supplement to the Compendium of Sanitation Systems and Technologies."

Tilley, E., Ulrich, L., Lüthi, C., Reymond, P., & Zurbrügg, C. (2014). Compendium of Sanitation Systems and Technologies."

	Values	Carbonisation Data Source				
FUNCTIONAL GROUP UNIQUE IDENTIFIER (ID)	T carbonisation	-				
DATA COMPILER :	SaniChoice Project Team transportedstored_faeces,	- McConville, J. et al. (2020)				
OUTPUT PRODUCT	transporteddried_faeces, transportedsludge, transportedbiochar	McConville, J. et al. (2020)				
RELATIONS COMMENTS	Output: NA	McConville, J. et al. (2020)				
e-Filter Criteria	Values	Data Source				
	(household = 0.5, neighbourhood = 0.5, city = 1) (household = 0.5, shared = 0.5, public = 1)	McConville, J. et al. (2020) McConville, J. et al. (2020)				
capex req level	6	Spuhler, D. et al. (2021)				
opex_req_level technical_maturity		Spuhler, D. et al. (2021) McConville, J. et al. (2020)				
development_phase	acute = 0, stabilisation = 0,	This tech has highly complex and would be				
1	development/recovery = 1)	difficult to establish in the acute and stabilisation phases of an emergency. Additionally,				
		carbonisation of sludge is usually done at a				
		centralised level, where sludge can be dried prior to the thermal treatment. This would not be ideal				
		for emergencies where generally, onsite				
		treatment technologies need to be implemented. However, it can allow for significant energy and				
		nutrient recovery and has a very fast treatment				
		time- therefore, could potentially be a good option for recovery phases. (Akanksha Jain, based				
		on McConville, J. et al. (2020))				
ening Criteria	Type and Function	Applicable for this Functional Group?	Categories [Unit]	Technology Values (Data)	Data Source / Assumptions	Internal Review
water_supply	Performance, Categorical	FALSE	house	NA	NA .	Done? NA
			yard public			
water volume	Performance, Trapez	FALSE	none [L/cap/day]	NA .	NA .	NA
electricity_supply	Performance, Categorical		electricity	(electricity = 1, intermittent = 0.75, no electricity	Electricity is required "if mechanical equipment is used for feedstock loading,	
			intermittent no electricity	= 0.5)	air pollution control and process control/monitoring equipment". Simple systems do not require electricity, but perform worse.	
fuel_supply	Performance, Categorical	FALSE	fuel	NA .	NA	NA
frequency_of_om	PDF, Categorica	TRUE	no fuel irregular	(irregular = 0.1, regular = 0.7, continous = 0.2)	Zabaleta et al. (2018)	+-
43			regular continuous			
pipe_supply	Performance, Categorical	TRUE	no pipes difficultly available	(no pipes = 1, difficultly available = 1, pipes = 1)	Zabaleta et al. (2018)	
pump_supply	Performance, Categorical	TRUE	no pumps	(no pumps = 1, difficultly available = 1, pumps =	Zabaleta et al. (2018)	
	notes a	TOUT	difficultly available pumps	In the second of	Zahalata akal (2010)	
concrete_supply	Performance, Categorical	IRUE	no concrete difficultly available concrete	(no concrete = 1, difficultly available = 1, concrete = 1)	Zaudieta et äl. (2018)	
spare_parts	PDF, Categorica	TRUE	simple technical	(simple = 0.5, technical = 0.5, special = 0)	Zabaleta et al. (2018)	
0	r	FALSE	special	NA NA	NA .	NA
0	C	FALSE	0	NA	NA .	NA
0 temperature	Performance, Categorical	FALSE TRUE	very cold		NA Zabaleta et al. (2018)	NA
	· -		cold temperate	= 1, hot = 1)		
			warm hot			
flooding	Performance, Categorical	TRUE	flooding no flooding	(flooding = 0.9, no flooding = 1)	Zabaleta et al. (2018)	
vehicular_acces	Performance, Categorical	FALSE	no access	NA .	NA .	NA
			difficult full			
slope	Performance, Categorical	FALSE	flat	NA	NA .	NA
soil_type	Performance, Categorical	CALCE	not flat clay	NA .	NA NA	NA
son_type	remormance, categorica	TABL	silt	TVA	194	NA.
			sand gravel			
groundwater depth	Performance, Trapez	FALSE	rock water depth [m]	NA .	NA NA	NA
excavation	Performance, Categorical		easy	(easy = 1 hard = 1)	Zabaleta et al. (2018)	
surface_area_onsite	Performance, Trapez	FALSE	hard [m2/plot]	NA .	NA .	NA
surface area offsite	Performance, Trapes		m2/pers	(a = 0,014, b = 0.025, c = 999, d = 999)	assuming 0.25kg/cap day feedstock and reactor of 40kg capacity using	\vdash
					2.25m2 (Expert Judgement (Zurbrügg, C. (2021)))	
0		FALSE FALSE		NA NA	NA NA	NA NA
0	C	FALSE	0	NA	NA	NA
inking_water_exposure	Performance, Categorical		Close Not close	NA	NA .	NA
0		FALSE	0	NA NA	NA NA	NA NA
0 construction_skills	Performance, Categorical	FALSE TRUE	Ladder:	NA (unskilled = 0, skilled = 1, professional = 1)	NA System based on batch processes (without conveyor belts) should be fairly	INA
			unskilled skilled		easy to construct. However, due to safety concerns associated with the operation, skilled workers should be employed.	
			professional			
design_skills	Performance, Categorical	TRUE	Ladder: unskilled	(unskilled = 0, skilled = 0, professional = 1)	"Each carbonisation technique uses different temperatures, heating duration, or reactor pressure to produce different quantities and qualities of the end	
			skilled		products" (SLU). "A gas filtering system, such as a bag filter, should be	
			professional		incorporated into the reactors to reduce harmful environmental gas emissions" (SLU).	
om_skills	Performance, Categorical	TRUE	Ladder:	(unskilled = 0, skilled = 1, professional = 1)	Requires expertise. "Accidental introduction of air into the pyrolysis reactor, for example,	\vdash
	,		Unskilled		through leaks in the reactor, may create unstable combustion and result into	
			Skilled Professional		explosions or fires. Regular inspection and maintenance of filter bags and safety devices are a necessity to minimise accident occurrences" (SLU).	
					Tasks are relatively basic, but due to safety concerns, skilled workers should	
					be employed.	
		FALSE		NA NA	NA .	NA NA
0		FAISE		NA	NA .	NA
0	0	FALSE FALSE			NA .	NA NA
0 0 0	C C	FALSE FALSE	0		NA .	
0	0	FALSE FALSE	0 Washers Soft wipers	NA NA	NA .	
0 0 0	C C Performance, Categorica	FALSE FALSE	0 Washers Soft wipers Hard wipers		NA NA	NA NA
0 0 cleansing_method	C Performance, Categorical	FALSE FALSE FALSE FALSE FALSE	Washers Soft wipers Hard wipers 0 0	NA NA NA		NA NA
0 0 0 cleansing_method	C C Performance, Categorica	FALSE FALSE FALSE FALSE FALSE	Washers Soft wipers Hard wipers 0 short (< 1 year) medium (1-5 years)	NA NA	NA NA	NA.
0 0 0 cleansing_method 0 lifetime	C C C Performance, Categorica C C Performance, Categorica C C Performance, Categorica C Performance, Categorica C C P Performance, Categorica C P P P P P P P P P P P P P P P P P P	FALSE FALSE FALSE FALSE FALSE TRUE	0 Washers Soft wipers Hard wipers 0 short (< 1 year) medium (1-5 years) [long (55 years)	NA NA (short = 1, medium = 1, long = 1)	NA NA 20 years assumed	NA NA yes
0 0 0 cleansing_method 0 lifetime	C Performance, Categorical	FALSE FALSE FALSE FALSE FALSE TRUE	0 Washers Soft wipers Hard wipers 30 to Vipers Short (< 1 year) 0 short (< 1 year) medium (1-5 years) long (55 years) rapid (< 3 days) 0 wederate (3 days to 2 weeks)	NA NA NA	NA NA	NA NA
0 0 cleansing_method	C C C Performance, Categorica C C Performance, Categorica C C Performance, Categorica C Performance, Categorica C C P Performance, Categorica C P P P P P P P P P P P P P P P P P P	FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE	0 Washers Soft wipers Hard wipers 3 Short (< 1 year) wedium (1-5 years) tong (55 years) rapid (< 3 days) or weeks slow (> 2 weeks) slow (> 2 weeks) rapid (few days to a week)	NA NA (short = 1, medium = 1, long = 1)	NA NA 20 years assumed NA Chamber made from bricks or concrete, would require minimum 7 days for	NA NA yes
0 0 0 cleansing_method 0 0 cleansing_method 0 0 0 lifetime	Performance, Categorica Performance, Categorica C Performance, Categorica PDF, Categorica	FALSE FALSE FALSE FALSE FALSE FALSE TRUE TRUE	0 Washers Soft wipers Hard wipers 0 short (< 1 year) 0 short (< 1 year) 0 short (= 2 years) 10ng (5 years) 17pid (< 3 days) 17pid (< 3 days) 17pid (> 3 days)	NA	NA NA 20 years assumed NA	NA NA yes

construction_parts	PDF, Categorical	TRUE	simple technical special	(simple = 0, technical = 0.7, special = 0.3)	The batch reactor will consist of a pipe closed to one end with a vessel dished end (curved shape). This requires less material than a flat end and is easier to manufacture than a hemispherical end. The top is equipped with a flange and closed with a lid that can be screwed to the flange, allowing easyl opened, filled, and tightly closed. A graphite sealing ring allows the reactor to be hermetically sealed. The electric heating is provided by a cylindrical heating mantle surrounding the vessel. The external temperature is controlled with a regulator connected to the heating mantle an energy meter is connected to the heating mantle and pressure as well as power consumption will be recorded over time on a computer during the reaction. The maximum allowable pressure is controlled with an overpressure valve that releases the pressure when going higher than a certain limit. The stam released is directed to the obtained with a stainless steel pipe. At the end of the released thanks to a drain valve and the residual gases directed to the outside through a plastic pipe. (Robbain, 2 (2013)) The batch reactor requires several parts that might possibly need to be esseidally manufactured. Around the vessel is necessary.		
runsier coemicients	(copied from "Sanitation_Technologies_TC_database_20210622.xlsm")		,	,	,		
	Biochar	Range	Airloss	Soilloss	Waterloss	Comments	Reference
ТР	1	-	- 0)	Zielinska et
							al. (2015)
med (R)	1		0			0	-
k	2					-	PA
TN	0.03	-	0.97			9	Krueger et al. (2020)
med (R)	0.03	-	0.97)	-
k	2						PA
H2O	0.01	-	0.99	'		,	Zurbrügg, 0 (2021)
med (R)	0.01		0.99)	-
k	_ 5						PA
TS	0.99	-	0.01		0)	Zurbrügg, (2021)
					-		
med (R)	0.99		0.01		3 ()	
med (R)	0.99	-	0.01		-	-	PA
med (R)	0.99		0.01				PA
med (R) k References	0.99		0.01				PA
References	1		0.01 //NJ, Swiss Federal Institute of Aquatic Science and Techn			-	PA
References iensch, R., Jennings, A., Renggli, S	1 S., & Reymond, P. (2018). Compendium of Sanitation Tec	chnologies in Emergencies . German WASH Network (GW		iology (Eawag), Global WASH Cluster (GWC) and Sustain		-	PA
References ensch, R., Jennings, A., Renggli, S oetscher, T., & Keller, J. (2002). A	1 S., & Reymond, P. (2018). Compendium of Sanitation Tec A decision support system for selecting sanitation syster	chnologies in Emergencies . German WASH Network (GW ns in developing countries. Socio-Economic Planning Sci	/N), Swiss Federal Institute of Aquatic Science and Techn	iology (Eawag), Global WASH Cluster (GWC) and Sustain 3121(02)00007-1	able Sanitation Alliance (SuSanA).	-	PA
References ensch, R., Jennings, A., Renggli, S oetscher, T., & Keller, J. (2002). A puhler, D., de Morais Lima, P., Fr	1 S. & Reymond, P. (2018). Compendium of Sonitation Tec A decision support system for selecting sanitation syster ritzsche, J., limanen, K., Jain, A., van Sloten, M., & Willim	chnologies in Emergencies . German WASH Network (GW ms in developing countries. Socio-Economic Planning Sci ann, C. (2021). Sanichoice Project Team. Department S	/N), Swiss Federal Institute of Aquatic Science and Technences, 36 (4), 267–290. https://doi.org/10.1016/S0038-C	tology (Eawag), Global WASH Cluster (GWC) and Sustain 3121(02)00007-1 tries (Sandec), Swiss Federal Institute of Aquatic Scienc	able Sanitation Alliance (SuSanA).	0	PA
References ensch, R., Jennings, A., Renggil, oetscher, T., & Keller, J. (2002). A puhler, D., de Morais Lima, P., Fr puhler, D., & Roller, L. (2020). Sa	1 S. & Reymond, P. (2018). Compendium of Sonitation Tec A decision support system for selecting sanitation syster ritzsche, J., limanen, K., Jain, A., van Sloten, M., & Willim	chnologies in Emergencies . German WASH Network (GW ns in developing countries . Socio-Economic Planning Sci ann, C. (2021). Sanichoice Project Team. Department Si oppropriateness profiles and transfer coefficients . Taway	I/N), Swiss Federal Institute of Aquatic Science and Technences, 36 (4), 267–290. https://doi.org/10.1016/50038-canitation, Water and Solid Waste for Development Coun	tology (Eawag), Global WASH Cluster (GWC) and Sustain 3121(02)00007-1 tries (Sandec), Swiss Federal Institute of Aquatic Scienc	able Sanitation Alliance (SuSanA).	-	PA
References iensch, R., Jennings, A., Renggli, S betscher, T., & Keller, J. (2002). A puhler, D., de Morais Lima, P., Fr puhler, D., & Roller, L. (2020). So urbrügg, C. (2021). Personal Com	1 S., & Reymond, P. (2018). Compendium of Sanitation Tec A decision support system for selecting sanitation syster ritszche, J., limanen, K., Jain, A., van Sloten, M., & Willim initation technology library: Details and data sources for	chnologies in Emergencies . German WASH Network (GW ns in developing countries. Socio-Economic Planning Sci nann, C. (2021). SaniChoice Project Team. Department S. swedish University of Agricultural Sciences (SLU).	I/N), Swiss Federal institute of Aquatic Science and Technences, 36 (4), 267–290. https://doi.org/10.1016/S0038-63 anitation, Water and Solid Waste for Development Coun	tology (Eawag), Global WASH Cluster (GWC) and Sustain 3121(02)00007-1 tries (Sandec), Swiss Federal Institute of Aquatic Scienc	able Sanitation Alliance (SuSanA).		PA
References sensch, R., Jennings, A., Renggli, i oetscher, T., & Keller, J. (2002). A puhler, D., de Morais Lima, P., Fr puhler, D., & Roller, L. (2020). Sa urbrügg, C. (2021). Personal Com rueger, B. C., et al. (2020). "Reso	1 5. & Reymond, P. (2018). Compendium of Sonitation Tee A decision support system for selecting sanitation system (ritzsche, J., ilmanen, K., Jain, A., van Sloten, M., & William initation technology library: Details and data sources for numulication with Cristian Zurbrügs, Uppsals, Sweeden,	chnologies in Emergencies. German WASH Network (GW ns in developing countries. Socio-Economic Planning Sid nann, C. (2021), Saul'Choice Project Team. Departments' Si oppoprolateness profels and transfer coefficients. Eaway Swedish University of Agricultural Sciences (SUU). Faceal sludge treatment and co-treatment with agricultural	I/N), Swiss Federal Institute of Aquatic Science and Techniences, 36 (4), 126–1200. https://doi.org/10.1016/S00386-dinitation, water and Solid Waste for Development Countries of Swiss Federal Institute of Aquatic Science and Technol University of Swiss Federal Institute of Aquatic Science and Technol University of Swiss Federal Institute of Aquatic Science.	tology (Eawag), Global WASH Cluster (GWC) and Sustain 3121(02)00007-1 tries (Sandec), Swiss Federal Institute of Aquatic Scienc	able Sanitation Alliance (SuSanA).		PA
References ensch, R., Jennings, A., Renggli, S oetscher, T., & Keller, J. (2002). A publer, D., de Morals Lima, P., Fr publer, D., & Roller, L. (2020). So urbrügg, C. (2021). Personal Com rueger, B. C., et al. (2020). "Reso leilriska, A., et al. (2015). "Effect.	5, & Reymond, P. (2018). Compendium of Sonitotion Ter Addecision support system for selecting sanitation system fitzsche J., Limanen, K. Jain, A., van Sidere, M., & William sonitotian technologi Brouy Details and dato sources for nomunication with Christian Zurbrügg. Uppsala, Sweden, ource recovery and biochar Characteristics from ful-scale.	chnologies in Emergencies . German WASH Network (CWN ms in developing countries . Socio-Economic Planning Sci sann, C. (2021). Sain/Choice Project Team. Departments 10 appropriateness profiles and transfer coefficients. Examina Swedish University of Agricultural Sciences (SUU). Flaces allough treatment and co-treatment with agricultural Colombia of Analysis 1122-201.	I/N), Swiss Federal Institute of Aquatic Science and Techniences, 36 (4), 126–1200. https://doi.org/10.1016/S00386-dinitation, water and Solid Waste for Development Countries of Swiss Federal Institute of Aquatic Science and Technol University of Swiss Federal Institute of Aquatic Science and Technol University of Swiss Federal Institute of Aquatic Science.	ology (Eawag), Global WASH Cluster (GWC) and Sustain 1121(02)00007-1 tries (Sandec), Swiss Federal Institute of Aquatic Science logy.	able Sanitation Alliance (SuSanA).		PA
References mensch, R., Jennings, A., Renggli, Joestscher, T., & Beller, J. (2002). A publier, D., de Morais Lima, P., Fri publier, D., & Roller, L. (2020). So rubrigg, C. (2021). Personal Com rueger, B. C., et al. (2020). "Reso ielińska, A., et al. (2015). "Effect obblani, Z. (2013). "Hydrothermar	5, & Reymond, P. (2018). Compendium of Sonitotion Ter Addecision support system for selecting sanitation system fitzsche J., Limanen, K. Jain, A., van Sidere, M., & William sonitotian technologi Brouy Details and dato sources for nomunication with Christian Zurbrügg. Uppsala, Sweden, ource recovery and biochar Characteristics from ful-scale.	chnologies in Emergencies German WASH Network (GNN in in developing countries. Socie-Economic Planning Soliannin, C. (2021). sail/cibicle reposet Team. Department S1 solianning. Soliannin, C. (2021). sail/cibicle reposet Team. Department S1 soliannin, S1	IN), Swiss Federal Institute of Aquatic Science and Techn ences, 36 (4), 267–290. https://doi.org/10.1016/500384 antiation, Water and Solid Waste for Development Coun- Swiss Federal Institute of Aquatic Science and Technic tural Waste. ** Water Research 169: 115253. -213.	ology (Eawag), Global WASH Cluster (GWC) and Sustain 1121(02)00007-1 tries (Sandec), Swiss Federal Institute of Aquatic Science logy.	able Sanitation Alliance (SuSanA).	-	PA
References lensch, R., Jennings, A., Renggli, 3 oetscher, T., & Keller, J. (2002). J publer, D., de Morais Lima, P., Fr publer, D., & Soller, L. (2020). Sourbrigg, C. (2021). Personal Com rueger, B. C., et al. (2020). "Reso ellriska, A., et al. (2021). "Effect obbiani, Z. (2013). "Hydrotherm scconville, J. et al. (2020). "disconville".	5, & Reymond, P. (2018). Compendium of Sanitation Fee dedection support system for selecting sanitation system for selecting sanitation system for selecting sanitation system for selecting sanitation systems from the sanitation standards flavory. Details and data sources for multication with Christian Zurvingg. Uppsals, Sweeten, but the sanitation with Christian Zurvingg. Uppsals, Sweeten, but the sanitation with Christian Zurvingg. Uppsals, Sweeten, but the sanitation with Christian Zurvingg. Uppsals, Sweeten, and a chromation of bowster/feet sidulege. Conception on a carboniation of bowster/feet sidulege." Conception on a carboniation of all arboniations of subsets/feet sidulege."	chnologies in Emergencies . German WASH Network (cW ms in developing countries . Sooio-Economic Planning So ann C. (2021). sain/Choice Project Team. Department St sowedish University of Apricultural Sciences (SUI). Swedish University of Apricultural Sciences (SUI). Enecal sludget treatment and co-treatment with agricul inc." Journal of Analytical and Applied Priyolysis 112: 201 and construction of a HTC prototype research unit for dr giges: a supplement on the Compendum of Sanitation S	IN), Swiss Federal Institute of Aquatic Science and Techn ences, 36 (4), 267–290. https://doi.org/10.1016/500384 antiation, Water and Solid Waste for Development Coun- Swiss Federal Institute of Aquatic Science and Technic tural Waste. ** Water Research 169: 115253. -213.	ology (Eawag), Global WASH Cluster (GWC) and Sustain 1121(02)00007-1 tries (Sandec), Swiss Federal Institute of Aquatic Science logy.	able Sanitation Alliance (SuSanA).	-	PA

Mono-Incineration		Mono-Incineration				
General Information	Values	Data Source				
FUNCTIONAL GROUP UNIQUE IDENTIFIER (ID)	mono_incineration	-	†			
DATA COMPILER	SaniChoice Project Team transportedstored_faeces,	- Spuhler, D. & Roller, L. (2020)	1			
INFOTRIODEC	transporteddried_faeces, transportedsludge, transportedprocessed_sludge, transportedstabilized_sludge,	Spurier, J. & Roller, L. (2020)				
OUTPUT PRODUCT	transportedpithumus transportedash	Spuhler, D. & Roller, L. (2020)	†			
RELATIONS		Spuhler, D. & Roller, L. (2020)				
COMMENTS						
Pre-Filter Criteria applicability_level	Values (household = 0, neighbourhood = 0.5, city = 1)	Data Source McConville, J. et al. (2020)				
management_level	(household = 0, shared = 0.5, public = 1)	McConville, J. et al. (2020)				
capex_req_level opex_req_level		Spuhler, D. et al. (2021) Spuhler, D. et al. (2021)	+			
technical_maturity	(acute = 0, stabilisation = 0.5,	McConville, J. et al. (2020) McConville, J. et al. (2020)	+			
	development/recovery = 1)					
Screening Criteria	Type and Function	Applicable for this Functional Group?	Categories [Unit]	Technology Values (Data)	Data Source / Assumptions	Internal Review
water_supply	Performance, Categorical	ENICE	house	NA	NA	Done?
water_supply	r errormance, caregorica	17122	yard			
			public none			
water_volume	Performance, Trapez		[L/cap/day]	NA	NA	NA
electricity_supply	Performance, Categorical	IRUE	electricity intermittent	(electricity = 1, inermittent = 1, no electricity = 1)	Expert judgement (McConville, J. et al. 2021)	
fuel_supply	Performance, Categorical	FAICE	no electricity fuel	NA NA	NA	NA
idei_supply			no fuel	IVA	NA .	IVA
frequency_of_om	PDF, Categorical	TRUE	irregular regular	(irregular = 0.2, regular = 0.7, continous = 0.1)	Expert judgement (McConville, J. et al. 2021)	
		TOUE	continuous	(Nambers & DMC 11 and 12 and 13	Francis Colonia and Greek Colonia and Colonia	
pipe_supply	Performance, Categorical	TRUE	no pipes difficultly available	(No pipes = 1, Difficulty available = 1, Pipes = 1)	Expert judgement (McConville, J. et al. 2021)	
May record to the second secon	Performance, Categorical	TOLLE	pipes no pumps	(No pumps= 1, Difficulty available = 1, Pumps= 1)	Evnert judgement (McConville 1 -+ -1 2024)	
pump_supply	Performance, Categorical	IRUE	difficultly available	(No pumps= 1, Difficulty available = 1, Pumps= 1)	expert judgement (McConville, J. et al. 2021)	
concrete_supply	Performance, Categorical	TRUE	pumps no concrete	(no concrete = 1, difficultly available = 1,	Expert judgement (McConville, J. et al. 2021)	
ccsupply	cacegorical		difficultly available	concrete = 1)	,	
spare_parts	PDF, Categorical	TRUE	concrete simple	(simple = 0.5, technical = 0.5, special = 0)	Expert judgement (McConville, J. et al. 2021)	
			technical special			
0		FALSE) NA	NA .	NA
0		FALSE FALSE		D NA D NA	NA NA	NA NA
temperature			very cold	(very cold = 0.7, cold = 0.8, temperate = 1, warm		
			cold temperate	= 1, hot = 1)		
			warm			
flooding	Performance, Categorical	TRUE	hot flooding	(flooding = 0.9, no flooding = 1)	Expert judgement (McConville, J. et al. 2021)	
unhimitar acces			no flooding	NA	NA	NA
vehicular_acces	Performance, Categorical	FALSE	no access difficult	NA	NA .	NA .
slope	Performance, Categorical	FAISE	full flat	NA .	NA .	NA
			not flat			
soil_type	Performance, Categorical	FALSE	clay silt	(Rock = 1, Clay = 1, Silt = 1, Sand = 1, Gravel = 1)	Expert judgement (McConville, J. et al. 2021)	
			sand			
			gravel rock			
groundwater_depth excavation	Performance, Trapez Performance, Categorical		water depth [m] easy	NA (easy = 1, hard = 1)	NA Expert judgement (McConville, J. et al. 2021)	NA
			hard			
surface_area_onsite	Performance, Trapez	FALSE	[m2/plot]	NA	NA	NA
surface_area_offsite	Performance, Trapez	TRUE	m2/pers	(a = 0,014, b = 0.025, c = 999, d = 999)	assuming 0.25kg/cap day feedstock and reactor	
					of 40kg capacity using 2.25m2 (Expert Judgement (Zurbrügg, C. (2021)))	
0		FALSE FALSE		NA D NA	NA NA	NA NA
0	0	FALSE	(NA NA	NA	NA
drinking_water_exposure	Performance, Categorical	FALSE	Close Not close	NA	NA	NA
0		FALSE	(NA NA	NA	NA NA
0 construction_skills		FALSE TRUE	Ladder:	NA (unskilled = 1, skilled = 1, professional = 1)	NA Expert judgement (McConville, J. et al. 2021)	NA
			unskilled skilled			
			professional			
design_skills	Performance, Categorical	TRUE	Ladder: unskilled	(unskilled = 0.5, skilled = 0.9, professional = 1)	Expert judgement (McConville, J. et al. 2021)	
			skilled			
om_skills	Performance, Categorical	TRUE	professional Ladder:	(unskilled = 0.8, skilled = 1, professional = 1)	Expert judgement (McConville, J. et al. 2021)	
			Unskilled Skilled			
			Professional			
0	0	FALSE FALSE		NA D NA	NA NA	NA NA
0	0	FALSE	(NA NA	NA	NA
0 cleansing_method		FALSE FALSE	Washers	NA NA	NA NA	NA NA
<u></u>			Soft wipers			
0		FALSE) NA	NA	NA
0 lifetime	Performance, Categorical	FALSE TRUE	short (< 1 year)	(short = 1, medium = 1, long = 1)	"the lifetime of typical incinerators (20-30 years)"	NA yes
came	caregorical		medium (1-5 years)		(National Research Council (US) 2000)	
			long (>5 years)		It is assumed that sludge incinerators have similar lifetimes to a normal incinerator. (Kukka	
speed implement tailet	DDC Categories	FAICE	souid (< 2 doug)	NA NA	Ilmanen, Eawag 2021)	NA
speed_implement_toilet	PDF, Categorical	N / NewNe	rapid (< 3 days) moderate (3 days to 2 weeks)		NA	
speed_implement_treatment	PDF, Categorical	TRUE	slow (> 2 weeks) rapid (few days to a week)	(rapid=0, moderate=1, slow=0)	Chamber made from bricks or concrete, would	
.,ueaunent	r Di , Categorical		moderate (few weeks up to three months)		require minimum 7 days for curing. No microbial	
			slow (> 3 months)		process involved, therefore no reduction in speed because of time needed for communities	
	Doefor Cata	TOLLE	eacu	(easy = 1, difficult = 0.5)	to establish. (Akanksha Jain)	was
scalability	Performance, Categorical	INUE	easy difficult	(easy = 1, difficult = 0.5)	Mono-incineration requires a complex installation that can neither be easily increased in	yes
					size nor replicated. However, it is assumed that a large enough incinerator has some flexibility in	
					regard to the input loading. (Kukka Ilmanen,	
construction_parts	PDF, Categorical	TRUE	simple	(simple = 0.8, technical = 0.2, special = 0)	Eawag 2021) Expert judgement (McConville, J. et al. 2021)	
			technical			
Transfer Coefficients	(copied from "Sanitation_Technologies_TC_database_20210622.xism")		special			
rransfer Coefficients	(copied from "Sanitation_Technologies_TC_database_20210622.vism")					

	Ash	Range	Airloss	Soilloss		Comments Specificatio	
						ns	
TP	1	-	0		0	judgement	McConville, J. et al. (2021)
med (R)	1	-	0	(0		-
k	2						PA
TN	0.03	0 - 0.06	0.97				McConville, J. et al. (2021)
med (R)	0.03		0.97	(0		-
k	2	[0.06]					PA
H20			0.99			Expert judgement	McConville, J. et al. (2021)
med (R)	0.01	-	0.99	(0		-
k	1						PA
TS	0.99	0.9 - 1	0.01	(0	judgement	McConville, J. et al. (2021)
med (R)	0.99		0.01	(0		-
k	5	[0.1]	-		-		PA

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oplication of Urine		Application of Urine				
FUNCTIONAL GROUP		Data Source				
UNIQUE IDENTIFIER (ID)		-				
INPUT PRODUCT		Spuhler, D. & Roller, L. (2020)	-			
OUTPUT PRODUCT	NA	Spuhler, D. & Roller, L. (2020)				
RELATIONS	Input: OR Output: NA	Spuhler, D. & Roller, L. (2020)				
COMMENTS	Output. NA					
-Filter Criteria	Values (household = 1, neighbourhood = 1,	Data Source				
applicability_level	(household = 1, neighbourhood = 1, city = 1)	Tilley, E. et al. (2014)				
management_level	(household = 1, shared = 1, public = 1)	Tilley, E. et al. (2014)				
capex_req_level	3	Spuhler, D. et al. (2021)				
opex_req_level technical_maturity		Spuhler, D. et al. (2021) McConville, J. et al. (2020)				
	(acute = 0, stabilisation = 0.5,	Gensch, R. et al. (2018)				
eening Criteria	development/recovery = 1) Type and Function	Applicable for this Functional Group?	Categories [Unit]	Technology Values (Data)	Data Source / Assumptions	Internal Review Done?
water_supply	Performance, Categorical		house	NA (Late)	NA NA	NA
			yard public			
			none			
water_volume electricity_supply	Performance, Trapez Performance, Categorical		[L/cap/day] electricity	NA (electricity = 1, intermittent = 1, no ele		NA yes
c.ecci.city_supply	. errormance, categorical		intermittent	- 1, 110 ele	J. Sections included.	,
fuel_supply	Performance, Categorical	FALSE	no electricity fuel	NA	NA .	NA
			no fuel			
frequency_of_om	PDF, Categorical	TRUE	irregular regular continuous	(tregular = 0.5, regular = 0.5, continous = 0)	"Over time, some minerals in urine will precipitate (especially, calcium and magnesium phosphates). Equipment that is used to collect, transport or apply urine (i.e., watering cans with small holes) may become clogged over time. Most deposits can easily be removed with hot water and a bit of acid (vinegar), or in more extreme cases, manually chipped off." (Compendium) "Urine application does not need special equipment, and thus additional costs for urine application are low. However, urine application and bel abour intensive." (SLU Compendium) Frequency of maintanance is low but the	yes
pipe_supply	Performance, Categorical	TRUE	no pipes difficultly available	(no pipes = 1, difficultly available = 1, pipes = 1	application needs a lot of work. No pipes needed.	yes
pump_supply	Performance, Categorical	TRUE	no pumps difficultly available pumps	(no pumps = 1, difficultly available = 1, pumps = 1)	No pumps needed.	yes
concrete_supply	Performance, Categorical	TRUE	no concrete difficultly available	(no concrete = 1, difficultly available = 1, concrete = 1)	No concrete needed.	yes
spare_parts	PDF, Categorical	TRUE	concrete simple		"Urine application does not need special	yes
			technical special		equipment, and thus additional costs for urine application are low []." (SLU Compendium) No special equipment means also that no technical or special spare parts are needed.	
0 0 0	0	FALSE FALSE FALSE	C	NA NA	NA	NA NA
temperature			very cold cold temperate warm hot	(very cold = 0.5, cold = 0.7, temperate	There is no doubt that land application of manure to frozen or cold and wet ground has potential to exacerbate nutrient loss in runoff. The absence, or poor growth of crops (limiting uptake of manure nutrients and water), winter weather, and winter soil conditions generally exacerbate off-site losses of manure-derived pollutants." (lut et al. (2018)) The application of stored urine is still possible on cold temperatures but the soil will not be able to absorb all of the nutritients and they would be washed away to surface waters or to the groundwater.	yes
flooding			flooding no flooding	(flooding = 0.9, no flooding = 1)	All technologies associated with "application of a certain product" are awarded performance values in accordance with each other. Generally, these products are aimed to be safe for use, however, they do carry a "low risk of pathogen transmission" (Compendium), in the event of flooding, surrounding areas of where these products are applied therefore bear some risk. Also, the social acceptance of these products are bow and people would not prefer flood waters to spread these products everywhere. Hence, their performance is reduced by 10% or 20% depending on the relative risk of pollution between different products (e.g., stabilized sludge risker than stored urine). (Akanskha Jain). Stored urine is considered to be quite a safe product therefore allotted a performance of 90%.	
vehicular_acces	Performance, Categorical	IFALSE	no access difficult full	NA	NA	NA
slope	Performance, Categorical	FALSE	flat	NA	NA	NA
soil_type	Performance, Categorical	TRUE	not flat clay	(clay = 1, silt = 1, sand = 1. gravel = 1. n	The application of stored urine is not based on	yes
			silt sand gravel	7,00-0-0-0-0-0-0-0-0-0-0-0-0-0-0-0-0-0-0	soil absorption. No difference between different soil types. Stored urine can be brought on the field on every type of soil.	
groundwater_depth	Performance, Trapez	TRUE	rock water depth [m]	(a = 0, b = 0, c = 999, d = 999)	"Urine poses a minimal risk of infection, especially when it has been stored for an extended period of time. Yet, urine should be carefully handled and should not be applied to crops less than one month before they are harvested. This waiting period is especially important for crops that are consumed raw []- "(Compendium) Because there is a remaining risk of contamination you should make safe that it is sterile before you applicate stored urine in an area with a high groundwater level.	yes

excavation	Performance, Categorical	TRUE	easy	(easy = 1, hard = 1)	No need for excavation.	yes]
		54465	hard				
surface_area_onsite	Performance, Trapez	FALSE	[m2/plot]	NA	NA	NA	
surface_area_offsite	Performance, Trapez	FALSE	m2/pers	NA	NA	NA	
0		FALSE	(NA NA	NA	NA	
0		FALSE		NA	NA	NA	
	•	FALSE	Close	(close = 1, not close = 1)	"Urine poses a minimal risk of infection,	NA yes	
drinking_water_exposure	renormance, Lategorical	TRUE	Viole Not close	(close = 1, not close = 1)	Unne poses a minimal risk or infection, especially when it has been stored for an extended period of time. Vet, urine should be carefully handled and should not be applied to crops less than one month before they are harvested. This walting period is especially important for crops that are consumed raw []-" (Compendium) Because there is a remaining risk of contamination you should make safe that it is sterile before you applicate stored urine close to a drinking water source.	yes	
0	0	FALSE	(NA NA	NA	NA	
0		FALSE	(NA .	NA	NA	
construction_skills	Performance, Categorical	TRUE	Ladder: unskilled skilled professional	(unskilled = 1, skilled = 1, professional = 1)	No construction needed.	yes	
design_skills	Performance, Categorical	THUE	Ladder: unskilled skilled professional	(unskilled = 0.5, professional = 1)	"There is no standard recommendation for dilution, and existing recommendations vary widely, usually between ratios of 1:3 to 1:10, depending on the soil and the type of vegetables. Keep in mind that dilution increases the total volume and thus labour and transport needs. If diluted urine is used in an irrigation system, it is referred to as "fertigation" (see R.19). During the rainy season, urine can be applied directly into small holes near plants, it is then diluted naturally." (SLU Compendium) "Urine poses a minimal risk of infection, especially when it has been stored for an extended period of time. Yet, urine should be carefully handled and should not be applied to crops less than one month before they are harvested. This waiting period is especially important for crops that are consumed raw []." (Compendium) High design skills are recommended to applicate the urine correct and to prevent contamination.	yes	
om_skills	Performance, Categorical	TRUE	Ladder: Unskilled Skilled	(unskilled = 1, skilled = 1, professional = 1)	OM skills required are low.	yes	
0		FALSE	Professional) NA	NA .	NA	
0		FALSE		NA NA	NA NA	NA NA	
0		FALSE		NA .	NA .	NA	
0		FALSE		NA NA	NA	NA	
cleansing_method	Performance, Categorical	FALSE	Washers Soft wipers Hard wipers	NA	NA	NA	
0		FALSE		NA .	NA	NA	
lifetime	Performance, Categorical		short (< 1 year) medium (1-5 years) long (>5 years)	NA (short = 1, medium = 1, long = 1)	NA The concept of applying stored urine does not have a lifetime and can therefore be used at anytime. The storage of urine itself takes place in the FGS or T. (Kukka Ilmanen, 2021)	NA yes	
speed_implement_toilet	PDF, Categorical		rapid (< 3 days) moderate (3 days to 2 weeks) slow (> 2 weeks)	NA	NA	NA	
speed_implement_treatment	PDF, Categorical		rapid (few days to a week) moderate (few weeks up to three months) slow (> 3 months)	NA	NA	NA	
scalability	Performance, Categorical	FALSE	easy	NA	NA	NA	
construction_parts	PDF, Categorical PDF, Categorical Copied from "Smithion_Technologies_TC_database_2022		aimeut simple technical special	(simple = 1, technical = 0, special = 0)	"Urine application does not need special equipment, and thus additional costs for urine application are low []." (SLU Compendium) No special equipment means that no technical or special parts are needed to apply stored urine.	yes	
Transfer Coefficients	Recovered	Range	Airloss	Soilloss	Waterloss	Comments	Reference
TP			Airioss				PA
med (R)							-
k TN	100		0.09			* sophisticated spreading techniques	PA Udert et al. (2006)
	0.89		0.1:	1 0	C	* Cattle manure	Vertregt and Rutgers
med (R)	0.91	0.89-0.99	0.00	7 0.01	0.01		PA -
med (k)	25		0.0.	- 0.01	0.01		PA
H2O	0.98	-	(PA
med (R)			(0.01	0.01		-
k TS	100 0.98		(0.01	0.01		PA PA
med (R)	0.98	-					-
k	100						PA
References							Spuhler et al. (2021)

References

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Liu, J., et al. (2018). "A review of regulations and guidelines related to winter manure application." Ambiguidelines related to winter manure application." Ambiguidelines related to winter manure application." Ambiguidelines related to winter manure application." Ambiguidelines related to winter manure application." Ambiguideline

Application of Concentrated L	Values	Application of Concentrated Urine Data Source					
FUNCTIONAL GROUP	D	-					
DATA COMPILER	application_concentrated_urine Matthias van Sloten	-					
	concentrated_urine, transportedconcentrated_urine	Spuhler, D. & Roller, L. (2020)					
OUTPUT PRODUCT	NA	Spuhler, D. & Roller, L. (2020)	1				
RELATIONS	Input: OR Output: NA	Spuhler, D. & Roller, L. (2020)					
COMMENTS							
Pre-Filter Criteria applicability_level	Values (household = 1, neighbourhood = 1,	McConville, J. et al. (2020)					
	city = 1)		-				
management_level							
capex_req_level opex_req_level		Spuhler, D. et al. (2021) Spuhler, D. et al. (2021)	-				
technical_maturity	3	McConville, J. et al. (2020)					
development_phase	(acute = 0, stabilisation = 0, development/recovery = 1)	Same values allotted as treatment technology aurin production					
		(Akanksha Jain)					
Screening Criteria	Type and Function	Applicable for this Functional Group?	Categories [Unit]	Technology Values (Data)	Data Source / Assumptions	Internal Review Done?	
water_supply	Performance, Categorical		house	NA	NA	NA	
			yard public				
water_volume	Performance, Trapez	FALSE	none [L/cap/day]	NA	NA	NA	
electricity_supply			electricity	(electricity = 1, intermittent = 1, no elec		yes	
			intermittent no electricity				
fuel_supply	Performance, Categorical	FALSE	fuel	NA	NA	NA	
frequency_of_om	PDF, Categorical	TRUE	no fuel irregular	(irregular = 0.8, regular = 0.2,	The only material you need for the	yes	
	,		regular continuous	continous = 0)	application of Aurin is a watering can or aomething similar. No further		
			continuous		maintenance needed.		
					"At a large scale, this liquid fertiliser requires appropriate equipment for		
					spreading on agricultural fields." (SLU		
					Compendium -> R.2 Concentrated Urine)		
					For the special equipment on a large		
					scale some regular maintenance might be necessary.		
pipe_supply	Performance, Categorical	TRUE	no pipes		No pipes needed.	yes	
			difficultly available pipes	pipes = 1			
pump_supply	Performance, Categorica	TRUE	no pumps difficultly available	(no pumps = 1, difficultly available = 1,	No pumps needed.	yes	
			pumps	pumps = 1			
concrete_supply	Performance, Categorical	TRUE	no concrete	(no concrete = 1, difficultly available =	No concrete needed.	yes	
			difficultly available concrete	1, concrete = 1)			
spare_parts	PDF, Categorical	TRUE	simple technical	(simple = 0.8, technical = 0.2, special = 0)	The only material you need for the application of Aurin is a watering can.	yes	
			special	,	No special spare parts are needed on		
					a small scale. "At a large scale, this liquid fertiliser		
					requires appropriate equipment for		
					spreading on agricultural fields." (SLU Compendium -> R.2 Concentrated		
					Urine)		
					For the special equipment on a large scale technical spare parts might be		
					necessary.		
0		FALSE FALSE		NA NA	NA NA	NA NA	
0 temperature	0	FALSE		NA (very cold = 0.5, cold = 0.7, temperate =	NA "There is no doubt that land	NA	
temperature	reriormance, Categorical	INVE	cold	very colu – 0.5, colu = 0.7, temperate :	application of manure to frozen or	yes	
			temperate		cold and wet ground has potential to		
			warm hot		exacerbate nutrient loss in runoff. The absence, or poor growth of crops		
					(limiting uptake of manure nutrients		
					and water), winter weather, and winter soil conditions generally		
					exacerbate off-site losses of manure-		
					derived pollutants." (Liu et al. (2018)) The application of Aurin is still possible		
					on cold temperatures but the soil will not be able to absorb all of the		
					nutritients and they would be washed		
					away to surface waters or to the groundwater.		
flooding	Performance, Categorica	TRUE	flooding no flooding	(flooding=0.9, no flooding=1)	All technologies associated with "Application of a certain product" are	yes	
			no nooung		awarded performance values in		
					accordance with each other.		
					Generally, these products are aimed to be safe for use, however, they do		
					carry a "low risk of pathogen transmission" (Compendium). In the		
					event of flooding, surrounding areas		
					of where these products are applied therefore bear some risk. Also, the		
					social acceptance of these products		
					can be low and people would not prefer flood waters to spread these		
					products everywhere. Hence, their		
					performance is reduced by 10% or 20% depending on the relative risk of		
					pollution between different products		
					(e.g., stabilized sludge riskier than stored urine). (Akanksha Jain).		
					Aurin is considered to be quite a safe		
					product therefore allotted a performance of 90%.		
vehicular_acces	Performance, Categorical	FALSE	no access difficult	NA	NA	NA	
		544.05	full				
slope	Performance, Categorical	FALSE	flat not flat	NA	NA	NA	
soil_type	Performance, Categorical	TRUE	clay	(clay = 1, silt = 1, sand = 1, gravel = 1, ro		yes	
			silt sand		on soil absorption. No difference between different soil types. Aurin can		
			gravel		be brought on the field on every type		
	I.	I .	rock	I .	of soil.	I .	

is safe to applicate everywhere. Accepted as commercial fertiliter by the Federal Office for Agriculture of Silvazerland, (Etter et al.) If applicated in areas with high a groundwater level it is very important not to applicate too much to prevent infiltration of nutritients to the groundwater. excavation Performance, Categorical TRUE easy (easy = 1, hard = 1) No need for excavation. yes surface_area_onsite Performance, Trapez FALSE [m2/plot] NA NA NA NA NA NA NA NA NA NA NA NA NA	
the Federal Office for Agriculture of Sixtzerland, (Etter et al.) If applicated in areas with high a groundwater level it is very important not to applicate to much to prevent infiltration of nutritients to the groundwater. Excavation Performance, Categorical TRUE easy (easy = 1, hard = 1) No need for excavation. yes surface_area_onsite Performance, Trapez FALSE (m2/plot) NA NA NA NA	
Sintzerland, (Etter et al.) If applicated in areas with high a groundwater level it is very important not to applicate too much to prevent infiltration of nutritients to the groundwater. excavation Performance, Categorical RUE easy (easy = 1, hard = 1) No need for excavation. yes surface_area_onsite Performance, Trapez FALSE [m2/plot] NA NA NA NA NA	
If applicated in areas with high a groundwater level its very important not to applicate too much to prevent infiltration of nutritients to the groundwater.	1
excavation Performance, Categorical TRUE easy (easy = 1, hard = 1) No need for excavation. yes surface_area_onsite Performance, Trapez FALSE [m2/plot] NA NA NA NA NA	
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excavation Performance, Categorical TRUE easy (easy = 1, hard = 1) No need for excavation. yes surface_area_onsite Performance, Trapez FALSE [m2/plot] NA NA NA NA NA	
excavation Performance, Categorical TRUE easy hard (easy = 1, hard = 1) No need for excavation. yes surface_area_onsite Performance, Trapez FALSE [m2/plot] NA NA NA	
surface_area_onsite Performance, Trapez FALSE [m2/plot] NA NA NA	
surface_area_offsite Performance, Trapez FALSE m2/pers NA NA NA NA	
0 0 FALSE 0 NA NA NA	
0 0 FALSE 0 NA NA NA NA NA NA	
drinking water_exposure Performance, Categorical TRUE Close (close = 1, not close = 1) Aurin is sterile and free of heavy yes	
Not close metals, hormons and medicaments. It	
is safe to applicate everywhere.	
Accepted as commercial fertilizer by the Federal Office for Agriculture of	
Siwtzerland. (Vuna)	
If applicated in areas close to a	
drinking water source it s very important not to approximation to much	
to prevent infiltration of nutritients to	
the drinking water.	
0 0 FALSE 0 NA NA NA NA NA NA	
construction_skills Performance, Categorical TRUE Ladder:	
unskilled = 1)	
skilled professional	
design_skills	
unskilled = 1) considered are the amount of Aurin	
skilled applicated and that it is not applicated professional on frozen, completely dried out or	
in treasured and out of soaked ground.	
om_skills Performance, Categorical TRUE Ladder: (unskilled = 1, skilled = 1, professional The only material you need for the	
Unskilled = 1) application of Aurin is a watering can Skilled (Vuna). No OM skills needed on a	
Professional small scale.	
"At a large scale, this liquid fertiliser	
requires appropriate equipment for spreading on agricultural fields, "GLU U	
spreaming for agricultural metals. (CC Compendium > R.2 Concentrated	
Urine)	
Moderate OM skills needed on a large scale.	
0 0 1 FALSE 0 NA NA NA	
0 0 FALSE 0 NA NA NA	
0 0 FALSE 0 NA NA NA NA NA NA	
cleansing method Performance, Categorical FALSE Washers NA NA NA NA	
Soft wipers	
NA NA NA NA	
0 0 FALSE 0 NA NA NA	
Ifetime Performance, Categorical TRUE short (< 1 year) (short = 1, medium = 1, long = 1) The concept does not have a lifetime yes	
medium (1-5 years) and can therefore be used at anytime. long (>5 years) (Kukka limanen, Eawag 2021)	
speed_implement_toilet PDF, Categorical FALSE rapid (< 3 days) NA NA NA NA NA NA NA NA NA NA NA NA NA	
moorarte; 3 oays, oz. weeks) slow (>2 weeks)	
speed_implement_treatment	
moderate (few weeks up to three	
moderate (few weeks up to three months)	
moderate (few weeks up to three	
moderate (few weeks up to three months) slow (> 3 months) scalability Performance, Categorical FALSE easy NA NA NA NA NA NA NA NA NA NA NA NA NA	
moderate (few weeks up to three months) slow (> 3 months) scalability Performance, Categorical FALSE easy NA NA NA NA Construction_parts PDF, Categorical TRUE simple (simple = 0.8, technical = 0.2, special = The only material you need for the yes	
moderate (few weeks up to three months) slow (>3 months) NA scalability Performance, Categorical FALSE easy difficult construction_parts PDF, Categorical TRUE simple technical 0) (simple = 0.8, technical = 0.2, special = The only material you need for the application of Aurin is a watering can. No special space parts are needed on	
monderate (few weeks up to three months) slow (> 3 months) slow (>	
moderate (few weeks up to three months) scalability Performance, Categorical FALSE easy NA MA construction_parts PDF, Categorical TRUE simple (simple = 0.8, technical = 0.2, special = The only material you need for the application of Aurin is a watering can. No special spare parts are needed on a small scale. "At a large scale, this liquid fertiliser	
months) slow (> 3 months) slow (> 3 months) scalability Performance, Categorical FALSE easy MA difficult construction_parts PDF, Categorical TRUE Simple technical special Special Special NA NA NA NA NA NA NA NA NA NA NA NA NA	
moderate (few weeks up to three months) scalability Performance, Categorical FALSE easy NA NA NA NA construction_parts PDF, Categorical TRUE simple (simple = 0.8, technical = 0.2, special = The only material you need for the application of Aurin is a watering can. No special space parts are needed on a small scale. "At a large scale, this liquid fertiliser requires appropriate equipment for spreading on agricultural fields." (SLU Compendium > A. Z. Concentrated	
monters (few weeks up to three months) slow (> 3 months) scalability Performance, Categorical FALSE easy NA difficult (simple = 0.8, technical = 0.2, special = The only material you need for the application of Aurin is a watering can. No special spare parts are needed on a small scale. "At a large scale, this liquid fertiliser requires appropriate equipment for spreading on agricultural fields." (SLU Compendium > R.Z Concentrated Urine)	
moderate (few weeks up to three months) slow (> 3 months) scalability Performance, Categorical FALSE easy NA difficult special NA difficult special Special NA NA NA NA NA NA NA MA NA Interval pour need for the application of Aurin is a watering can. No special spare parts are needed on a small scale. "At a large scale, this liquid fertiliser requires application of regreating on a gricultural fields." (SLU Compendum > R.Z. Concentrated Urine) For spreading on a gricultural fields." (SLU Compendum > R.Z. Concentrated Urine) For spreading on a large scale special technical equipment might become	
moderate (few weeks up to three months) slow (> 3 months) NA **Construction_parts** **POF, Categorical** **POF, Categorical** **POF, Categorical** **POF, Categorical** **TRUE** **In a large scale, this liquid fertiliser requires appropriate equipment for spreading on a large scale special technical (Urine) **For spreading on a large scale special technical equipment might become necessary.**	
moderate (few weeks up to three months) slow (> 3 months) slow (> 3 months) Construction_parts PDF, Categorical TRUE Simple (simple = 0.8, technical = 0.2, special = The only material you need for the application of Aurin is a watering can. No special spare parts are needed on a small scale. "At a large scale, this liquid fertiliser requires appropriate equipment for spreading on agricultural fields." (\$\text{SU} \text{Compendium} > \text{R2} \tex	Reference
moderate (few weeks up to three months) slow (> 3 months) Scalability Performance, Categorical FALSE easy NA Construction_parts PDF, Categorical TRUE simple (simple = 0.8, technical = 0.2, special = The only material you need for the application of Aurin is a watering can. No special spare parts are needed on a small scale. "At a large scale, this liquid fertiliser requires appropriate equipment for spreading on agricultural fields." (SLU Compendium > R.2. Concentrated Urine) For spreading on a first part of the compendium of the special technical equipment might become necessary. Transfer Coefficients Recovered Range Alfoss Soilloss Waterloss Comments TP 0.98 - 0 0.01 Make Manage NA MA NA NA NA NA NA NA NA NA NA	Reference PA
moderate (few weeks up to three months) slow (> 3 months) Scalability Performance, Categorical FALSE easy NA MA	PA -
moderate (few weeks up to three months) slow (> 3 months) Scalability Performance, Categorical FALSE easy MA MA Construction_parts PDF, Categorical TRUE Simple technical special Special Special Special MA NA NA NA NA NA NA NA NA NA	PA - PA
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moderate (few weeks up to three months) slow (> 3 months)	PA PA - PA - ue to nitrification* PA PA
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moderate (few weeks up to three months) slow (> 3 months) s	PA
moderate (few weeks up to three months) slow (> 3 months) sl	PA

References

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Liu., J. et al. (2018). "Sanitation Systems and guidelines related to winter manure application." Ambio 47(6): 657-670.

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pplication of Struvite or Drie	d Hring	Applciation of Struvite or Dried Urine				
	Values	Data Source				
FUNCTIONAL GROUP JNIQUE IDENTIFIER (ID)	application_struvite_driedurine	-				
DATA COMPILER	SaniChoice Project Team struvite, transportedstruvite,	- Spuhler, D. et al. (2021)				
	dried_urine, transporteddried_urine					
OUTPUT PRODUCT RELATIONS	Input: OR	Spuhler, D. et al. (2021) Spuhler, D. et al. (2021)				
COMMENTS	Output: NA					
ter Criteria	Values	Data Source				
applicability_level	(household = 0.5, neighbourhood = 1, city = 1)	McConville, J. et al. (2020)				
management_level		McConville, J. et al. (2020)				
capex_req_level		Spuhler, D. et al. (2021)				
opex_req_level technical_maturity		Spuhler, D. et al. (2021) McConville, J. et al. (2020)				
	(acute = 0, stabilisation = 0,	Same values allotted as treatment				
	development/recovery = 1)	technology struvite precipitation (Akanksha Jain)				
ning Criteria	Type and Function	Applicable for this Functional Group?	Categories [Linit]	Technology Values (Data)	Data Source / Assumptions	Internal Review Done?
water_supply	Performance, Categorical		house	NA	NA NA	NA NA
			yard public			
water_volume	Performance, Trapez	FAISE	none [L/cap/day]	NA	NA	NA
electricity_supply	Performance, Categorical		electricity	(electricity = 1, intermittent = 1, no elec	No electricity needed. (Senecal-Smith,	INA.
			intermittent no electricity		J. 2021)	
fuel_supply	Performance, Categorical	FALSE	fuel	NA	NA	NA
frequency_of_om	PDF, Categorical	TRUE	no fuel irregular	(irregular = 1, regular = 0, continous =	"As fertiliser is applied only one or	yes
			regular continuous	0)	twice in a growing season, storage of the dry urine is a given, and thus	
					storage as a treatment is an ideal	
					option." (Dry Urine SLU Compendium)	
					"Can be stored in a compact form and	
					is easy to handle, transport and apply, especially in a granulated form."	
					(Struvite SLU Compendium)	
					Struvite and dried urine can be stored easily and only require irregular use as	
pipe_supply	Performance, Categorical	TRUE	no pipes	(no pipes = 1, difficultly available = 1,	fertiliser. No pipes needed. (Senecal-Smith, J.	yes
			difficultly available pipes	pipes = 1	2021)	
pump_supply	Performance, Categorical	TRUE	no pumps		No pumps needed. (Senecal-Smith, J.	yes
			difficultly available pumps	pumps = 1)	2021)	
concrete_supply	Performance, Categorical	TRUE	no concrete difficultly available	(no concrete = 1, difficultly available = 1, concrete = 1)	No concrete needed. (Senecal-Smith, J. 2021)	yes
			concrete			
spare_parts	PDF, Categorical	TRUE	simple technical	(simple = 1, technical = 0, special = 0)	"Can be stored in a compact form and is easy to handle, transport and apply,	yes
			special		especially in a granulated form."	
					(Struvite SLU Compendium) "Stable, so can be stockpiled/stored.",	
					"Dry urine is a powder that can be	
					applied using a mechanical spreader, but it can also be pelletised and	
					applied with conventional farming	
					equipment." (Dry Urine SLU Compendium)	
					Application as dry fertiliser does not require any additional technical or	
					special parts.	
0		FALSE FALSE		NA NA	NA NA	NA NA
0 temperature		FALSE		NA (very cold = 0.5, cold = 0.7, temperate =	NA "There is no doubt that land	NA yes
temperature	. enormance, categorical		cold	, cola – 0.3, cola – 0.7, temperate =	application of manure to frozen or	,
			temperate warm		cold and wet ground has potential to exacerbate nutrient loss in runoff. The	
			hot		absence, or poor growth of crops	
					(limiting uptake of manure nutrients and water), winter weather, and	
					winter soil conditions generally	
					exacerbate off-site losses of manure- derived pollutants." (Liu et al. (2018))	
					The application of struvite is still	
					possible in cold temperatures but the soil will not be able to absorb all of the	
					nutritients and they would be washed away to surface waters or to the	
					groundwater.	
flooding	Performance, Categorical	TRUE	flooding	(flooding = 0.9, no flooding = 1)	All technologies associated with	yes
ounig	and the second second		no flooding		"Application of a certain product" are	
					awarded performance values in accordance with each other.	
					Generally, these products are aimed	
					to be safe for use, however, they do carry a "low risk of pathogen	
					transmission" (Compendium). In the	
					event of flooding, surrounding areas of where these products are applied	
					therefore bear some risk. Also, the social acceptance of these products	
					can be low and people would not	
					prefer flood waters to spread these products everywhere. Hence, their	
					performance is reduced by 10% or	
					20% depending on the relative risk of pollution between different products	
					(e.g., stabilized sludge riskier than	
					stored urine). (Akanksha Jain). Struvite is considered to be quite a	
					safe product therefore allotted a performance of 90%.	
		FALCE		ALA.		NA.
vehicular_acces	Performance, Categorical	FALSE	no access difficult	NA	NA	NA
slope	Performance, Categorical	FALSE	full	NA	NA .	NA
			not flat			
soil_type	Performance, Categorical	IKUE	clay silt	(clay = 1, silt = 1, sand = 1, gravel = 1, ro	NOT affected by soil type.	yes
			sand gravel			
			rock			

groundwater_depth	Performance, Trapez	TRUE	water depth [m]	(a = 0, b = 0, c = 999, d = 999)	Not affected by groundwater table, however, product should be sterile before application. (Senecal-Smith, J.	yes	
excavation	Performance, Categorical	TRUE	easy	(easy = 1, hard = 1)	2021) No need for excavation.	yes	
surface_area_onsite	Performance, Trapez	FALSE	hard [m2/plot]	NA	NA	NA	
	Performance, Trapez						
surface_area_offsite 0	0	FALSE	m2/pers	NA NA	NA NA	NA NA	
0		FALSE FALSE		NA NA	NA NA	NA NA	
drinking_water_exposure	Performance, Categorical	TRUE	Close Not close	(close = 1, not close = 1)	'Struvite formation may be coupled with precipitation of other constituents present in urine and wastewater, such as pathogens and heavy metals. However, the concentrations of these constituents, especially those of heavy metals, are generally below the permissible limits in the precipitated product, particularly if the struvite is precipitated directly from source-sparated urine. If the struvite is precipitated from other, more contaminated sources (e.g., blackwater or reject water), heavy	yes	
0		FALSE		NA NA		NA NA	
0		FALSE		NA	NA	NA	
construction_skills	Performance, Categorical		Ladder: unskilled skilled professional	(unskilled = 1, skilled = 1, professional = 1)	No construction needed.	yes	
design_skills	Performance, Categorical	TRUE	Ladder: unskilled skilled professional	(unskilled = 0.5, skilled = 1, professional = 1)	Very basic knowledge needed to know how much struvite to apply as fertilizer.	yes	
om_skills	Performance, Categorical	TRUE	Ladder: Unskilled Skilled Professional	(unskilled = 1, skilled = 1, professional = 1)	No specific skills needed.	yes	
0		FALSE FALSE	(NA NA	NA NA	NA NA	
0	0	FALSE	(NA	NA	NA	
0 cleansing_method		FALSE		NA NA	NA	NA	
		IFΔISE	Washers	NΔ		NΔ	
	Performance, Categorical	FALSE	Washers Soft wipers	NA	NA	NA	
0	0	FALSE	Soft wipers Hard wipers	NA	NA NA	NA	
0 0 lifetime	0	FALSE FALSE	Soft wipers Hard wipers		NA		
0	0	FALSE FALSE TRUE	Soft wipers Hard wipers (short (< 1 year) medium (1-5 years)	NA NA	NA NA NA The concept of applying struvite as fertiliser does not have a lifetime and can therefore be used at anytime.	NA NA	
0 lifetime	0 0 Performance, Categorical	FALSE FALSE FALSE	Soft wipers Hard wipers (short (< 1 year) medlum (1:5 years) long (>5 years) rapid (< 3 days) moderate (3 days to 2 weeks) slow(> 2 weeks) rapid (few days to a week) moderate (few weeks up to three months)	NA NA (short = 1, medium = 1, long = 1)	NA NA The concept of applying struvite as fertiliser does not have a lifetime and can therefore be used at anytime. (Kukka Ilmanen, Eawag 2021)	NA NA yes	
0 lifetime speed_implement_toilet	Performance, Categorical PDF, Categorical	FALSE FALSE FALSE FALSE	Soft wipers Hard wipers (short (< 1 year) medium (1-5 years) long (>5 years) rapid (< 3 days) moderate (3 days to 2 weeks) slow (> 2 weeks) rapid (few days to a week) moderate (few weeks up to three months) slow (> 3 months) easy	NA NA (short = 1, medium = 1, long = 1) NA	NA NA The concept of applying struvite as fertiliser does not have a lifetime and can therefore be used at anytime. (Kukka Ilmanen, Eawag 2021) NA	NA NA Ves	
Speed_implement_toilet speed_implement_treatment scalability construction_parts	Performance, Categorical PDF, Categorical PDF, Categorical PDF, Categorical PDF, Categorical	FALSE FALSE FALSE FALSE TRUE FALSE TRUE	Soft wipers Hard wipers (short (< 1 year) medium (1-5 years) long (>5 years) rapid (< 3 days) moderate (3 days to 2 weeks) slow (> 2 weeks) rapid (few days to a week) moderate (few weeks up to three months) slow (> 3 months)	NA NA (Short = 1, medium = 1, long = 1) NA	NA NA The concept of applying struvite as fertiliser does not have a lifetime and can therefore be used at anytime. (Kukka limanen, Eawag 2021) NA NA	NA NA Yes NA NA NA NA NA NA	
o lifetime speed_implement_toilet speed_implement_treatment scalability construction_parts	PDF, Categorical PDF, Categorical PDF, Categorical PDF, Categorical PDF, Categorical PDF, Categorical	FALSE FALSE FALSE FALSE TRUE FALSE FALSE FALSE TRUE	Soft wipers Hard wipers (short (< 1 year) medium (1-5 years) long (>5 years) rapid (< 3 days) moderate (3 days to 2 weeks) slow (> 2 weeks) rapid (few days to a week) moderate (few weeks up to three months) easy difficult simple technical special	NA NA (short = 1, medium = 1, long = 1) NA NA NA NA (simple = 1, technical = 0, special = 0)	NA NA The concept of applying struvite as fertiliser does not have a lifetime and can therefore be used at anytime. (Kukka Ilmanen, Eawag 2021) NA NA NA "Can be stored in a compact form and is easy to handle, transport and apply, especially in a granulated form. Slow-release fertiliser that provides plants with nutrients without the risk of burning the roots." (R7. Struvite - SLU Compendium) "Dry urine is a powder that can be applied using a mechanical spreader, but it can also be pelletised and applied with conventional farming equipment." (Dry Urine SLU Compendium) The application of struvite and dried urine does not require any technical or special parts.	NA NA Yes	Reference
O lifetime speed_implement_toilet speed_implement_treatment construction_parts construction_parts	Performance, Categorical PDF, Categorical PDF, Categorical PDF, Categorical PDF, Categorical PDF, Categorical	FALSE FALSE TRUE FALSE FALSE FALSE TRUE Range	Soft wipers Hard wipers (short (< 1 year) medium (1-5 years) long (>5 years) rapid (< 3 days) moderate (3 days to 2 weeks) slow (> 2 weeks) slow (> 2 weeks) rapid (few days to a week) moderate (few weeks up to three months) easy difficult simple technical special	NA NA (Short = 1, medium = 1, long = 1) NA NA NA NA NA Simple = 1, technical = 0, special = 0)	NA NA The concept of applying struvite as fertiliser does not have a lifetime and can therefore be used at anytime. (Kukka Ilmanen, Eawag 2021) NA NA NA TCan be stored in a compact form and is easy to handle, transport and apply, especially in a granulated form. Slow-release fertiliser that provides plants with nutrients without the risk of burning the roots." (R7. Struvite - SU Compendium) Toy urine is a powder that can be applied using a mechanical spreader, but t can also be pelietied and applied with conventional farming equipment." (Dry Urine SLU Compendium) The application of struvite and dried urine does not require any technical or special parts. Waterloss	NA NA NA NA NA NA NA Comments	Reference (Seneral-Smith, J. 2021)
o lifetime speed_implement_toilet speed_implement_treatment scalability construction_parts Transfer Coefficients	Performance, Categorical PDF, Categorical PDF, Categorical PDF, Categorical PDF, Categorical PDF, Categorical	FALSE FALSE FALSE TRUE FALSE FALSE FALSE TRUE FALSE	Soft wipers Hard wipers (short (< 1 year) medium (1-5 years) long (>5 years) rapid (< 3 davs) moderate (3 days to 2 weeks) slow (>2 weeks) rapid (few days to a week) moderate (few days to a week) solow (>3 moderate (few days to a seek) pasy difficult simple technical special	NA NA (Short = 1, medium = 1, long = 1) NA NA NA NA NA Simple = 1, technical = 0, special = 0)	NA NA The concept of applying struvite as fertiliser does not have a lifetime and can therefore be used at anytime. (Kukka Ilmanen, Eawag 2021) NA NA NA TCan be stored in a compact form and is easy to handle, transport and apply, especially in a granulated form. Slow-release fertiliser that provides plants with nutrients without the risk of burning the roots." (R7. Struvite - SU Compendium) Toy urine is a powder that can be applied using a mechanical spreader, but t can also be pelietied and applied with conventional farming equipment." (Dry Urine SLU Compendium) The application of struvite and dried urine does not require any technical or special parts. Waterloss	NA NA NA NA NA NA NA Comments	
Speed_implement_toilet speed_implement_treatment scalability construction_parts Transfer Coefficients TP med (R) R	Performance, Categorical PDF, Categorical PDF, Categorical PDF, Categorical PDF, Categorical PDF, Categorical PDF, Categorical PDF, Categorical PDF, Categorical	FALSE FALSE FALSE TRUE FALSE FALSE FALSE TRUE	Soft wipers Hard wipers (short (< 1 year) medium (1-5 years) long (>5 years) rapid (< 3 days) moderate (3 days) to 2 weeks) slow (> 2 weeks) rapid (few days to a week) moderate (few days to a week) moderate (few days to a week) slow (> 3 months) easy difficult simple technical special	NA NA (Short = 1, medium = 1, long = 1) NA NA (simple = 1, technical = 0, special = 0) Soilloss	NA NA The concept of applying struvite as fertiliser does not have a lifetime and can therefore be used at anytime. (Kukka Ilmanen, Eawag 2021) NA NA NA NA Can be stored in a compact form and is easy to handle, transport and apply, especially in a granulated form. Slow-release fertiliser that provides plants with nutrients without the risk of burning the roots." (R7. Struvite - SLU Compendium) "Dry urine is a powder that can be applied using a mechanical spreader, but it can also be pelletised and applied with conventional farming equipment." (Dry Urine SLU Compendium) The application of struvite and dried urine does not require any technical or special parts. Waterloss	NA NA NA NA NA NA NA Comments	(Senecal-Smith, J. 2021)
Speed_implement_toilet speed_implement_treatment scalability construction_parts Transfer Coefficients TP med (R) TN med (R)	Performance, Categorical PDF, Categorical PDF, Categorical PDF, Categorical PDF, Categorical PDF, Categorical PDF, Categorical PDF, Categorical PDF, Categorical PDF, Categorical	FALSE FALSE FALSE TRUE FALSE FALSE FALSE	Soft wipers Hard wipers (short (< 1 year) medium (1-5 years) long (>5 years) rapid (< 3 days) moderate (3 days) to a week) slow (> 2 weeks) rapid (few days to a week) moderate (few days to a week) moderate (few days to a seek) moderate (few days to a seek) slow (> 3 months) easy difficult simple technical special	NA NA (Short = 1, medium = 1, long = 1) NA NA (Simple = 1, technical = 0, special = 0) Soilloss	NA NA The concept of applying struvite as fertiliser does not have a lifetime and can therefore be used at anytime. (Kukka Ilmanen, Eawag 2021) NA NA "Can be stored in a compact form and is easy to handle, transport and apply, especially in a granulated form. Slow-release fertiliser that provides plants with nutrients without the risk of burning the roots." (R7. Struvite - SLU Compendium) "Dry urine is a powder that can be applied using a mechanical spreader, but it can also be pelletised and applied with conventional farming equipment." (Dry Urine SLU Compendium) The application of struvite and dried urine does not require any technical or special parts. Waterloss	NA NA NA NA NA NA NA NA NA NA NA NA NA N	(Senecal-Smith, J. 2021) PA (Senecal-Smith, J. 2021) PA
Speed_implement_toilet speed_implement_treatment scalability construction_parts Transfer Coefficients TP med (R) In med (R) med (R)	Performance, Categorical PDF, Categorical PDF, Categorical PDF, Categorical PDF, Categorical PDF, Categorical PDF, Categorical PDF, Categorical PDF, Categorical Open Tommune, Categorical PDF, Categorical Open Tommune, Categori	FALSE FALSE FALSE FALSE FALSE FALSE	Soft wipers Hard wipers (short (< 1 year) medium (1-5 years) long (>5 years) rapid (< 3 days) moderate (3 days) to 2 weeks) slow (> 2 weeks) rapid (few days to a week) moderate (few days to a week) moderate (few days to a week) slow (> 3 months) easy difficult simple technical special	NA NA (short = 1, medium = 1, long = 1) NA NA NA (simple = 1, technical = 0, special = 0) Soilloss C C C C C C C C C C C C C C C C C C	NA NA The concept of applying struvite as fertiliser does not have a lifetime and can therefore be used at anytime. (Kukka Ilmanen, Eawag 2021) NA NA NA "Can be stored in a compact form and is easy to handle, transport and apply, especially in a granulated form. Slow-release fertiliser that provides plants with nutrients without the risk of burning the rocks." (R.P. Struvite - SLU Compendium) "Ory urine is a powder that can be applied using a mechanical spreader, but it can also be pelletised and applied with conventional farming equipment." (Dry Urine I SLU Compendium) The application of struvite and dried urine does not require any technical or special parts. Waterloss	NA NA NA Yes NA NA NA Comments	(Senecal-Smith, J. 2021) - PA (Senecal-Smith, J. 2021) -
Speed_implement_toilet speed_implement_treatment scalability construction_parts Transfer Coefficients TP med (R) RADO med (R)	Performance, Categorical PDF, Categorical PDF, Categorical PDF, Categorical PDF, Categorical PDF, Categorical PDF, Categorical PDF, Categorical PDF, Categorical OBJECT OF CATEGORICA (CATEGORICA) PDF, Categorical OBJECT OF CATEGORICA (CATEGORICA) OBJECT OF CATEGORICA OBJECT OF CATEGORICA (CATEGORICA) OBJECT OF CATEGORICA (CATEGORICA) OBJECT OF CATEGORICA (CATEGORICA) OBJECT OF CATEGORICA (CATEGORICA) OBJECT OF CATEGORICA (CATEGORICA) OBJECT OF CATEGO	FALSE FALSE FALSE FALSE FALSE FALSE FALSE	Soft wipers Hard wipers (short (< 1 year) medium (1-5 years) (ong (>5 years) long (>5 years) rapid (< 3 davys) moderate (3 days to 2 weeks) slow (>2 weeks) rapid (few days to 3 week) rapid (few days to 3 week) slow (>3 moderate (few days to 3 in the days) slow (>3 moderate (few days to 3 week) rapid (few days to 3 week) slow (>3 moderate (few days to 3 week) slow (>3 moderate (few days to 3 week) slow (>4 moderate (few days to 3 week) slow (>5 moderate (few days to 3 week) slow (>5 moderate (few days to 3 week) slow (>6 moderate (few days to 3 week) slow (>6 moderate (few days to 3 week) slow (>6 moderate (few days to 3 week) slow (>6 moderate (few days to 3 week) slow (>6 moderate (few days to 3 week) slow (>7 moderate (few days to 3 week) slow (NA NA (Short = 1, medium = 1, long = 1) NA NA NA (Simple = 1, technical = 0, special = 0) Soilloss	NA NA The concept of applying struvite as fertiliser does not have a lifetime and can therefore be used at anytime. (Kukka Ilmanen, Eawag 2021) NA NA NA "Can be stored in a compact form and is easy to handle, transport and apply, sepcially in a graulated form. Slow-release fertiliser that provides plants with nutrients without the risk of burning the rocks." (R.P. Struvite – SLU Compendium) 'Tory urine is a powder that can be applied using a mechanical spreader, but it can also be pleitised and applied with conventional farming equipment." (By Uriner I SLU Compendium) The application of struvite and dried urine does not require any technical or special parts. Waterloss	NA NA NA Yes Comments	(Senecal-Smith, J. 2021) - PA (Senecal-Smith, J. 2021) - PA (Senecal-Smith, J. 2021) - PA (Senecal-Smith, J. 2021) - PA
Speed_implement_toilet speed_implement_treatment scalability construction_parts Transfer Coefficients TP med (R) k TN med (R) f BDO med (R) f TS med (R)	Performance, Categorical PDF, Categorical PDF, Categorical PDF, Categorical PDF, Categorical PDF, Categorical PDF, Categorical PDF, Categorical PDF, Categorical OSC OSC OSC OSC OSC OSC OSC OS	FALSE FALSE FALSE FALSE TRUE FALSE FALSE FALSE	Soft wipers Hard wipers (short (< 1 year) medium (1-5 years) long (>5 years) rapid (< 3 days) moderate (3 days to 2 weeks) slow (>2 weeks) rapid (few days to 3 week) moderate few weeks up to three months) slow (>3 months) easy difficult simple technical special	NA NA (Short = 1, medium = 1, long = 1) NA NA NA NA NA Soliloss C C C C C C C C C C C C C C C C C C	NA NA The concept of applying struvite as fertiliser does not have a lifetime and can therefore be used at anytime. (Kukka Ilmanen, Eawag 2021) NA NA NA YCan be stored in a compact form and is easy to handle, transport and apply, especially in a granulated form. Slow-release fertiliser that provides plants with nutrients without the risk of burning the roots. (R7. Struvite - SU Compendium) Toyr urine is a powder that can be applied using a mechanical spreader, but it can also be pelietised and applied with conventional farming equipment." (Dry Urine SLU Compendium) The application of struvite and dried urine does not require any technical or special parts. Waterloss	NA NA NA NA NA NA NA NA NA NA NA NA NA N	(Senecal-Smith, J. 2021)
Speed_implement_toilet speed_implement_treatment scalability construction_parts Transfer Coefficients TP med (R) med (R) # #20 med (R)	Performance, Categorical PDF, Categorical PDF, Categorical PDF, Categorical PDF, Categorical PDF, Categorical PDF, Categorical PDF, Categorical PDF, Categorical OSC OSC OSC OSC OSC OSC OSC OS	FALSE FALSE FALSE FALSE TRUE FALSE FALSE FALSE	Soft wipers Hard wipers (short (< 1 year) medium (1-5 years) long (>5 years) rapid (< 3 days) moderate (3 days to 2 weeks) slow (> 2 weeks) rapid (few days to a week) moderate (few weeks up to three months) easy difficult simple technical special	NA NA (Short = 1, medium = 1, long = 1) NA NA NA NA NA Soliloss C C C C C C C C C C C C C C C C C C	NA NA The concept of applying struvite as fertiliser does not have a lifetime and can therefore be used at anytime. (Kukka Ilmanen, Eawag 2021) NA NA NA YCan be stored in a compact form and is easy to handle, transport and apply, especially in a granulated form. Slow-release fertiliser that provides plants with nutrients without the risk of burning the roots. (R7. Struvite - SU Compendium) Toyr urine is a powder that can be applied using a mechanical spreader, but it can also be pelietised and applied with conventional farming equipment." (Dry Urine SLU Compendium) The application of struvite and dried urine does not require any technical or special parts. Waterloss	NA NA NA NA NA NA NA NA NA NA NA NA NA N	(Senecal-Smith, J. 2021) - PA (Senecal-Smith, J. 2021) - PA (Senecal-Smith, J. 2021) - PA (Senecal-Smith, J. 2021) - PA

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pplication of Dried Faeces	Values	Application of Dried Faeces Data Source					
FUNCTIONAL GROUP	D						
	application_of_dried_faeces Matthias van Sloten	-	-				
	dried_faeces, transporteddried_faeces	Spuhler, D. & Roller, L. (2020)					
OUTPUT PRODUCT	NA	Spuhler, D. & Roller, L. (2020)					
RELATIONS	Input: OR	Spuhler, D. & Roller, L. (2020)					
COMMENTS	Output: NA						
re-Filter Criteria	Values	Data Source	T				
applicability_level	(household = 1, neighbourhood = 0.5, city = 0)	Tilley, E. et al. (2014)					
management_level	(household = 1, shared = 1, public =	Tilley, E. et al. (2014)	1				
capex_req_level	0.5)	Spuhler, D. et al. (2021)					
opex_req_level	4	Spuhler, D. et al. (2021)					
technical_maturity	(acute = 0, stabilisation = 0.5,	McConville, J. et al. (2020) Gensch, R. et al. (2018)					
	development/recovery = 1)						
reening Criteria water_supply	Type and Function Performance, Categorical	Applicable for this Functional Group?	Categories [Unit] house	Technology Values (Data) NA	Data Source / Assumptions NA	Internal Review Done? NA	
	renomance, categorica		yard public none				
water_volume	Performance, Trapez	FALSE	[L/cap/day] electricity	NA (electricity = 1 intermittent = 1 no ele		NA	
electricity_supply	Performance, Categorical		intermittent	(electricity = 1, intermittent = 1, no ele	no electricity needed.	yes	
fuel_supply	Performance, Categorical	FALSE	no electricity fuel	NA	NA .	NA	
			no fuel				
frequency_of_om	PDF, Categorical	TRUE	irregular	(irregular = 1, regular = 0, continous = 0)	Dried faeces usually are applicated before planting crops. So there is a lot of work in a short time but then	yes	
			regular continuous	o,	crops. So there is a lot of work in a short time but then no regular operation or maintenance is required. Application is similar to the application of compost.		
pipe_supply	Performance, Categorical	TRUE	difficultly available	(no pipes = 1, difficultly available = 1, pipes = 1	No pipes needed.	yes	
pump_supply	Performance, Categorical	TRUE	pipes no pumps difficultly available	(no pumps = 1, difficultly available = 1, pumps = 1)	No pumps needed.	yes	
concrete_supply	Performance, Categorical	TRUE	pumps no concrete difficultly available	(no concrete = 1, difficultly available = 1, concrete = 1)	No concrete needed.	yes	
spare_parts	PDF, Categorical	TRUE	concrete simple technical special	(simple = 1, technical = 0, special = 0)	Since there is no need for technical or special material or tools for the application there is no need for technical or special spare parts. Application is similar to the application of compost: "Materials required for Application of Pit Humus and include wheelbarrows, showels, spades, rakes, and pinclude wheelbarrows, showels, spades, rakes, and personal protective equipment (PPE). For cultivating land where compost or pit humus has been applied other gardening tools such as hoes, watering cans, seeds, etc. are required." (Emersan > D.3 Application	yes	
0		FALSE FALSE			of Pit Humus and Compost) NA	NA NA	
0 temperature		FALSE		NA (very cold = 0.5, cold = 0.7, temperate	NA	NA yes	
Competition	Tomana, casgaran		cold cold temperate warm hot	100,000 00,000	frozen or cold and wet ground has potential to exacerbate nutrient loss in runoff. The absence, or poor growth of roos [limiting uptake of manure nutrients and water), winter weather, and winter soil conditions generally exacerbate off-site losses of manure-derived pollutants." (Liu et al. (2018)) The application of dried faces is still possible on cold temperatures but the soil will not be able to absorb the nutritients and they would be washed away to surface waters or to the groundwater.	1-0	
flooding	Performance, Categorical	TRUE	flooding no flooding	(flooding = 0.9, no flooding = 1)		yes	
vehicular_acces	Performance, Categorical	FALSE	no access difficult	NA	NA	NA	
			full				
slope	Performance, Categorical	FALSE	flat not flat	NA	NA	NA	
soil_type	Performance, Categorical	TRUE	clay silt sand gravel	(clay = 1, silt = 1, sand = 1, gravel = 1, n	The application is not based on soil absorption. No difference between different soil types. Dried faeces can be brought on the field on every type of soil.	yes	
groundwater_depth	Performance, Trapez	TRUE	rock water depth [m]	(a = 0, b = 0, c = 999, d = 999)	Not affected by groundwater table. However, it should be assured, that the dried faeces are sterile and safe	yes	
excavation	Performance, Categorical	TRUE	easy	(easy = 1, hard = 1)	for application. No need for excavation.	yes	
			hard				
surface_area_onsite	Performance, Trapez	FALSE	[m2/plot]	NA	NA	NA	
surface_area_offsite	Performance, Trapez			NA		NA	
0	0	FALSE	0	NA		NA	
0		FALSE FALSE		NA NA		NA NA	
drinking_water_exposure	Performance, Categorical	TRUE	Close Not close	(close = 1, not close = 1)	"It is generally accepted that faeces should be stored between 6 to 24 months, although patheges may still exist after this time (refer to WHO guidelines for specific guidance)." (Compendium) Because there is a remaining risk of contamination you should make safe that it is sterile before you applicate compost made of human excrements close to a drinking water source.	yes	
0		FALSE FALSE		NA NA	NA	NA NA	
construction_skills	Performance, Categorical	TRUE		(unskilled = 1, skilled = 1, professional	No construction needed.	yes	
construction_skills	Performance, Categorical	TRUE	Ladder: unskilled skilled	= 1)	No construction needed.	yes	

design_skills	Performance, Categorical	TRUE	Ladder: unskilled skilled professional	(unskilled = 0, skilled = 0.5, professional = 1)	"C should be stored for 1.5 to 2 years before being used at the household or regional level. At higher temperatures (i.e., >20" C average), storage over 1 year is recommended to inactivate Ascaris eggs (a type of parasitic worm). A shorter storage time of 6 months is required if the faeces have a ph above 9 (i.e., adding ash or lime increases the ph). WhO guidelines concerning the use of excreta in agriculture should be consulted beforehad." (Compendium) "If water or urine is mixed with the drying faeces, however, odours and organisms may become problematic because bacteria easily survive and multiply in wet faeces. Warm, moist environments are conducive to anaerobic processes, which can generate offensive odours. Dehydrated faeces should not be applied to crope less than one month before they are harvested. This waiting period is especially important for crops that are consumed raw." (Compendium) Some important considerations have to be done. Therefore high design skills are recommended.	yes	
om_skills	Performance, Categorical	TRUE	Ladder: Unskilled Skilled Professional	(unskilled = 0.5, skilled = 1, professional = 1)	Requires consideration of health aspects! "When removing dehydrated faeces from dehydration vaults, care must be taken to prevent the powder from blowing and being inhaled. Workers should were appropriate protective of	yes	
0	0	FALSE	0	NA NA	NA	NA	
0	0	FALSE	0	NA NA	NA	NA	1
0		FALSE				NA	1
0		FALSE		NA NA		NA	1
cleansing_method	Performance, Categorical		Washers Soft wipers Hard wipers	NA .		NA	
0		FALSE FALSE		NA NA		NA NA	1
lifetime	Performance, Categorical	TRUE	short (< 1 year) medium (1-5 years) long (>5 years)	(short = 1, medium = 1, long = 1)	"The degree of pathogen inactivation will depend on the temperature, the pH (ash or lime addition raises the pH and inactivates pathogens) and the storage time. It is generally recommended that faces should be stored and dehydrated for between 6 to 24 months, although pathogens can remain viable even after this	yes	
					time." (Dried Faeces SLU Compendium) The concept of applying dried faeces does not have a lifetime and can therefore be used at anytime. The storage and drying of faeces itself takes place in technologies in the functional groups FG S or FG T. Therefore that a too short storage time might add pathogens into the soil and the technology might therefore not be the best short-term solution, is not considered here. (Kukka Ilmanen, Eawag 2021)		
speed_implement_toilet	PDF, Categorical		rapid (< 3 days) moderate (3 days to 2 weeks) slow (> 2 weeks)	NA		NA	
speed_implement_treatment	PDF, Categorical		rapid (few days to a week) moderate (few weeks up to three months) slow (> 3 months)	NA		NA	
scalability	Performance, Categorical	FALSE	easy difficult	NA	NA	NA	
construction_parts	PDF, Categorical	TRUE	difficult simple technical special	(simple = 1, technical = 0, special = 0)	"The Application of Dried Faeces requires wheelbarrows, shovels, spades, rakes, and personal protective equipment (PPE). For cultivating the land where dried faeces have been applied other gardening tools may be required. Dried faeces can be stored and transported in used containers or bags." (Emersan)	yes	
Transfer Coefficients	(copied from "Sanitation_Technologies_TC_database_20210	(622.xism")					
		Range	Airloss				Reference
TP	0.98	-	0	0.01		than incorporation into soil	Dunigan and Dick (1980)
med (R)	0.98		0	0.01	1 0.01		-
k	100						PA
TN			0.04			* higher losses with surface application	Dunigan and Dick (1980)
med (R)	0.94 100		0.04	0.01	1 0.01		PA
H2O	0.98		. 0	0.01	1 0.01		EJ EJ
med (R)	0.98						-
k	100		i i i i i i i i i i i i i i i i i i i				PA
TS	0.69	-	C	0.3	3 0.01	Effects are comparable to processed	Lima et al. (2009)
		ļ				sludge application	1
med (R)	0.69		0	0.30	0.01		-
med (R)	0.69 5	-		0.30	0 0.01		PA

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Application of Compost and B	Biochar Values	Data Source				
FUNCTIONAL GROUP	D					
UNIQUE IDENTIFIER (ID)	application_of_compost_biochar Matthias van Sloten	-				
	compost, transportedcompost,	Spuhler, D. & Roller, L. (2020)				
	pithumus, transportedpithumus,					
	biochar, transportedbiochar, ash, transportedash					
OUTPUT PRODUCT	NA NA	Spuhler, D. & Roller, L. (2020)				
RELATIONS		Spuhler, D. & Roller, L. (2020)				
COMMENTS	Output: NA					
e-Filter Criteria	Values	Data Source	L			
applicability_level	(household = 1, neighbourhood = 1,	Tilley, E. et al. (2014)				
management level	city = 0.5) (household = 1, shared = 1, public =	Tilley, E. et al. (2014)				
	0.5)					
capex_req_level opex_req_level		Spuhler, D. et al. (2021) Spuhler, D. et al. (2021)				
technical_maturity	3	McConville, J. et al. (2020)				
development_phase	(acute = 0, stabilisation = 0.5,	Gensch, R. et al. (2018)				
reening Criteria	development/recovery = 1) Type and Function	Applicable for this Functional Group?	Categories [Unit]	Technology Values (Data)	Data Source / Assumptions	Internal Review Done?
water_supply	Performance, Categorical		house			NA
			yard public			
			none			
water_volume			[L/cap/day]			NA
electricity_supply	Performance, Categorical	TRUE	electricity intermittent	(electricity = 1, intermittent = 1, no elec	No electricity needed.	yes
			no electricity			
fuel_supply	Performance, Categorical	FALSE	fuel	NA	NA	NA
frequency_of_om	PDF, Categorical	TRUF	no fuel irregular	(irregular = 1, regular = 0, continous =	"The material must be allowed to	yes
arequency_or_om	r Dr, Categorical		regular	0)	adequately mature before being	,
			continuous		removed from the system. Then, it	
					can be used without further treatment." (Compendium)	
pipe_supply	Performance, Categorical	TRUE	no pipes			yes
			difficultly available	pipes = 1)		
pump_supply	Performance, Categorical	TRUE	pipes no pumps	(no pumps = 1, difficultly available = 1,	No pumps needed.	yes
F=b_200bli	ae., caregorical		difficultly available	pumps = 1)		
concrete	Darforman C-4 '	TRUE	pumps		No concrete needed	vec
concrete_supply	Performance, Categorical	INUE	no concrete difficultly available	(no concrete = 1, difficultly available = 1, concrete = 1)	INO CONCrete needed.	yes
			concrete			
spare_parts	PDF, Categorical	TRUE	simple		"Materials required for Application of	yes
			technical special		Pit Humus and Compost are locally available in most situations and	
					include wheelbarrows, shovels,	
					spades, rakes, and personal protective	
					equipment (PPE). For cultivating land where compost or pit humus has been	
					applied other gardening tools such as	
					hoes, watering cans, seeds, etc. are	
					required." (Emersan)	
0	0	FALSE FALSE	0			NA NA
0		FALSE				NA NA
temperature	Performance, Categorical		very cold	(very cold = 0.5, cold = 0.7, temperate =	"There is no doubt that land	yes
			cold temperate		application of manure to frozen or cold and wet ground has potential to	
			warm		exacerbate nutrient loss in runoff. The	
			hot		absence, or poor growth of crops	
					(limiting uptake of manure nutrients and water), winter weather, and	
		l .			winter soil conditions generally	
					exacerbate off-site losses of manure-	
					derived pollutants." (Liu et al. (2018)) The application of compost is still	
					derived pollutants." (Liu et al. (2018)) The application of compost is still possible on cold temperatures but the	
					derived pollutants." (Liu et al. (2018)) The application of compost is still	
					derived pollutants." (Liu et al. (2018)) The application of compost is still possible on cold temperatures but the soil will not be able to absorb the nutritients and they would be washed away to surface waters or to the	
					derived pollutants." (Liu et al. (2018)) The application of compost is still possible on cold temperatures but the soil will not be able to absorb the nutritients and they would be washed	
flooding	Performance, Categorical	TRUE	flooding		derived pollutants." (Liu et al. (2018)) The application of compost is still possible on cold temperatures but the soil will not be able to absorb the nutritients and they would be washed away to surface waters or to the groundwater.	yes
flooding	Performance, Categorical	TRUE	flooding no flooding	(flooding = 0.9, no flooding = 1)	derived pollutants." (Liu et al. (2018)) The application of compost is still possible on cold temperatures but the soil will not be able to absorb the nutritients and they would be washed away to surface waters or to the groundwater. All technologies associated with "Application of a certain product" are	yes
flooding	Performance, Categorical	TRUE		(flooding = 0.9, no flooding = 1)	derived pollutants." (Liu et al. (2018)) The application of compost is still possible on cold temperatures but the soil will not be able to absorb the nutritients and they would be washed away to surface waters or to the groundwater. All technologies associated with "Application of a certain product" are awarded performance values in	yes
flooding	Performance, Categorical	TRUE		(flooding = 0.9, no flooding = 1)	derived pollutants." (Liu et al. (2018)) The application of compost is still possible on cold temperatures but the soil will not be able to absorb the nutritients and they would be washed away to surface waters or to the groundwater. All technologies associated with "Application of a certain product" are awarded performance values in accordance with each other. Generally, these products are aimed	yes
flooding	Performance, Categorical	TRUE		(flooding = 0.9, no flooding = 1)	derived pollutants." (Liu et al. (2018)) The application of compost is still possible on cold temperatures but the soil will not be able to absorb the nutritients and they would be washed away to surface waters or to the groundwater. All technologies associated with "application of a certain product" are awarded performance values in accordance with each other. Generally, these products are aimed to be safe for use, however, they do	yes
flooding	Performance, Categorical	TRUE		(flooding = 0.9, no flooding = 1)	derived pollutants." (Liu et al. (2018)) The application of compost is still possible on cold temperatures but the soil will not be able to absorb the nutritients and they would be washed away to surface waters or to the groundwater. All technologies associated with "Application of a certain product" are awarded performance values in accordance with each other. Generally, these products are aimed	yes
flooding	Performance, Categorical	TRUE		(flooding = 0.9, no flooding = 1)	derived pollutants." (Liu et al. (2018)) The application of compost is still possible on cold temperatures but the soil will not be able to absorb the nutritients and they would be washed away to surface waters or to the groundwater. All technologies associated with "Application of a certain product" are awarded performance values in accordance with each other. Generally, these products are aimed to be safe for use, however, they do carry a "low risk of pathogen transmission" (Compedium). In the event of flooding, surrounding areas	yes
flooding	Performance, Categorical	TRUE		(flooding = 0.9, no flooding = 1)	derived pollutants." (Liu et al. (2018)) The application of compost is still possible on cold temperatures but the soil will not be able to absorb the nutritients and they would be washed away to surface waters or to the groundwater. All technologies associated with "application of a certain product" are awarded performance values in accordance with each other. Generally, these products are aimed to be safe for use, however, they do carry a "low risk of pathogen transmission" (Compendium). In the event of flooding, surrounding areas of where these products are applied	yes
flooding	Performance, Categorical	TRUE		(flooding = 0.9, no flooding = 1)	derived pollutants." (Liu et al. (2018)) The application of compost is still possible on cold temperatures but the soil will not be able to absorb the nutritients and they would be washed away to surface waters or to the groundwater. All technologies associated with "Application of a certain product" are awarded performance values in accordance with each other. Generally, these products are aimed to be safe for use, however, they do carry a "low risk of pathogen transmission" (Compedium). In the event of flooding, surrounding areas	yes
flooding	Performance, Categorical	TRUE		(flooding = 0.9, no flooding = 1)	derived pollutants." (Liu et al. (2018)) The application of compost is still possible on cold temperatures but the soil will not be able to absorb the nutritients and they would be washed away to surface waters or to the groundwater. All technologies associated with "Application of a certain product" are awarded performance values in accordance with each other. Generally, these products are aimed to be safe for use, however, they do carry a "low risk of pathogen transmission" (Compendium). In the event of flooding, surrounding areas of where these products are applied of where these products are applied of where these products are applied of the products are applied of the products are applied of the products are applied of the products are applied the products are applied the products are applied the products are applied to the products are applied the products are applied the products are applied to the produc	yes
flooding	Performance, Categorical	TRUE		(flooding = 0.9, no flooding = 1)	derived pollutants." (Liu et al. (2018)) The application of compost is still possible on cold temperatures but the soil will not be able to absorb the nutritients and they would be washed away to surface waters or to the groundwater. All technologies associated with "Application of a certain product" are awarded performance values in accordance with each other. Generally, these products are aimed to be safe for use, however, they do carry a "low risk of pathogen transmission" (Compendium). In the event of flooding, surrounding areas of where these products are applied therefore bear products can be low and people would not prefer flood waters to spread these	yes
flooding	Performance, Categorical	TRUE		(flooding = 0.9, no flooding = 1)	derived pollutants." (Liu et al. (2018)) The application of compost is still possible on cold temperatures but the soil will not be able to absorb the nutritients and they would be washed away to surface waters or to the groundwater. All technologies associated with "Application of a certain product" are awarded performance values in accordance with each other. Generally, these products are aimed to be safe for use, however, they do carry a "low risk of pathogen transmission" (Compendium). In the event of flooding, surrounding areas of where these products are applied of where these products are applied of where these products are applied of the products are applied of the products are applied of the products are applied of the products are applied the products are applied the products are applied the products are applied to the products are applied the products are applied the products are applied to the produc	yes
flooding	Performance, Categorical	TRUE		(flooding = 0.9, no flooding = 1)	derived pollutants." (Liu et al. (2018)) The application of compost is still possible on cold temperatures but the soil will not be able to absorb the nutritients and they would be washed away to surface waters or to the groundwater. All technologies associated with "Application of a certain product" are awarded performance values in accordance with each other. Generally, these products are aimed to be safe for use, however, they do carry a "low risk of pathogen transmission" (Compendium). In the event of flooding, surrounding areas of where these products are applied therefore bear some risk. Also, the social acceptance of these products can be low and people would not prefer flood waters to spread these products end was the performance is reduced by 10% or 20% depending on the relative risk of	yes
flooding	Performance, Categorical	TRUE		(flooding = 0.9, no flooding = 1)	derived pollutants." (Liu et al. (2018)) The application of compost is still possible on cold temperatures but the soil will not be able to absorb the nutritients and they would be washed away to surface waters or to the groundwater. All technologies associated with "Application of a certain product" are awarded performance values in accordance with each other. Generally, these products are aimed to be safe for use, however, they do carry a "low risk of pathogen transmission" (Compendium). In the event of flooding, surrounding areas of where these products are applied therefore bear some risk. Also, the social acceptance of these products can be low and people would not prefer flood waters to spread these products can be low and people would not prefer flood waters to spread these products everywhere. Hence, their performance is reduced by 10% or 20% depending on the relative risk of pollution between different products	yes
flooding	Performance, Categorical	TRUE		(flooding = 0.9, no flooding = 1)	derived pollutants." (Liu et al. (2018)) The application of compost is still possible on cold temperatures but the soil will not be able to absorb the nutritients and they would be washed away to surface waters or to the groundwater. All technologies associated with "Application of a certain product" are awarded performance values in accordance with each other. Generally, these products are aimed toe salfe for the short work of the product of the control of the cont	yes
flooding	Performance, Categorical	TRUE		(flooding = 0.9, no flooding = 1)	derived pollutants." (Liu et al. (2018)) The application of compost is still possible on cold temperatures but the soil will not be able to absorb the nutritients and they would be washed away to surface waters or to the groundwater. All technologies associated with "application of a certain product" are awarded performance values in accordance with each other. Generally, these products are aimed to be safe for use, however, they do carry a "low risk of pathogen transmission" (Compendium). In the event of flooding, surrounding areas of where these products are applied therefore bear some risk. Also, the social acceptance of these products can be low and people would not prefer flood waters to spread these products everywhere. Hence, their performance is reduced by 10% or 20% depending on the relative risk of pollution between different products (e.g., stabilized sudge risker than stored urine). (Akanksha Jain). Compost is considered to be quite a	yes
flooding	Performance, Categorical	TRUE		(flooding = 0.9, no flooding = 1)	derived pollutants." (Liu et al. (2018)) The application of compost is still possible on cold temperatures but the soil will not be able to absorb the nutritients and they would be washed away to surface waters or to the groundwater. All technologies associated with "Application of a certain product" are awarded performance values in accordance with each other. Generally, these products are aimed toe salfe for the short work of the product of the control of the cont	yes
			no flooding	(flooding = 0.9, no flooding = 1)	derived pollutants." (Liu et al. (2018)) The application of compost is still possible on cold temperatures but the soil will not be able to absorb the nutritions and they would be washed away to surface waters or to the groundwater. All technologies associated with "application of a certain product" are awarded performance values in accordance with each other. Generally, these products are aimed to be safe for use, however, they do carry a "low risk of pathogen transmission" (Compendium). In the event of flooding, surrounding areas of where these products are applied therefore bear some risk. Also, the social acceptance of these products can be low and people would not prefer flood waters to spread these products are products even pr	
flooding			no flooding	(flooding = 0.9, no flooding = 1)	derived pollutants." (Liu et al. (2018)) The application of compost is still possible on cold temperatures but the soil will not be able to absorb the nutritients and they would be washed away to surface waters or to the groundwater. All technologies associated with "application of a certain product" are awarded performance values in accordance with each other. Generally, these products are aimed to be safe for use, however, they do carry a "low risk of pathogen transmission" (Compendium). In the event of flooding, surrounding areas of where these products are applied therefore bear some risk. Also, the social acceptance of these products can be low and people would not prefer flood waters to spread these products are products even p	yes
	Performance, Categorical	FALSE	no flooding	(flooding = 0.9, no flooding = 1)	derived pollutants." (Liu et al. (2018)) The application of compost is still possible on cold temperatures but the soil will not be able to absorb the nutritients and they would be washed away to surface waters or to the groundwater. All technologies associated with "application of a certain product" are awarded performance values in accordance with each other. Generally, these products are aimed to be safe for use, however, they do carry a "low risk of pathogen transmission" (Compendium). In the event of flooding, surrounding areas of where these products are applied therefore bear some risk. Also, the social acceptance of these products can be low and people would not prefer flood waters to spread these products are products even p	
		FALSE	no access difficult full flat	(flooding = 0.9, no flooding = 1)	derived pollutants." (Liu et al. (2018)) The application of compost is still possible on cold temperatures but the soil will not be able to absorb the nutritients and they would be washed away to surface waters or to the groundwater. All technologies associated with "Application of a certain product" are awarded performance values in accordance with each other. Generally, these products are aimed to esafe for use, however, they do carry a "low risk of pathogen transmission" (Compendium). In the event of flooding, surrounding areas of where these products are applied therefore bear some risk. Also, the social acceptance of these products are below and people would not prefer flood waters to spread these products are below and people would not prefer flood waters to spread these products everywhere. Hence, their performance is reduced by 10% or 20% depending on the relative risk of pollution between different products (e.g., stabilized sludge risker than stored urine). (Akanisha Jain). Compost is considered to be quite a safe product therefore allotted a performance of 90%.	
vehicular_acces slope	Performance, Categorical Performance, Categorical	FALSE	no access difficult full flat mot flat	(flooding = 0.9, no flooding = 1) NA	derived pollutants." (Liu et al. (2018)) The application of compost is still possible on cold temperatures but the soil will not be able to absorb the nutritients and they would be washed away to surface waters or to the groundwater. All technologies associated with "Application of a certain product" are awarded performance values in accordance with each other. Generally, these products are aimed to be safe for use, however, they do carry a "low risk of pathogen transmission" (Compendium). In the event of flooding, surrounding areas of where these products are applied of where these products are applied of where these products are applied of where these products are applied of where these products are applied of where these products are products and be low and people would not prefer flood waters to spread these products are products everywhere. Hence, their performance is reduced by 10% or 20% depending on the relative risk of pollution between different products (e.g., stabilized sludge riskier than stored urine). (Akanisha Jain). Compost is considered to be quite a performance of 90%.	NA NA
vehicular_acces	Performance, Categorical Performance, Categorical	FALSE	no access difficult full flat noor flat clay silt	(flooding = 0.9, no flooding = 1)	derived pollutants." (Liu et al. (2018)) The application of compost is still possible on cold temperatures but the soil will not be able to absorb the nutritions and they would be washed away to surface waters or to the groundwater. All technologies associated with "application of a certain product" are awarded performance values in accordance with each other. Generally, these products are aimed to be safe for use, however, they do carry a "low risk of pathogen transmission" (Compendium). In the event of flooding, surrounding areas of where these products are applied therefore bear some risk. Also, the social acceptance of these products or here they product some products are products are products are products are products of the products	NA .
vehicular_acces slope	Performance, Categorical Performance, Categorical	FALSE	no access difficult full flat not flat clay silt sand	(flooding = 0.9, no flooding = 1) NA NA (clay = 1, silt = 1, sand = 1, gravel = 1, ro	derived pollutants." (Liu et al. (2018)) The application of compost is still possible on cold temperatures but the soil will not be able to absorb the nutritients and they would be washed away to surface waters or to the groundwater. All technologies associated with "Application of a certain product" are awarded performance values in accordance with each other. Generally, these products are aimed to be safe for use, however, they do carry a "low risk of pathogen transmission" (Compendium). In the event of flooding, surrounding areas of where these products are applied therefore bear some risk. Also, the social acceptance of these products and be low and people would not prefer flood waters to spread these products everywhere. Hence, their performance is reduced by 10% or 20% depending on the relative risk of pollution between different products (e.g., stabilized studge riskier than stored urine). (Akanisha Jain). Compost is considered to be quite a safe product therefore allotted a performance of 90%. NA The application of compost is not based on soil absorption. No	NA NA
vehicular_acces slope	Performance, Categorical Performance, Categorical	FALSE	no access difficult full flat noor flat clay silt	(flooding = 0.9, no flooding = 1) NA NA (clay = 1, silt = 1, sand = 1, gravel = 1, ro	derived pollutants." (Liu et al. (2018)) The application of compost is still possible on cold temperatures but the soil will not be able to absorb the nutritions and they would be washed away to surface waters or to the groundwater. All technologies associated with "application of a certain product" are awarded performance values in accordance with each other. Generally, these products are aimed to be safe for use, however, they do carry a "low risk of pathogen transmission" (Compendium). In the event of flooding, surrounding areas of where these products are applied therefore bear some risk. Also, the social acceptance of these products or here they product some products are products are products are products are products of the products	NA NA

groundwater_depth	Performance, Trapez	TRUE	water depth [m]	(a = 0, b = 0, c = 999, d = 999)	"The process of thermophilic composting generates heat (50 to 80 °C) which kills the majority of pathogens present." (Compendium) "Pit humus must be allowed to	yes	
					adequately mature before being removed from the system. It can then be used without further treatment." (Emersan) 'A small risk of pathogen transmission exists, but, if in doubt, any material		
					removed from the pit or vault can be further composted in a regular compost heap before being used or mixed with additional soil and put into a 'tree pit', i.e., a nutrient-filled pit		
					used for planting a tree." ((Compendium) Because there is a remaining risk of contamination you should make safe that it is sterile before you applicate compost made of human excrements		
	Derference Catanalist	TOUR		(constant a)	in an area with a high groundwater level.		
excavation surface_area_onsite	Performance, Categorical Performance, Trapez		easy hard [m2/plot]	(easy = 1, hard = 1) NA	No need for excavation. NA	yes NA	
surface_area_offsite	Performance, Trapez		m2/pers	NA	NA	NA	
0		FALSE FALSE		NA NA	NA NA	NA NA	
0 drinking_water_exposure		FALSE		NA (close = 1, not close = 1)	NA "The process of thermophilic	NA yes	
	Comme, dage a		Not close	(100.2.2.3)	composting generates heat (S0 to 80 °C) which kills the majority of pathogens present. (Compendium) "A small risk of pathogen transmission exists, but, if ind doubt, any material removed from the pit or vault can be further composted in a regular compost heap before being used or mixed with additional soil and put into a 'tree pit', i.e., a untrient-filled pit	-	
0		FALSE FALSE		NA NA	used for planting a tree." (Compendium) Because there is a remaining risk of contamination you should make safe that it is strelle before you applicate compost made of human excrements close to a drinking water source. NA NA	NA NA	
construction_skills	Performance, Categorical		Ladder:	(unskilled = 1, skilled = 1, professional	No construction needed.	yes	
			unskilled skilled	= 1)			
design_skills	Performance, Categorical	TRUE	professional Ladder:	(unskilled = 0, skilled = 0.5,	"Compost and pit humus should not	yes	
			unskilled skilled professional	professional = 1)	be applied to crops less than one month before they are harvested." (Compendium) Requires consideration of health aspects!		
om_skills	Performance, Categorical		Ladder: Unskilled Skilled Professional	(unskilled = 1, skilled = 1, professional = 1)	No OM skills required.	yes	
0		FALSE FALSE		NA NA	NA NA	NA NA	
0	0	FALSE FALSE	C	NA NA	NA NA	NA NA	
cleansing_method	Performance, Categorical		Washers Soft wipers Hard wipers	NA NA	NA NA	NA NA	
0 lifetime		FALSE		NA (short = 1, medium = 1, long = 0.5)	NA The concept of applying compost does not have a lifetime and can therefore be used at anytime. (Kukka Ilmanen, Eawag 2021)	NA	
speed_implement_toilet	PDF, Categorical	FALSE	rapid (< 3 days) moderate (3 days to 2 weeks)	NA	NA	NA	
speed_implement_treatment	PDF, Categorical		slow (> 2 weeks) rapid (few days to a week) moderate (few weeks up to three months) slow (> 3 months)	NA	NA	NA	
scalability construction_parts	Performance, Categorical PDF, Categorical		easy difficult simple technical special	NA (simple = 1, technical = 0, special = 0)	"Materials required for Application of Pit Humus and Compost are locally available in most situations and include wheelbarrows, shovels, spades, rakes, and personal protective equipment (PPE). For cultivating land where compost or pit humus has been applied other gardening tools such as hoes, watering cans, seeds, etc. are required." (Emersan) To set up the application of compost and biochar no technical or special	yes	
Transfer Coefficients	(copied from "Sanitation_Technologies_TC_database_202	10622.xism")			parts are required.		
	Recovered	Range	Airloss	Soilloss	Waterloss	Comments	Reference
TP med (R)	0.98 0.98	-	C		0.01		PA -
k TN	100		0.04				PA PA based on He et al. (2003)
med (R)	0.94	-	0.04				-
k H2O	100 0.98			0.01	0.01		PA PA
med (R)	0.98	-					-
k TS	100 0.69		C	0.3	0.01	PA based on: Effects are comparable to	PA Lima et al. (2009)
med (R)	0.69		(processed sludge application	-
k	5						PA
	(Data from: He et al. (2003)) Biosolids	Compost	Airloss Biosolids incorporated	Airloss Biosolids surface	Airloss Compost incorporated	Airloss Compost surface	Spuhler et al. (2021)
Total N	49'000	18'800	0.00	0.01	0.00	0.00	
NH _{4 - N} % Ammonia of TN	2'726 0.06			0.23	3 0%	18%	
References							

Gensch, R., Jennings, A., Renggli, S., & Reymond, P. (2018). Compendium of Sonitation Technologies in Emergencies. German WASH Network (GWN), Swiss Federal Institute of Aquatic Science and Technology (Eawag), Global WASH Cluster (GWC) and Sustainable Sanitation Alliance (SuSanA). Leetscher, T., & Reller, J. (2002). A decision support system for selecting sanitation systems in developing countries. Socio-Economic Planning Sciences, 36 (4), 267–290. https://doi.org/10.1016/50038-0121(02)00007-1
Spuhler, D., & Robier, L. (2020). Sanitation Exhalogy (Eawag), Dibendorf, Switzerland. Spuhler, D., & Robier, L. (2020). Sanitation Exhalogy (Eawag), Dibendorf, Switzerland. Spuhler, D., & Robier, L. (2020). Sanitation technology in Express view and the State of Development Countries (Sandec), Swiss Federal Institute of Aquatic Science and Technology.

He, Z., et al. (2003). "Nitrogen Transformation and Ammonia Volatilization From Biosolids and Compost Applied to Calcareous Soil." Compost Science & Utilization 11: 81-88.

Mcconville, J., et al. (2020). "Guide to Sanitation Resource-Recovery Products & Technologies: a supplement to the Compendium of Sanitation Systems and Technologies."

LU, J., et al. (2018). "A review of regulations and guidelines related to winter manure application." Ambio 47(6): 657-670.

Lima, D. L. D., et al. (2009). "Effects of organic and inorganic amendments on soil organic matter properties." Geoderma 150(1-2): 38–45.

Annellandlan Co. L.							
	Values	Data Source					
FUNCTIONAL GROUP DUNIQUE IDENTIFIER (ID) a							
DATA COMPILER N	Matthias van Sloten						
INPUT PRODUCT p	processed_sludge, transportedprocessed_sludge,	Spuhler, D. & Roller, L. (2020)					
s	stabilized_sludge,						
t	transportedstabilized_sludge, pithumus, transportedpithumus,						
F	pellets, transportedpellets, briquettes,						
	transportedbriquettes	Souther D & Pollor I (2020)	-				
RELATIONS I	Input: OR	Spuhler, D. & Roller, L. (2020) Spuhler, D. & Roller, L. (2020)					
C	Output: NA						
COMMENTS Pre-Filter Criteria	Values	Data Source					
applicability_level ((household = 0, neighbourhood = 0.5,	Tilley, E. et al. (2014)					
	city = 1) (household = 1, shared = 1, public = 1)	Tilley, E. et al. (2014)					
capex_req_level	2	Spuhler, D. et al. (2021)					
opex_req_level	4	Spuhler, D. et al. (2021)					
technical_maturity	(acute = 1, stabilisation = 1,	Tilley, E. et al. (2014) Gensch, R. et al. (2018)					
c	development/recovery = 1)						
Screening Criteria T water_supply	Type and Function Performance, Categorical	Applicable for this Functional Group? FALSE	house	Technology Values (Data) NA	Data Source / Assumptions NA	Internal Review Done? NA	
			yard				
			public none				
water_volume	Performance, Trapez		[L/cap/day]	NA	NA No electricity peopled	NA was	
electricity_supply	Performance, Categorical	IKUE	electricity intermittent	(electricity = 1, intermittent = 1, no elec	No electricity needed.	yes	
	Performance, Categorical	EALCE	no electricity	NA .	NA .	NA .	
fuel_supply	Performance, Categorical	FALSE	no fuel	NA .	INA	NA .	
frequency_of_om	PDF, Categorical	TRUE		(irregular = 0, regular = 1, continous = 0)	"Solids are spread on the ground surface using conventional manure	yes	
			continuous	0)	spreaders, tank trucks or specially		
					designed vehicles." (Compendium) "Spreading equipment must be		
					maintained to ensure continued use.		
					The amount and rate of sludge application should be monitored to		
					prevent overloading and, thus, the		
					potential for nutrient pollution." (Compendium)		
					Regular maintenance and monitoring		
pipe_supply	Performance, Categorical	TRUE	no pipes	(no pipes = 1, difficultly available = 1,	is required. No pipes needed.	yes	
рірс_зарріу	renormance, categorical	1102	difficultly available	pipes = 1	no pipes necucu.	,	
pump_supply	Performance, Categorical	TRUE	pipes no pumps	(no pumps = 1, difficultly available = 1,	No pumps needed.	yes	
			difficultly available	pumps = 1)	.,.,.		
concrete_supply	Performance, Categorical	TRUE	pumps no concrete	(no concrete = 1, difficultly available =	No concrete needed.	yes	
			difficultly available	1, concrete = 1)			
spare_parts	PDF, Categorical	TRUE	concrete simple	(simple = 0.2, technical = 0.5, special =	"Solids are spread on the ground	yes	
			technical	0.3)	surface using conventional manure		
			special		spreaders, tank trucks or specially designed vehicles." (Compendium)		
					"Spreading equipment must be		
					maintained to ensure continued use. []." (Compendium)		
					"May require special spreading		
į l					equipment" (Compendium) Maintenance and reparation of the		
					spreading equipment can occure. This		
					will require techical spare parts and for the specially designed vehicles		
					even specially manufactured spare		
0	0	FALSE	0	NA	parts. NA	NA	
0		FALSE		NA NA	NA NA	NA	
0 temperature	Performance, Categorical	FALSE TRUE	very cold	NA (very cold = 0.5, cold = 0.7, temperate =	NA "There is no doubt that land	yes	
			cold temperate		application of manure to frozen or		
			temperate warm		cold and wet ground has potential to exacerbate nutrient loss in runoff. The		
			hot		absence, or poor growth of crops (limiting uptake of manure nutrients		
					and water), winter weather, and		
					winter soil conditions generally exacerbate off-site losses of manure-		
					exacerbate off-site losses of manure- derived pollutants." (Liu et al. (2018))		
					The application of stabilized sludge is still possible on cold temperatures but		
					the soil will not be able to absorb all of		
					the nutritients and they would be washed away to surface waters or to		
					the groundwater.		
flooding	Performance, Categorical	TRUE	flooding	(flooding = 0.8, no flooding = 1)	All technologies associated with	yes	
			no flooding		"Application of a certain product" are awarded performance values in		
					accordance with each other.		
					Generally, these products are aimed to be safe for use, however, they do		
					carry a "low risk of pathogen		
					transmission" (Compendium). In the event of flooding, surrounding areas		
					of where these products are applied		
					therefore bear some risk. Also, the social acceptance of these products		
					can be low and people would not		
					prefer flood waters to spread these products everywhere. Hence, their		
					performance is reduced by 10% or		
					20% depending on the relative risk of pollution between different products		
					(e.g., stabilized sludge riskier than		
					stored urine). (Akanksha Jain).		
					Sludge is can still carry a lot of pathogens and is not considered to be		
					as safe as other products and is		
					therefore allotted a performance of 80%.		
'			İ.		İ		
	Desference Cotons and	FALCE		NIA.	ALA.	N/A	
vehicular_acces	Performance, Categorical	FALSE	no access difficult	NA	NA	NA	
vehicular_acces	Performance, Categorical Performance, Categorical		difficult full	NA NA	NA NA	NA NA	

		TRA 1.5	Γ.	In a man in a la	I	1
soil_type	Performance, Categorical	TRUE	clay silt sand gravel	(clay = 1, silt = 1, sand = 1, gravel = 1, ro	The application is not based on soil absorption. No difference between different soil types. Stabilized sludge can be brought on the field on every	yes
			rock		type of soil.	
groundwater_depth	Performance, Trapez	TRUE	water depth [m]	(a = 0, b = 0, c = 999, d = 999)	"Depending on the source of the sludge and on the treatment method, it can be treated to a level where it is generally safe and no longer generates significant odour or vector problems. Following appropriate safety and application regulations is important. WHO guidelines on excreta use in agriculture should be consulted for detailed information." (Compendium) "May pose public health risks, depending on its quality and application" (Compendium) It's very important to d treat the sludge correctly and to prove its quality. But even though it seems like a small risk remains. That's why it's not recommendend to applicate it in or recommendend to applicate it in	yes
					areas with a high groundwater level. If you do so you should do further treatment do be safe that the sludge is free of pathogens.	
excavation	Performance, Categorical	TRUE	easy hard	(easy = 1, hard = 1)	No need for excavation.	yes
surface_area_onsite	Performance, Trapez	FALSE	[m2/plot]	NA	NA	NA
surface_area_offsite	Performance, Trapez		m2/pers		NA	NA
0	0	FALSE FALSE	0	NA	NA NA	NA NA
drinking_water_exposure	O Performance, Categorical	FALSE TRUE	Close Not close	NA (close = 1, not close = 1)	NA Topending on the source of the sludge and on the treatment method, it can be treated to a level where it is generally safe and no longer generals significant odour or vector problems. Following appropriate safety and application regulations is important. WHO guidelines on excreta use in apprication regulations is important. WHO guidelines on excreta use in agriculture should be consulted for detailed information." (Compendium) "May pose public health risks, depending on its quality and application" (Compendium) It's very important to direat the sludge correctly and to prove its quality. But even though it seems like a small risk remains. That's why it's not recommendend to applicate it close to drinking water sources.	NA yes
0		FALSE FALSE			NA NA	NA NA
construction_skills	Performance, Categorical		Ladder: unskilled skilled professional		No construction needed.	yes
design_skills	Performance, Categorical	TRUE	Ladder: unskilled skilled professional	(unskilled = 0, skilled = 0.5, professional = 1)	"Application rates and usage of sludge should take into account the presence of pathogens and contaminants, and the quantity of nutrients available so that it is used at a sustainable and agronomic rate." (Compendium) It's important to prove the quality of the sludge on a high level to prevent contamination with pathogens. Further are high design skills required to bring out the appropriate amount of sludge. If not enough is applicated the crop would suffer and if too much is applicated nutritients are washed away to surface waters or to the groundwater.	yes
					Requires consideration of health aspects!	
om_skills	Performance, Categorical	TRUE	Ladder: Unskilled Skilled Professional	(unskilled = 0, skilled = 1, professional = 1)	"solids are spread on the ground surface using conventional manure spreaders, tank trucks or specially designed vehicles." (Compendium) Spreading equipment must be maintained to ensure continued use." (Compendium) The mainenance of the spreading equipment should be possible with moderate OM skills. NA	yes
0	0	FALSE	0	NA	NA	NA
0	0	FALSE FALSE	0	NA	NA NA	NA NA
cleansing_method	Performance, Categorical		Washers Soft wipers Hard wipers	NA NA	NA NA	NA NA
0	0	FALSE	0	NA	NA	NA
lifetime	Performance, Categorical		short (< 1 year) medium (1-5 years) long (>5 years)	(short = 1, medium = 1, long = 1)	The concept does not have a lifetime and can therefore be used at anytime. (Kukka Ilmanen, Eawag 2021)	yes
speed_implement_toilet speed_implement_treatment	PDF, Categorical		rapid (< 3 days) moderate (3 days to 2 weeks) slow (> 2 weeks) rapid (few days to a week)	NA NA	NA NA	NA NA
			moderate (few weeks up to three months) slow (> 3 months)			
scalability	Performance, Categorical	FALSE	easy difficult	NA	NA	NA

	PDF, Categorical	TOUE	simple	(simple = 0.2, technical = 0.5, special =	"Solids are spread on the ground	yes	1
construction_parts	PDF, Categorical		technical			yes	
				0.3)	surface using conventional manure		
			special		spreaders, tank trucks or specially		
					designed vehicles." (Compendium)		
					"Spreading equipment must be		
					maintained to ensure continued use.		
					[]." (Compendium)		
					"May require special spreading		
					equipment" (Compendium)		
					Spreading equipment is required,		
					which can consist of vehicles with		
					additional installed technical parts or		
					even specially designed and		
					manufactured vehicles.		
ransfer Coefficients	(copied from "Sanitation_Technologies_TC_database_202	(10622.xlsm")			mandractured venicles.		
runsici cociniciciits	Recovered		Airloss	Soilloss	Waterloss	Comments	Reference
TP			Allioss	0.01		* fresh manure	Smith et al. (1998)
	0.96		0	0.01			-
k	25		-				PA
TN			0.1	0		* 11- 60% of applied NH4-N lost by NH3	Ryan und Keeney (1975)
	0.88	-	0.07	0.01	0.03		PA based on Smith et al. (1998)
	0.89	-	0.09	0.01	0.02		-
	25						PA
H2O	0.01	-	0	0.01	0.01		PA
	0.01	-	0	0.01	0.01		-
	100						PA
TS	0.69	-	0	0.3	0.01	Organic Matter content in Processed	Torri et al. (2014)
						sludge is 40-70%; PA: upper range used	
						to account for inorganic beneficial	
						compounds	
	0.69	-	0	0.30	0.01		-
k	5						PA
	T						
	(Data from: Ryan und Keeney (1975))						Spuhler et al. (2021)
	Processed sludge				Medians	TC_lost_min	TC_lost_max
Total N			35'449				
NH4 - N			9'394				
% Ammonia of TN	0.59	0.29	0.27	0.23	0.28		

References

Gensch, R., Jennings, A., Renggil, S., & Reymond, P. (2018). Compendium of Sanitation Technologies in Emergencies . German WASH Network (GWN), Swiss Federal Institute of Aquatic Science and Technology (Eawag), Global WASH Cluster (GWC) and Sustainable Sanitation Alliance (SuSanA). Loetscher, T., & Reller, J. (2002). A decision support system for selecting sanitation systems in developing countries. Socie-Comomic Planning Sciences, 36 (4), 267–290. https://doi.org/10.1016/S0038-0121(20)00007-1

Spuhler, D., & Rohras Lima, B., Christoph, J., Imanen, K., Jain, A., van Sloten, M., & Williaman, C. (2021). Sanitotion sterious Projection and Technology (Eawag), Dübendorf, Switzerland. Spuhler, D., & Roller, L. (2020). Sanitation technology library: Details and data sources for appropriateness profiles and transfer coefficients . Eawag. - Swiss Federal Institute of Aquatic Science and Technology. (Paragonic Market of Selection of Aquatic Science and Technology. (Paragonic Market of Selection). A control of Projection of Aquatic Science and Technology. (Paragonic Market of Selection). A control reference of Projection of Aquatic Science and Technology. (Paragonic Market of Projection

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Outstand Control Contr		stabilized_sludge,					
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March Marc	management level		Tillev. E. et al. (2014)				
Section Sect		0)					
March Marc							
March Marc	technical_maturity	3	Tilley, E. et al. (2014)				
Technology Tec	development_phase		Gensch, R. et al. (2018)				
Prof. Prof	creening Criteria	Type and Function					
March Marc	water_supply	Performance, Categorical	FALSE		NA	NA	NA
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### Annual Processor Process	water volume	Performance Transa	FALSE		NA .	NA .	NA
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Performance, Composition (1982)							
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ples_upple Performance_Categorian Titld				continuous			
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print_useph print_						animals." (Compendium)	
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oper_parts For, Categorial Study Securit	concrete cun-l-	Parformance Categoris	TRUE	pumps		No concrete needed	ves
speed, parts PDF, Categorical TRUE simple (simple + 1, technical = 0, special = 0) No. Speed No. No. No. No. No. No. No. No. No. No.	concrete_supply	renormance, categorical	INOL	difficultly available		no concrete needed.	yes
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Description Description	spare_parts	PDF, Categorical	IKUE		(simple = 1, technical = 0, special = 0)	No spare parts needed.	yes
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temporature Performance, Categorical (TRUE experiments) Performan							
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	O 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	PDF, Categorical	FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE	Unskilled Skilled Professional Comparison of the state o	= 1) NA NA NA NA NA NA NA NA NA N	users" (Compendium) "There is little maintenance associated with a closed pit other than taking care of the tree or plant. Trees planted in abandoned pits should be regularly watered. A small fence of stucks and sacks should be constructed around the sapling to protect it from animats." (Compendium) Low OM skills required. NA NA NA NA NA NA NA NA NA N	NA NA NA NA NA NA NA NA NA NA NA NA NA N	
Eawag 2021	O 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	PDF, Categorical	FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE	Unskilled Skilled Professional Comparison of the state o	= 1) NA NA NA NA NA NA NA NA NA N	users" (Compendium) "There is little maintenance associated with a closed pit other than taking care of the tree or plant. Trees planted in abandoned pits should be regularly watered. A small fence of sticks and sacks should be constructed around the sapiling to protect it from animals." (Compendium) Low OM skills required. NA NA NA NA NA NA NA NA NA NA NA NA NA	NA NA NA NA NA NA NA NA NA NA NA NA NA N	
Recovered Range Airloss Soilloss Waterloss Comments Reference	O 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	PDF, Categorical	FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE	Unskilled Skilled Professional Comparison of the state o	= 1) NA NA NA NA NA NA NA NA NA N	users" (Compendium) "There is little maintenance associated with a closed pit other than taking care of the tree or plant. Trees planted in abandoned pits should be regularly watered. A small fence of sticks and sacks should be constructed around the sapiling to protect it from animats." (Compendium) Low OM skills required. NA NA NA NA NA NA NA NA NA N	NA NA NA NA NA NA NA NA NA NA NA NA NA N	
Recovered Range Airloss Soilloss Waterloss Comments Reference	O 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	PDF, Categorical	FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE	Unskilled Skilled Professional Comparison of the state o	= 1) NA NA NA NA NA NA NA NA NA N	users" (Compendium) "There is little maintenance associated with a closed pit other than taking care of the tree or plant. Trees planted in abandoned pits should be regularly watered. A small fence of sticks and sacks should be constructed around the sapiling to protect it from animals." (Compendium) Low OM skills required. NA. NA. NA. NA. NA. NA. NA. N	NA NA NA NA NA NA NA NA NA NA NA NA NA N	
TP 0 - 0 1 0 PA med (R) 0 - 0 1 0 - -	o 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Performance, Categorical Popp, Categorical PDF, Categorical PDF, Categorical PDF, Categorical PDF, Categorical	FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE TRUE FALSE TRUE	Unskilled Skilled Professional Comparison of the state o	= 1) NA NA NA NA NA NA NA NA NA N	users" (Compendium) "There is little maintenance associated with a closed pit other than taking care of the tree or plant. Trees planted in abandoned pits should be regularly watered. A small fence of sticks and sacks should be constructed around the sapiling to protect it from animals." (Compendium) Low OM skills required. NA. NA. NA. NA. NA. NA. NA. N	NA NA NA NA NA NA NA NA NA NA NA NA NA N	
	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Performance, Categorical Performance, Categorical PDF, Categorical PDF, Categorical PDF, Categorical PDF, Categorical PDF, Categorical	FALSE FALSE FALSE FALSE FALSE FALSE FALSE TRUE FALSE TRUE	Unskilled Skilled Professional C C C C C C C C C C C C C C C C C C	= 1) NA	users" (Compendium) "There is little maintenance associated with a closed pit other than taking care of the tree or plant. Trees planted in abandoned pits should be regularly watered. A small fence of sticks and sacks should be constructed around the sapiling to protect it from animals." (Compendium) Low OM skills required. NA NA NA NA NA NA NA NA NA N	NA NA NA NA NA NA NA NA NA NA NA NA NA Ves	Reference
A 100 PA	O O O O O O O O O O O O O O O O O O O	PDF, Categorical PDF, Categorical PDF, Categorical PDF, Categorical PDF, Categorical PDF, Categorical PDF, Categorical PDF, Categorical	FALSE FALSE FALSE FALSE FALSE FALSE FALSE TRUE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE	Unskilled Skilled Professional C C C C C C C C C C C C C C C C C C	= 1) NA	users" (Compendium) "There is little maintenance associated with a closed pit other than taking care of the tree or plant. Trees planted in abandoned pits should be regularly watered. A small fence of sticks and sacks should be constructed around the sapiling to protect it from animals." (Compendium) Low OM skills required. NA NA NA NA NA NA NA NA NA N	NA NA NA NA NA NA NA NA NA NA NA NA NA Ves	
	O O O O O O O O O O O O O O O O O O O	Performance, Categorical Performance, Categorical PDF, Categorical PDF, Categorical PDF, Categorical PDF, Categorical PDF, Categorical PCF, Categorical PCF, Categorical	FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE TRUE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE	Unskilled Skilled Professional C C C C C C C C C C C C C C C C C C	= 1) NA	users" (Compendium) "There is little maintenance associated with a closed pit other than taking care of the tree or plant. Trees planted in abandoned pits should be regularly watered. A small fence of sticks and sacks should be constructed around the sapiling to protect it from animals." (Compendium) Low OM skills required. NA NA NA NA NA NA NA NA NA N	NA NA NA NA NA NA NA NA NA NA NA NA NA Ves	

TN	0	-	0	1)	PA
med (R)	0	٠	0	1			-
k	100						PA
H2O	0		0	1			PA
med (R)	0		0	1	(-
k	100						PA
TS	0		0	1			PA
med (R)	0	-	0	1	(-
k	100						PA

References

Gensch, R., Jennings, A., Renggli, S., & Reymond, P. (2018). Compendium of Sanitation Technologies in Emergencies . German WASH Network (GWN), Swiss Federal Institute of Aquatic Science and Technology (Eawag), Global WASH Cluster (GWC) and Sustainable Sanitation Alliance (SuSanA).

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Tilley, E., Ulrich, L., Lüthi, C., Reymond, P., & Zurbrügg, C. (2014). Compendium of Sanitation Systems and Technologies—2nd revised edition. Swiss Federal Institute of Aquatic Science and Technology (EAWAG).

iogas Combustion		Biogas Combustion Data Source				
FUNCTIONAL GROUP UNIQUE IDENTIFIER (ID)	D	-				
DATA COMPILER	Matthias van Sloten					
INPUT PRODUCT OUTPUT PRODUCT	biogas, transportedbiogas	Spuhler, D. & Roller, L. (2020) Spuhler, D. & Roller, L. (2020)				
RELATIONS	Input: OR	Spuhler, D. & Roller, L. (2020)				
COMMENTS	Output: NA					
re-Filter Criteria		Data Source	I.			
applicability_level	(household = 1, neighbourhood = 0.5, city = 0)	Tilley, E. et al. (2014)				
management_level	(household = 1, shared = 1, public = 1)	Tilley, E. et al. (2014)				
capex_req_level	4	Spuhler, D. et al. (2021)				
opex_req_level	5	Spuhler, D. et al. (2021)				
technical_maturity development_phase	(acute = 0, stabilisation = 0.5,	McConville, J. et al. (2020) Gensch, R. et al. (2018)				
	development/recovery = 1)					
creening Criteria water_supply	Type and Function Performance, Categorical	Applicable for this Functional Group? FALSE	house [Unit]	Technology Values (Data) NA	NA NA	Internal Review Done?
			yard			
			public none			
water_volume	Performance, Trapez		[L/cap/day]	NA	NA	NA
electricity_supply	Performance, Categorical	TRUE	electricity intermittent	(electricity = 1, intermittent = 1, no ele	"When produced in household-level biogas reactors,	yes
			no electricity		it is most suitable for cooking."	
					(Compendium) Biogas can be burned for thermal use, no	
					electricity supply needed. Instead it	
fuel_supply	Performance, Categorical	FAISE	fuel	NA	produces a type of energy. NA	NA .
			no fuel			
frequency_of_om	PDF, Categorical	TRUE	irregular	(irregular = 0.5, regular = 0.5,	"Biogas is usually fully saturated with water vapour, which leads to condensation. To	yes
			regular continuous	continous = 0)	vapour, which leads to condensation. To prevent blocking and corrosion, the	
					accumulated water has to be periodically	
					emptied from the installed water traps. The gas pipelines, fittings and appliances must	
					be regularly monitored by trained	
					personnel. When using biogas for an engine, it is necessary to first reduce the	
					hydrogen sulphide because it forms	
					corrosive acids when combined with condensing water." (Compendium)	
					"When produced in household-level biogas	
					reactors,	
					it is most suitable for cooking." (Compendium)	
					When it is used only for cooking on	
					household level only irregular OM should be necessary.	
pipe_supply	Performance, Categorical	TRUE	no pipes	(no pipes = 0, difficultly available =	Assumed that gas pipelines are required.	yes
			difficultly available pipes	0.5, pipes = 1)		
pump_supply	Performance, Categorical	TRUE	no pumps	(no pumps = 1, difficultly available = 1,	No need for pumps	yes
			difficultly available pumps	pumps = 1)		
concrete_supply	Performance, Categorical	TRUE	no concrete	(no concrete = 1, difficultly available =	No need for concrete	yes
			difficultly available concrete	1, concrete = 1)		
spare_parts	PDF, Categorical	TRUE	simple	(simple = 0.3, technical = 0.5, special =		yes
			technical special	0.2)	reactors, it is most suitable for cooking." (Compendium)	
			special		"When using biogas for an engine, it is	
					necessary to first reduce the hydrogen	
					sulphide because it forms corrosive acids when combined with condensing water."	
					(Compendium)	
					"Appliances required depend on how the biogas will be used. Many appliances have	
					to be designed specifically for use with	
					biogas and these are not always widely available. However, conventional gas	
					burning stoves can be easily modified for	
					use with biogas by widening the jets and burner holes and reducing the primary air	
					intake." (Emersan)	
					Technical or even special spare parts might be needed for a biogas engine. It can be	
					used only for cooking on household level	
					and there technical parts for normal stoves are required. However, for some specially	
					designed appliances, special spare parts	
0	n	FALSE		NA	might be required NA	NA .
0	0	FALSE	C	NA	NA	NA
0 temperature	0 Performance, Categorical	FALSE TRUE	very cold	NA (very cold = 1, cold = 1, temperate = 1,	NA Since the combustion of biogas is an	NA yes
perocal e	and a contegorital		cold	, , , temperate = 1,	exothermic process it is possible at any	
			temperate warm		temperature. The difference in efficiency between different temperatures is	
			hot		negligible.	
flooding	Performance, Categorical	TRUE	flooding no flooding	(flooding = 1, no flooding = 1)	For the technology "use of biogas for	yes
			no flooding		combustion", the criterion "flooding" is considered to irrelevant. It should function	
					successfully (100% performance) in flood	
					prone areas without any issues. (Akanksha Jain)	
vehicular_acces	Performance, Categorical	FALSE	no access	NA	NA NA	NA
			difficult full			
slope	Performance, Categorical	FALSE	flat	NA	NA	NA
	Performance, Categorical	TRUE	not flat	(clay = 1, silt = 1, sand = 1, gravel = 1, re	Combustion of biogas is not based on sall	yes
soil_type	renormance, Categorical	THOL	clay silt	(Cody = 1, 3110 = 1, 5d110 = 1, gravet = 1, f0	Combustion of biogas is not based on soil absorption. No difference between	,
			sand		different soil types.	
			gravel rock			
groundwater_depth	Performance, Trapez	TRUE	water depth [m]	(a = 0, b = 0, c = 999, d = 999)	Combustion of biogas is not based on soil	yes
					absorption. The groundwater depth has no influence on the performance.	
excavation	Performance, Categorical	TRUE	easy	(easy = 1, hard = 1)	No need for excavation.	yes
surface_area_onsite	Performance, Trapez	FALSE	hard [m2/plot]	NA .	NA	NA .
surface_area_offsite	Performance, Trapez		m2/pers	NA NA	NA NA	NA NA
0	0	FALSE FALSE		NA NA	NA NA	NA NA
0	0	FALSE	C	NA	NA	NA
drinking_water_exposure	Performance, Categorical	IKUE	Close Not close	(close = 1, not close = 1)	Combustion of biogas is not based on soil absorption. Exponation to drinking water	yes
					has no influence on the performance.	
0		FALSE		NA NA	NA NA	NA NA
0	6	FALSE				

construction_skills	Performance, Categorical	TRUE	Ladder:	(unskilled = 0, skilled = 0.5,	"Assuming that the biogas plant is well-	yes	
_			unskilled	professional = 1)	constructed, operated and maintained (e.g.,	į l	•
			skilled		water is drained), the risk of leaks,	l l	•
			professional		explosions or any other threats to human health is negligible." (Compendium)		1
					Since there is a fatal risk of explosion if the		,
					application is not constructed properly high		,
					construction skills are recommended.		,
design_skills	Performance, Categorical	TRUE	Ladder: unskilled	(unskilled = 0, skilled = 0, professional		yes	1
			skilled	= 1)	less air for combustion. Therefore, conventional gas appliances need to be	l l	•
			professional		modified when they are used for biogas		,
					combustion (e.g., larger gas jets and burner	l l	•
					holes). The distance through which the gas	l l	•
					must travel should be minimized since losses and leakages may occur. Drip valves	l l	•
					should be installed for the drainage of		,
					condensed water, which accumulates at the		,
					lowest points of the gas pipe."	l l	•
					(Compendium)	l l	•
					"Assuming that the biogas plant is well- constructed, operated and maintained (e.g.,	l l	•
					water is drained), the risk of leaks,	l l	•
					explosions or any other threats to human	l l	•
					health is negligible." (Compendium)	l l	•
					Since there are different things to take in account and there is a fatal risk of explosion	l l	•
					if the application is not designed properly		,
					high design skills required.		,
	Desferons Cotes and all	TOUE	to ddo	Constitued Contribut C5	IID)		1
om_skills	Performance, Categorical	TRUE	Ladder: Unskilled	(unskilled = 0, skilled = 0.5, professional = 1)	"Biogas is usually fully saturated with water vapour, which leads to condensation. To	yes	1
			Skilled	professional = 1)	prevent blocking and corrosion, the		,
			Professional		accumulated water has to be periodically		,
					emptied from the installed water traps. The	l l	•
					gas pipelines, fittings and appliances must be regularly monitored by trained		,
					personnel. When using biogas for an	l l	•
					engine, it is necessary to first reduce the		,
					hydrogen sulphide because it forms		,
					corrosive acids when combined with		,
					condensing water." (Compendium) "When produced in household-level biogas		,
1					reactors, it is most suitable for cooking."		,
					(Compendium)		,
					"Assuming that the biogas plant is well-		,
					constructed, operated and maintained (e.g., water is drained), the risk of leaks,		,
					explosions or any other threats to human		1
					health is negligible." (Compendium)		,
					Since there is a fatal risk of explosion if the		,
					application is not maintained properly high		,
					maintenance skills are recommended even	l l	•
					though the operation of the application of biogas as cooking heat requires only low	l l	•
					skills.		,
0		FALSE		NA		NA	,
0		FALSE FALSE		NA NA		NA NA	,
0		FALSE		NA NA		NA NA	,
cleansing_method	Performance, Categorical	FALSE	Washers	NA	NA	NA	•
cleansing_method	Performance, Categorical	FALSE	Soft wipers	NA	NA	NA	
			Soft wipers Hard wipers				
cleansing_method	0	FALSE	Soft wipers Hard wipers	NA	NA	NA	
0	0	FALSE FALSE	Soft wipers Hard wipers		NA	NA NA	
0	0	FALSE FALSE	Soft wipers Hard wipers 0 short (<1 year) medium (1-5 years)	NA NA	NA NA The lifetime of using biogas depends on the lifetime of the specific appliance. Therefore	NA NA	
0	0	FALSE FALSE	Soft wipers Hard wipers 0 short (< 1 year)	NA NA	NA NA The lifetime of using biogas depends on the lifetime of the specific appliance. Therefore it is possible to use biogas in the short- and	NA NA	
0	0	FALSE FALSE	Soft wipers Hard wipers 0 short (<1 year) medium (1-5 years)	NA NA	NA NA The lifetime of using biogas depends on the lifetime of the specific appliance. Therefore	NA NA	
0 0 lifetime	0	FALSE FALSE TRUE	Soft wipers Hard wipers 0 short (<1 year) medium (1-5 years)	NA NA	NA. NA The lifetime of using biogas depends on the lifetime of the specific appliance. Therefore it is possible to use biogas in the hort- and long-term. (Kukka limanen, Eawag 2021)	NA NA	
0	0 0 Performance, Categorical	FALSE FALSE TRUE	Soft wipers Hard wipers 0 Short (< 1 year) medium (1-5 years) long (>5 years) rapid (< 3 days) moderate (3 days to 2 weeks)	NA NA (short = 1, medium = 1, long = 1)	NA. NA The lifetime of using biogas depends on the lifetime of the specific appliance. Therefore it is possible to use biogas in the hort- and long-term. (Kukka limanen, Eawag 2021)	NA NA yes	
0 0 lifetime speed_implement_toilet	0 0 Performance, Categorical PDF, Categorical	FALSE FALSE FALSE FALSE	Soft wipers Hard wipers 0 short (< 1 year) medium (1-5 years) long (>5 years) rapid (< 3 days) moderate (3 days to 2 weeks) slow (> 2 weeks)	NA NA (short = 1, medium = 1, long = 1) NA	NA NA The lifetime of using biogas depends on the lifetime of the specific appliance. Therefore it is possible to use biogas in the short- and long-term. (Kukka Ilmanen, Eawag 2021) NA	NA NA Yes	
0 0 lifetime	0 0 Performance, Categorical	FALSE FALSE FALSE FALSE	Soft wipers Hard wipers 0 short (< 1 year) medium (1-5 years) long (>5 years) rapid (< 3 days) moderate (3 days to 2 weeks) slow (>2 weeks)	NA NA (short = 1, medium = 1, long = 1)	NA. NA The lifetime of using biogas depends on the lifetime of the specific appliance. Therefore it is possible to use blogas in the hort- and long-term. (Kukka Ilmanen, Eawag 2021)	NA NA yes	
0 0 lifetime speed_implement_toilet	0 0 Performance, Categorical PDF, Categorical	FALSE FALSE FALSE FALSE	Soft wipers Hard wipers short (< 1 year) medium (1-5 years) long (>5 years) rapid (< 3 days) moderate (3 days to 2 weeks) sibow > 2 weeks) rapid (few days to a week) moderate (few days to a beek) moderate (few days to a to three	NA NA (short = 1, medium = 1, long = 1) NA	NA NA The lifetime of using biogas depends on the lifetime of the specific appliance. Therefore it is possible to use biogas in the short- and long-term. (Kukka Ilmanen, Eawag 2021) NA	NA NA Yes	
0 0 lifetime speed_implement_toilet	0 0 0 0 Performance, Categorical PDF, Categorical	FALSE FALSE FALSE FALSE FALSE	Soft wipers Hard wipers short (< 1 year) medium (1-5 years) long (>5 years) rapid (< 3 days) moderate (3 days to 2 weeks) slow (> 2 weeks) rapid (few days to a week) moderate (few days to a week) moderate (few weeks up to three months) slow (> 3 months)	NA NA (Short = 1, medium = 1, long = 1) NA NA	NA NA The lifetime of using biogas depends on the lifetime of the specific appliance. Therefore it is possible to use biogas in the short- and long-term. (Kukka Ilmanen, Eawag 2021) NA NA	NA NA Ves	
0 0 lifetime speed_implement_toilet	0 0 Performance, Categorical PDF, Categorical	FALSE FALSE FALSE FALSE FALSE	Soft wipers Hard wipers 0 short (< 1 year) medium (1-5 years) long (>5 years) rapid (< 3 days) moderate (3 days to 2 weeks) slow (> 2 weeks) rapid (few days to a week) moderate (few weeks up to three months) slow (> 3 months) easy	NA NA (short = 1, medium = 1, long = 1) NA	NA NA The lifetime of using biogas depends on the lifetime of the specific appliance. Therefore it is possible to use biogas in the short- and long-term. (Kukka Ilmanen, Eawag 2021) NA	NA NA Yes	
0 0 lifetime speed_implement_toilet	0 Performance, Categorical PDF, Categorical PDF, Categorical PDF, Categorical	FALSE FALSE FALSE FALSE FALSE	Soft wipers Hard wipers short (< 1 year) medium (1-5 years) long (>5 years) rapid (< 3 days) moderate (3 days to 2 weeks) slow (> 2 weeks) rapid (few days to a week) moderate (few days to a week) moderate (few weeks up to three months) slow (> 3 months)	NA NA (short = 1, medium = 1, long = 1) NA NA	NA NA The lifetime of using biogas depends on the lifetime of the specific appliance. Therefore it is possible to use biogas in the short- and long-term. (Kukka Ilmanen, Eawag 2021) NA NA	NA NA Ves	
0 0 lifetime speed_implement_toilet	0 0 0 0 Performance, Categorical PDF, Categorical	FALSE FALSE FALSE FALSE FALSE	Soft wipers Hard wipers short (< 1 year) medium (1-5 years) long (>5 years) rapid (< 3 days) moderate (3 days to 2 weeks) slow (> 2 weeks) rapid (few days to a week) moderate (few days to a week) slow (> 3 moderate (3 days) difficult simple	NA NA (short = 1, medium = 1, long = 1) NA NA NA (simple = 0.3, technical = 0.5, special =	NA NA The lifetime of using biogas depends on the lifetime of the specific appliance. Therefore it is possible to use biogas in the short- and long-term. (Kukka Ilmanen, Eawag 2021) NA NA NA "Appliances required depend on how the	NA NA Ves	
0 0 lifetime speed_implement_toilet	0 Performance, Categorical PDF, Categorical PDF, Categorical PDF, Categorical	FALSE FALSE FALSE FALSE FALSE	Soft wipers Hard wipers 0 short (< 1 year) medium (1-5 years) long (>5 years) rapid (< 3 days) moderate (3 days to 2 weeks) slow (> 2 weeks) rapid (few days to a week) moderate (few weeks up to three months) slow (> 3 months) easy	NA NA (short = 1, medium = 1, long = 1) NA NA	NA NA The lifetime of using biogas depends on the lifetime of the specific appliance. Therefore it is possible to use biogas in the short- and long-term. (Kukka Ilmanen, Eawag 2021) NA NA	NA NA Ves	
0 0 lifetime speed_implement_toilet	0 Performance, Categorical PDF, Categorical PDF, Categorical PDF, Categorical	FALSE FALSE FALSE FALSE FALSE	Soft wipers Hard wipers short (< 1 year) medium (1:5 years) long (>5 years) rapid (< 3 days) moderate (3 days to 2 weeks) slow (> 2 weeks) moderate (2 weeks) moderate (few weeks up to three months) siow (> 3 months) easy difficult simple technical	NA NA (short = 1, medium = 1, long = 1) NA NA NA (simple = 0.3, technical = 0.5, special =	NA NA The lifetime of using biogas depends on the lifetime of the specific appliance. Therefore it is possible to use biogas in the short- and long-term. (Kukka limanen, Eawag 2021) NA NA NA 'Appliances required depend on how the biogas will be used. Many appliances have to be designed specifically for use with biogas and these are not always widely	NA NA Ves	
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Transfer Coefficients Transfer Coefficients Transfer (R) Transfer (R) Transfer (R) Transfer (R) Transfer (R) Transfer (R) Transfer (R) Transfer (R) Transfer (R) Transfer (R) Transfer (R)	O O O Performance, Categorical PDF, Cate	FALSE FALSE	Soft wipers Hard wipers 0 short (< 1 year) medium (1-5 years) long (>5 years) rapid (< 3 days) moderate (3 days to 2 weeks) slow (> 2 weeks) rapid few days to a week) moderate (few weeks up to three months) slow (> 3 months) easy difficult simple technical special	NA NA (Short = 1, medium = 1, long = 1) NA NA NA NA NA NA (Simple = 0.3, technical = 0.5, special = 0.2) Soilloss C C C C C C C C C	NA NA The lifetime of using biogas depends on the lifetime of the specific appliance. Therefore it is possible to use biogas in the hort- and long-term. (Kukka Ilmanen, Eawag 2021) NA NA NA "Appliances required depend on how the biogas will be used. Many appliances have to be designed specifically for use with biogas will be used. Many appliances have to be designed specifically for use with biogas and these are not always widely available. However, conventional gas burning stoves can be easily modified for use with biogas by widening the jets and burner holes and reducing the primary air intake." (Emersan) "Origo valves should be installed for the drainage of condensed water, which accumulates at the lowest points of the gas pipe.", "Piping is required and generally available in local markets. Gas cooking stoves are cheap and widely available. With modifications can be done by a local handyperson." (Emersan) Biogas can be used in different types of appliances (noushold cooking stove, in an engine etc.). Most of these appliances can be found locally, though some further technical parts (e.g. drip valves) might be required. Some specially designed appliances with the designed appliances with the other specially manufactured. Waterloss O 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	NA NA NA NA NA NA Comments	PA

References

Gensch, R., Jennings, A., Rengill, S., & Reymond, P. (2018). Compendium of Sonitation Technologies in Emergencies. German WASH Network (GWN), Swiss Federal Institute of Aquatic Science and Technology (Eawag), Global WASH Cluster (GWC) and Sustainable Sanitation Alliance (SuSanA). Lostscher, T., & Keller, J. (2002), A decision support system for selecting sanitation systems in developing countries. Socio-Economic Planning Sciences, 36 (4), 267–290. https://doi.org/10.1016/S0038-0121(02)00007-1

Spubler, D., de Morais Lima, P., Fritzsche, J., Ilmanen, K., Jain, A., van Sloten, M., & Willimann, C. (2021). SanitChoice Project Team. Department Sanitation, Water and Solid Waste for Development Countries (Sandec), Swiss Federal Institute of Aquatic Science and Technology (Eawag), Dibendorf, Switzerland. Spubler, D., & Roller, L. (2020). Sanitation technology in England Contries and England Cont

riquettes as Fuel						
FUNCTIONAL GROUP	Values D	Data Source				
UNIQUE IDENTIFIER (ID)	briquettes_as_fuel	•				
INPUT PRODUCT	Matthias van Sloten briquettes, transportedbriquettes	Spuhler, D. & Roller, L. (2020)				
OUTPUT PRODUCT RELATIONS		Spuhler, D. & Roller, L. (2020) Spuhler, D. & Roller, L. (2020)				
	Output: NA					
COMMENTS e-Filter Criteria	Values	Data Source				
applicability_level	(household = 0, neighbourhood = 0.5, city = 1)	From Sanivation Website: The plant intakes fecal sludge from exhauster trucks and outputs biomass fuels to replace firewood in industrial boilers.				
		Application of briquettes happens in industrial boilers and therefore happens on a high level.				
management_level	(household = 0, shared = 0.5, public = 1)	From Sanivation Website: The plant intakes fecal sludge from exhauster trucks and outputs biomass fuels to replace firewood in industrial boilers. Application of briquettes happens in industrial boilers and should therefore be managed on a high level.				
capex_req_level opex_req_level		Spuhler, D. et al. (2021) Spuhler, D. et al. (2021)				
technical_maturity	2	Sanivation successfully piloted this approach and is currently expanding. We assume medium maturity. See here: https://www.cdc.gov/globalhealth/sto/ies/transforming_waste_to_fuel.htmlvaft.ets-Sanivations/20uses/20ichtnnlvaft.ets-Sanivations/20uses/20ichtnnlvaft.ets-Sanivations/20uses/20ichtnnlvaft.ets-Sanivations/20uses/20ichtnnlvaft.ets-Sanivations/20ichtnnlvaft.				
	development/recovery = 1)	"Application of sludge" and treatment technology "Briquetting" (Akanksha Jain based on Gensch, R. et al. (2018)).				
reening Criteria	Type and Function	Applicable for this Functional Group?	Categories [Unit]	Technology Values (Data)	Data Source / Assumptions	Internal Review Done?
water_supply	Performance, Categorical	FALSE	house yard	NA NA	NA NA	NA NA
			public			
water_volume	Performance, Trapez		none [L/cap/day]	NA	NA	NA
electricity_supply	Performance, Categorical	TRUE	electricity intermittent	(electricity = 1, intermittent = 1, no elec	No electricity needed.	yes
fort	Parforman C-+ ! !	EALSE	no electricity	NA .	NA.	NA.
fuel_supply	Performance, Categorical		fuel no fuel	NA	NA	NA
frequency_of_om	PDF, Categorical	TRUE	irregular regular continuous	(trregular = 1, regular = 0, continous = 0)	"Sanivation uses innovative, low-cost solar treatment technologies to transform fecal waste into briquettes that can be sold and used as a smell-free fuel source for cooking or heating," (CC- Sanivation) No additional O&M to other cooking/heating resources.	yes
pipe_supply	Performance, Categorical		no pipes difficultly available pipes	pipes = 1	No pipes needed.	yes
pump_supply	Performance, Categorical		no pumps difficultly available	(no pumps = 1, difficultly available = 1, pumps = 1	No pumps needed.	yes
concrete_supply	Performance, Categorical		pumps no concrete difficultly available concrete	(no concrete = 1, difficultly available = 1, concrete = 1)	No concrete needed.	yes
spare_parts	PDF, Categorical		simple technical special	(simple = 0.4, technical = 0.4, special = 0.2)	"Sanivation uses innovative, low-cost solar treatment technologies to transform fecal waste into briquettes that can be soid and used as a smell- free fuel source for cooking or heating." (CDC - Sanivation) For the application at a small scale there is no need for any special application, at a large scale there might be need for a special oven or similar.	yes
0	0	FALSE FALSE	0	NA NA	NA NA	NA NA
0 temperature	0 Performance, Categorical	FALSE TRUE	very cold cold temperate warm hot	NA (very cold = 1, cold = 1, temperate = 1,	NA Since the application of briquettes as fuel is an exothermic process it is possible at any temperature.	NA .
flooding	Performance, Categorical	TRUE	flooding no flooding	(flooding=1, no flooding=1)	For the technology "using briquettes as fuel", the criterion "flooding" is considered to irrelevant. It should function successfully (100% performance) in flood prone areas without any issues. (Akanksha Jain)	yes
vehicular_acces	Performance, Categorical	FALSE	no access	NA	NA	NA
			difficult full			
slope	Performance, Categorical	FALSE	flat not flat	NA	NA	NA
soil_type	Performance, Categorical		clay silt sand gravel	(clay = 1, silt = 1, sand = 1, gravel = 1, ro	The application is not based on soil absorption. No difference between different soil types.	yes
groundwater_depth	Performance, Trapez	TRUE	rock water depth [m]	(a = 0, b = 0, c = 999, d = 999)	The application is not based on soil absorption and contains no health risks. No difference between different groundwater depths.	yes
excavation	Performance, Categorical	TRUE	easy	(easy = 1, hard = 1)	No excavation needed.	yes
surface_area_onsite	Performance, Trapez	FALSE	hard [m2/plot]	NA	NA	NA
_						
surface_area_offsite	Performance, Trapez	FALSE	m2/pers	NA	NA	NA

0						
		FALSE		NA	NA	NA
drinking_water_exposure	Performance, Categorical	TRUE	Close	(close = 1, not close = 1)	The application is not based on soil	yes
			Not close		absorption and contains no health	
					risks. No difference between different	
					drinking water exponation.	
0		FALSE		NA	NA	NA
0		FALSE		NA	NA	NA
construction_skills	Performance, Categorical	TRUE	Ladder:	(unskilled = 1, skilled = 1, professional	It is asumed that there is no need for	yes
			unskilled	= 1)	any construction in private use. For a	
			skilled		application at a large scale moderate	
			professional		or even high construction skills might	
					be required.	
design_skills	Performance, Categorical	TRUE	Ladder: unskilled	(unskilled = 1, skilled = 1, professional	On a small scale there is no need for	yes
				= 1)	any design skills, on a large scale	
			skilled professional		moderate or high design skills might	
1.00-	Doeformore Cotonomical	TOUT		Constilled A stilled A conference	be required.	
om_skills	Performance, Categorical	TRUE	Ladder:	(unskilled = 1, skilled = 1, professional	On a small scale there is no need for	yes
			Unskilled Skilled	= 1)	any OM skills, on a large scale	
	I	I			moderate OM skills might be required.	1
0	 	FALSE	Professional	NA .	NA .	NA
0		FALSE		NA NA	NA NA	NA NA
0		FALSE		NA NA	NA NA	NA NA
0		FALSE		NA NA		
				NA NA	NA NA	NA NA
cleansing_method	reriormance, Categorical	FALSE	Washers	INA.	INA	INA
			Soft wipers			
0	 	FALSE	Hard wipers	NA	NA	NA
0		FALSE		NA NA	NA NA	NA NA
lifetime			short (< 1 year)	(short = 1, medium = 1, long = 1)	The concept of using briquettes as fuel	
iiretime	Performance, Categorical	INGE	medium (1-5 years)	(SHOLL = 1, medium = 1, long = 1)	does not have a lifetime and can	yes
			long (>5 years)		therefore be used at anytime. (Kukka	
			iong (>5 years)		Ilmanen, Eawag 2021)ÿes	
speed_implement_toilet	PDF, Categorical	EALSE	rapid (< 3 days)	NA	NA	NA
speed_implement_tollet	PDF, Categorical	FALSE	moderate (3 days to 2 weeks)	NA .	NA.	NA .
			slow (> 2 weeks)			
eed_implement_treatment	PDF, Categorical	EALCE	rapid (few days to a week)	NA	NA	NA
beeu_implement_treatment	PDF, Categorical	FALSE	moderate (few weeks up to three	NA .	NA.	NA .
			months)			
			slow (> 3 months)			
scalability	Performance, Categorical	EALSE	easy	NA	NA	NA
scalability	renormance, categorical	TALSE	difficult	NA.	NA.	NA .
construction_parts	PDF, Categorical	TDIE	simple	(simple = 0.4, technical = 0.4, special =	"Sanivation uses innovative, low-cost	yes
construction_parts	PDF, Categorical	INGE	technical	(Simple = 0.4, technical = 0.4, special = 0.2)	solar treatment technologies to	yes
			special	0.21	transform fecal waste into briquettes	
			эресіві		that can be sold and used as a smell-	
				1	mor con he soin and asen as a sillell.	
1					free fuel source for cooking or	
					free fuel source for cooking or	
					heating." (CDC -> Sanivation)	
					heating." (CDC -> Sanivation) For the application at a small scale	
					heating." (CDC -> Sanivation) For the application at a small scale there is no need for any special	
					heating." (CDC -> Sanivation) For the application at a small scale there is no need for any special application, at a large scale there	
					heating." (CDC -> Sanivation) For the application at a small scale there is no need for any special application, at a large scale there might be need for a special oven or	
					heating." (CDC -> Sanivation) For the application at a small scale there is no need for any special application, at a large scale there	
ancter Coefficients	Coped from "Santation Technologies, TC, database 202	10622.htm*)			heating." (CDC -> Sanivation) For the application at a small scale there is no need for any special application, at a large scale there might be need for a special oven or	
	Gopied from "Santiation_Technologies_TC_database_202 Recovered		Airloss	Soilloss	heating." (CDC -> Sanivation) For the application at a small scale there is no need for any special application, at a large scale there might be need for a special oven or similar.	Comments
	Recovered	Range	Airloss	Soilloss nos	heating." (CDC -> Sanivation) For the application at a small scale there is no need for any special application, at a large scale there might be need for a special oven or similar. Waterloss	Comments Some airlos is assumed
TP	Recovered 0	Range	0.09	0.95	heating." (CDC -> Sanivation) For the application at a small scale there is no need for any special application, at a large scale there might be need for a special oven or similar. Waterloss	Comments some airloss is assumed
	Recovered	Range		0.95	heating." (CDC -> Sanivation) For the application at a small scale there is no need for any special application, at a large scale there might be need for a special oven or similar. Waterloss	
TP med (R)	Recovered 0 0 0 0 25	Range	0.09	0.95 0.95	heating." (CDC -> Sanivation) For the application at a small scale there is no need for any special application, at a large scale there might be need for a special oven or similar. Waterloss (some airloss is assumed
TP med (R) k TN	Recovered 0 0 0 25 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Range	0.09 0.09	0.95 0.95 0.50	heating." (CDC -> Sanivation) For the application at a small scale there is no need for any special application, at a large scale there might be need for a special oven or similar. Waterloss	
TP med (R)	Recovered 0 0 0 25 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Range	0.09	0.95 0.95 0.50	heating." (CDC -> Sanivation) For the application at a small scale there is no need for any special application, at a large scale there might be need for a special oven or similar. Waterloss	some airloss is assumed
TP med (R) & TN med (R)	Recovered 0 0 0 0 25 0 0 0 0 0 0 0 0 0 5 5	Range	0.09 0.09	0.95 0.95 0.50	heating." (CDC -> Sanivation) For the application at a small scale there is no need for any special application, at a large scale there might be need for a special oven or similar. Waterloss	some airloss is assumed 50% of airloss, rest goes to residue
TP med (R) k TN med (R) k H2O	Recovered 0 0 0 25 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Range	0.03 0.03 0.15 0.50	0.95 0.95 0.50	heating." (CDC -> Sanivation) For the application at a small scale there is no need for any special application, at a large scale there might be need for a special oven or similar. Waterloss	some airloss is assumed
TP med (R) & TN med (R)	Recovered 0 0 0 25 0 0 5 0 0 0 0 0 0 0 0 0 0 0 0 0	Range	0.09 0.09	0.95 0.95 0.50	heating." (CDC -> Sanivation) For the application at a small scale there is no need for any special application, at a large scale there might be need for a special oven or similar. Waterloss	some airloss is assumed 50% of airloss, rest goes to residue
TP med (R) (R) TN med (R) (H2O med (R)	Recovered 0 0 25 0 0 0 55 0 0 0 5 0 0 0 0 0 0 0	Range	0.03 0.03 0.15 0.50	0.95 0.95 0.50 0.50	heating." (CDC -> Sanivation) For the application at a small scale there is no need for any special application, at a large scale there might be need for a special oven or similar. Waterloss ((((((((((((((((((some airloss is assumed 50% of airloss, rest goes to residue water is all lost to air
TP med (R) k TN med (R) k H2O	Recovered 0 0 25 0 0 0 55 0 0 0 5 0 0 0 0 0 0 0	Range	0.03 0.03 0.15 0.50	0.95 0.95 0.50	heating." (CDC -> Sanivation) For the application at a small scale there is no need for any special application, at a large scale there might be need for a special oven or similar. Waterloss ((((((((((((((((((some airloss is assumed 50% of airloss, rest goes to residue water is all lost to air 50% can be reused, all the rest is lost
TP med (R) TN med (R) H2O med (R)	Recovered 0 0 25 0 0 0 55 0 0 0 5 0 0 0 0 0 0 0	Range	0.03 0.03 0.15 0.50	0.95 0.95 0.50 0.50	heating." (CDC -> Sanivation) For the application at a small scale there is no need for any special application, at a large scale there might be need for a special oven or similar. Waterloss ((((((((((((((((((some airloss is assumed 50% of airloss, rest goes to residue water is all lost to air 50% can be reused, all the rest is lot based on the assumption that all the
TP med (R) (R) TN med (R) (H2O med (R)	Recovered 0 0 25 0 0 0 55 0 0 0 5 0 0 0 0 0 0 0	Range	0.03 0.03 0.15 0.50	0.95 0.95 0.50 0.50	heating." (CDC -> Sanivation) For the application at a small scale there is no need for any special application, at a large scale there might be need for a special oven or similar. Waterloss ((((((((((((((((((some airloss is assumed 50% of airloss, rest goes to residue water is all lost to air 50% can be reused, all the rest is lost based on the assumption that all the
TP med (R) TN med (R) H2O med (R)	Racovered	Range	0.03 0.03 0.15 0.50	0.95 0.95 0.50 0.50	heating." (CDC -> Sanivation) For the application at a small scale there is no need for any special application, at a large scale there might be need for a special oven or similar. Waterloss ((((((((((((((((((some airloss is assumed 50% of airloss, rest goes to residue water is all lost to air 50% can be reused, all the rest is lost - based on the assumption that all the as + some of the rest of TS contribute.

References

Gensch, R., Jennings, A., Renggli, S., & Reymond, P. (2018). Compendium of Sanitation Technologies in Emergencies . German WASH Network (GWN), Swiss Federal Institute of Aquatic Science and Technology (Eawag), Global WASH Cluster (GWC) and Sustainable Sanitation Alliance (SuSanA).

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		Co-combustion				
	Values	Data Source	T			
FUNCTIONAL GROUP UNIQUE IDENTIFIER (ID)	co_combustion	•				
	Matthias van Sloten transportedstored_faeces, transporteddried_faeces, transportedsludge, transportedprocessed_sludge, transportedstabilized_sludge,	- Gensch, R. et al. (2018)				
OUTPUT PRODUCT	transportedpithumus NA	Gensch, R. et al. (2018)				
RELATIONS		Gensch, R. et al. (2018)				
COMMENTS		Data Carrier				
re-Filter Criteria applicability_level	(household = 0, neighbourhood = 0,	Data Source Gensch, R. et al. (2018)				
management_level	city = 1) (household = 0, shared = 0, public = 1)	Gensch, R. et al. (2018)				
capex_req_level		Spuhler, D. et al. (2021)				
opex_req_level technical_maturity		Spuhler, D. et al. (2021) Gensch, R. et al. (2018)				
development_phase	(acute = 0, stabilisation = 0, development/recovery = 1)	Gensch, R. et al. (2018)				
Screening Criteria water_supply	Type and Function Performance, Categorical	Applicable for this Functional Group?	Categories [Unit] house	Technology Values (Data) NA	Data Source / Assumptions NA	Internal Review Done?
2.77			yard public			
water_volume	Performance, Trapez	FAICE	none	NA .	NA NA	NA
electricity_supply	Performance, Categorical		[L/cap/day] electricity		"As part of the process energy is generated,	yes
fuel_supply	Performance, Categorical	FAISF	intermittent no electricity fuel	NA NA	which can be used for heating or the production of electricity." (Emersan) Since the technology itself can be used for the production of electricity, no electricity supply is needed. NA	NA .
frequency_of_om	PDF, Categorical		no fuel irregular			yes
requericy_or_om	r or, categorical		rregular regular continuous	(irregular = 0, regular = 0.3, continous = 0.7)	regular monitoring of the plant or reactor is needed." (Emersan) "Operation and maintenance (O & M) costs are also high, as specialised personnel must operate the plant." (Emersan) Continous operation of the incineration plant is assumed.	,
pipe_supply	Performance, Categorical		no pipes difficultly available pipes	pipes = 1)	No pipes needed except for ventilation, which can be constructed from local material (e.g. mental)	yes
pump_supply	Performance, Categorical Performance, Categorical		no pumps difficultly available pumps	(no pumps = 1, difficultly available = 1, pumps = 1)		yes
concrete_supply	rertormance, Lategorical	IKUE	no concrete difficultly available concrete	(no concrete = U.S, afficulty available = 0.75, concrete = 1)	incineration furnace. [] Pyrolysis and gasification reactors can be constructed with locally available materials on a small scale." (Emersan) To construct an incineration furnace, pyrolysis or a gasification reactor, it is assumed that they can be built from concrete or other material (metal, brick, etc.). We assume that the other material would perform less well, e.g. in regard to litetime and local experience working with such alternative materials. (Kukla limanen, Eawag	yes
spare_parts	PDF, Categorical	TRUE	simple	(simple = 0.1, technical = 0.4, special =	2021) "The main requirement for incineration is an	yes
0		FALSE	technical special	0.5)	incineration furnace, an inioneration furnace requires many different special parts and materials, particularly for the treatment of the exhaust gases, which can be dangerous for public and environmental health. The required special parts are often not locally available. With an existing solid waste incineration plant, Co-Combustion of Sludge can be done immediately. Pryphysis and gasfication reactors can be constructed with locally available materials on a small scale." (Increasin) "In modern incinerators, advanced pollution control systems (electrostatic precipitators, acid gas scrubbers, etc.) are designed to minimise pollution and to ensure compliance with environmental standards." (SLU Compendium)	NA NA
0	0	FALSE FALSE	C		NA	NA NA
temperature	Performance, Categorical		very cold cold temperate warm			yes
flooding	Performance, Categorical	TRUE	hot flooding no flooding	(flooding = 1, no flooding = 1)	For the technology "incineration or co- combustion of sludge", the criterion "flooding" is considered to irrelevant. It should function successfully (100% performance) in flood prone areas without any issues. (Akanksha Jain)	yes
vehicular_acces	Performance, Categorical	FALSE	no access difficult full	NA	NA	NA
slope	Performance, Categorical	FALSE	flat not flat	NA	NA	NA
soil_type	Performance, Categorical	TRUE	clay silt sand gravel	(clay = 1, silt = 1, sand = 1, gravel = 1, rd	Co-Combustion of Sludge is not based on soil absorption. No difference between different soil types.	
groundwater_depth	Performance, Trapez	TRUE	rock water depth [m]	(a = 0, b = 0, c = 999, d = 999)	Co-Combustion of sludge is not based on soil absorption. The groundwater depth has no	
excavation	Performance, Categorical	TRUE	easy hard	(easy = 1, hard = 0.75)	influence on the performance. 'The main requirement for incineration is an incineration furnace. An incineration furnace requires many different special parts and materials, particularly for the treatment of the exhaust gases, which can be dangerous for public and environmental health. The required special parts are often not locally available. With an existing solid waste incineration plant, Co-Combustion of Sludge can be done immediately. Pyrolysis and gasification reactors can be constructed with locally available materials (e.g. oil drum, locally produced burner) on a small scale. "(Emersan') To build an incineration furnace excavation might be needed. To run pyrolysis or a gasification reactor excavation should not be needed.	yes
surface_area_onsite	Performance, Trapez	FALSE	[m2/plot]	NA	NA .	NA

surface_area_offsite	Performance, Trapez	FALSE	m2/pers	NA	NA	NA	
0	C	FALSE	C	NA NA	NA	NA	
0		FALSE FALSE		NA NA		NA NA	
drinking_water_exposure			Close	(close = 1, not close = 1)	Co-Combustion of sludge is not based on soil		
			Not close		absorption. Exponation to drinking water has no influence on the performance.		
0		FALSE		NA .	NA	NA	
0 construction_skills		FALSE	Ladder:	NA (unskilled = 0, skilled = 0.5,	"The main requirement for incineration is an	NA yes	
construction_skins	remainer, eategories	THOSE STATE OF THE	unskilled	professional = 1)	incineration furnace. An incineration furnace	,	
			skilled professional		requires many different special parts and materials, particularly for the treatment of the		
			professional		exhaust gases, which can be dangerous for		
					public and environmental health. The required special parts are often not locally available. With		
					an existing solid waste incineration plant, Co-		
					Combustion of Sludge can be done immediately.		
					Pyrolysis and gasification reactors can be constructed with locally available materials (e.g.		
					oil drum, locally produced burner) on a small scale." (Emersan)		
					For the construction of the incineration furnace		
					with lots of special parts and not locally available material high construction skills are		
					recommended. However, if only moderate or		
					low construction skills are available the		
					application of pyrolysis or a gasification reactor could still be feasible.		
dester 100	Dorfe C-t-	TRUE	Laddon	(unckilled = 0 chilled 0f '		voc	
design_skills	Performance, Categorical	IKUE	Ladder: unskilled	(unskilled = 0, skilled = 0, professional = 1)	"Before incineration, sludge needs to be dewatered e.g. in Unplanted or Planted Drying	yes	
			skilled		Beds. The energy can be used for example, to		
			professional		power cement kilns. [] Methods for incineration include mass burn incineration,		
					fluidised-bed incineration and co-incineration		
					with municipal solid waste or in cement factories. An emerging technology in heat		
					application treatment is pyrolysis or gasification		
					of faecal sludge. Pyrolysis or gasification happens through heating in an oxygen-depleted		
					environment, thus preventing combustion.		
					Gasification occurs at temperatures above 800 °C, pyrolysis between 350 and 800 °C." (Emersan)		
					Lots of different things to take in account. High		
					design skills required.		
om_skills	Performance, Categorical	TRUE	Ladder:	(unskilled = 0, skilled = 0.5,	"Highly skilled workers are needed to operate	yes	
			Unskilled Skilled	professional = 1)	and maintain an incinerator and a pyrolysis or gasification reactor. Since high temperatures are		
			Professional		reached, only trained staff should operate and		
					maintain the reactor and be in the vicinity." (Emersan)		
0		FALSE		NA NA	NA	NA NA	
0	C	FALSE FALSE		NA NA		NA NA	
0	C	FALSE		NA NA		NA NA	
cleansing_method	Performance, Categorica	I ALJE	Washers Soft wipers	NA	IVO.	ING.	
0	,	FALSE	Hard wipers) NA	NA NA	NA	
0	C	FALSE	C	NA NA	NA	NA	
lifetime	Performance, Categorica	TRUE	short (< 1 year) medium (1-5 years)	(short = 1, medium = 1, long = 1)	"the lifetime of typical incinerators (20-30 years)" (National Research Council (US) 2000)	yes	
			long (>5 years)		It is assumed that sludge incinerators have		
					similar lifetimes to a normal incinerator. (Kukka Ilmanen, Eawag 2021)		
speed_implement_toilet	PDF, Categorica	FALSE	rapid (< 3 days)	NA		NA	
			moderate (3 days to 2 weeks) slow (> 2 weeks)				
speed_implement_treatment	PDF, Categorica	FALSE	rapid (few days to a week)	NA	NA	NA	
			moderate (few weeks up to three months)				
			slow (> 3 months)				
scalability	Performance, Categorical	FALSE	easy difficult	NA	NA	NA	
construction_parts	PDF, Categorica	TRUE	simple	(simple = 0.1, technical = 0.4, special =			
			technical special	0.5)	incineration furnace. An incineration furnace requires many different special parts and		
					materials, particularly for the treatment of the		
					exhaust gases, which can be dangerous for public and environmental health. The required		
					special parts are often not locally available. With		
					an existing solid waste incineration plant, Co-		
					Combustion of Sludge can be done immediately. Pyrolysis and gasification reactors can be		
					constructed with locally available materials on a		
					small scale." (Emersan) "In modern incinerators, advanced pollution		
					control systems (electrostatic precipitators, acid		
					gas scrubbers, etc.) are designed to minimise pollution and to ensure compliance with		
					environmental standards." (SLU Compendium)		
	(copied from "Sanitation_Technologies_TC_database_20 Recovered	210622.xism*) Range	Airloss	Soilloss	Waterloss	Comments	Reference
Transfer Coefficients		-	0	1	0		PA
TP			0	1	0		PA
TP med (R)	100		1	0			PA
med (R) k TN med (R) k	100 C C	-	1	0			- PA
TP med (R) k TN med (R) k k H20	100 C 100 100 100	-	1		0 - 0		-
TP med (R) k TN med (R) k H20 med (R)	0 1000 1000 1000 1000 1000 1000 1000 1		1	0 0	0		- PA PA - PA
TP med (R)	C 1000 1000 1000 1000 1000 1000 1000 10		1	0 0	0		- PA PA -
TP med (R) k TN med (R) k H20 med (R)	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		1	0 0	0		- PA PA - PA

Spuhler et al. (2021)

References

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Loestsche, T., & Reller, J. (2002). A decision support system for selecting sanitation systems in developing countries. Socie-Caronomic Planning Science, 36 (kl), 267–230 https://doi.org/10.1016/S0038-0121(02)00007-1

Spubler, D., & Roller, L. (2002). Sonitation technology (Eawag), Federal Institute of Aquatic Science and Technology (Eawag), Dübendorf, Switzerland. Spubler, D., & Roller, L. (2002). Sonitation technology library: Details and data sources for appropriateness profiles and transfer coefficients . Eawag. Swiss Federal Institute of Aquatic Science and Technology.

Mccomille, J., et al. (2020). "Sonitation Resource-Recovery Products & Technologies: a supplement to the Compendium of Sanitation Systems and Technologies."

Incinceration, N. R. C. U. c. o. H. E. O., 2000). "Waste Incinceration Overview.

Tilley, E., Ulrich, L., Lüthi, C., Reymond, P., & Zurbrigg, C. (2014). Compendium of Sanitation Systems and Technologies."

	Values	Soak Pit Data Source				
FUNCTIONAL GROUP UNIQUE IDENTIFIER (ID)	D soak_pit	-				
DATA COMPILER INPUT PRODUCT	Julian Fritzsche	- Spuhler, D. & Roller, L. (2020)				
OUTPUT PRODUCT RELATIONS	NA	Spuhler, D. & Roller, L. (2020) Spuhler, D. & Roller, L. (2020)				
COMMENTS -Filter Criteria	Values	Data Source				
applicability_level	(household = 1, neighbourhood = 0.5, city = 0)	Tilley, E. et al. (2014)				
	(household = 1, shared = 1, public = 0)					
capex_req_level opex_req_level		Spuhler, D. et al. (2021) Spuhler, D. et al. (2021)				
technical_maturity	(acute = 0.5, stabilisation = 0.5,	Tilley, E. et al. (2014) Gensch, R. et al. (2018)				
	development/recovery = 1)					
eening Criteria water_supply	Type and Function Performance, Categorical	Applicable for this Functional Group?	Categories [Unit] house	Technology Values (Data) NA	Data Source / Assumptions NA	Internal Review Done? NA
2.777			yard public			
water_volume	Performance, Trapez	FAISE	none [L/cap/day]	NA	NA .	NA
electricity_supply			electricity intermittent		No electricity is required for a soak pit	
fuel_supply	Performance, Categorical	FALSE	no electricity fuel	NA .	NA	NA
	_		no fuel			
frequency_of_om	PDF, Categorical	TRUE	irregular regular	(irregular = 1, regular = 0, continuous = 0)	"A well-sized soak pit should last between 3 and 5 years	yes
			regular continuous		without maintenance. To extend the life of a soak pit, care should be taken to ensure that the effluent has been clarified and/	
					or filtered to prevent the excessive build-up of solids. Particles and biomass will eventually	
					clog the pit and it will need to be cleaned or moved.	
					When the performance of the soak pit	
					deteriorates, the material inside the soak pit can be excavated and	
					refilled." (Compendium) Almost no operation and maintenance	
					should be required	
pipe_supply	Performance, Categorical	TRUE	no pipes difficultly available pipes	(no pipes = 1, difficultly available = 1, pipes = 1	No pipes are required for this technology	yes
pump_supply	Performance, Categorical	TRUE	no pumps difficultly available	(no pumps = 1, difficultly available = 1, pumps = 1)	No pumps are required for this technology	yes
concrete_supply	Performance, Categorical	TRUE	no concrete	(no concrete = 1, difficultly available =	"It can be left empty and lined with a	yes
spare_parts	PDF, Categorical	TRUE	difficulty available concrete simple technical	1, concrete = 1) (simple = 1, technical = 0, special = 0)	porous material to provide support and prevent collapse, or left unlined and filled with coarse rocks and gravel. The rocks and gravel will prevent the walls from collapsing, but will still provide a dequate space for the wastewater, in both cases, a layer of sand and fine gravel should be spread across the bottom to help disperse the flow. To allow for future access, a removable (preferably concrete) lid should be used to seal the pit until it needs to be maintained." (Compendium) Concrete is not necessary but preferably used as a lid. However, the lid material does not affect the performance of the technology. "Can be built and repaired with locally vaniable materials" (Compendium)	yes
		FALSE	special		"Particles and biomass will eventually clog the pit and it will need to be cleaned or moved. When the performance of the soak pit deteriorates, the material inside the soak pit can be excavated and refilled." (Emersan) The filling and lining material might need to be replaced, but it consists of porous material, sand gravel, coars rocks, that should be locally available.	
0	0	FALSE	0	NA NA	NA NA	NA NA
0 temperature		FALSE TRUE	very cold	NA (very cold = 0.5, cold = 0.7, temperate =	NA "They can be used in almost every	NA yes
comperature	. Cromane, caregolical	-	cold temperate warm hot	- ,, temperate -	temperature, although there may be problems with pooling effluent in areas where the ground freeze." (Kumar (2017))	•
flooding	Performance, Categorical	TRUE	flooding no flooding	(flooding = 0.1, no flooding = 1)	"They are not appropriate for areas prone to flooding or that have high groundwater tables." (Compendium) This technology is generally not suited for flood prone areas as its function; is hampered severely under inundation conditions. However, they are still awarded a low performance of 10% as there exists a possibility to construct these technologies in allood prone region. (Alanshka Jain) a flood prone region. (Alanshka Jain)	yes
vehicular_acces	Performance, Categorical	FALSE	no access	NA	NA	NA
slope	Performance, Categorical	FALSE	difficult full flat	NA .	NA	NA

soil_type	Performance, Categorical	TRUE	Lelau	(clay = 0, silt = 0.25, sand = 1, gravel = 0	I "As wastowator (groundstor or	I	1
		-	clay	(Clay - 0, Siit - 0.23, Saliu - 1, gravei - 0		yes	
			silt sand		blackwater after primary treatment) percolates through the soil from the		1
			gravel		soak pit, small particles are filtered		1
			rock		out by the soil matrix and organics		
					are digested by microorganisms. Thus,		
					soak pits are best suited for soil with good absorptive properties; clay, hard		
					packed or rocky soil is not		
					appropriate." (Compendium)		
					Does primarily rely on soil absorption.		1
							1
group donates 1 11	nt =	TOLIC	unter death [1	(a = 4.5, b = 7, c = 999, d = 999)	"s The early pit should be 1	wes	1
groundwater_depth	Performance, Trapez	TRUE	water depth [m]	(a = 4.5, b = 7, c = 999, d = 999)	"s The soak pit should be between 1.5 and 4 m deep, but as a rule of thumb,	yes	
					never less than 2 m above the		
					groundwater table." (Compendium)		
					The vertical distance also depends on		
					the permeability of the soil, we use 3		
					meters as a minimum distance to the		
					groundwater as suggested by Monvois		
					et al. (2012).		
excavation	Performance, Categorical	TRUE	easy	(easy = 1, hard = 0.5)	Excavation is necessary.	yes	
CACUVACION	renormance, categorica	THOSE .	hard	(665) - 1, Hard - 6.5)	Excuration is necessary.	,	
surface_area_onsite	Performance, Trapez	FALSE	[m2/plot]	NA	NA	NA	
							1
surface_area_offsite	Performance, Trapez		m2/pers	NA NA	NA NA	NA NA	1
0	0	FALSE FALSE		D NA D NA	NA NA	NA NA	1
0		FALSE) NA	NA NA	NA NA	1
drinking_water_exposure	Performance, Categorical		Close	(close = 0, not close = 1)	"It should be located at a safe distance		1
			Not close	/	from a drinking water source (ideally		1
					more than 30 m)" (Compendium)		1
		FAICE		200	818	***	1
0	0	FALSE FALSE		NA NA	NA NA	NA NA	1
construction_skills	Performance, Categorical		Ladder:	NA (unskilled = 0, skilled = 1, professional	" The main design criterion is the	NA yes	1
construction_SKIIIS	r en ormance, Categorica	IIIOE	unskilled	(unskilled = 0, skilled = 1, professional = 1)	volume of the pit, which should be in	,	1
			skilled		proportion to the number of people		1
			professional		using the soakaway and based on		1
					local water consumption levels to		1
					ensure efficient infiltration. The		[
					construction of a soakaway does not require high-level skills.", "Low-level		1
					require high-level skills.", "Low-level skills (can be constructed by a local		1
					craftsman)" (Monvois et al. (2012))		
		<u></u>	<u> </u>	<u> </u>		<u> </u>]
design_skills	Performance, Categorical	TRUE	Ladder:	(unskilled = 0, skilled = 0.5,	"The main design criterion is the	yes	1
_	· ·		unskilled	professional = 1)	volume of the pit, which should be in		1
			skilled		proportion to the number of people		1
			professional		using the soakaway and based on		1
					local water consumption levels to ensure efficient infiltration" (Monvois		1
					et al. (2012))		
					The design is rather simple, however,		
					the prevailing geological		1
					circumstances must be considered.		1
					Requires at least basic expertise for		1
					design.]
om_skills	Performance, Categorical	TRUE	Ladder:	(unskilled = 0, skilled = 1, professional	"A well-sized soak pit should last	yes	1
			Unskilled	= 1)	between 3 and 5 years without		1
			Skilled		maintenance. To extend the life of a		1
			Professional		soak pit, care should be taken to		1
					ensure that the effluent has been		l
					clarified and/ or filtered to prevent the excessive build-up of solids. Particles		
					and biomass will eventually clog the		
					pit and it will need to be cleaned or		
					moved. When the performance of the		
					soak pit deteriorates, the material		
					inside the soak pit can be excavated		1
					and refilled." (Compendium)		
					Operation and maintenance should be		
					Operation and maintenance should be required very rarely and only include		
					Operation and maintenance should be required very rarely and only include declogging, excavating, refilling or		
					Operation and maintenance should be required very rarely and only include declogging, excavating, refilling or similar.		
					Operation and maintenance should be required very rarely and only include declogging, excavating, refilling or similar. The only crucial factor is determining		
					Operation and maintenance should be required very rarely and only include declogging, excavating, refilling or similar. The only crucial factor is determining which actions should be taken. The		
					Operation and maintenance should be required very rarely and only include declogging, excavating, refilling or similar. The only crucial factor is determining		
					Operation and maintenance should be required very rarely and only include declogging, excavating, refilling or similar. The only crucial factor is determining which actions should be taken. The		
0		FALSE)NA	Operation and maintenance should be required very rarely and only include declogging, excavating, refilling or similar. The only crucial factor is determining which actions should be taken. The actions itself are very basic.	NA NA	
0 0	0	FALSE	(NA NA	Operation and maintenance should be required very rarely and only include declogging, excavating, refilling or similar. The only crucial factor is determining which actions should be taken. The actions itself are very basic. NA NA	NA NA	
-	0	FALSE FALSE	(NA NA	Operation and maintenance should be required very rarely and only include declogging, excavating, refilling or similar. The only routal factor is determining which actions should be taken. The actions itself are very basic. NA NA NA NA NA	NA NA NA	
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0	0	FALSE FALSE	() () () Washers	NA NA	Operation and maintenance should be required very rarely and only include declogging, excavating, refilling or similar. The only routal factor is determining which actions should be taken. The actions itself are very basic. NA NA NA NA NA	NA NA NA	
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0 0 0 0 cleansing_method	0 0 0 Performance, Categorical	FALSE FALSE FALSE FALSE	Washers Soft wipers Hard wipers) NA) NA NA NA	Operation and maintenance should be required very rarely and only include declogging, excavating, refilling or similar. The only crucial factor is determining which actions should be taken. The actions itself are very basic. NA NA NA NA NA NA NA NA NA NA	NA NA NA NA	
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References

Gensts, R., Iennings, A., Renggli, S., & Reymond, P. (2018). Compendium of Sonitation Technology is in Emergencies . Giernan WASH Network (GWN), Swits Federal Institute of Aquatic Science and Technology (Eawag), Global WASH Cluster (GWC) and Sustainable Sanitation Alliance (SuSanA). Loetscher, T., & Keller, J. (2002). A decision support system for selecting sanitation systems in developing countries. Socio-Economic Planning Sciences, 36 (4), 267–290. https://doi.org/10.1016/S0038-0121(02)00007-1

Spulher, D., de Morais Lima, P., -Tritsche, J., Imanen, K., Jain, A., van Solten, M., & Williamann, C. (2021). Sanitation technology in the Company of t

Section Sect	Land Plate							
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Section Process Proc	FUNCTIONAL GROUP UNIQUE IDENTIFIER (ID)	D leach_field	-					
Column C	INPUT PRODUCT	effluent, transportedeffluent, secondary_effluent, transportedsecondary_effluent,	- Tilley, E. et al. (2014)					
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Methods of the professional College of the College	water volume	Porformanco Tranca	EALCE		NIA.	N/A	N/A	
The Analysis of Company of the Compa				electricity		"A dosing or pressurized distribution		
Performance, Cinggerout Rold Part Company (Rold Part Company) Performance, Cinggerout Rold P						the whole length of the leach field is utilized and that aerobic conditions are allowed to recover between dosings." (Emersan) Usually no electricity is required, however, a dosing or pressurized distribution system may be used. Technology can work without electricity, however, in some cases a larger-scale dosing or pressurized system may be introducted and		
No Seal PROPOSITION OF THE PROPO	fuel supply	Performance, Categorical	FALSE	fuel	NA .		NA .	
pump, supply Performance, Categorical TRUE on pump: on to exceed the second process of the second process o				no fuel irregular regular	(irregular = 0.9, regular = 0.1, continuous = 0)	"A leach field will become clogged over time, although this may take 20 or more years, if a well-maintained and well-functioning primary treatment technology is in place. Effectively, a leach field should require minimal maintenance; however, if the system stops working efficiently, the pipes should be cleaned and/or removed and replaced. To maintain the leach field, there should be no plants or trees on it." (Compendium) Regular maintenance should not be necessary except for weeding the		
difficulty valiable pumps and provided the search field is statical to receive that the whole legach for the search field is statical and that excordic conditions design from the search field is statical and that excordic conditions design from the search field is statical and that excordic conditions designs from the search field in search for pumps are usually respect done gry stem (search to search field in parameter search for pumps are usually respect done gry stem (search to search field in parameter	pipe_supply			difficultly available	pipes = 1)	on top." (Compendium) Pipes are necessary for distribution pipes and also to build the recommended sewer connection for future connections/emptying.	yes	
concrete_upply Performance, Categorical TRUE filled by available concrete difficulty available concrete difficulty available concrete spare_parts PDF, Categorical TRUE dimple dimple = 0.3, technical = 0.5, special PDF, Categorical TRUE dimple = 0.3, technical = 0.5, special PDF, Categorical TRUE dimple = 0.3, technical = 0.5, special PDF, Categorical TRUE D NA D O D FALSE D NA NA D O D FALSE PErformance, Categorical TRUE Very cold = 0.5, cold = 0.7, temperater temperature Performance, Categorical TRUE Performance, Categorical TRUE Rooding Performance, Categorical TRUE Rooding Performance, Categorical TRUE Rooding No flooding Performance, Categorical TRUE Rooding No flooding Performance, Categorical TRUE Rooding No flooding Performance, Categorical TRUE Rooding No flooding Performance, Categorical TRUE Rooding No flooding Performance, Categorical TRUE Rooding No flooding Performance, Categorical TRUE Rooding No flooding Performance, Categorical TRUE Rooding No flooding Performance, Categorical TRUE Rooding No flooding No flooding Performance, Categorical TRUE Rooding No flooding Performance, Categorical TRUE Rooding No flooding Performance, Categorical TRUE Rooding No flooding Rooding No flooding No flooding flooding no take the concept is the part parts with part labels to overflow, readering the new theory parts with part labels to overflow, readering the new theory parts with part labels to overflow, readering the new theory flooding is hampered severely under in unudation conditions. Notwer, they are all avarded a low performance of 10% as the exist a possibility to condition the lower, they are still avarded a low performance of 10% as the exist a possibility to condition the lower, they are still avarded a low performance of 10% as the exist a possibility to condition the lower, they are still avarded a low performance of 10% as the exist a possibility to condition the lower, they are still avarded a low performance of 10% as the exist appea	pump_supply	Performance, Categorical	TRUE	difficultly available	0.75, pumps = 1)	system may be installed to ensure that the whole length of the leach field is utilized and that aerobic conditions are allowed to recover between dosings." (Compendium) Even though no pumps are usually required, a presurted dosing system (which is essentially a pumping system) might be installed and therefore has a higher score if pumps	yes	
Spare_parts PDF, Categorical TRUE simple (simple = 0.3, technical = 0.5, special = Not all parts and materials may be technical special D	concrete_supply	Performance, Categorical	TRUE			Usually no concrete is used	yes	
technical special spec	chara norte	DDE Catagorical	TRUE	concrete			ves	
O IFALSE O NA NA NA NA temperature Performance, Categorical TRUE very cold cold temperate warm hot Performance, Categorical TRUE (looding = 0.1, no flooding = 0.1, no flooding = 0.1, no flooding = 0.1, no flooding = 0.1, no flooding = 0.1, no flooding = 0.1, no flooding = 0.1, no flooding = 0.1, no flooding = 0.1, no flooding is then temporative authorise at a case where the ground freezes." (Morrow) at at (2012) This technology is generally not suited for flood performance of 10% as a test suited in undation conditions. However, they are still awarded a low performance of 10% as there exists a possibility to construct these technologies in elevated or non-flooded plot areas of a flood grone region. (Akanksha Jain) vehicular_acces Performance, Categorical FALSE no access difficult full				technical special	0.2)	locally available" (Compendium) Pipes and other technical spare parts will be necessary. Special geotextile fabric might need to be replaced.		
O GEASE Performance, Categorical TRUE Very cold (very cold = 0.5, cold = 0.7, temperate temperate warm not flooding Performance, Categorical TRUE flooding Performance, Categorical TRUE flooding no flooding no flooding No flooding								
cold temperate warm hot lemperate warm hot lemperate warm hot (Compendum) Performance, Categorical TRUE flooding no flooding flooding flooding flooding here to be cated in an area prone to flooding as they are liable to overflow, rendering them temporarily unusable." (Morrowis et al. (2012)) This technology is generally not suited for flood prone areas as its functioning is hampered severely under inundation conditions. However, they are still awarded a low performance of 10% as there exists a possibility to construct these technologies in elevated or non-flooded plot areas of a flood prone region. (Akanksha Jain) vehicular_acces Performance, Categorical FALSE no access MA NA NA NA NA NA NA NA NA NA NA NA NA NA	0	0	FALSE	0	NA	NA	NA	
no flooding located in an area prone to flooding as they are liable to overflow, rendering them temporarily unusable." (Monvois et al. (2012)) This technology is generally not suited for flood prone areas as its functioning is hampered severely under inundation conditions. However, they are still awarded a low performance of 10% as there exists a possibility to construct these technologies in elevated or non-flooded plot areas of a flood prone region. (Akanksha Jain) vehicular_acces Performance, Categorical FALSE no access officult full	temperature	rertormance, Categorical	IKUE	cold temperate warm		temperature, although there may be problems with pooling effluent in areas where the ground freezes."	yes	
for flood prone areas as its functioning is hampered severely under inundation conditions. However, they are still awarded a low performance of 10% as there exists a possibility to construct these technologies in elevated or non-flooded plot areas of a flood prone region. (Akanksha Jain) vehicular_acces Performance, Categorical FALSE no access ANA NA NA NA NA NA NA NA NA	flooding	Performance, Categorical	TRUE			located in an area prone to flooding as they are liable to overflow, rendering them temporarily unusable." (Monvois et al. (2012))	yes	
difficult full		Bufumma Casarini	EALSE	PA Proper		for flood prone areas as its functioning is hampered severely under inundation conditions. However, they are still awarded a low performance of 10% as there exists a possibility to construct these technologies in elevated or non-flooded plot areas of a flood prone region. (Akanksha Jain)	NA NA	
	condition 4	rertormance, Categorical	TALDE		INA.	INA.	INA	
	vehicular_acces							

soil_type	Performance, Categorica	TRUE	clay	(clay = 0, silt = 0.25, sand = 1, gravel = 0		yes	
			silt sand		effluent to infiltrate (Monvois et al. (2012)).		
			gravel		Similar to the soak pit a leach field		
			rock		also requires soil with good absorptive properties (Compendium).		
					Does primarily rely on soil absorption.		
groundwater_depth	Performance, Trapez	TRUE	water depth [m]	(a = 3.45, b = 5, c = 999, d = 999)		yes	
					0.3 to 1 m wide. " (Compendium) The trenches are laid at least 15cm		
					beneath the ground (Compendium).		
					We assume a maximum depth of 50cm of the trenches. The minimum		
					permissible groundwater depth with a		
					vertical safety distance of 3 meters therefore is 3.45 (0.3 + 0.15 + 3) (best		
					case). The optimum is reached at 5m		
					(1.5 + 0.5 + 3) (worst case). There's no upper limit.		
					иррег шп		
excavation	Performance, Categorica	TRUE	easy hard	(easy = 1, hard = 0.5)	"Each trench is 0.3 to 1.5 m deep and 0.3 to 1 m wide." (Compendium)	yes	
			Ilaiu		Shallow and wide excavation required.		
surface_area_onsite	Performance, Trapez	EALCE	[m2/plot]	NA	NA	NA	
surface_area_onsite	Performance, mapes	PALSE	[mz/piot]	NA .	IVA	IVA	
surface_area_offsite 0	Performance, Trapez	FALSE FALSE	m2/pers	NA NA	NA NA	NA NA	
0		FALSE		NA NA	NA NA	NA NA	
0 drinking_water_exposure	C	FALSE		NA (close = 0, not close = 1)	NA "To prevent contamination, a leach	NA ves	
unnking_water_exposure	renormance, Categorica	INOL	Not close	(close = 0, not close = 1)	field should be located at least 30 m	yes	
					away from any drinking water		
0		FALSE		NA	source." (Compendium) NA	NA	
0		FALSE		NA	NA	NA	
construction_skills	Performance, Categorica	INUE	Ladder: unskilled	(unskilled = 0, skilled = 1, professional = 1)	"The main design criteria are the volumes of water discharged, the	yes	
			skilled		available surface area and the		
			professional		infiltration capacity of the soil. The design and construction of infiltration		
					trenches require highlevel skills."		
					(Monvois et al. (2012)) The construction requires high level		
					skills, but the design is more important		
					and difficult.		
design_skills	Performance, Categorica	TRUE	Ladder:	(unskilled = 0, skilled = 0.5,	"The main design criteria are the	yes	
			unskilled skilled	professional = 1)	volumes of water discharged, the available surface area and the		
			professional		infiltration capacity of the soil. The		
					design and construction of infiltration trenches require highlevel skills "		
					trenches require highlevel skills." (Monvois et al. (2012))		
					trenches require highlevel skills." (Monvois et al. (2012)) To ensure proper infiltration and no		
					trenches require highlevel skills." (Monvois et al. (2012))		
					trenches require highlevel skills." (Monvois et al. (2012)) To ensure proper infiltration and no pollution to the groundwater, high		
					trenches require highlevel skills." (Monvois et al. (2012)) To ensure proper infiltration and no pollution to the groundwater, high level skills are required. Especially if a great amount of effluent is discharged.		
om_skills	Performance, Categorica	TRUE	Ladder:	(unskilled = 0, skilled = 0.5,	trenches require highlevel skills." (Monvois et al. (2012)) To ensure proper infiltration and no pollution to the groundwater, high level skills are required. Especially if a great amount of effluent is discharged. "Low-level skills (no on-going	yes	
om_skills	Performance, Categorica	TRUE	Unskilled Skilled	(unskilled = 0, skilled = 0.5, professional = 1)	trenches require highlevel skills." (Monvois et al. (2012)) To ensure proper infiltration and no pollution to the groundwater, high level skills are required. Especially if a great amount of effluent is discharged.	yes	
om_skills	Performance, Categorica	TRUE	Unskilled		trenches require highlevel skills." (Monvois et al. (2012)) To ensure proper infiltration and no pollution to the groundwater, high level skills are required. Specially if a great amount of effluent is discharged. "Low-level skills (no on-going maintenance) to high-level skills (if there is clogging)" (Monvois et al. 2012)	yes	
om_skills	Performance, Categorica	TRUE	Unskilled Skilled		trenches require highlevel skills." (Monvois et al. (2012)) To ensure proper infiltration and no pollution to the groundwater, high level skills are required. Especially if a great amount of effluent is discharged. "Low-level skills (no on-going maintenance) to high-level skills (if there is clogging)" (Monvois et al. 2012) If there is clogging, high level skills are required, however, it is assumed that	yes	
			Unskilled Skilled Professional	professional = 1)	trenches require highlevel skills." (Monvois et al. (2012)) To ensure proper infiltration and no pollution to the groundwater, high level skills are required. Especially if a great amount of effluent is discharged. "Low-level skills (no on-going maintenance) to high-level skills (if there is clogging)" (Monvois et al. 2012) If there is clogging, high level skills are required, however, it is assumed that skilled labour is partly sufficient.		
0 0	C	FALSE FALSE	Unskilled Skilled Professional	professional = 1) NA NA	trenches require highlevel skills." (Monvois et al. (2012)) To ensure proper infiltration and no pollution to the groundwater, high level skills are equired. Especially if a great amount of effluent is discharged. "Low-level skills (no on-going maintenance) to high-level skills (if there is clogging)" (Monvois et al. 2012) If there is clogging, high level skills are required, however, it is assumed that skilled labour is partly sufficient. NA	NA NA	
0 0		FALSE FALSE FALSE	Unskilled Skilled Professional	professional = 1) NA NA NA	trenches require highlevel skills." (Monvois et al. (2012)) To ensure proper infiltration and no pollution to the groundwater, high level skills are required. Especially if a great amount of effluent is discharged. "Low-level skills (no on-going maintenance) to high-level skills (if there is clogging)." (Monvois et al. 2012) If there is clogging, high level skills are required, however, it is assumed that skilled abour is partity sufficient. NA NA NA	NA NA NA	
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0 0 0	C	FALSE FALSE FALSE FALSE	Unskilled Skilled Professional C C C Washers Soft wipers	professional = 1) NA NA NA NA	trenches require highlevel skills." (Monvois et al. (2012)) To ensure proper infiltration and no pollution to the groundwater, high level skills are required. Specially if a great amount of effluent is discharged. "Low-level skills (no on-going maintenance) to high-level skills (if there is clogging)" (Monvois et al. 2012) If there is clogging, high level skills are required, however, it is assumed that skilled abour is partly sufficient. NA NA NA NA NA	NA NA NA	
0 0 0 0 cleansing_method	C C Performance, Categorica	FALSE FALSE FALSE FALSE FALSE FALSE	Unskilled Skilled Professional C C C Washers Soft wipers Hard wipers	professional = 1) NA NA	trenches require highlevel skills." (Monvois et al. (2012)) To ensure proper infiltration and no pollution to the groundwater, high level skills are required. Especially if a great amount of effluent is discharged. "Low-level skills (no on-going maintenance) to high-level skills (if there is clogging)" (Monvois et al. 2012) If there is clogging, high level skills are required, however, it is assumed that skilled labour is partly sufficient. NA NA NA NA NA NA NA NA NA N	NA NA NA NA NA	
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0 0 0 0 cleansing_method	C C Performance, Categorica	FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE	Unskilled Skilled Professional C C C Washers Soft wipers Hard wipers c short (< 1 year) medium (1-5 years)	professional = 1) NA NA	trenches require highlevel skills." (Monvois et al. (2012)) To ensure proper infiltration and no pollution to the groundwater, high level skills are required. Especially if a great amount of effluent is discharged. "Low-level skills (no on-going maintenance) to high-level skills (if there is clogging)" (Monvois et al. 2012) If there is clogging, high level skills are required, however, it is assumed that skilled labour is partly sufficient. NA NA NA NA NA NA NA NA NA N	NA NA NA NA NA	
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References

Gensch, R., Jennings, A., Renggli, S., & Reymond, P. (2018). Compendium of Sanitation Technologyis in Emergencies - German WASH Network (GWN), Switss Federal Institute of Aquatic Science and Technology (Eawag), Global WASH Cluster (GWC) and Sustainable Sanitation Alliance (SuSanA).

Loetscher, T., & Kreller, J. (2002). A decision support system for selecting sanitation systems in developing countries. Socio-Economic Planning Sciences, 36 (4), 267–290. https://doi.org/10.1016/50038-0121(02)00007-1

Spulher, D., de Morais Lima, P., Fritzsche, J., Imanen, K., Jain, A., van Solten, M., & Williaman, C. (2021). Sanitation technology interpretation of the Spulher, D. (2021). Sanitation technology interpretation of the Spulher, D. (2021). Sanitation technology interpretation of the Spulher, D. (2021). Sanitation technology interpretation of the Spulher, D. (2021). Sanitation technology interpretation of the Spulher, D. (2021). Sanitation technology interpretation of the Spulher, D. (2021). Sanitation technology interpretation of the Spulher, D. (2021). Sanitation technology interpretation of the Spulher (2021). Sanitation technology interpretation of the Spulher (2021). Sanitation technology interpretation of the Spulher (2021). Sanitation technology interpretation of the Spulher (2021). Sanitation technology interpretation of the Spulher (2021). Sanitation technology interpretation of the Spulher (2021). Sanitation technology interpretation of the Spulher (2021). Sanitation technology interpretation of the Spulher (2021). Sanitation technology interpretation of the Spulher (2021). Sanitation technology interpretation of the Spulher (2021). Sanitation technology interpretation of the Spulher (2021). Sanitation technology interpretation of the Spulher (2021). Sanitation technology interpretation of the Spulher (2021). Sanitation technology interpretation of the Spulher (2021). Sanitation technology interpretation of the Spulher (2021). Sanitation technology interpretation of the Spulher (2021). Sanitation te

Irrigation		Irrigation					
	Values D	Data Source					
UNIQUE IDENTIFIER (ID)		-					
INPUT PRODUCT	effluent, transportedeffluent,	Spuhler, D. & Roller, L. (2020)					
	secondary_effluent, transportedsecondary_effluent,						
OUTPUT PRODUCT	stormwater, transportedstormwater NA	Spuhler, D. & Roller, L. (2020)					
RELATIONS	Input: OR Output: NA	Spuhler, D. & Roller, L. (2020)					
COMMENTS							
Pre-Filter Criteria applicability_level	Values (household = 1, neighbourhood = 1,	Tilley, E. et al. (2014)					
management level	city = 1) (household = 1, shared = 1, public = 1)	Tilley, F. et al. (2014)					
capex reg level	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	Spuhler, D. et al. (2021)					
opex_req_level		Spuhler, D. et al. (2021)					
technical_maturity development_phase	(acute = 0.5, stabilisation = 1,	McConville, J. et al. (2020) Gensch, R. et al. (2018)					
Screening Criteria	development/recovery = 1) Type and Function	Applicable for this Functional Group?	Categories [Unit]	Technology Values (Data)	Data Source / Assumptions	Internal Review Done?	
water_supply	Performance, Categorical		house yard	NA	NA .	NA	
			public				
water_volume	Performance, Trapez		none [L/cap/day]	NA	NA NA	NA	
electricity_supply	Performance, Categorical	TRUE	electricity intermittent	(electricity = 1, intermittent = 0.5, no e	"Commercial-scale irrigation systems for industrial production are expensive, requiring pumps and an operator. Small-scale drip irrigation systems can be	yes	
			no electricity		constructed out of locally available low-tech materials and are inexpensive. Ready-made kits are also widely available. A filtration unit before the drip		
					irrigation system is highly recommended to reduce the risk of clogging." (SLU Compendium)		
					Electricity is not necessary, since pumps can be replaced by gravitation.		
					However, electricity for pumps might be required on a large sale or if the irrigation is not possible only with gravitation.		
fuel_supply	Performance, Categorical	FALSE	fuel	NA	NA .	NA	
frequency_of_om	PDF, Categorical	TRUE	no fuel irregular	(irregular = 0, regular = 1, continous =	"Drip irrigation systems must be periodically flushed to avoid biofilm growth and	yes	
			regular continuous	U)	clogging from all types of solids. Pipes should be checked for leaks as they are prone to damage from rodents and humans. Drip irrigation is more costly than		
					conventional irrigation, but offers improved yields and decreased water/operating costs" (Compendium)		
					At a small scale irrigation might also be possible manual with a watering can. That needs less maintenance since there you do not need any special material or		
					construction but it is very labour intensive. Both cases lead to a need for regular		
pipe_supply	Performance, Categorical	TRUE	no pipes	(no pipes = 0.5, difficultly available =	OM. "There are two kinds of irrigation technologies appropriate	yes	
			difficultly available pipes	0.75, pipes = 1)	for treated wastewater: 1) Drip irrigation above or below ground, where the		
					water is slowly dripped on or near the root area; and 2) Surface water irrigation where water is routed overland		
					in a series of dug channels or furrows.		
					[]Generally, drip irrigation is the most appropriate irrigation method; it is especially good for arid and drought prone areas. Surface irrigation is prone to		
					large losses from evaporation but requires little or no infrastructure and may be appropriate in some situations. []Drip irrigation is the only type of irrigation that		
					should be used with edible crops" (Emersan)		
					At a small scale irrigation might also be possible manual with a watering can. And the technology configuration with surface water irrigation can be conducted		
numa sumalu	Performance, Categorical	TRUE		(no pumps = 0.5, difficultly available =	without pipes. However it performs a lot worse than drip irrigation.		
pump_supply	renormance, categorical	INGE	no pumps difficultly available	0.75, pumps = 1)	"Commercial-scale irrigation systems for industrial production are expensive, requiring pumps and an operator. Small-scale drip irrigation systems can be	yes	
			pumps		constructed out of locally available low-tech materials and are inexpensive. Ready-made kits are also widely available. A filtration unit before the drip		
					irrigation system is highly recommended to reduce the risk of clogging." (SLU Compendium)		
					Alternative configuration of technology without pumps is possible, since gravitation can be used. But it usually performs worse depending on the local		
					slopes.		
concrete_supply	Performance, Categorical	TRUE	no concrete difficultly available	(no concrete = 1, difficultly available = 1, concrete = 1)	No concrete needed.	yes	
spare_parts	PDF, Categorical	TRUE	concrete simple	(simple = 0.5, technical = 0.5, special	"Commercial-scale irrigation systems for industrial production are expensive,	yes	
	,		technical special	= 0)	requiring pumps and an operator. Small-scale drip irrigation systems can be	,	
			special		constructed out of locally available low-tech materials and are inexpensive. Ready-made kits are also widely available. A filtration unit before the drip		
					irrigation system is highly recommended to reduce the risk of clogging." (SLU Compendium)		
					"A drip irrigation system can be constructed using locally available materials such as a storage tank, and a hose or drip tape." (Compendium)		
					"Not all parts and materials may be locally available" (Emersan)		
0		FALSE FALSE		NA NA	NA NA	NA NA	
0 temperature		FALSE		NA (very cold = 0.5, cold = 0.7, temperate	NA "There is no doubt that land application of manure to frozen or cold and wet	NA yes	
comperature	. Cromunte, Categorital	·-	cold	. ,, colo - 5.7, temperate	ground has potential to exacerbate nutrient loss in runoff. The absence, or poor		
			temperate warm		growth of crops (limiting uptake of manure nutrients and water), winter weather, and winter soil conditions generally exacerbate off-site losses of manure-derived		
			hot		pollutants." (Liu et al. (2018)) Irrigation can still be possible in cold temperatures but the soil will not be able to		
					absorb all of the nutritients and they would be washed away to surface waters or to the groundwater. Further a construction with pipes can take serious damage		
				10 10 10 10 10 10 10 10 10 10 10 10 10 1	when the irrigation water freezes.		
flooding	Performance, Categorical	TRUE	flooding no flooding	(flooding = 0.8, no flooding = 1)	"Appropriate treatment (i.e., adequate pathogen reduction) should precede any irrigation scheme to limit health risks to those who come in contact with the	yes	
					water. Furthermore, it may still be contaminated with the different chemicals that are discharged into the system depending on the degree of treatment the		
					effluent has undergone." (Compendium) A risk for a contamination either with		
					pathogens or with chemicals remains and because irrigation is based on soil absorption.		
					Irrigation can be considered as "Application of reclaimed water" All technologies associated with "Application of a certain product" are awarded		
					performance values in accordance with each other. Generally, these products are aimed to be safe for use, however, they do carry a "low risk of pathogen		
					transmission" (Compendium). In the event of flooding, surrounding areas of		
					where these products are applied therefore bear some risk. Also, the social acceptance of these products can be low and people would not prefer flood		
					waters to spread these products everywhere. Hence, their performance is reduced by 10% or 20% depending on the relative risk of pollution between		
					different products (e.g., stabilized sludge riskier than stored urine). (Akanksha Jain).		
					Effluent water used for irrigation must be properly treated before use in fields,		
					however the risk of pathogen transmission during flooding events will be quite serious if this effluent quality is not up to the standard. It therefore bears more		
					risk than other products and is accordingle allotted a performance of 80%.		
vehicular_acces	Performance, Categorical	FALSE	no access	NA	NA NA	NA	
			difficult full				
slope	Performance, Categorical	FALSE	flat not flat	NA	NA .	NA	
soil_type	Performance, Categorical	TRUE	clay	(clay = 1, silt = 1, sand = 1, gravel = 1, r	Even though irrigation is based on soil absorbtion the performance of the	yes	
			silt sand		technology must not depend on the soil type. If drip irrigation is used there is almost no risk of seepage of the irrigated effluent.		
-	·	·	-	•	·		

groundwater_depth	Performance, Trapez	TRUE	water depth [m]	(a = 3, b = 3, c = 999, d = 999)	*Appropriate treatment (i.e., adequate pathogen reduction) should precede any irrigation scheme to limit health risks to those who come in contact with the water. Furthermore, it may still be contaminated with the different chemicals that are discharged into the system depending on the degree of treatment the effluent has undergone.* (Compendium) Since the risk for a contamination either with pathogens or with chemicals remains irrigation should not be done in areas with a high groundwater table.	yes	
excavation	Performance, Categorical	TRUE	easy hard	(easy = 1, hard = 1)	"There are two kinds of irrigation technologies appropriate for treated wastewater: 1) Drip irrigation above or below ground, where the water is slowly dripped on or near the root area; and 2) Surface water irrigation where water is routed overland in a series of dug channels or furrows." (Compendium) At a small scale irrigation might also be possible manual with a watering can. There are variations possible without need for excavation.	yes	
surface_area_onsite	Performance, Trapez	FALSE	[m2/plot]	NA	NA	NA	
surface_area_offsite	Performance, Trapez	FALSE	m2/pers	NA	NA	NA	
0		FALSE FALSE		NA NA	NA NA	NA NA	
0		FALSE		NA NA	NA .	NA NA	
drinking_water_exposure	Performance, Categorical	TRUE	Close Not close	(close = 0, not close = 1)	"Appropriate treatment (i.e., adequate pathogen reduction) should precede any irrigation scheme to limit health risks to those who come in contact with the water. Furthermore, it may still be contaminated with the different chemicals that are discharged into the system depending on the degree of treatment the effluent has undergone." (Compendium) Since the risk for a contamination either with pathogens or with chemicals remains irrigation should not be done close to a drinking water source.		
0		FALSE FALSE	C	NA NA	NA NA	NA NA	
construction_skills	Performance, Categorical	TRUE	Ladder: unskilled skilled professional	(unskilled = 0.5, skilled = 1, professional = 1)	NAM: "May require expert design and installation" (Compendium) High construction skills are recommended, moderate construction skills could be sufficient but also cause problems such as Gogging more often due to inpropper construction. However, at a small scale irrigation might also be possible manual with a watering can. That leads to need for lower construction skills since there you do not need any special construction. The performance might be lower at a small scale.	yes	
design_skills	Performance, Categorical	TRUE	Ladder: umskilled skilled professional	(unskilled = 0, skilled = 0.5, professional = 1)	"May require expert design and installation" (Compendium) "Faw sewage or untreated blackwater should not be used, and even well-treated water should be used with caution. Long-term use of poorty or improperly treated water may cause long-term damage to the soil structure and its ability to hold water." (Compendium) "The application rate must be appropriate for the soil, crop and climate, or it could be damaging. To increase the nutrient value, uninc can be dosed into irrigation water; this is called "fertigation". The dilution ratio has to be adapted to the special needs and resistance of the crop." (Compendium) "Appropriate treatment (i.e., adequate pathogen reduction) should precede any irrigation scheme to limit health risks to those who come in contact with the water. Furthermore, it may still be contaminated with the different chemicals that are discharged into the system depending on the degree of treatment the effluent has undergone. When effluent is used for irrigation, households and industries connected to the system should be made aware of the products that are and are not appropriate to discharge into the system. Drip irrigation is the only type of irrigation that should be used with edible crops, and even then, care should be taken to prevent workers and harvested crops from coming in contact with the treated effluent. The Who guidelines on wastewater use in agriculture should be consulted for detailed information and specific guidance." Lots of things to be taken in account. High design skills are required.	yes	
om_skills	Performance, Categorical	TRUE	Ladder: Unskilled Skilled Professional	(unskilled = 0.5, skilled = 1, professional = 1)	"Drip irrigation systems must be periodically flushed to avoid biofilm growth and clogging from all types of solids. Pipes should be checked for leaks as they are prone to damage from rodents and humans. Drip irrigation is more costly than conventional irrigation, but offers improved yields and decreased water/operating costs." (Compendium) At a small scale irrigation might also be possible manual with a watering can. That leads to need for lower maintenance skills since there you do not need any special material or construction to maintain. The performance might be lower at a small scale.	yes	
0	0	FALSE		NA NA	NA .	NA	
0		FALSE		NA	NA	NA	
0		FALSE FALSE		NA NA	NA NA	NA NA	
cleansing_method	Performance, Categorical	FALSE	Washers Soft wipers	NA	NA	NA	
		FALCE	Hard wipers	2016	NA .	NA	
0	0	FALSE FALSE		NA NA	NA NA	NA NA	
lifetime	Performance, Categorical	TRUE	short (< 1 year) medium (1-5 years) long (>5 years)	(short = 1, medium = 1, long = 1)	Typical Irrigation systems are drip Irrigation and surface Irrigation systems. "Avormal life expectancy of a [subsurface drip Irrigation] system is considered to be 12 to 15 years. Some systems have been reported to last 20 years with good maintenance, and could last longer provided good quality water is used." (Reich, D. et al. (2014). No data could be found for the lifetime of surface Irrigation systems, but is assumed to have a similar lifetime or at least more than 5 years.	yes	
speed_implement_toilet	PDF, Categorical	FALSE	rapid (< 3 days) moderate (3 days to 2 weeks)	NA	NA	NA	
speed_implement_treatment	PDF, Categorical	FALSE	slow (> 2 weeks) rapid (few days to a week) moderate (few weeks up to three	NA	NA NA	NA	
scalability	Performance, Categorical	FALSE	months) slow (> 3 months) easy	NA .	NA NA	NA .	
			difficult				
construction_parts	PDF, Categorical PDF (Categorical		simple technical special	(simple = 0.6, technical = 0.4, special = 0)	"Not all parts and materials may be locally available" (Compendium) "Commercial-scale irrigation systems for industrial production are expensive, requiring pumps and an operator. Small-scale drip irrigation systems can be constructed out of locally available low-tech materials and are inexpensive. Ready-made kits are also widely available. A filtration unit before the drip irrigation system is highly recommended to reduce the risk of clogging." (SLU Compendium) 'A drip irrigation system can be constructed using locally available materials such as a storage tank, and a hose or drip tape. Ready-made kits are also widely available." (Emersan)	yes	
ı	Recovered	Range	Airloss	Soilloss	Waterloss		Reference
TP med (R)	0.9			0.1		* retainment depends on soil type	Odindo et al. (2016) -
k	100			-			PA
TN med (R)	0.87 0.87		0.03			* retainment depends on soil type	Odindo et al. (2016)
k	100		0.03	-			PA
H2O med (R)	0.9		(0.1		* retainment depends on soil type	Odindo et al. (2016)
k	100						PA
TS med (R)	0.9		(* retainment depends on soil type	Odindo et al. (2016)
mea (R)	100			- 0.1			PA
References							

FUNCTIONAL GROUP UNIQUE IDENTIFIER (ID) DATA COMPILER							
UNIQUE IDENTIFIER (ID) DATA COMPILER	Values	Fish Pond Data Source					
DATA COMPILER		-	-				
	Matthias van Sloten	Tillou E et al. (2044)]				
	effluent, transportedeffluent, secondary_effluent,	Tilley, E. et al. (2014)					
	transportedsecondary_effluent, greywater, transportedgreywater,						
	stormwater, transportedstormwater						
OUTPUT PRODUCT RELATIONS	NA	Tilley, E. et al. (2014) Tilley, E. et al. (2014)	-				
	Output: NA	c, L. Ct al. (2014)					
COMMENTS		Data Source					
	Values (household = 0, neighbourhood = 0.5,	Data Source Tilley, E. et al. (2014)					
	city = 1)		-				
management_level	(household = 0, shared = 0.5, public = 1)	Tilley, E. et al. (2014)					
capex_req_level		Spuhler, D. et al. (2021)					
opex_req_level technical_maturity	7	Spuhler, D. et al. (2021) McConville, J. et al. (2020)					
development_phase	(acute = 0, stabilisation = 0.5,	Gensch, R. et al. (2018)					
creening Criteria	development/recovery = 1) Type and Function	Applicable for this Functional Group?	Categories [Unit]	Technology Values (Data)	Data Source / Assumptions	Internal Review Done?	
water_supply	Performance, Categorical		house	NA	NA	NA	
			yard public				
			none				
water_volume electricity_supply	Performance, Trapez Performance, Categorical		[L/cap/day] electricity		"No electrical energy is required" (T5. WSP -	NA ves	
,,,			intermittent	(, -,,	Emersan)	,	
			no electricity		Fish ponds can be ventilated to support aerobic conditions. However it is possible to build it		
					without any electricity supply and since the		
					technology configuration with aerobic fish ponds is		
					based on T5. WSP, which does not require any electrical energy, it is assumed that electricity		
					does not affect the technology performance.		
					Other configurations of the fish pond require even less aeration.		
fuel_supply	Performance, Categorical	FALSE	fuel no fuel	NA	NA	NA	
frequency_of_om	PDF, Categorical	TRUE	irregular	(irregular = 0, regular = 1, continous =	"The fish need to be harvested when they reach an	yes	
			regular continuous	0)	appropriate age/size. Sometimes after harvesting,		
			continuous		the pond should be drained so that (a) it can be desludged and (b) it can be left to dry in the sun		
					for 1 to 2 weeks to destroy any pathogens living		
					on the bottom or sides of the pond." (Compendium)		
					"The water used to dilute the waste should not be		
					too warm, and the ammonium levels should be kept low		
					kept low or negligible because of its toxicity to fish."		
					(Compendium)		
					Temperature and ammonium level should be monitored regularly.		
pipe_supply	Performance, Categorical	TRUE	no pipes difficultly available	(no pipes = 0.5, difficultly available = 0.75, pipes = 1)	Ponds require inlet and outlet pipes (Emersan)	yes	
			difficultly available pipes	0.75, pipes = 1)			
pump_supply	Performance, Categorical	TRUE	no pumps	(no pumps = 1, difficultly available =	No pumps needed.	yes	
			difficultly available pumps	1, pumps = 1)			
concrete_supply	Performance, Categorical	TRUE	no concrete	(no concrete = 1, difficultly available =		yes	
			difficultly available concrete	1, concrete = 1)	materials" (Emersan) No concrete needed.		
spare_parts	PDF, Categorical	TRUE	simple technical		"Can be built and maintained with locally available	yes	
			technical special	= 0)	materials" (Emersan) If not built at an industrial scale or/and with pump		
		i e		1			
1					ventilation, simple spare parts are sufficient to		
0		FALSE		D NA	operate and maintain the fish pond. NA	NA	
0	0	FALSE	(NA NA	operate and maintain the fish pond. NA NA	NA	
	0	FALSE FALSE	(() () () () () () () () () (D NA	operate and maintain the fish pond. NA NA NA This technology is appropriate for warm or		
0	0	FALSE FALSE	very cold cold	D NA	operate and maintain the fish pond. NA NA NA This technology is appropriate for warm or tropical climates with no freezing temperatures,	NA NA	
0	0	FALSE FALSE	very cold cold temperate	D NA	operate and maintain the fish pond. NA NA NA This technology is appropriate for warm or	NA NA	
0 0 temperature	0 0 Performance, Categorical	FALSE FALSE TRUE	very cold cold temperate warm	D NA NA (very cold = 0, cold = 0.5, temperate = :	operate and maintain the fish pond. NA NA This technology is appropriate for warm or tropical climates with no freezing temperatures, []- (Compendium)	NA NA yes	
0	0	FALSE FALSE TRUE	very cold cold temperate warm hot flooding	D NA	operate and maintain the fish pond. NA NA NA NA NA NA NA NA NA N	NA NA	
0 0 temperature	0 0 Performance, Categorical	FALSE FALSE TRUE	very cold cold temperate warm	D NA NA (very cold = 0, cold = 0.5, temperate = :	operate and maintain the fish pond. NA NA This technology is appropriate for warm or tropical climates with no freezing temperatures, []- (Compendium)	NA NA yes	
0 0 temperature	0 0 Performance, Categorical	FALSE FALSE TRUE	very cold cold temperate warm hot flooding	D NA NA (very cold = 0, cold = 0.5, temperate = :	operate and maintain the fish pond. NA NA This technology is appropriate for warm or tropical climates with no freezing temperatures, []- (Compendium) Regular flooding could be fatal for this technology. Fish could leave the pond and escape or be dead after a flood. "There may be concern about contamination of	NA NA yes	
0 0 temperature	0 0 Performance, Categorical	FALSE FALSE TRUE	very cold cold temperate warm hot flooding	D NA NA (very cold = 0, cold = 0.5, temperate = :	operate and maintain the fish pond. NA NA NA This technology is appropriate for warm or tropical climates with no freezing temperatures, []-" (Compendium) Regular flooding could be fatal for this technology. Fish could leave the pond and escape or be dead after a flood. There may be concern about contamination of the fish, especially when they are harvested,	NA NA yes	
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0 0 temperature	0 0 Performance, Categorical	FALSE FALSE TRUE	very cold cold temperate warm hot flooding	D NA NA (very cold = 0, cold = 0.5, temperate = :	operate and maintain the fish pond. NA NA This technology is appropriate for warm or tropical climates with no freezing temperatures, []." (Compendium) Regular flooding could be fatal for this technology. Fish could leave the pond and escape or be dead after a flood. There may be concern about contamination of the fish, especially when they are harvested, cleaned and prepared. If they are cooked well, they should be safe, but it is advisable to move the fish to a clear-water pond for several weeks	NA NA yes	
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0 0 temperature	0 0 Performance, Categorical	FALSE FALSE TRUE	very cold cold temperate warm hot flooding	D NA NA (very cold = 0, cold = 0.5, temperate = :	operate and maintain the fish pond. NA NA This technology is appropriate for warm or tropical climates with no freezing temperatures, []-" (Compendium) Regular flooding could be fatal for this technology. Fish could leave the pond and escape or be dead after a flood. There may be concern about contamination of the fish, especially when they are harvested, cleaned and prepared. If they are cooked well, they should be safe, but it is advisable to move the fish they are harvested for several weeks before they are harvested for consumption." (Compendium) Further contamination of the surrounding area is a risk due to wastewater leaving the pond.	NA NA yes	
0 0 temperature	0 0 Performance, Categorical	FALSE FALSE TRUE	very cold cold temperate warm hot flooding	D NA NA (very cold = 0, cold = 0.5, temperate = :	operate and maintain the fish pond. NA NA NA This technology is appropriate for warm or tropical climates with no freezing temperatures, []- (compendium) Regular flooding could be fatal for this technology. Fish could leave the pond and escape or be dead after a flood. There may be concern about contamination of the fish, especially when they are harvested, cleaned and prepared. If they are cooked well, they should be safe, but it is advisable to move the fish to clear-water pond for several weeks before they are harvested for consumption." (Compendium) Further contamination of the surrounding area is a risk due to wastewater leaving the pond. However, to prevent the fish from escaping and wastewaster leaving the pond.	NA NA yes	
0 0 temperature	0 0 Performance, Categorical	FALSE FALSE TRUE	very cold cold temperate warm hot flooding	D NA NA (very cold = 0, cold = 0.5, temperate = :	operate and maintain the fish pond. NA NA This technology is appropriate for warm or tropical climates with no freezing temperatures, []* (Compendium) Regular flooding could be fatal for this technology. Fish could leave the pond and escape or be dead after a flood. "There may be concern about contamination of the fish, especially when they are harvested, cleaned and prepared. If they are cooked well, they should be safe, but it is advisable to move the fish to a clear-vater pond for several weeks before they are harvested for consumption." (Compendium) Further contamination of the surrounding area is a risk due to wastewater leaving the pond. However, to prevent the fish from escaping and wastewaster leaving the pond precautions can be made. Therefore additional design and	NA NA yes	
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0 0 temperature	0 0 Performance, Categorical	FALSE FALSE TRUE	very cold cold temperate warm hot flooding	D NA NA (very cold = 0, cold = 0.5, temperate = :	operate and maintain the fish pond. NA NA This technology is appropriate for warm or tropical climates with no freezing temperatures, []- (compendium) Regular flooding could be fatal for this technology. Fish could leave the pond and escape or be dead after a flood. There may be concern about contamination of the fish, especially when they are harvested, cleaned and prepared. If they are cooked well, they should be asfe, but it is advisable to move the fish to a clear-water pond for several weeks before they are harvested for committee in the fish to a clear-water pond for several weeks before they are harvested for commyption." (Compendium) Further contamination of the surrounding area is a risk due to wastewater leaving the pond. However, to prevent the fish from escaping and wastewaster leaving the pond precautions can be mode. Therefore additional design and construction is required. The functioning of this technology can be severely	NA NA yes	
0 0 temperature	0 0 Performance, Categorical	FALSE FALSE TRUE	very cold cold temperate warm hot flooding	D NA NA (very cold = 0, cold = 0.5, temperate = :	operate and maintain the fish pond. NA NA This technology is appropriate for warm or tropical climates with no freezing temperatures, []-* (Compendium) Regular flooding could be fatal for this technology. Fish could leave the pond and escape or be dead after a flood. There may be concern about contamination of the fish, especially when they are harvested, cleaned and prepared. If they are cooked well, they should be safe, but it is advisable to move the fish to a clean-water pond for several weeks before they are harvested for consumption." (Compendium) Further contamination of the surrounding area is a risk due to wastewater leaving the pond. However, to prevent the fish from escaping and wastewaster leaving the pond precautions can be made. Therefore additional design and construction is required. The functioning of this technology can be severely disrupted by flooding events. However, it is	NA NA yes	
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0 0 temperature	0 0 Performance, Categorical	FALSE FALSE TRUE	very cold cold temperate warm hot flooding	D NA NA (very cold = 0, cold = 0.5, temperate = :	operate and maintain the fish pond. NA NA This technology is appropriate for warm or tropleal climates with no freezing temperatures, []." (Compendium) Regular flooding could be fatal for this technology. Fish could leave the pond and escape or be dead after a flood. There may be concern about contamination of the fish, especially when they are harvested, cleaned and prepared. If they are cooked well, they should be safe, but it is advisable to move the fish to a clean-water pond for several weeks before they are harvested of consumption." (Compendium) Further contamination of the surrounding area is a risk due to wastewaster leaving the pond. However, to prevent the fish from escaping and wastewaster leaving the pond recautions can be made. Therefore additional design and construction is required. The functioning of this technology can be severely disrupted by flooding events. However, it is possible that they can be protected from flooding by building embakments or mounds of adequate they building embakments or mounds of adequate they building embakments or mounds of adequate they waste and the content of the conten	NA NA yes	
0 0 temperature	0 0 Performance, Categorical	FALSE TRUE TRUE	very cold cold temperate warm hot flooding no flooding	DNA [very cold = 0, cold = 0.5, temperate = : (flooding = 0.5, no flooding = 1)	operate and maintain the fish pond. NA NA This technology is appropriate for warm or tropocal climates with no freezing temperatures, []." (Compendium) Regular flooding could be fatal for this technology. Fish could leave the pond and escape or be dead after a flood. There may be concern about contamination of the fish, especially when they are harvested, cleaned and prepared. If they are cooked well, they should be safe, but it is advisable to move the fish to a clean-water pond for several weeks before they are harvested of the consumption." (Compendium) Further contamination of the surrounding area is a risk due to wastewater leaving the pond. However, to prevent the fish from escaping and wastewaster leaving the pond precautions can be made. Therefore additional design and construction is required. The functioning of this technology can be severely disrupted by flooding events. However, it is possible that they can be protected from flooding by building embankments or mounds of adequate height around them. Since a flood-preventive configuration of the technology is possible, it is allotted a performance of 50%, (Akanksha Jain)	NA Yes yes	
0 0 temperature	0 0 Performance, Categorical	FALSE TRUE TRUE	very cold cold temperate warm hot flooding	D NA NA (very cold = 0, cold = 0.5, temperate = :	operate and maintain the fish pond. NA NA This technology is appropriate for warm or troplocal climates with no freezing temperatures, []." (Compendium) Regular flooding could be fatal for this technology. Fish could leave the pond and escape or be dead after a flood. There may be concern about contamination of the fish, especially when they are harvested, cleaned and prepared. If they are cooked well, they should be safe, but it is advisable to move the fish to a clean-water pond for several weeks before they are harvested of consumption." (Compendium) Further contamination of the surrounding area is a risk due to wastewater leaving the pond. However, to prevent the fish from escaping and wastewaster leaving the pond recautions can be made. Therefore additional design and construction is required. The functioning of this technology can be severely disrupted by flooding events. However, it is possible that they can be protected from flooding by building embankments or mounds of adequate height around them. Since a flood-preventive configuration of the technology possible, it is configurated to fit technology possible, it is configurated to fit technology possible, it is configurated to fit technology possible, it is configurated to fit technology possible, it is configurated to fit technology possible, it is configuration of the technology possible, it is configurated to the technology possible, it is configurated to fit the technology possible, it is configuration of the technology possible, it is configurated to fit the technology possible, it is configurated to fit the configuration of the technology possible, it is configurated to fit the technology possible, it is configurated to fit the technology possible, it is configurated to fit the configuration of the technology possible, it is configurated to fit the configuration of the technology possible, it is configurated to fit the configuration of the technology possible, it is configurated to fit the configuration of the technology possible.	NA NA yes	
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vehicular_acces	Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical	FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRU	very cold cold cold temperate warm hot flooding no flooding flooding to flooding flooding flooding flooding flooding flooding flooding flooding flooding	NA (very cold = 0, cold = 0.5, temperate = : (flooding = 0.5, no flooding = 1) NA NA NA (clay = 1, silt = 1, sand = 1, gravel = 1, ri	operate and maintain the fish pond. NA NA This technology is appropriate for warm or troppcal climates with no freezing temperatures, []." (Compendium) Regular flooding could be fatal for this technology. Fish could leave the pond and escape or be dead after a flood. There may be concern about contamination of the fish, especially when they are harvested, cleaned and prepared. If they are cooked well, they should be safe, but it is advisable to move the fish to a clear-water pond for several weeks before they are harvested of consumption." (Compendium) Further contamination of the surrounding area is a risk due to wastewate releaving the pond recautions can be made. Therefore additional design and construction is required. The functioning of this technology can be severely disrupted by flooding events. However, it is possible that they can be protected from flooding by building embankments or mounds of adequate height around them. Since a flood preventive configuration of the technology is possible, it is allotted a performance of 50%. (Akanisha Jain) NA The application is not based on soil absorption. No difference between different soil types.	NA NA Yes yes NA NA Yes	
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vehicular_acces	Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical	FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRU	very cold cold cold temperate warm hot flooding no flooding flooding to flooding flooding flooding flooding flooding flooding flooding flooding flooding	NA (very cold = 0, cold = 0.5, temperate = : (flooding = 0.5, no flooding = 1) NA NA NA (clay = 1, silt = 1, sand = 1, gravel = 1, ri	operate and maintain the fish pond. NA NA This technology is appropriate for warm or tropical climates with no freezing temperatures, []-' (Compendium) Regular flooding could be fatal for this technology. Fish could leave the pond and escape or be dead after a flood. There may be concern about contamination of the fish, especially when they are harvested, cleaned and preaped. If they are cooked well, they should be safe, but it is advisable to move the fish to a clear-water pond for several weeks before they are harvested for consumption." (Compendium) Further contamination of the surrounding area is a risk due to wastewater leaving the pond. However, to prevent the fish from escaping and wastewaster leaving the pond precautions can be made. Therefore additional design and construction is required. The functioning of this technology can be severely disrupted by flooding events. However, it is possible that they can be protected from flooding by building embankments or mounds of adequate height around them. Since a flood preventive configuration of the technology is possible, it is addited a performance of 50%. (Akanksha Jain) NA The application is not based on soil absorption. No difference between different soil types. There may be concern about contamination of the fish, especially when they are harvested, cleaned and prepared. If they are cooked well, they should be safe, but it is advisable to move the	NA NA Yes yes NA NA Yes	
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vehicular_acces	Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical Performance, Categorical	FALSE TRUE TRUE TRUE TRUE TRUE TRUE TRUE TRU	very cold cold cold temperate warm hot flooding no flooding flooding to flooding flooding flooding flooding flooding flooding flooding flooding flooding	NA (very cold = 0, cold = 0.5, temperate = : (flooding = 0.5, no flooding = 1) NA NA NA (clay = 1, silt = 1, sand = 1, gravel = 1, ri	operate and maintain the fish pond. NA NA This technology is appropriate for warm or tropical climates with no freezing temperatures, []* (Compendium) Regular flooding could be fatal for this technology. Fish could leave the pond and escape or be dead after a flood. "There may be concern about contamination of the fish, especially when they are harvested, cleaned and preaded if the yar ecoked well, they should be safe, but it is advisable to move the fish to a clear-water pond for several weeks before they are harvested for consumption." (Compendium) Further contamination of the surrounding area is a risk due to wastewater leaving the pond. However, to prevent the fish from escaping and wastewaster leaving the pond precautions can be made. Therefore additional design and construction is required. The functioning of this technology can be severely disrupted by flonding events. However, it is possible that they can be protected from flooding by building embankments or mounds of adequate height around them. Since a flood-preventive configuration of the technology is possible, it is allotted a performance of 50%. (Akanisha Jain) NA The application is not based on soil absorption. No difference between different soil types. "There may be concern about contamination of the fish, especially when they are harvested, cleaned and prepared. If they are cooked well, they should be safe, but it is advisable to move the fish to a clear-water pond for several weeks before they are harvested of consumption." (Compendium) The technology is not based on soil absorption. But there is a remaining risk of contaminating the groundwater. However it is possible to build it at a groundwater. However it is possible to build it at a groundwater. However it is possible to build it at a groundwater. However it is possible to build it at a groundwater. However it is possible to build it at a groundwater. However it is possible to build it at a groundwater. However it is possible to build it at a groundwater. However it is pos	NA NA Yes yes NA NA Yes	

Marie	surface_area_onsite	Performance, Trapez	FALSE	[m2/plot]	NA	NA	NA	
		·			NA .	NA .	NA .	
The content of the	0	0	FALSE	0		NA		
MACADO MICHAEL CONTROL AND ADDRESS AND AD		0	FALSE					
S	drinking_water_exposure			Close		There may be concern about contamination of the fish, especially when they are harvested, cleaned and prepared. If they are cooked well, they should be safe, but it is advisable to move the fish to a clear-water pond for several weeks before they are harvested for consumption." (Compendium) The technology is not based on soil absorption. But there is a remaining risk of contaminating the drinking water. However It is possible to build it close to a drinking water source, but then it is very important to build it properly and to prevent any	yes	
Controlled Profession Congress Congres	0							
The Community of Community Congress of the Stands	construction_skills	Performance, Categorical	TRUE	Ladder: unskilled skilled professional Ladder: unskilled skilled	(unskilled = 0, skilled = 1, professional = 1) (unskilled = 0, skilled = 0.5,	"Nay require expert design and installation" (Compendium) it is assumed that a simple design variation without any pumps that is built only with locally available material can be contructed with low construction skills. However, moderate construction skills are recommended." Nay require expert design and installation." (Compendium) "The design should be based on the quantity of put intensit to be removed, the nutrients required by the fish and the water requirements needed to ensure healthy living conditions (e.g., low ammonium levels, required water temperature, etc.). When introducing nutrients in the form of effluent or sludge, it is important to limit the additions on that aerobic conditions are maintained. BOD should not exceed 1 g/m.2/d and oxygen should be tolerant to diseases and adverse environmental conditions. Different varieties of carp, militifsh and tiligal have been successfully used, but the specific choice will depend on local preference and suitability." (Compendium)	yes	
D	om_skills			Unskilled Skilled Professional	= 1)	too warm, and the ammonium levels should be kept low or negligible because of its toxicity to fish." (Compendium) Lots of things to be taken in account. High design skills are required. "The fish need to be harvested when they reach an appropriate age/size. Sometimes after harvesting, the pond should be drained so that (a) it can be desludged and (b) it can be left to dry in the sun for 1 to 2 weeks to destroy any pathogens living on the bottom or sides of the pond." (Compendium) "The water used to dilute the waste should not be too warm, and the ammonium levels should be kept low or negligible because of its toxicity to fish." (Compendium) Monitoring of the the temperature and the ammonium level requires at least moderate, better high, OM skills.		
O O FALSE O NA NA NA NA NA NA NA	0	0	FALSE FALSE					
Cleansing_method Performance, Categorical PALSE Soft wipers NA NA NA NA NA NA NA N	0	0	FALSE	0	NA	NA	NA	
Soft wipers Soft wipers	Cleansing method							
speed_implement_toilet PDF, Categorical FALSE rapid (< 3 days) adaptate to thanking oparinc loads, decreased studge handling, long design life, serve as widelife habitat.* (PSATS, Olivitorio) Fish ponds are assumed to be similar to treatment conds. Speed_implement_toilet PDF, Categorical FALSE rapid (< 3 days) and sove 2 weeks) slow 5 2 weeks) slow 5 2 weeks) slow 6 2 weeks up to three months) slow 9 a months slow 9 a months slow 9 a months slow 9 a months) slow 9 a months slow 9 a months slow 9 a months slow 9 a months slow 9 a months slow 9 a months slow 9 a months slow 9 a months slow 9 a months slow 9 a months slow 9 a month slow 1 find at an indistrial scale or/ and with pump ventilation, some technical parts are required in the fish pond. **Receved Range Airloss Solloss Waterloss Comments Reference TP 0	0	0	FALSE FALSE	Soft wipers Hard wipers 0 0	NA NA	NA NA	NA NA	
moderate (3 days to 2 weeks) slow (> 2 weeks) slow (> 2 weeks) slow (> 2 weeks) slow (> 2 weeks) slow (> 2 weeks) slow (> 3 weeks) slow (> 3 weeks) slow (> 3 months)				medium (1-5 years) long (>5 years)		are economical, capable of handling high flows, adaptable to changing organic loads, decreased sludge handling, long design life, serve as wildlife habitat." (PSATS, Di Vittorio) Fish ponds are assumed to be similar to treatment onods.		
Slow 2 weeks Slow 2 weeks NA NA NA NA NA NA NA N	speea_implement_toilet	PDF, Categorical	FALSE	moderate (3 days to 2 weeks)	INA	INA	INA	
Construction_parts	speed_implement_treatment			slow (> 2 weeks) rapid (few days to a week) moderate (few weeks up to three months) slow (> 3 months)				
Construction_parts						NA.	INO.	
Recovered Range Airos Sollos Waterios Comments Reference				simple technical		materials" (Emersan) If built at an industrial scale or/and with pump ventilation, some technical parts are required in	yes	
med (R) 0 0 1 - £ 100 - 2 PA TN 0 0 0 1 PA med (R) 0 0 0 1 PA H2O 0 - 0 0 1 PA med (R) 0 0 0 1 PA k 100 - 0 0 1 PA TS 0 - 0 0 1 PA	F	Recovered				Waterloss		
E 100 : PA TN 0 : O 0 0 1 PA med(R) 0 : O 0 0 1 PA E 100 : O 0 1 PA H20 0 0 : O 0 1 PA med(R) 0 : O 0 1 PA H20 10 : PA TS 0 0 : O 0 1 PA PA PA PA PA PA PA PA PA PA			-			1		PA
med (R) 0 0 1 - Å 100 - - - PA H2O 0 - 0 0 1 PA med (R) 0 - 0 0 1 - - Å 100 - - - - PA TS 0 - 0 0 1 PA	k	100				1		
k 100 - - - PA H2O 0 - 0 0 1 PA med(R) 0 - 0 0 1 - - k 100 - - - - PA TS 0 - 0 0 1 PA								PA
med (R) 0 0 0 1 - A 100 - - - PA TS 0 - 0 0 1 PA	k	100						
k 100 PA TS 0 - 0 0 1 PA						1		PA -
	k	100				1		
1 100 PA				0	0	1		PA
	med (K)	100				1		PA
	References							

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Lotestcher, T., & Keller, J. (2002). A decision support system for selecting sanitation systems in developing countries. Socio-Economic Planning Sciences, 36 (4), 267–290. https://doi.org/10.1016/S0038-0121(02)00007-1.

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Tilley, E., Ulrich, L., Lüthl, C., Reymond, P., & Zurbrügg, C. (2014). Compendium of Sanitation Systems and Technologies and Technologies (PAWAG).

ating Plant Pond	Values	Data Source				
FUNCTIONAL GROUP UNIQUE IDENTIFIER (ID)	D	-				
DATA COMPILER INPUT PRODUCT	Matthias van Sloten effluent, transportedeffluent, secondary_effluent, transportedsecondary_effluent, greywater, transportedgreywater,	Tilley, E. et al. (2014)				
OUTPUT PRODUCT RELATIONS	stormwater, transportedstormwater	Tilley, E. et al. (2014) Tilley, E. et al. (2014)				
COMMENTS -Filter Criteria	Values	Data Source				
applicability_level management_level	(household = 0, neighbourhood = 0.5, city = 1)	Tilley, E. et al. (2014) Tilley, E. et al. (2014)				
	(household = 0, shared = 0.5, public = 1)					
capex req_level opex req_level technical_maturity development_phase	5 3 (acute = 0, stabilisation = 0.5, development/recovery = 1)	Spuhler, D. et al. (2021) Spuhler, D. et al. (2021) Tilley, E. et al. (2014) Similar technology concept (with regard to construction, design, O&M, etc.) to that of fish ponds, hence same values allotted. (Akanksha Jain based on Gensch, R. et al. (2018))				
reening Criteria water_supply	Type and Function Performance, Categorical	Applicable for this Functional Group? FALSE	Categories [Unit] house	Technology Values (Data) NA	Data Source / Assumptions NA	Internal Review Done? NA
water_volume electricity_supply	Performance, Trapez Performance, Categorical	FALSE TRUE	yard public none [L/cap/day] electricity intermittent no electricity	NA (electricity = 1, intermittent = 0.9, no e	NA To provide extra oxygen to a floating plant technology, the water can be mechanically aerated but at the cost increased power and machinery. (Compendium) Floating plant ponds can be ventilated and supplied with fresh water with pumps which could improve the performance of the technology slightly.	NA yes
fuel_supply	Performance, Categorical	FALSE	fuel no fuel	NA	NA	NA
frequency_of_om	PDF, Categorical		irregular regular continuous	(trregular = 0, regular = 1, continous = 0)	Floating plants require constant harvesting. The harvested biomass can be used for small artisanal businesses, or it can be composted. Mosquito problems can develop when the plants are not regularly harvested. Depending on the amount of solids that enter the pond, it must be periodically desludged. Trained staff is required to constantly operate and maintain it. *Compendium!	yes
pipe_supply	Performance, Categorical		no pipes difficultly available pipes	(no pipes = 0.5, difficultly available = 0.75, pipes = 1)	Ponds require inlet and outlet pipes (Compendium)	yes
pump_supply	Performance, Categorical		no pumps difficultly available pumps	(no pumps = 1, difficultly available = 1, pumps = 1)	No pumps needed.	yes
concrete_supply	Performance, Categorical		no concrete difficultly available concrete	(no concrete = 1, difficultly available = 1, concrete = 1)	"Can be built and maintained with locally available materials" (Compendium) No concrete needed.	yes
spare_parts	PDF, Categorical	inue	simple technical special	(simple = 0.9, technical = 0.1, special = 0)	"Can be built and maintained with locally available materials" (Compendium) "To provide extra oxygen to a floating plant technology, the water can be mechanically aerated but at the cost of increased power and machinery." (Compendium) if not built at an industrial scale or/and with additional technical components, simple spare parts are sufficient to operate and maintain the floating plant pond.	yes
0		FALSE FALSE		NA NA	NA NA	NA NA
0 temperature	O Performance, Categorical	FALSE TRUE	very cold cold temperate warm hot		NA This technology is appropriate for warm or tropical climates with no freezing temperatures, []." (Compendium)	NA yes
flooding flooding vehicular_acces	Performance, Categorical Performance, Categorical		flooding no flooding	(flooding = 0.5, no flooding = 1)	Some plants can become invasive species if released into natural environments" (Compendium) "Adequate signage and fencing should be used to prevent people and animals fro-m coming in contact with Floating Plant Pond the water. Workers should wear appropriate protective clothing []. Regular flooding could be fatal for this technology. Invasive plants and wastewater could leave the pond to the surrounding area. However, to prevent invasive plants and wastewaster from leaving the pond precautions can be made. Therefore additional design and construction is required. The functioning of this technology can be severely disrupted by flooding events. However, it is possible that they can be protected from flooding by building embankments or mounds of adequate height around them. Since a flood-preventive configuration of the technology is possible, it is allotted a performance of SCM. (Askarska lain).	yes
slope	Performance, Categorical	FALSE	difficult full flat	NA	NA NA	NA
soil_type	Performance, Categorical	TRUE	not flat clay silt sand gravel	(clay = 1, silt = 1, sand = 1, gravel = 1, n	The application is not based on soil absorption. No difference between different soil types.	yes
				Í.	"Adequate signage and fencing should be used to	1
groundwater_depth	Performance, Trapez		rock water depth [m]	(a = 0, b = 0, c = 999, d = 999)	prevent people and animals fro-m coming in contact with Floating Plant Pond the water. Workers should wear appropriate protective clothing [].* (Compendium) The technology is not based on soil absorption. But there is a remaining risk of contaminating the groundwater. However it is possible to build it at a high groundwater table, but then it is very important to build it propperly and to prevent any leakage of the ondo to the ground.	yes
	Performance, Categorical	TRUE	water depth [m] easy hard	(a = 0, b = 0, c = 999, d = 999) (easy = 1, hard = 0.5)	prevent people and animals fro-m coming in contact with Floating Plant Pond the water. Workers should wear appropriate protective clothing []." (Compendium) The technology is not based on soil absorption. But there is a remaining risk of contaminating the groundwater. However it is possible to build it at a high groundwater table, but then it is very important to build it propendy and to prevent any leakage of the	
groundwater_depth excavation		TRUE	water depth [m]	(easy = 1, hard = 0.5)	prevent people and animals fro-m coming in contact with Floating Plant Pond the water. Workers should wear appropriate protective clothing [].* (Compendium) The technology is not based on soil absorption. But there is a remaining risk of contaminating the groundwater. However it is possible to build it at a high groundwater table, but then it is very important to build it propperly and to prevent any leakage of the cond to the ground. Shallow and wide excavation is assumed to be required.	yes

drinking_water_exposure		FALSE				yes NA NA	
0		FALSE		NA	NA		
construction_skills design_skills	Performance, Categorical Performance, Categorical		Ladder: unskilled skilled professional	(unskilled = 0, skilled = 1, professional = 1) (unskilled = 0, skilled = 0.5,	It is assumed that a simple design variation without any technical components that is built only with locally available material can be contructed with low construction skills. However, moderate construction skills are recommended. "Iocally appropriate plants can be selected depending	yes	•
			unskilled skilled professional	professional = 1)	on their availability and the characteristics of the wastewater. To provide extra oxygen to a floating plant technology, the water can be mechanically aerated but at the cost of increased power and machinery. Aerated ponds can withstand higher loads and can be built with smaller footprints. Non-aerated ponds should not be too deep otherwise there will be insufficient contact between the bacteria-harbouring roots and the wastewater. (Compendium) "Adequate signage and fencing should be used to prevent people and animals from coming in contact with the water. Workers should wear appropriate protective dothing. WHD guidelines on wastewater and excreta use in aquaculture should be consulted for detailed information and specific guidance." (Compendium) Lots of things to be taken in account. High design skills are required.		
om_skills	Performance, Categorica	TRUE	Ladder: Unskilled Skilled Professional	(unskilled = 0.5, skilled = 1, professional = 1)	"Floating plants require constant harvesting. The harvested biomass can be used for small artisanal businesses, or it can be composted. Mosquito problems can develop when the plants are not regularly harvested. Depending on the amount of solids that enter the pond, it must be periodically desludged. Trained staff is required to constantly operate and maintain it." (Compendium)	yes	
0	0	FALSE	C	NA .	NA	NA	
0	0	FALSE	0	NA	NA	NA	
		FALSE		NA .	NA NA	NA NA	t e
				NA NA			
cleansing_method		FALSE					
	Performance, Categorical		Washers Soft wipers	NA NA	NA NA	NA NA	
0			Washers Soft wipers Hard wipers	NA	NA	NA	
0	C	FALSE	Washers Soft wipers Hard wipers	NA NA	NA NA	NA NA	
0 lifetime	C C Performance, Categorica	FALSE FALSE TRUE	Washers Soft wipers Hard wipers C short (<1 year) medium (1:5 years) long (>5 years)	NA NA NA (short = 1, medium = 1, long = 1)	NA NA NA "Advantages of ponds and lagoons include they are economical, capable of handling high flows, adaptable to changing organic loads, decreased sludge handling, long design life, serve as wildlife habitat." (PSATS, DI Vittorio) Floating ponds are assumed to be similar to treatment ponds	NA NA NA yes	
0 lifetime speed_implement_toilet	Performance, Categorical PDF, Categorical	FALSE FALSE TRUE	Washers Soft wipers Hard wipers C short (< 1 year) medium (1.5 years) long (>5 years) rapid (< 3 days) moderate (3 days to 2 weeks) slow (> 2 weeks)	NA NA (short = 1, medium = 1, long = 1) NA NA NA NA NA NA NA N	NA NA "Advantages of ponds and lagoons include they are economical, capable of handling high flows, adaptable to changing organic loads, decreased sludge handling, long design life, sever as wildliff babatat." (PSATS, Di Vittorio) Vittorio) NA NA	NA NA NA yes	
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speed_implement_toilet speed_implement_treatment scalability construction_parts	PDF, Categorica Performance, Categorica PDF, Categorica PDF, Categorica PDF, Categorica	FALSE FALSE FALSE FALSE FALSE FALSE TRUE	Washers Soft wipers Hard wipers Soft (<1 year) medium (1-5 years) long (>5 years) rapid (<3 days) moderate (3 days to 2 weeks) slow (>2 yeeks) rapid (few days to a week) moderate (few weeks up to three months) slow (>3 months)	NA NA (short = 1, medium = 1, long = 1) NA NA NA	NA NA NA A A A A A A A A A A	NA NA NA yes	
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speed_implement_toilet speed_implement_treatment speed_implement_treatment construction_parts Transfer Coefficients	Performance, Categorica PDF, Categorica PDF, Categorica PDF, Categorica PDF, Categorica	FALSE FALSE FALSE FALSE TRUE FALSE FALSE FALSE TRUE	Washers Soft wipers Hard wipers Soft (1 year) medium (1-5 years) long (>5 years) rapid (< 3 days) moderate (3 days to 2 weeks) slow (> 2 weeks) sarbol (2 weeks) moderate (few weeks up to three months) slow (> 3 months) easy difficult simple technical special	NA NA (short = 1, medium = 1, long = 1) NA NA NA NA (simple = 0.9, technical = 0.1, special = 0)	NA NA "Advantages of ponds and lagoons include they are economical, capable of handling high flows, adaptable to changing organic loads, decreased sludge handling, long design life, sever as wildlife habitat." (PSATS, Di Vittorio) Toloring ponds are assumed to be similar to treatment ponds NA NA NA "Can be built and maintained with locally available materials" (Compendium) "To provide extra oxygen to a floating plant technology, the water can be mechanically aerated but at the cost of increased power and machinery." (Compendium) If built at an industrial scale or/and with pump ventilation, some technical parts are required in the floating plant pond. Waterloss	NA NA NA NA NA NA NA Comments	
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speed_implement_toilet speed_implement_treatment scalability construction_parts Transfer Coefficients TP med (R) R med (R)	PDF, Categorica PDF, Categorica PDF, Categorica PDF, Categorica PDF, Categorica PDF, Categorica PDF, Categorica PDF, Categorica PDF, Categorica PDF, Categorica PDF, Categorica PDF, Categorica PDF, Categorica	FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE	Washers Soft wipers Hard wipers Soft (1 year) medium (1-5 years) long (>5 years) rapid (< 3 days) moderate (3 days to 2 weeks) slow (> 2 weeks) sarbol (2 weeks) moderate (few weeks up to three months) slow (> 3 months) easy difficult simple technical special	NA NA (short = 1, medium = 1, long = 1) NA NA NA NA (simple = 0.9, technical = 0.1, special = 0)	NA NA "Advantages of ponds and lagoons include they are economical, capable of handling high flows, adaptable to changing organic loads, decreased sludge handling, long design life, sever as wildlife habitat." (PSATS, DI VILLORIO) NA NA NA NA NA "Can be built and maintained with locally available materials" (Compendium) "To provide extra oxygen to a floating plant technology, the water can be mechanically aerated but at the cost of increased power and machinery." (Compendium) If built at an industrial scale or/and with pump vernilation, some technical parts are required in the floating plant pond. Waterloss	NA NA NA NA NA NA NA Comments	PA - PA - PA - PA
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speed_implement_toilet speed_implement_treatment scalability construction_parts Transfer Coefficients TP med (R) med (R) 120 med (R) TS med (R)	Performance, Categorica PDF, Categorica	FALSE FALSE TRUE FALSE FALSE FALSE	Washers Soft wipers Hard wipers Soft (1 year) medium (1-5 years) long (>5 years) rapid (< 3 days) moderate (3 days to 2 weeks) slow (> 2 weeks) moderate (few weeks up to three months) slow (> 3 months) easy difficult simple technical special	NA NA (short = 1, medium = 1, long = 1) NA NA NA NA (simple = 0.9, technical = 0.1, special = 0)	NA NA NA NA NA NA NA NA NA NA NA NA NA N	NA NA NA NA NA NA NA NA Comments	PA
speed_implement_toilet speed_implement_treatment scalability construction_parts Transfer Coefficients TP med (R) 120 med (R) 120 med (R) TS	Performance, Categorica PDF, Categorica	FALSE FALSE TRUE FALSE FALSE FALSE	Washers Soft wipers Hard wipers Soft (1 year) medium (1-5 years) long (>5 years) rapid (< 3 days) moderate (3 days to 2 weeks) slow (> 2 weeks) moderate (few weeks up to three months) slow (> 3 months) easy difficult simple technical special	NA NA (short = 1, medium = 1, long = 1) NA NA NA NA (simple = 0.9, technical = 0.1, special = 0)	NA NA NA NA A A A A A A A A	NA NA NA NA NA NA NA NA Comments	PA
speed_implement_toilet speed_implement_treatment scalability construction_parts Transfer Coefficients TP med (R) R20 med (R) TS med (R) TS med (R)	Performance, Categorica PDF, Categorica	FALSE FALSE TRUE FALSE FALSE FALSE	Washers Soft wipers Hard wipers Soft (1 year) medium (1-5 years) long (>5 years) rapid (< 3 days) moderate (3 days to 2 weeks) slow (> 2 weeks) moderate (few weeks up to three months) slow (> 3 months) easy difficult simple technical special	NA NA (short = 1, medium = 1, long = 1) NA NA NA NA (simple = 0.9, technical = 0.1, special = 0)	NA NA NA NA A A A A A A A A	NA NA NA NA NA NA NA NA Comments	PA

References

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urfaco Water Diez		Water Disposal				
		Water Disposal Data Source				
FUNCTIONAL GROUP UNIQUE IDENTIFIER (ID)	water_disposal	-				
DATA COMPILER	SaniChoice Project Team secondary_effluent,	- Spuhler, D. & Roller, L. (2020)				
	transportedsecondary_effluent, stormwater, transportedstormwater					
OUTPUT PRODUCT RELATIONS	NA	Spuhler, D. & Roller, L. (2020) Spuhler, D. & Roller, L. (2020)				
	Output: NA					
COMMENTS re-Filter Criteria	Values	Data Source				
applicability_level	(household = 1, neighbourhood = 1, city = 1)	Tilley, E. et al. (2014)				
management_level	(household = 1, shared = 1, public = 1)	Tilley, E. et al. (2014)				
capex_req_level opex_req_level		Spuhler, D. et al. (2021) Spuhler, D. et al. (2021)				
technical_maturity	3	Tilley, E. et al. (2014)				
	(acute = 0, stabilisation = 0.5, development/recovery = 1)	Gensch, R. et al. (2018)				
Screening Criteria water_supply	Type and Function Performance, Categorical	Applicable for this Functional Group? FALSE	house	Technology Values (Data) NA	Data Source / Assumptions NA	Internal Review Done? NA
			yard public			
and a contra	Basing To	ENISE	none	NA.	NA.	NA.
water_volume electricity_supply	Performance, Trapez Performance, Categorical	TRUE	electricity	NA (electricity = 1, intermittent = 1, no elec-		NA yes
			intermittent no electricity		similar functionality to stormwater drains. Water can be transported by gravity and pumps are not necessary	
fuel_supply	Performance, Categorical	FALSE	fuel no fuel	NA	NA	NA
frequency_of_om	PDF, Categorical	TRUE	irregular	(irregular = 0, regular = 1, continous =	"Regular monitoring and sampling is important to ensure	yes
			regular continuous	9,	compliance with regulations and to ensure public health requirements. Depending on the recharge method, some	
pipe_supply	Performance, Categorical	TRUE	no pipes	(no pipes = 1, difficultly available = 1,	mechanical maintenance may be required." (Compendium) "Groundwater Recharge does not require materials.	yes
			difficultly available pipes	pipes = 1)	Preceding technologies to add the water to the receiving water body," (Emersan)	
					Pipes are needed for conveyance but not for disposal itself. No additional pipes needed.	
pump_supply	Performance, Categorical	TRUE	no pumps	(no pumps = 1, difficultly available =	"Groundwater Recharge does not require materials.	yes
			difficultly available pumps	1, pumps = 1)	Preceding technologies to add the water to the receiving water body," (Emersan)	
					Pipes are needed for conveyance but not for disposal itself. No additional pumps needed.	
concrete_supply	Performance, Categorical	TRUE	no concrete difficultly available	(no concrete = 1, difficultly available = 1, concrete = 1)		yes
	0	TRUE	concrete		*Describes on the real and the second	
spare_parts	PDF, Categorical	INUE	simple technical	(simple = 0.5, technical = 0.5, special = 0)	"Depending on the recharge method, some mechanical maintenance may be required." (Compendium)	yes
			special		No information of any special material required. Availability of technical spare parts should be sufficient.	
0		FALSE FALSE		NA NA		NA NA
0 temperature		FALSE		NA	NA If the ground is frozen, water disposal might not be possible	NA
temperature	renormance, Categorical		cold	(ve. y colu = 0.5, colu = 0.7, temperate :	If the ground is frozen, water disposal might not be possible anymore.	yes
			temperate warm			
flooding	Performance, Categorical	TRUE	hot flooding	(flooding = 1, no flooding = 1)	For the technology "water disposal", the criterion "flooding"	yes
			no flooding	, ,	is considered to irrelevant. It should function successfully (100% performance) in flood prone areas without any issues.	
continue to a con-	Darfarman - Correct -	ENISE	no accore	NA .	(Akanksha Jain)	NA .
vehicular_acces	Performance, Categorical	INDE	no access difficult	ING.	NA	INO.
slope	Performance, Categorical	FALSE	full	NA .	NA .	NA .
soil_type	Performance, Categorical		not flat clay	(clay = 1, silt = 1. sand = 1. gravel = 1. re	Technology is relying on stormwater drains or on pipes with	yes
3011_type	and the second s		silt	. , ,	similar functionality to stormwater drains. Therefore the	
			gravel		technology uses lining material and does not rely on soil absorption.	
groundwater_depth	Performance, Trapez	TRUE	rock water depth [m]	(a = 3, b = 3, c = 999, d = 999)	"Groundwater recharge is increasing in popularity as	yes
					groundwater resources deplete and as saltwater intrusion becomes a greater threat to coastal communities. Although	
					the soil is known to act as a filter for a variety of contaminants, groundwater recharge should not be viewed	
					as a treatment method. Once an aquifer is ontaminated, it is	
					next to impossible to reclaim it." (Compendium) The effluent/water should not reach the groundwater.	
excavation	Performance, Categorical	TRUE	easy hard	(easy = 1, hard = 1)	Excavation is needed for the construction of the conveyance but not for disposal itself. No additional excavation needed.	yes
surface_area_onsite	Performance, Trapez	FALSE	[m2/plot]	NA .	NA NA	NA .
surface area offsite	Performance, Trapez			NA NA		NA NA
Surrace area offsite	0	FALSE	0	NA	NA	NA
0	0	FALSE FALSE	0	NA NA		NA NA
drinking_water_exposure	Performance, Categorical	TRUE	Close Not close	(close = 0, not close = 1)	"There are numerous models for the remediation potential of contaminants and microorganisms, but predicting	
					downstream or extracted water quality for a large suite of	
					parameters is rarely feasible. Therefore, potable and non- potable water sources should be clearly identified, the most	
					important parameters modelled and a risk assessment completed." (Compendium)	
					"Groundwater recharge is increasing in popularity as groundwater resources deplete and as saltwater intrusion	
					becomes a greater threat to coastal communities. Although	
					the soil is known to act as a filter for a variety of contaminants, groundwater recharge should not be viewed	
					as a treatment method. Once an aquifer is ontaminated, it is next to impossible to reclaim it." (Compendium)	
					The effluent/water should not reach a drinking water source.	
0		FALSE FALSE	0	NA NA		NA NA
construction_skills			Ladder:	(unskilled = 0, skilled = 1, professional	Construction skills are needed for the construction of the	yes
			unskilled skilled	= 1)	conveyance but not specifically for disposal itself. No high- level construction skills needed.	
design_skills	Performance, Categorical	TRUE	professional Ladder:	(unskilled = 0, skilled = 0, professional	"It is necessary to ensure that the assimilation capacity of the	yes
			unskilled skilled	= 1)	receiving water body is not exceeded, i.e. that the receiving body can accept the quantity of nutrients without being	
			professional		overloaded. Parameters such as turbidity, temperature,	
					suspended solids, BOD, nitrogen and phosphorus (among others) should be carefully controlled and monitored before	
					releasing any water into a natural body. Local authorities should be consulted to determine the discharge limits for the	
					relevant parameters as they can widely vary. For especially sensitive areas, a post-treatment technology (e.g.,	
					chlorination) may be required to meet microbiological limits.	
					The quality of water extracted from a recharged aquifer is a function of the quality of the wastewater introduced, the	
					method of recharge, the characteristics of the aquifer, the residence time, the amount of blending with other waters	
					and the history of the system. Careful analysis of these factors should precede any recharge project." (Compendium)	
					factors should precede any recharge project." (Compendium) Very complex design and therefore high design skills required.	
			•			

om_skills	Performance, Categorical	TRUE	Ladder:	(unskilled = 0, skilled = 0, professional	"Regular monitoring and sampling is important to ensure	yes	
			Unskilled	= 1)	compliance with regulations and to ensure public health		
			Skilled	· ·	requirements. Depending on the recharge method, some		
			Professional		mechanical maintenance may be required." (Compendium)		
					Since there is a complex design and due to the monitoring		
					and sampling high OM skills are highly recommended.		
0	0	FALSE	C	NA NA	NA	NA	
0		FALSE	0	NA NA	NA	NA	
0	0	FALSE	0	NA NA	NA	NA	
0	0	FALSE	0	NA NA	NA	NA	
cleansing_method	Performance, Categorical		Washers	NA	NA .	NA	
			Soft wipers				
			Hard wipers				
0		FALSE		NA	NA .	NA	
0		FALSE	0	NA	NA .	NA	
lifetime	Performance, Categorical	TRUE	short (< 1 year)	(short = 1, medium = 1, long = 1)	The concept of discharging effluent into waterbodies does	yes	
			medium (1-5 years)		not have a lifetime and can therefore be used for the short-		
			long (>5 years)		or long-term. (Kukka Ilmanen, Eawag 2021)		
speed_implement_toilet	PDF, Categorical	FALSE	rapid (< 3 days)	NA	NA .	NA	
			moderate (3 days to 2 weeks)				
			slow (> 2 weeks)				
speed_implement_treatment	PDF, Categorical	FALSE	rapid (few days to a week)	NA	NA .	NA.	
			moderate (few weeks up to three				
			months)				
			slow (> 3 months)				
scalability	Performance, Categorical	FALSE	easy	NA	NA .	NA	
			difficult				
construction_parts	PDF, Categorical	TRUE	simple	(simple = 0.7, technical = 0.3, special	"Depending on the recharge method, some mechanical	yes	
			technical	= 0)	maintenance may be required." (Compendium)		
			special		No information of any special material required. Availability		
					of technical parts should be sufficient.		
Transfer Coefficients	(copied from "Sanitation_Technologies_TC_database_2021						
		Range	Airloss	Soilloss	Waterloss	Comments	Reference
TP	0	-	()	0 1		PA
med (R)	0	-	(0	0		-
k	100				-		PA
TN	0	-	C		0 1		PA
med (R)	0	-	((0 1		-
k	100				•		PA
H20	0				0 1		PA
med (R)	0	-)	0 1		-
k	100				•		PA
TS	0				0 1		PA
med (R)	0	-	((0 1		-
k	100				•		PA

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		Surface Disposal and Storage				
	Values	Surface Disposal and Storage Data Source				
FUNCTIONAL GROUP UNIQUE IDENTIFIER (ID)	D surface_disposal_and_storage	-				
DATA COMPILER	SaniChoice Project Team	•				
INPUT PRODUCT	dried_faeces, transporteddried_faeces,	Spuhler, D. & Roller, L. (2020)				
	processed_sludge,					
	transportedprocessed_sludge,					
	stabilized_sludge, transportedstabilized_sludge,					
	pithumus, transportedpithumus,					
OUTPUT PRODUCT		Spuhler, D. & Roller, L. (2020)	1			
RELATIONS	Input: OR	Spuhler, D. & Roller, L. (2020)	<u> </u>			
COMMENTS	Output: NA					
e-Filter Criteria		Data Source	I.			
	(household = 0.5, neighbourhood =	Tilley, E. et al. (2014)				
management_level	0.5, city = 1) (household = 0.5, shared = 1, public =	Tilley, E. et al. (2014)	†			
	1)					
capex_req_level opex_req_level		Spuhler, D. et al. (2021) Spuhler, D. et al. (2021)				
technical_maturity	3	Tilley, E. et al. (2014)				
development_phase	(acute = 1, stabilisation = 0.5, development/recovery = 1	"Immediate Surface Disposal sites can later be upgraded to more				
		advanced Sanitary				
		Landfills by retrofitting leachate piping and lining materials				
		for groundwater protection. An				
		engineered Sanitary				
		Landfill needs expert technical design." (Gensch, R. et al. (2018))				
		design." (Gensch, R. et al. (2018)) For 'development/recovery' 100%				
		suitability instead of 50% were				
		allotted. The reasoning was that a landfills are often used in				
		development projects and can				
		become more appropriate by upgrading them. (Kukka Ilmanen,				
		Eawag 2021)				
		Applicable for this Functional Group?		Technology Values (Data)		Internal Review Done?
water_supply	Performance, Categorical	FALSE	house yard	IVA	NA	INA.
			public			
water_volume	Performance, Trapez	FALSE	none [L/cap/day]	NA	NA	NA
electricity_supply	Performance, Categorical	TRUE	electricity	(electricity = 1, intermittent = 1, no elec		yes
			intermittent no electricity			
fuel_supply	Performance, Categorical	FALSE	fuel	NA	NA	NA
frequency_of_om	PDF, Categorical	TRUE	no fuel irregular	(irregular = 0.5, regular = 0.5,	"Little operation skills or maintenance	yes
equency_or_om	r or, categorical		regular	continous = 0)	required" (Compendium)	,
			continuous		No additional operation and maintenance	
					required but to deposit materials (perhaps by hand).	
pipe_supply	Performance, Categorical	TRUE	no pipes		No pipes needed.	yes
			difficultly available pipes	pipes = 1)		
pump_supply	Performance, Categorical	TRUE	no pumps	(no pumps = 1, difficultly available = 1,	No pumps needed.	yes
			difficultly available pumps	pumps = 1)		
concrete_supply	Performance, Categorical	TRUE	no concrete		No concrete needed.	yes
			difficultly available	1, concrete = 1)		
spare_parts	PDF, Categorical	TRUE	concrete simple		"For more advanced systems, leachate	yes
			technical	0.1)	piping and liner materials are needed and	
			special		possibly piping to collect the gas produced. For some landfill uses it is advised to cover	
					the waste and therefore a waterproof	
					cover is needed." (Emersan) "May require special spreading	
					equipment" (Compendium)	
					This special spreading equipment might require specially-manufactured spare parts.	
					What kind of spare parts are needed is	
ļ					depending on what equipment is used.	
					The larger the scale of the application the more technical equipment might be	
					required.	
0	n	FALSE	n	NA	NA	NA
0	0	FALSE	0	NA	NA	NA
0 temperature	0 Performance, Categorical	FALSE TRUE	very cold	NA (very cold = 1, cold = 1, temperate = 1,	NA "Surface disposal and storage can be	NA yes
temperature	· errormance, categorical		cold	, colo - 1, colo - 1, temperate = 1,	practiced in almost	,
			temperate		every climate []." (Compendium)	
			warm hot		Feasible for all temperatures.	
flooding	Performance, Categorical	TRUE	flooding	(flooding = 0.1, no flooding = 1)	"Surface disposal and storage can be	yes
			no flooding		practiced in almost every climate and environment, although	
					they may not	
					be feasible where there is frequent flooding or where	
					the groundwater table is high."	
					(Compendium)	
					This technology is generally not suited for	
					flood prone areas as its functioning is	
ļ					hampered severely under inundation conditions. However, they are still	
					awarded a low performance of 10% as	
					there exists a possibility to construct these	
					technologies in elevated or non-flooded plot areas of a flood prone region.	
salsin to	Parforman C-+ ' '	ENICE	no access	NA.	(Akanksha Jain)	NA.
vehicular_acces	Performance, Categorical	FALSE	no access difficult	NA	NA	NA
,	Parforman C-+ '	EVICE	full	NA .	NA .	NA.
-1-	Performance, Categorical		flat not flat		NA	NA
slope	<u> </u>		clay	(clay = 1, silt = 1, sand = 0.5, gravel = 0.5	"If a surface disposal and storage site is	yes
slope soil_type	Performance, Categorical	TRUE		Ĺ	protected (e.g., by a fence) and located far	
	Performance, Categorical	TRUE	silt sand			
	Performance, Categorical	TRUE	sand gravel		from the public, there should be no risk of contact or nuisance. The contamination of	
	Performance, Categorical	TRUE	sand		contact or nuisance. The contamination of groundwater resources by leachate should	
	Performance, Categorical	TRUE	sand gravel		contact or nuisance. The contamination of groundwater resources by leachate should be prevented by adequate siting and	
	Performance, Categorical	TRUE	sand gravel		contact or nuisance. The contamination of groundwater resources by leachate should be prevented by adequate siting and design." (Compendium) Since a small risk of contaminating the	
	Performance, Categorical	TRUE	sand gravel		contact or nuisance. The contamination of groundwater resources by leachate should be prevented by adequate siting and design." (Compendium) Since a small risk of contaminating the groundwater remains the soil type has an	
	Performance, Categorical	TRUE	sand gravel		contact or nuisance. The contamination of groundwater resources by leachate should be prevented by adequate sting and design. "Compendium) Since a small risk of contaminating the groundwater remains the soil type has an influence on the performance. On sandy, gravelly or rocky ground the water seeps	
	Performance, Categorical	TRUE	sand gravel		contact or nuisance. The contamination of groundwater resources by leachast should be prevented by adequate siting and design." (Compendium) Since a small risk of contaminating the groundwater remains the soil type has an influence on the performance. On sandy, grawelly or rocky ground the water seeps away faster and contamination is teasier	
	Performance, Categorical	TRUE	sand gravel		contact or nuisance. The contamination of groundwater resources by leachate should be prevented by adequate sting and design. "Compendium) Since a small risk of contaminating the groundwater remains the soil type has an influence on the performance. On sandy, gravelly or rocky ground the water seeps	

		ı	1		1	
groundwater_depth	Performance, Trapez		water depth [m]	(a = 3, b = 3, c = 999, d = 999)	"If a surface disposal and storage site is protected (e.g., by a fence) and located far from the public, there should be no risk of contact or nuisance. The contamination of groundwater resources by leachase should be prevented by adequate siting and design." (Compendium) "Surface disposal and storage can be practiced in almost every climate and environment, although they may not be feasible where there is frequent flooding or where the groundwater table is high." (Compendium) Since a small risk of contamination remains the application at areas with a high groundwater table is not recommended. "The contamination of groundwater	yes
			hard		resources by leachate should be prevented by adequate siting and design." (Compendium) The construction for example of a drainage to prevent the leachate to reach groundwater could require some excavation. However also designs excluding excavation are possible.	
surface_area_onsite	Performance, Trapez	FALSE	[m2/plot]	NA	NA	NA
surface_area_offsite	Performance, Trapez	FALSE	m2/pers	NA	NA	NA
0		FALSE FALSE		NA NA	NA NA	NA NA
0	0	FALSE	(NA NA	NA	NA NA
drinking_water_exposure	Performance, Categorical	TRUE	Close Not close	(close = 0.5, not close = 1)	"If a surface disposal and storage site is protected (e.g., by a fence) and located far from the public, there should be no risk of contact or nuisance. The contamination of groundwater resources by leachate should be prevented by adequate siting and design." (Compendium) Since a small risk of contamination remains the application close to a drinking water source is not recommended. However it can be built safe but therefore more effort is needed.	
0		FALSE	(NA NA	NA	NA
0 construction_skills	Performance, Categorical	FALSE TRUE	Ladder:	(unskilled = 0, skilled = 1, professional	NA Construction skills are needed for the	yes NA
design_skills	Performance, Categorical		unskilled skilled professional Ladder:	= 1) (unskilled = 0, skilled = 0.5,	construction of the conveyance but not for disposal itself. No high-level construction skills needed. "The main difference between surface	yes
om_skills	Performance, Categorical		unskilled skilled professional	professional = 1) [unskilled = 1, skilled = 1, professional	disposal and land application rate. There is no limit to the quantity of sludge that can be applied to the surface no limit to the surface since nutrient loads or agronomic rates are not a concern. Attention must be paid, however, to groundwater contamination and leaching. More advanced surface disposal systems may incorporate a liner and leachate collection system in order to prevent nutrients and ontaminants from infiltrating the groundwater. Sites for the temporary storage of a product should be covered to avoid rewetting by rainwater and the generation of leachate." (Compendum) For a simple design without any security measures low design sillis could be sufficient. However, for a safer design that prevents the ground from being contaminated high design sillis are recommended.	yes
0		FALSE	Unskilled Skilled Professional	= 1) NA	required" (Compendium) "Staff should ensure that only appropriate materials are disposed of at the site and must maintain control over the traffic and hours of operation. Workers should wear appropriate protective clothing." [Compendium] NA	NA NA
0	0	FALSE		NA NA	NA	NA
0		FALSE FALSE		NA NA	NA NA	NA NA
cleansing_method	Performance, Categorical	FALSE	Washers Soft wipers Hard wipers	NA	NA	NA
0	0	FALSE FALSE		NA NA	NA NA	NA NA
lifetime	Performance, Categorical	TRUE	short (: 1 year) medium (1-5 years) long (>5 years)	(short = 1, medium = 1, long = 1)	"Surface Disposal and Sanitary Landfills can be suitable options for sludge disposal during an acute response phase, if there is land available away from human contact and waterbodies. Immediate Surface Disposal sites can later be upgraded to more advanced Sanitary Landfills by retrofitting leachate piping and lining materials for groundwater protection." (Emersan) Surface Disposal can be used in the short-term, but also in the long-term in upgraded facilities as long as sufficient space is available.	yes
speed_implement_toilet	PDF, Categorical PDF, Categorical		rapid (< 3 days) moderate (3 days to 2 weeks) slow (> 2 weeks) rapid (few days to a week)	NA NA	NA NA	NA NA
speed_implement_treatment	rDF, Categorical	FALSE	rapid (few days to a week) moderate (few weeks up to three months) slow (> 3 months)	IN/A	INFA	INFA
scalability	Performance, Categorical	FALSE	easy	NA	NA	NA
		1	difficult	1	1	

							3
construction_parts	PDF, Categorical	TRUE	simple	(simple = 0.4, technical = 0.5, special =	"For more advanced systems, leachate	yes	
			technical	0.1)	piping and liner materials are needed and		
			special		possibly piping to collect the gas produced.		
					For some landfill uses it is advised to cover		
					the waste and therefore a waterproof		
					cover is needed." (Emersan)		
					For larger scale applications more		
					technical equipment (piping) might be		
					required.		
					"May require special spreading		
					equipment" (Compendium)		
					This special spreading equipment might		
					need to be specially manufactured.		
	(copied from "Sanitation_Technologies_TC_database_202	10622.xlsm")					
	Recovered	Range	Airloss		Waterloss		Reference
TP	Recovered 0	Range -	Airloss 0	Soilloss 0.97		Inspired by application of compost and	Reference PA
TP	Recovered 0	Range -	Airloss 0	0.97	0.03	Inspired by application of compost and application of Processed sludge	
	0	-	Airloss 0		0.03	Inspired by application of compost and application of Processed sludge	PA -
TP med (R)	0 0 25	-	0	0.97	0.03	Inspired by application of compost and application of Processed sludge	PA - PA
TP med (R) k	0	-	0.01	0.97 0.97 0.96	0.03	Inspired by application of compost and application of Processed sludge	PA -
TP med (R)	0 0 25 0	-	0	0.97 0.97 0.96	0.03	Inspired by application of compost and application of Processed sludge	PA - PA
TP med (R) k TN med (R) k	0	-	0.01 0.01	0.97 0.97 0.96 0.96	0.03 0.03 0.03 0.03	Inspired by application of compost and application of Processed sludge Some air loss, otherwise as above	PA
TP med (R) k TN	0 0 25 0	-	0.01	0.97 0.97 0.96 0.96	0.03 0.03 0.03 0.03	Inspired by application of compost and application of Processed sludge	PA
TP med (R) k TN med (R) k 4 R) H20	0 0 25 0	-	0.01 0.01	0.97 0.97 - 0.96 0.96	0.03 0.03 0.03 0.03	Inspired by application of compost and application of Processed sludge Some air loss, otherwise as above more airloss than soil loss, otherwise like	PA
TP med (R) k TN med (R) k	0 0 25 0		0.01 0.01 0.03	0.97 0.97 - 0.96 0.96	0.03 0.03 0.03 0.03	Inspired by application of compost and application of Processed sludge Some air loss, otherwise as above more airloss than soil loss, otherwise like	PA
TP med (R) k TN med (R) k 4 R) H20	0 0 25 0 0 25 0		0.01 0.01 0.03	0.97 0.97 0.96 0.96 0.96	0.03 0.03 0.03 0.03 0.03	Inspired by application of compost and application of Processed sludge Some air loss, otherwise as above more airloss than soil loss, otherwise like	PA
TP med (R) k TN med (R) k 4 R) H20	0 0 25 0 0 25 0		0.01 0.01 0.03	0.97 0.97 0.96 0.96 0.96	0.03 0.03 0.03 0.03 0.03	Inspired by application of compost and aspolication of Processed sludge Some air loss, otherwise as above more airloss than soil loss, otherwise like p Same as for water	PA PA PA PA PA PA PA PA PA PA PA PA PA P
med (R) # TN med (R) # K TN H # # # # # # # # # # # # # # # # # #	0 0 25 0 0 25 0		0.01 0.01 0.01 0.03 0.03	0.97 0.97 0.96 0.96 0.96	0.03 0.03 0.03 0.03 0.03	Inspired by application of compost and aspolication of Processed sludge Some air loss, otherwise as above more airloss than soil loss, otherwise like p Same as for water	PA PA PA PA PA PA PA PA PA PA PA PA PA P

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orehole Latrine	Values	Data Source					
FUNCTIONAL GROUP	D						
UNIQUE IDENTIFIER (ID)		-	-				
	Matthias van Sloten faeces, excreta, blackwater	Gensch, R. et al. (2018)	†				
OUTPUT PRODUCT	NA	Gensch, R. et al. (2018)]				
RELATIONS	Input: OR Output: NA	Gensch, R. et al. (2018)					
COMMENTS			-				
re-Filter Criteria	Values	Data Source					
applicability_level	(household = 1, neighbourhood = 1,	Gensch, R. et al. (2018)					
management level	city = 0) (household = 1, shared = 1, public =	Gensch, R. et al. (2018)	†				
	0.5)						
capex_req_level		Spuhler, D. et al. (2021)	-				
opex_req_level technical_maturity		Spuhler, D. et al. (2021) Gensch, R. et al. (2018)	-				
	(acute = 1, stabilisation = 0.5,	Gensch, R. et al. (2018)	1				
creening Criteria	development/recovery = 0)	Applicable for this Functional Group?	Catagories [Unit]	Tashnalagu Values (Data)	Data Saurea / Assumptions	Internal Review Done?	
water_supply	Type and Function Performance, Categorica		house	Technology Values (Data) NA	Data Source / Assumptions NA	NA NA	
			yard				
			public none				
water_volume	Performance, Trape	FALSE	[L/cap/day]	NA	NA	NA	
electricity_supply			electricity	(electricity = 1, intermittent = 1, no elec		yes	
			intermittent no electricity				
fuel_supply	Performance, Categorica	FALSE	fuel	NA	NA	NA	
			no fuel				
frequency_of_om	PDF, Categorica	TRUE	irregular	(irregular = 0.5, regular = 0.5,	"General operation and maintenance (O & M) measures include routine	yes	
			regular continuous	continous = 0)	(O & M) measures include routine tasks such as checking the availability		
					of water to ensure personal hygiene,		
					of soap and dry cleansing material and		
					monitoring the condition and fill level of the hole. Particular attention		
					should be paid to the cleanliness of		
					the top of the borehole. This is easily		
					soiled and will quickly begin to smell		
					and harbour flies if not regularly cleaned. As desludging is usually not		
					an option the latrine should be		
					decommissioned X.6 when filled up to		
					the top 0.5 m of the hole." (Emersan)		
					Maintenance is between regular and irregular.		
	D	TRUE	ne pines	(no pines = 0 difficulti	"Ear the herel- !- !- !- !	wes	
pipe_supply	Performance, Categorica	TRUE	no pipes difficultly available	(no pipes = 0, difficultly available = 0.5, pipes = 1)	"For the borehole lining, a pipe should be used, with a minimum length of 0.5	yes	
			pipes	F-F-3 - 41	m and corresponding to the borehole		
					diameter.","diameter usually between		
					0.3 to 0.5m."(Emersan)		
pump_supply	Performance, Categorica	TRUE	no pumps	(no pumps = 1, difficultly available = 1,	No need for numps.	yes	
F=b_20bbis			difficultly available	pumps = 1)	and the second		
			pumps				
concrete_supply	Performance, Categorica	TRUE	no concrete difficultly available	(no concrete = 0.75, difficultly available = 0.75, concrete = 1)	"The user interface can be made out of wood, bamboo, concrete or	yes	
			difficultly available concrete	available - 0.75, concrete = 1)	of wood, bamboo, concrete or prefabricated plastic. For the		
					superstructure, materials should be		
					used that are readily available and		
					that can be applied rapidly (e.g. bamboo, grass matting, cloth, wood,		
					plastic or metal sheeting)." (Emersan)		
					Concrete not necessary, but can		
					perform a bit better for long-term		
					solutions compared to local materials with shorter lifetimes.		
					with shorter metimes.		
spare_parts	PDF, Categorica	TRUE	simple	(simple = 1, technical = 0, special = 0)	"To construct a Borehole Latrine a	yes	
			technical		manual or mechanical auger or a		
			special		requirement. The user interface can		
					be made out of wood, bamboo,		
					concrete or prefabricated plastic. For		
					the superstructure, materials should be used that are readily available and		
					that can be applied rapidly (e.g.		
					bamboo, grass matting, cloth, wood,		
					plastic or metal sheeting)." (Emersan)		
					The drill is only required for the construction and is not needed as a		
	1				spare part. The spare parts can be		
					made from local material.		
						i l	
	,	ENISE		NA	NA.	NA	
0		FALSE FALSE		NA NA	NA NA	NA NA	
0 0 0	(FALSE FALSE	0	NA NA	NA NA	NA NA	
0	(FALSE FALSE	0 very cold	NA	NA NA A borehole latrine can be built in	NA	
0	(FALSE FALSE	very cold cold	NA NA	NA NA A borehole latrine can be built in colder climates but there has to be	NA NA	
0	(FALSE FALSE	very cold cold temperate	NA NA	NA NA A borehole latrine can be built in colder climates but there has to be taken in account that leachate	NA NA	
0	(FALSE FALSE	very cold cold	NA NA	NA NA A borehole latrine can be built in coider climates but there has to be taken in account that leachate respectively soil absorbtion performance can be lower if the	NA NA	
0 0 temperature	Performance, Categorica	IFALSE FALSE TRUE	very cold cold temperate warm hot	NA NA (very cold = 0.5, cold = 0.7, temperate :	NA A borehole latrine can be built in colder climates but there has to be taken in account that leachate respectively soil absorbtion performance can be lower if the bottom of the pit is frozen.	NA NA yes	
0	Performance, Categorica	IFALSE FALSE TRUE	very cold cold temperate warm hot flooding	NA NA	NA NA A borehole latrine can be built in colder climates but there has to be taken in account that leachate respectively soil absorbtion performance can be lower if the bottom of the pit is frozen. "As with all pit-based systems,	NA NA	
0 0 temperature	Performance, Categorica	IFALSE FALSE TRUE	very cold cold temperate warm hot	NA NA (very cold = 0.5, cold = 0.7, temperate :	NA A borehole latrine can be built in colder climates but there has to be taken in account that leachate respectively soil absorbtion performance can be lower if the bottom of the pit is frozen. 'As with all pit-based systems, groundwater contamination can be an	NA NA yes	
0 0 temperature	Performance, Categorica	IFALSE FALSE TRUE	very cold cold temperate warm hot flooding	NA NA (very cold = 0.5, cold = 0.7, temperate :	NA NA A borehole latrine can be built in colder climates but there has to be taken in account that leachate respectively soil absorbtion performance can be lower if the bottom of the pit is frozen. "As with all pit-based systems,	NA NA yes	
0 0 temperature	Performance, Categorica	IFALSE FALSE TRUE	very cold cold temperate warm hot flooding	NA NA (very cold = 0.5, cold = 0.7, temperate :	NA A borehole latrine can be built in colder climates but there has to be taken in account that leachate respectively soil absorbtion performance can be lower if the bottom of the pit is frozen. "As with all pit-based systems, groundwater contamination can be an issue and soil properties such as the permeability of the soil and groundwater collect should be properly groundwater clevel should be properly	NA NA yes	
0 0 temperature	Performance, Categorica	IFALSE FALSE TRUE	very cold cold temperate warm hot flooding	NA NA (very cold = 0.5, cold = 0.7, temperate :	NA A borehole latrine can be built in colder climates but there has to be taken in account that leachate respectively soil absorbtion performance can be lower if the bottom of the pit is frozen. "As with all pit-based systems, groundwater contamination can be an issue and soil properties such as the permeability of the soil and groundwater level should be properly assessed X.3 to identify the minimum	NA NA yes	
0 0 temperature	Performance, Categorica	IFALSE FALSE TRUE	very cold cold temperate warm hot flooding	NA NA (very cold = 0.5, cold = 0.7, temperate :	NA A borehole latrine can be built in colder climates but there has to be taken in account that leachate respectively soil absorbtion performance can be lower if the bottom of the pit is frozen. 'As with all pit-based systems, groundwater contamination can be an issue and soil properties such as the permeability of the soil and groundwater colt the soil and groundwater colt the soil and groundwater level should be properly assessed X.3 to identify the minimum distance to the next water source and	NA NA yes	
0 0 temperature	Performance, Categorica	IFALSE FALSE TRUE	very cold cold temperate warm hot flooding	NA NA (very cold = 0.5, cold = 0.7, temperate :	NA A borehole latrine can be built in colder climates but there has to be taken in account that leachate respectively soil absorbtion performance can be lower if the bottom of the pit is frozen. "As with all pit-based systems, groundwater contamination can be an issue and soil properties such as the permeability of the soil and groundwater level should be properly assessed X.3 to identify the minimum distance to the next water source and limit exposure to microbial contamination," (Emersan)	NA NA yes	
0 0 temperature	Performance, Categorica	IFALSE FALSE TRUE	very cold cold temperate warm hot flooding	NA NA (very cold = 0.5, cold = 0.7, temperate :	NA A borehole latrine can be built in colder climates but there has to be taken in account that leachate respectively soil absorbtion performance can be lower if the bottom of the pit is frozen. "As with all pit-based systems, groundwater contamination can be an issue and soil properties such as the permeability of the soil and groundwater level should be properly assessed X.3 to identify the minimum distance to the next water source and limit exposure to microbial contamination." (Emersan) A low performance of 10% is allotted	NA NA yes	
0 0 temperature	Performance, Categorica	IFALSE FALSE TRUE	very cold cold temperate warm hot flooding	NA NA (very cold = 0.5, cold = 0.7, temperate :	NA A borehole latrine can be built in colder climates but there has to be taken in account that leachate respectively soil absorbtion performance can be lower if the bottom of the pit is frozen. *As with all pit-based systems, groundwater contamination can be an issue and soil properties such as the permeability of the soil and groundwater level should be properly assessed X.3 to identify the minimum distance to the next water source and limit exposure to microbial contamination." (Emersan) A low performance of 10% is allotted to the category "flooding" given that	NA NA yes	
0 0 temperature	Performance, Categorica	IFALSE FALSE TRUE	very cold cold temperate warm hot flooding	NA NA (very cold = 0.5, cold = 0.7, temperate :	NA A borehole latrine can be built in colder climates but there has to be taken in account that leachate respectively soil absorbtion performance can be lower if the bottom of the pit is frozen. "As with all pit-based systems, groundwater contamination can be an issue and soil properties such as the permeability of the soil and groundwater level should be properly assessed X.3 to identify the minimum distance to the next water source and limit exposure to microbial contamination." (Emersan) A low performance of 10% is allotted to the category "flooding" given that there exists the possibility that	NA NA yes	
0 0 temperature	Performance, Categorica	IFALSE FALSE TRUE	very cold cold temperate warm hot flooding	NA NA (very cold = 0.5, cold = 0.7, temperate :	NA A borehole latrine can be built in colder climates but there has to be taken in account that leachate respectively soil absorbtion performance can be lower if the bottom of the pit is frozen. *As with all pit-based systems, groundwater contamination can be an issue and soil properties such as the permeability of the soil and groundwater level should be properly assessed X.3 to identify the minimum distance to the next water source and limit exposure to microbial contamination." (Emersan) A low performance of 10% is allotted to the category "flooding" given that	NA NA yes	
0 0 temperature	Performance, Categorica	IFALSE FALSE TRUE	very cold cold temperate warm hot flooding	NA NA (very cold = 0.5, cold = 0.7, temperate :	NA A borehole latrine can be built in colder climates but there has to be taken in account that leachate respectively soil absorbtion performance can be lower if the bottom of the pit is frozen. "As with all pit-based systems, groundwater contamination can be an issue and soil properties such as the permeability of the soil and groundwater level should be properly assessed X.3 to identify the minimum distance to the next water source and limit exposure to microbial contamination." (Emersan) A low performance of 10% is allotted to the category "flooding" given that there exists the possibility that borehole latrines could be built at elevated/non-flooded plot areas of the flood-prone region. (Akanisha	NA NA yes	
0 0 temperature	Performance, Categorica Performance, Categorica	FALSE FALSE TRUE	very cold cold temperate warm hot flooding no flooding	NA (very cold = 0.5, cold = 0.7, temperate: (flooding = 0.1, no flooding = 1)	NA A borehole latrine can be built in colder climates but there has to be taken in account that leachate respectively soil absorbtion performance can be lower if the bottom of the pit is frozen. *As with all pit-based systems, groundwater contamination can be an issue and soil properties such as the permeability of the soil and groundwater level should be properly assessed X3 to identify the minimum distance to the next water source and limit exposure to microbial contamination." (Emersan) A low performance of 10% is allotted to the category "flooding" given that there exists the possibility that borehole latrines could be built at elevated/ non-flooded plot areas of the flood-prone region. (Akanisha Jain)	NA NA Yes	
0 0 temperature	Performance, Categorica Performance, Categorica	FALSE FALSE TRUE	very cold cold temperate warm hot flooding no flooding	NA NA (very cold = 0.5, cold = 0.7, temperate :	NA A borehole latrine can be built in colder climates but there has to be taken in account that leachate respectively soil absorbtion performance can be lower if the bottom of the pit is frozen. "As with all pit-based systems, groundwater contamination can be an issue and soil properties such as the permeability of the soil and groundwater level should be properly assessed X.3 to identify the minimum distance to the next water source and limit exposure to microbial contamination." (Emersan) A low performance of 10% is allotted to the category "flooding" given that there exists the possibility that borehole latrines could be built at elevated/non-flooded plot areas of the flood-prone region. (Akanisha	NA NA yes	
0 0 temperature flooding	Performance, Categorica Performance, Categorica Performance, Categorica	FALSE TRUE TRUE	very cold cold temperate warm hot flooding no flooding no flooding flooding flooding flooding flooding flooding flooding flooding flooding flooding flooding flooding flooding flooding flooding flooding flooding flooding	NA (very cold = 0.5, cold = 0.7, temperate: (flooding = 0.1, no flooding = 1)	NA A borehole latrine can be built in colder climates but there has to be taken in account that leachate respectively soil absorbtion performance can be lower if the bottom of the pit is frozen. "As with all pit-based systems, groundwater contamination can be an issue and soil properties such as the permeability of the soil and groundwater level should be properly assessed X.3 to identify the minimum distance to the next water source and limit exposure to microbial contamination." (Emersan) A low performance of 10% is allotted to the category "flooding" given that there exists the possibility that borehole latrines could be built at elevated /non-flooded plot areas of the flood-prone region. (Akanksha Jain)	NA NA Yes yes	
0 0 temperature	Performance, Categorica Performance, Categorica Performance, Categorica	FALSE TRUE TRUE	very cold cold temperate warm hot flooding no flooding no flooding	NA (very cold = 0.5, cold = 0.7, temperate: (flooding = 0.1, no flooding = 1)	NA A borehole latrine can be built in colder climates but there has to be taken in account that leachate respectively soil absorbtion performance can be lower if the bottom of the pit is frozen. *As with all pit-based systems, groundwater contamination can be an issue and soil properties such as the permeability of the soil and groundwater level should be properly assessed X3 to identify the minimum distance to the next water source and limit exposure to microbial contamination." (Emersan) A low performance of 10% is allotted to the category "flooding" given that there exists the possibility that borehole latrines could be built at elevated/ non-flooded plot areas of the flood-prone region. (Akanisha Jain)	NA NA Yes	
0 0 temperature flooding	Performance, Categorica Performance, Categorica Performance, Categorica	FALSE TRUE TRUE	very cold cold temperate warm hot flooding no flooding no flooding flooding flooding flooding flooding flooding flooding flooding flooding flooding flooding flooding flooding flooding flooding flooding flooding flooding	NA (very cold = 0.5, cold = 0.7, temperate: (flooding = 0.1, no flooding = 1)	NA A borehole latrine can be built in colder climates but there has to be taken in account that leachate respectively soil absorbtion performance can be lower if the bottom of the pit is frozen. "As with all pit-based systems, groundwater contamination can be an issue and soil properties such as the permeability of the soil and groundwater level should be properly assessed X.3 to identify the minimum distance to the next water source and limit exposure to microbial contamination." (Emersan) A low performance of 10% is allotted to the category "flooding" given that there exists the possibility that borehole latrines could be built at elevated /non-flooded plot areas of the flood-prone region. (Akanksha Jain)	NA NA Yes yes	
0 0 temperature flooding	Performance, Categorica Performance, Categorica Performance, Categorica	FALSE TRUE TRUE	very cold cold temperate warm hot flooding no flooding no flooding	NA (very cold = 0.5, cold = 0.7, temperate: (flooding = 0.1, no flooding = 1)	NA A borehole latrine can be built in colder climates but there has to be taken in account that leachate respectively soil absorbtion performance can be lower if the bottom of the pit is frozen. "As with all pit-based systems, groundwater contamination can be an issue and soil properties such as the permeability of the soil and groundwater level should be properly assessed X.3 to identify the minimum distance to the next water source and limit exposure to microbial contamination." (Emersan) A low performance of 10% is allotted to the category "flooding" given that there exists the possibility that borehole latrines could be built at elevated /non-flooded plot areas of the flood-prone region. (Akanksha Jain)	NA NA Yes yes	

soil_type	Performance, Categorical	TRUE	clay	(clay = 0.25, silt = 0.5, sand = 1, gravel =	"Special attention should be paid to	yes	1
331,75			silt	(,,,,8	[] ground conditions and soil	,	
			sand gravel		permeability. Poorly permeable soil will increase the rate at which the		
			rock		borehole fills." (Emersan)		
					"The soil needs to be stable and free of rock, gravel and boulders."		
					(Emersan)		
					Soil percolation and filtration is desired resulting in lower desludging		
					rates.		
groundwater_depth	Performance, Trapez	TRUE	water depth [m]	(a = 8, b = 13, c = 999, d = 999)	"Depending on the soil type and	yes	
					drilling equipment the borehole should be between 5 to 10 m deep		
					with a diameter of usually between		
					0.3 to 0.5m." (Emersan)		
					"Groundwater contamination might be an issue" (Emersan)		
excavation	Performance, Categorical	TRUE	easy	(easy = 1, hard =0.5)	"Depending on the soil type and	yes	
			hard		drilling equipment the borehole should be between 5 to 10 m deep		
					with a diameter of usually between		
					0.3 to 0.5m." (Emersan) Volume of excavation is not that big.		
					In areas where excavation is hard the		
					construction is still possible but		
					therefore it gets more labour intensive.		
surface_area_onsite	Performance, Trapez	FALSE	[m2/plot]	NA	NA	NA	
surface_area_offsite	Performance, Trapez	FAICE	m2/pers	NA	NA	NA	
Surface_area_offsite		FALSE		NA NA	NA NA	NA NA	
0		FALSE		NA	NA	NA	
0 drinking_water_exposure	Performance, Categorical	FALSE TRUF	Close	NA (close = 0, not close = 1)	"As with all pit-based systems,	NA yes	
292			Not close	(groundwater contamination can be an	,	
					issue and soil properties such as the permeability of the soil and		
					groundwater level should be properly		
					assessed X.3 to identify the minimum		
					distance to the next water source and limit exposure to microbial		
					contamination." (Emersan)		
0		FALSE FALSE		NA NA	NA NA	NA NA	
construction_skills			Ladder:	(unskilled = 0, skilled = 1, professional	"Quick to construct" (Emersan)	yes	
			unskilled	= 1)	Requires the operation of drilling		
			skilled professional		equipment.		
design_skills	Performance, Categorical	TRUE	Ladder:	(unskilled = 0, skilled = 0.5,	Special attention should be paid to the	yes	
			unskilled skilled	professional = 1)	expected groundwater level and the associated risks of groundwater		
			professional		pollution as well as the topography,		
					ground conditions and soil		
					permeability. Poorly permeable soil will increase the rate at which the		
					borehole fills.		
					Some design knowledge required to identify the location of the latrine.		
om_skills	Performance, Categorical	TRUE	Ladder:	(unskilled = 0.5, skilled = 1,	"General operation and maintenance	yes	
			Unskilled Skilled	professional = 1)	(O & M) measures include routine		
			Professional		tasks such as checking the availability of water to ensure personal hygiene,		
					of soap and dry cleansing material and		
					monitoring the condition and fill level		
					monitoring the condition and fill level of the hole. Particular attention should be paid to the cleanliness of the top of the borehole. This is easily		
					monitoring the condition and fill level of the hole. Particular attention should be paid to the cleanliness of		
					monitoring the condition and fill level of the hole. Particular attention should be paid to the cleanliness of the top of the borehole. This is easily soiled and will quickly begin to smell and harbour files if not regularly cleaned. As desludging is usually not		
					monitoring the condition and fill level of the hole. Particular attention should be paid to the cleanliness of the top of the borehole. This is easily soiled and will quickly begin to smell and harbour files if not regularly cleaned. As desludging is usually not an option the latrine should be		
					monitoring the condition and fill level of the hole. Particular attention should be paid to the cleanliness of the top of the borehole. This is easily soiled and will quickly begin to smell and harbour files if not regularly cleaned. As desludging is usually not		
					monitoring the condition and fill level of the hole. Particular attention should be paid to the cleanliness of the top of the borehole. This is easily soiled and will quickly begin to smell and harbour flies if not regularly cleaned. As desludging is usually not an option the latrine should be decommissioned X.6 when filled up to the top 0.5 m of the hole." (Emersan)		
					monitoring the condition and fill level of the hole. Particular attention should be paid to the cleanliness of the top of the borehole. This is easily soiled and will quickly begin to smell and harbour files if not regularly cleaned. As desludging is usually not an option the latrine should be decommissioned X.6 when filled up to		
					monitoring the condition and fill level of the hole. Particular attention should be paid to the cleanliness of the top of the borehole. This is easily soled and will quickly begin to soled and will quickly begin to sually not cleaned. As deskudging is usually not an option the latrine should be decommissioned X.6 when filled up to the top 0.5 m of the hole." (Emersan) The only crucial thing is determining		
					monitoring the condition and fill level of the hole. Particular attention should be paid to the cleanliness of the top of the borehole. This is easily soled and will quickly begin to soled and will quickly begin to sually not cleaned. As deskudging is usually not an option the latrine should be decommissioned X.6 when filled up to the top 0.5 m of the hole." (Emersan) The only crucial thing is determining		
0	0	FALSE		NA NA	monitoring the condition and fill level of the hole. Particular attention should be paid to the cleanliness of the top of the borehole. This is easily soiled and will quickly begin to smell and harbour flies if not regularly cleaned. As deskudging is usually not an option the latrine should be decommissioned X.6 when filled up to the top 0.5 m of the hole." (Emersan) The only crucial thing is determining when to decommission the latrine. NA	NA NA	
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k	100						PA
TN	0	-	0	1			PA
med (R)	0	-	0	1	C		-
k	100						PA
H2O	0	-	0	1	C)	PA
med (R)	0	-	0	1	C		-
k	100						PA
TS	0	-	0	1	C		PA
med (R)	0	-	0	1	C		-
k	100						PA

Additional Information

All the inputs of the borehole latrine end up as losses, no products recovered.

Spuhler et al. (2021)

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