Milestone 3: Script of our design

Policies and our design

Our design will provide pastoralists in the Ethiopian Lowlands with clean water. This aim is aligned with sustainable development goal 6: Clean Water and Sanitation. To reach this goal in Ethiopia in 2030, Ethiopia aligned and maintained the SDGs with its Second Growth and Transformation Plan (GTP ll). This plan was made by the National Planning Committee in Ethiopia and is an important milestone towards the country's aim of being a low middle-income country by 2025. This plan also focuses on water supply. Their main focus in this area is on efficient use and development of water resources. This aligns with our need for our design to be water efficient and our requirement of being able to recycle or collect used water. One of the main objectives here is the provision of access to a safe and sustainable water supply. This aligns with our design being durable and trustworthy, and therefore sustainable. Furthermore, it shows that our function that purifies the water and keeps outside contamination out is indeed in accordance with the governmental policies. The aim is this plan was to increase rural water supply coverage from 59% in 2014–2015 to 85% in 2019–2020. However, a report from the World Bank shows that in 2019, the water access varies from 39–61%, which again emphasizes how much needed our design is. Lastly, the GTP ll wants to encourage WASH committees (WASHCOs) to maintain and rehabilitate water supply schemes. This relates to our requirement to repair our design without prior knowledge and local resources.

Based on the goals, aims, and standards in the GTP ll, the One WASH National Program ll was developed. Within this program, there will be a greater emphasis on sustainable and resilient water supply, which again aligns with our aim to make our product durable. With regards to the rural areas, it is mentioned technologies may have to become more diverse and simple since the focus on springs and wells limited the usage of sources such as surface water and rainwater, of which the first is often available in the lowlands. This advice is in accommodation with various requirements and needs. First of all, our design is required to not be dependent on one type of water source. Furthermore, our design needs to be portable by our stakeholders, which makes it non-static and therefore usable in different situations. In the OWNP ll, it is again mentioned the WASHCOs should be able to repair the water supply systems. However, since sustainable technologies are way more complex, higher level staff is needed. Our design will therefore be easy to repair with local tools and without prior knowledge, to prevent non-use because of a broken design.

As part of the ONWP, the sub-program "Development of Sustainable Water Supply, Sanitation and Hygiene Program in Drought Prone Areas of Ethiopia" was developed. This subprogram specifically focuses on reaching the ONWP goals in the Ethiopian Lowlands. It is mentioned that water conservation and water utilization efficiency are of importance in these areas. This translates into our design having the function to store the water and having the function to reuse the water. Furthermore, it stresses the importance of making our design inclusive. This responds to the tap being reachable for children and women, but also to the requirement that our design can be used regardless the water source. Finally, the social and environmental impacts should be taken into

account. This translates into our design being portable and therefore not causing harm due to overgrazing.

There are many more policies and documents about the (implementation of) water supply in Ethiopia, but the policies and plans described above are often based on these.

The human right to water and sanitation

Our goal of creating access to clean water in Ethiopian lowlands responds to the human right to clean drinking water and sanitation which was recognised by the United Nations General Assembly as 'essential for the full enjoyment of life' (United Nations, 2010). This corresponds with the four capabilities we aim to create – health, life, thought, and play. Furthermore, our goal supports article 90 in the constitution of Ethiopia: '[...] policies shall aim to provide all Ethiopians access to public health and education, clean water, housing, food and social security (FAOLEX, 1994).

Water quality standard

We have established that one of the main functions of our design is filtering and purifying of water – removing impurities and harmful substances. Given that we intend for the treated water to be used for both hand washing and drinking, it follows that the treatment system of our design must be able to output water that meets certain standards to be safe for consumption by humans.

We consider drinking-water specifications in the Compulsory Ethiopian Standard (CES) published by Ethiopian Standards Agency (ESA), which are largely based on ISO standards of relevant domains. The International Organization for Standardization (ISO) is an international organisation that specifies and publishes standards in virtually all domains – from water quality to food safety to healthcare. ISO standards aid in the creation of high-quality, safe, and reliable products and services as well as safeguard end-users (ISO, n.d.).

Specifications stipulated in the Compulsory Ethiopian Standard include (of water) maximum permissible levels of:

- taste and odour
- turbidity and colour
- chemicals that are of health significance (e.g. fluoride)
- radioactivity (alpha and beta decay activities)
- bacteria and microorganisms that are of health significance (Ethiopian Standards Agency, 2013).

Results from a socio-economic survey conducted in 2016 on water quality in Ethiopia give us insights into even more specific aspects of water quality that we should focus on. Based on this knowledge, we identified and selected specifications from the CES that are relevant to our geographical context. We aim to design our technology such that the treated water complies with the selected specifications to ensure our stakeholders do not suffer any health complications.

Selected specifications for treated drinking water (Ethiopian Standards Agency, 2013)

Faecal organisms (E. Coli, streptococci, and coliform organisms) must not be detectable. Faecal contamination is one of the most serious health hazards when it comes to drinking water. A common method of determining faecal contamination of water is through detection of a faecal bacteria *E. Coli* in a 100 ml sample. Results from the survey indicate the presence of *E. Coli* in high-risk water sources in Ethiopia such as surface water and unprotected springs (Central Statistical Agency of Ethiopia, 2017) and hence is relevant to the safety of our stakeholders.

Turbidity must not exceed 5 NTU. Turbidity measures the 'cloudiness' of water. While turbidity on its own does not affect quality, high turbidity is often caused by suspended chemical or biological particles which can have health implications (WHO, 2017). Sources with high turbidity include surface water and unprotected dug wells which are known to be associated with high to very high *E. Coli* risk. As our stakeholders might collect surface water, this specification is highly relevant.

Fluoride must not exceed 1.5 mg/l. While only 3.8% of the Ethiopian population use water with fluoride concentration higher than the maximum permissible level (Central Statistical Agency of Ethiopia, 2017), this specification is still relevant as excessive fluoride intake is known to cause permanent damage to teeth (WHO, n.d.).

Interactions

We aim for maximum discoverability in our design to encourage correct usage via scripts and technological mediation. In this section, we summarise (un)intended interactions and the specific functions and design requirements that aim to mitigate or minimise them.

Intended interactions

First, our stakeholders must be able to pour the water they collected in our product, in order to let our product filter it. This relates to the function of pouring water in our product, but also relates to our requirement of being adaptable to different water sources.

After our design has filtered the water, it is intended that people wash their hands and/or drink the water by opening the tap. This interacts with our requirement of making the tap at a certain height and being opened without too much force. By doing so, we make sure that our design is appropriate for all our stakeholders: children, women and men.

In order for our stakeholders to drink the water, the water must be potable and filtered by our design. We ensure this by our function of filtering the water and by our requirement of the water being clean according to the Compulsory Ethiopian Standard.

Since efficiency of water use is of high importance, one of the intended interactions of our design with our stakeholders is the reuse of water. This connects to our requirement of our design being water efficient and being able to take the water back to the filtering unit.

Lastly, because of the way our stakeholders live, we intend our design to be moved, which is reflected in the requirement of our design being portable by 6 people.

Unintended interactions

Our stakeholders must not be harmed by using our technology. For this, our design requirements specify that the product shall not have hot surfaces, emit any harmful gases, or contain no sharp edges. This will ensure that the product is accessible to all – both children and adults. Additionally, the tap cannot be too high as it would not be accessible to children and would require a lot of effort to put water into the system, which could lead to people stop using the technology altogether.

As the technology is going to be used by a large number of people, the design must be capable of delivering treated water to all. For this, the storage space has to be able to hold at least 2,500 litres of water. Should these requirements be not satisfied, conflicts between families could arise as people fight for the limited resource of clean water. Furthermore, to address the risk of overgrazing, the product should be portable to allow our stakeholders to maintain a nomadic lifestyle.

Maintenance is another factor we should consider. People might not be willing to put in the time and effort to properly maintain the product. As a result, critical components – such as the filtering system or the storage unit – could break after years of intense use and hence the provision of clean water would no longer be effective. Therefore, we aim for our design to be durable and functional for at least 5 years without maintenance. The material should be able to withstand the elements to not break and expose the water inside to particles. It should also be independent of electricity as that would add another layer of complexity to the maintenance.

The efficiency of our design is important to ensure our design is sustainable and environmentally friendly. Possible unintended interactions that could result from having easy access to clean water include people wasting water. To counteract this, we aim to include a system that transports used water back to the filtering unit to be re-filtered and reused.

Other unintended interactions that perhaps cannot be directly addressed by appropriate design include people stealing the product for their use. Nevertheless, by making sure all the aforementioned requirements and functions are met, the chance of that happening is minimised as clean water would be sufficiently provided to everyone in the community and people would have no incentive to steal.

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