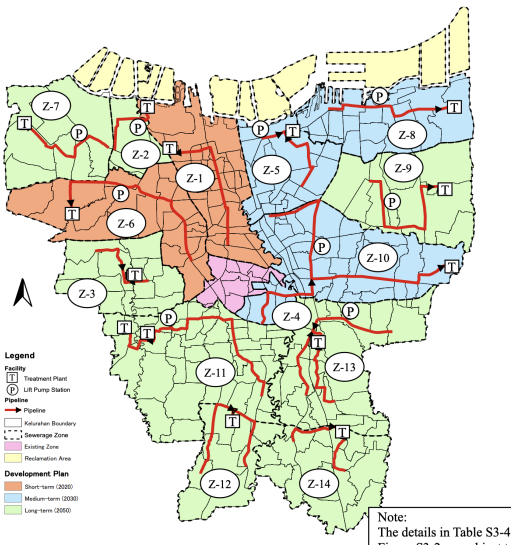
Q1. Applying systems thinking, problematize the issues observed in your field trip as a case study to explore phenomenon like urban stream syndrome, too-much-too little-too dirty water, or vulnerability of urban communities to hydro-meteorological disasters. Please provide a narrative explaining your reference mode/behaviour over time graph and causal loop diagram (CLD) (s)- 50 marks

Context

This case study seeks to explore the phenomenon of 'Institutional Fit' affecting the sustainability of wastewater management through septic tanks in Jakarta.

Wastewater is categorised as grey water, resulting from washing and bathing, and black water, which results from flush toilets. Jakarta has previously adopted a centralised system to serve the entire city with an off-site system that transports wastewater to a central treatment plant using an extensive sewage network, but this was inefficient due to the uncontrolled urban sprawl and lack of adequate legal frameworks across all communities. Currently, they have shifted focus to creating a decentralised system to handle and treat wastewater at a more local level which includes more household septic tanks, and include more actors like private companies, communities and households to participate in the sanitation solutions. On-site systems refers to when individual households have their own septic tanks installed, while off-site systems refers to households which are connected to a public sewerage system.

In 2010, a New Wastewater Management Master Plan (NMP) was drafted and it is estimated to be completed by 2050. Its first key element includes developing 15 zones of large-scale sewerage networks with separate wastewater treatment plants, increasing off-site coverage of the sewerage system to allow it to serve a larger population. These zones are implemented in phases up to 2050, and an estimated 80% of Jakarta will be covered by the off-site systems and the other 20% consisting of slums and informal settlements will be covered by on-site systems.



Secondly, it aims to improve on the current state of the on-site systems (household septic tanks). This entails introducing a regular desludging and maintenance system. There are also plans to modify existing septic tanks to treat both black and grey water.

Lastly, under the Urban Sanitation Development Program (PPSP) enacted in 2010, it aims to eradicate open defecation in the whole of Jakarta by 2014.

In the Wastewater Management Master Plan Review in DKI Jakarta conducted by JICA (2012), it was identified that only 1.26% of the people had received wastewater services through a piping system with a relatively better technology, 25.00% the community treats their wastewater through an individual wastewater treatment plant (IPAL), 64.03% used a conventional septic tanks to absorb it directly to the ground and 9.71% of the people in slum areas dispose of their domestic wastewater directly into the river.

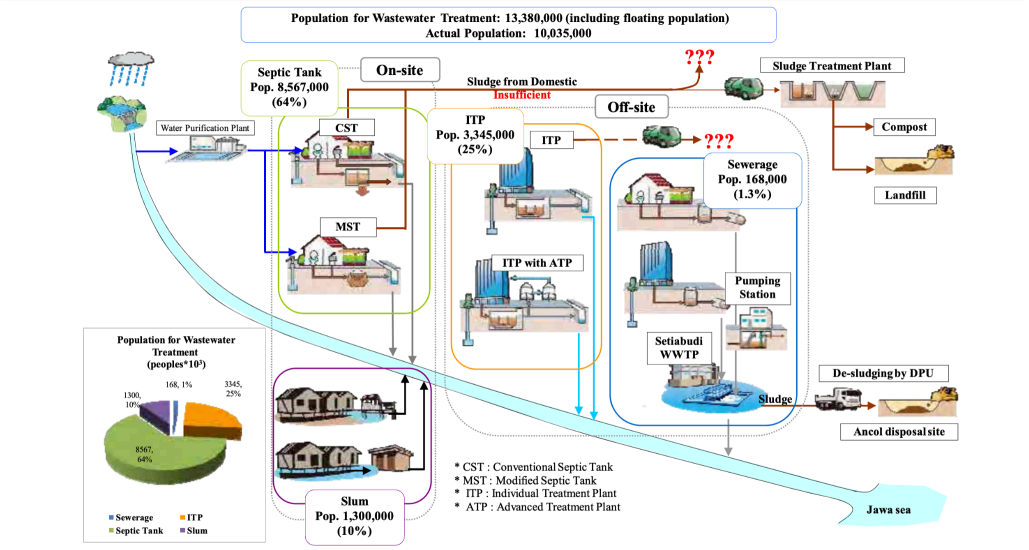


Figure S2-1 Current Situation for Wastewater Discharge in DKI Jakarta

Problem

Despite the extensive and seemingly well developed plan, there has been little to no significant improvement on the wastewater management in Jakarta, more than 10 years after the drafting of the NMP. Today, Jakarta is still home to some of the most polluted rivers in the world. Upon close analysis, we have identified some key problems that have led to this inaction.

Since 1983, only 5% land area was covered by sewerage yet its network length has not doubled since its construction. Conversely, Jakarta has been coined a “City with Millions of Septic Tanks”, testament to the extent of the current reliance of on-site systems instead of the public sewerage network. Despite this, they have not been efficient or effective in managing household wastewater, due to the fact that communities are not optimising their usage.

Concept of Fit

Institutional fit refers to the alignment and compatibility between institutional arrangements and specific ecological and economic contexts. This phenomenon is vital in assessing water governance as it deduces tailored governance structures and policies that will eventually foster stakeholder collaboration and resilient water management systems. We will be using this concept to evaluate the problems identified with the wastewater management in Jakarta, and use causal loop diagrams to illustrate the dynamics of the system.

The three fit archetypes are spatial, functional and social fit.

Spatial fit refers to congruence between the geographical extents of ecological problems and institutions, whereas spatial misfits arise when institutional applications are either too localised to encompass ecological problems or too large to meaningfully address the heterogeneous nature of those problems.

In the masterplan, it relies on large-scale infrastructure with sewage pipe networks to cross over large zones, and this does not align with Jakarta’s fragmented urban layout and diverse ecological conditions. The city has a high population density, with 65% of formal development in Jakarta being residential areas developed in fragments. This spatial fragmentation has caused hindrances to expand sewerage networks. This suggests that their current zones established are not specific enough as each zone covers too large an area to adequately consider the geographies of the area with respect to the decentralised sewerage network. Therefore, we have identified that there is the problem of spatial misfit of the NMP. However, upon analysis of the issue using a CLD, we noticed it is a linear issue instead of one with any feedback loops and as such we will not be exploring deeply into this aspect.

Next, we looked into the wastewater treatment policy through the lens of social fit. Social fit refers to the congruence between institutions and the social systems they

operate within, promoting cooperation, compliance and positive environmental outcome. In the case of wastewater treatment, the proposed plan does not seem to resonate well with the community's interests.

Firstly, it is assumed that communities would voluntarily connect to new sewerage networks. However, especially for residents in low socio-economic backgrounds, they do not see the importance of such a system, leading to the unwillingness to co-operate and pay for the system.

Next, there is a lack of legal enforcement of the wastewater treatment policy on villagers, which results in a lack of urgency and responsibility in accounting for this wastewater treatment intervention. This exacerbates villagers' unwillingness to collaborate.

Governance problem

Besides the problems regarding Fit, there are also underlying issues in governance that lead to the inaction and lack of progress on the NMP.

The NMP projects require a huge investment of 5.5 billion USD (of which 500 million USD will come from the central government's Special Allocation Fund), amounting to an annual average of 216 billion IDR. Indonesia is among the countries with the lowest spending on water and sanitation, only 0.2% of national GDP. As of 2023, total budget set aside for all infrastructure development is 392.0 trillion IDR. Considering this budget is for the whole of Indonesia's infrastructure, the budget allocated to Jakarta's waste and sanitation sector would be largely insufficient.

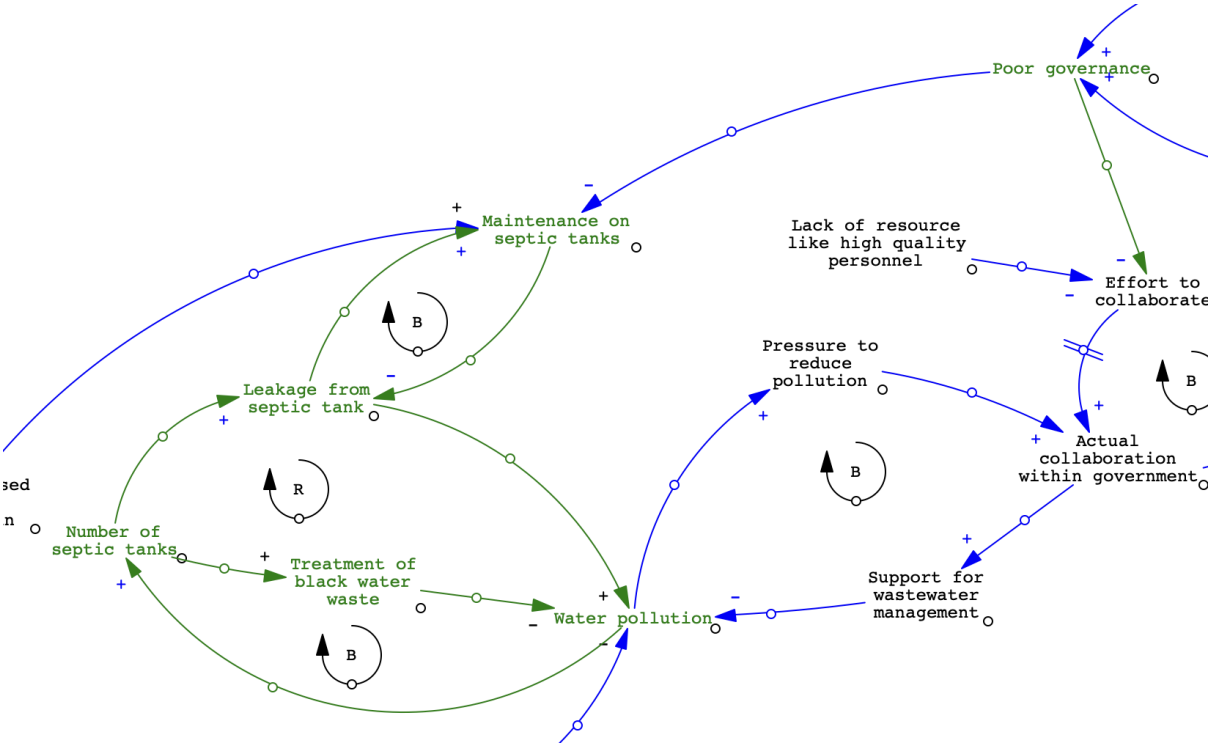
In order to ensure such a broad plan can come into fruition, there must be strong collaboration between the institutions involved, including the various levels of governing bodies, citizens, and sectors. Some issues that prevent successful collaboration amongst the governing bodies, which will be further elaborated on later, are sectoral ego, lack of communication and undefined roles.

The policy has merits in that it identified maintenance of the existing septic tanks as an issue to be better addressed. It writes "On-site desludging is implemented on an on-call basis only. Sludge accumulates in the tank and the effective treatment capacity decreases. This leads to deterioration of the treatment function and the leaking of sludge out of the system, which then causes environmental pollution of rivers and underground water sources" and to tackle this, the policy proposes a regular desludging system. On paper, this is a good solution, but the reality is that this is still not happening at all. This is due to the underlying issues of poor governance, lack of collaboration and financial constraints as mentioned above.

Causal Loop Diagram

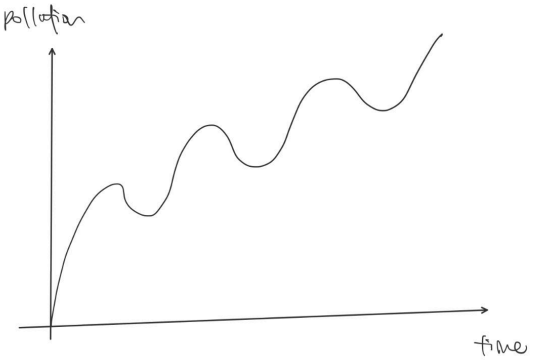
We will first begin by modelling the CLD for each main issues identified and attempt to match them to a systems archetype. Then, we will be examining how each of these issues and their variables interplay with each other to affect the entire waste water management system.

1 Maintenance issue

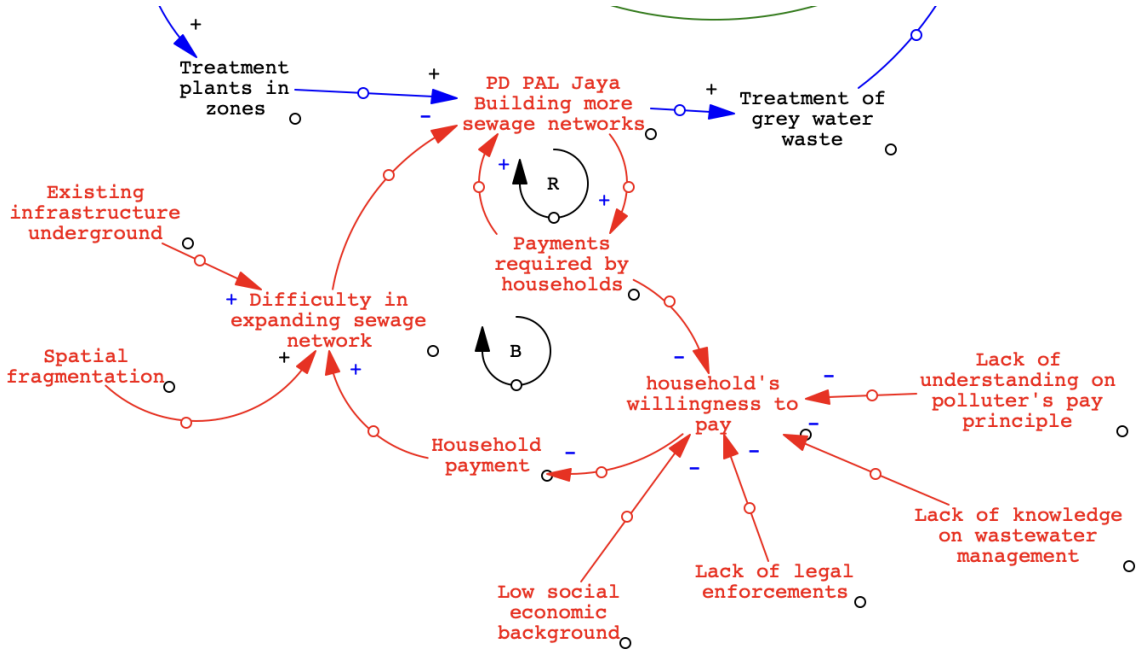


This issue can be better understood using the fixes that fail and limits to growth archetypes. Simply put, septic tanks were built as a solution to the wastewater pollution problem, but there was an unintended consequence of leakages. In the CLD, we see that there is a balancing loop formed between septic tanks and pollution which would ideally lead to a goal seeking curve on the reference mode. However, due to the leaks from lack of maintenance, it contributes to the pollution problem and there is now a reinforcing loop created, causing the pollution problem to perpetuate. To combat this unintended consequence, the NMP proposes proper maintenance systems to be put in place. This would form another balancing loop to counter reduce the pollution caused by leakages. However, due to the limiting conditions which include the factors brought about by poor governance, the effects of this new policy of maintenance are unable to take place. This is reflected by the new balancing loop formed between leakages and maintenance.

Overall, the reference mode for pollution will show an increasing oscillation pattern as shown.



2 Social and spatial misfit issue

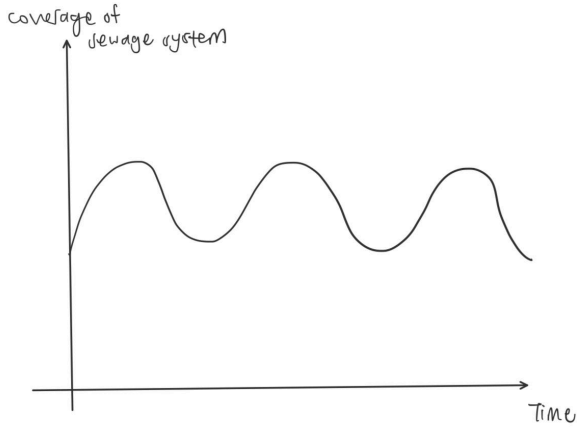


Social misfit: This issue represents how the aspect of building more treatment plants in different zones of Jakarta is unable to be achieved due to the lack of social fit. The local government of Jakarta passes the job of constructing sewage networks and treatment plants to the private company PD PAL Jaya, which is owned by the local government. Given that it is a company, it will require payments by households to engage in the provision of the wastewater treatment services. Despite grants allocated, (**need verify)** it is not substantial enough for the entire domestic wastewater treatment project. Hence, we see a reinforcing loop between the building of sewage networks and payments required by households.

However, the government failed to consider the interests of the community and their willingness to pay. This is reflected by the balancing loop where the increased payment required decreases a household's willingness to pay, leading to lower payment received. This results in a higher difficulty in expanding sewage networks due to lack of financial support, and eventually hindering the project. In addition,

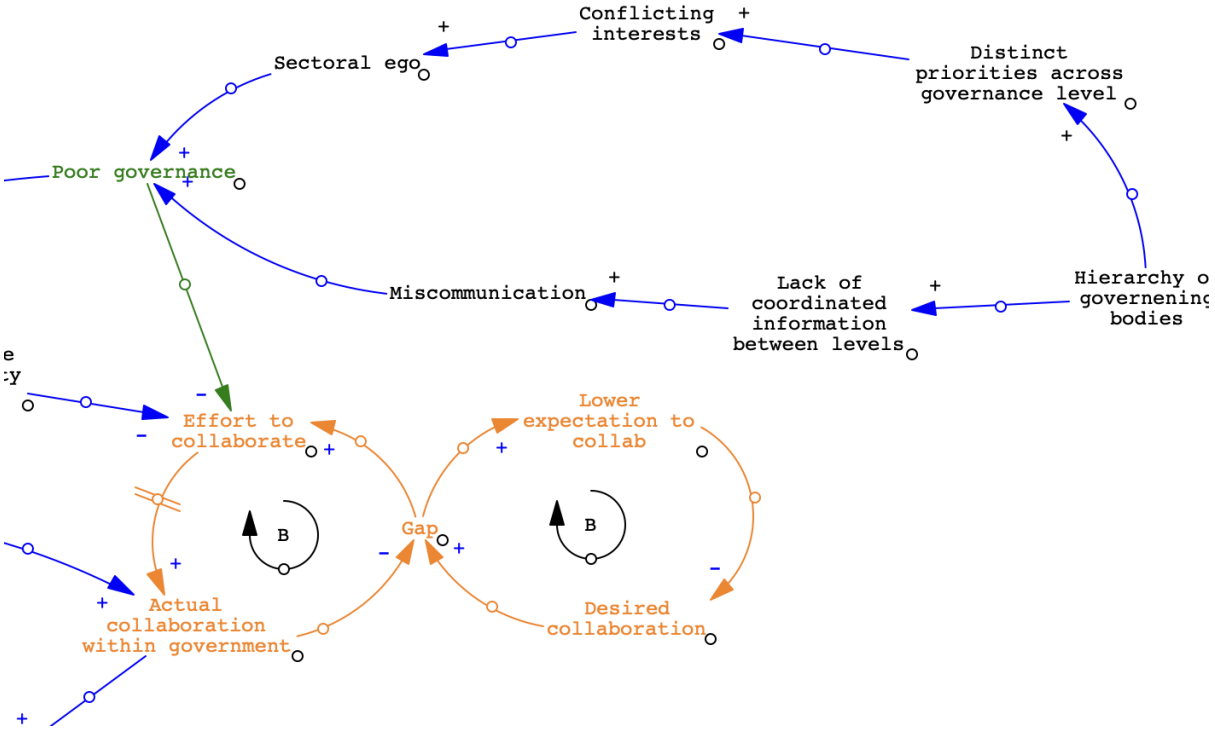
several other factors also decrease the household's willingness to pay. Firstly, they may be from a low socioeconomic background, rendering reduced capacity to pay for the sewage system, hence they decide not to utilise the facility. Secondly, there is a lack of legal obligation for households to engage in wastewater treatment facilities, which increases the likelihood of people not wanting to pay. Thirdly, due to a lack of knowledge on wastewater management, the community may not be well informed of the harms and impacts of a heavily polluted river. This could result in the community not seeing a need to play a part in utilising wastewater treatment facilities, and be less inclined to pay for them. Lastly, there is a weak sense of responsibility among the community due to a lack of understanding on the polluter pays principle. This principle aims to make the polluter be responsible for the damage done by them, and play a bigger role in mitigating the impacts they have brought. However, if the community is not aware of this principle, they will likely not be willing to bear the cost of the wastewater treatment facilities.

Spatial misfit: It was mentioned in review articles of the masterplan with regards to the zoning, that there is a lack of alignment between the planned sewage infrastructure and the actual physical landscape of the city. Due to the scattered settlements and presence of slums, the layout and implementation of sewage networks become very complicated. These areas often lack clear demarcation of ownership or zoning regulations, making it difficult to integrate them into one sewage network. This is further complicated by the existing underground infrastructure, which includes water pipes and electrical lines.

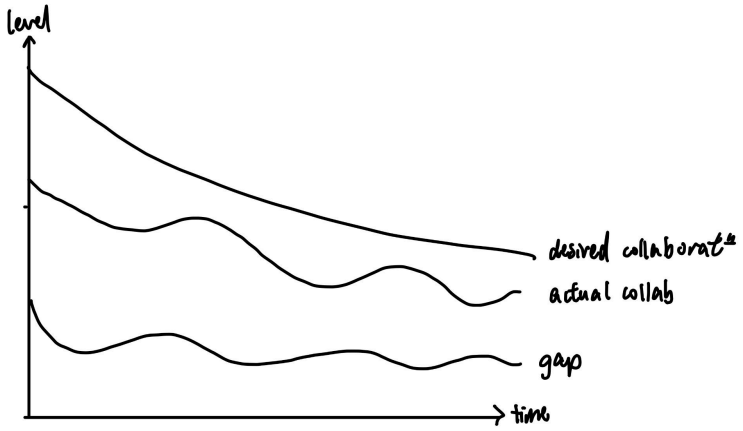


Overall, the reference mode for coverage of sewage systems will show an oscillating pattern around a constant value, showing the inefficiency of the masterplan to implement the decentralised system.

3 Governance issue



The problem of governance and government collaboration is a typical example of the ‘eroding goals’ archetype. The gap we identified here would be the gap between desired level of collaboration and the actual level of collaboration. With the current low levels of actual collaboration this gap is increased which would spur the relevant authorities to try to make more effort in collaboration. Over some time, this should lead to an increase in actual collaboration, thus forming a balancing loop. However, the increase in the gap has also led to the lowering of expectations to collaborate. This is often because repeatedly falling into the trap of eroding goals eventually becomes embedded in an organisation’s culture as a justifiable and even reasonable thing to do. Over time, the government falls farther and farther behind the expectations of the citizens and eventually fails altogether. As such, the desired levels of collaboration is also reduced, forming another balancing loop. This leads to the phenomenon where both desired and actual levels of collaboration end up decreasing over time while the gap continues persisting.



The factors that fuel the initial decrease of actual collaboration include the complexity of networking across governance levels, pertaining to issues like miscommunication, allocation of responsibilities and conflict of interest, the lack of resources, sectoral ego and lack of political will. These are specific factors that have been identified based on studies regarding the challenges of collaboration faced by Indonesian local governments.

Q2. Given your hypothesis from the case study, what according to are the policy leverage points to navigate the system into more social-hydrologically desirable situation? Please use your above conceptual model (i.e. CLD & reference mode) to recommend new strategies, and explain the changes 30 marks

Based on the above problems mentioned, the top-down approach does not render any success in implementation of policies, hence one possible solution would be to focus on bottom-up approaches to better implement policies. The bottom-up approach refers to a consideration of the 'local' community dynamics into the respective sanitation developments. This can be substantiated by a case study – Mercy Corp (MC) Organisation's successful implementation of the Program of Urban Sanitation & Hygiene Promotion (PUSH) to test an alternative technology of modular septic tanks. Their policy was well written, with successful implementations. In their implementation, they considered three key factors that took into account communities' needs, which includes

a. Addressing the neediest beneficiaries through increasing its tangible value proposition to meet the needs of communities
b. Incorporating innovative designs to ease users' pain points in using septic tanks
c. Connecting the needs for infrastructure development to villagers desire for livelihood improvement

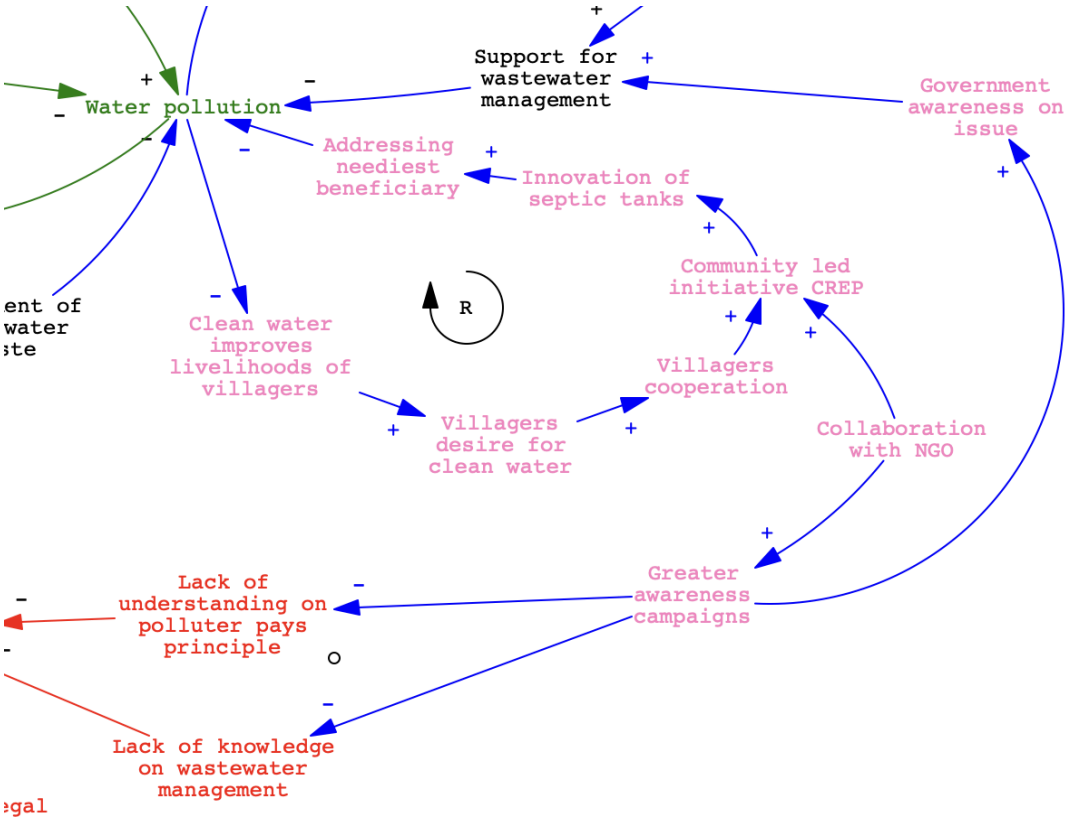
These considerations largely factored in villagers' needs and concerns, which increased their willingness to cooperate as their share of benefits were pragmatic. This approach hence brought out greater ownership of the policy implementation and was one of the factors that led to its success.

Aligning back to this project and issue on the lack of collaboration – a key collaboration point that needs to be strategically considered is the collaboration with communities. By aligning the implementation strategy with the priorities and needs or livelihood improvements to the communities, there would be a greater uptake and faith in the policy, translating into increased motivation / cooperation amongst villagers to make it work.

Another key collaboration point would be in raising awareness through active campaigning and education programmes. During Singapore's early interventions for their river clean up plan in 1987, the government had ambitions to raise awareness of the negative effects of dumping waste into Singapore's waterways. This was done so through extensive collaborations with organisations such as Waterways Watch Society and the Singapore Environment Council – who both played vital roles in connecting between the people and the government. Their awareness campaign, Clean Rivers (A)Education Programme (CREP), fostered a greater collaborative spirit between the government, organisations, and communities and helped develop a greater sense of ownership amongst Singaporeans for Singapore's river. Taking

Singapore's river clean up as a reference point, Jakarta could consider collaborations with NGOs, considering the large presence of NGOs pioneering environmental causes in Indonesia. In collaboration with NGOs, education programmes could be laid out for communities and progressively build up the sense of ownership of Jakarta's rivers. The presence of NGOs would also be a link between communities and the governing bodies as NGOs could be at the forefront in advocating for greater support from the government in advancing their ambitions of clean rivers.

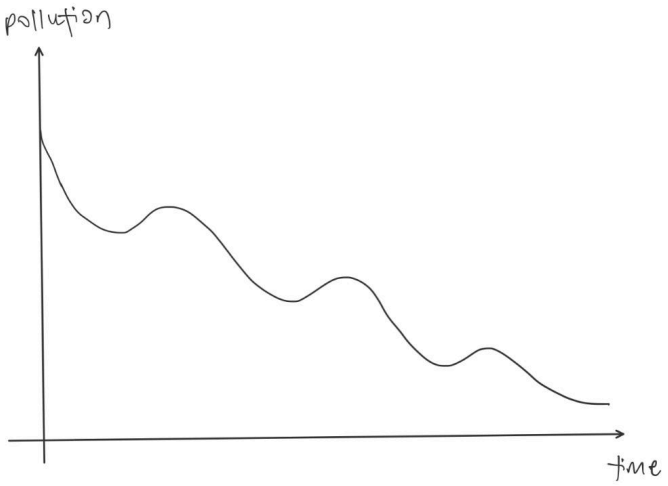
CLD:



According to the CLD, the community-led initiative CREP will also allow the community to experience the tangible benefits from reduced water pollution, hence they will be more incentivised to continue maintaining and improving the situation by being more cooperative. This is shown by the reinforcing loop in the CLD, indicating how the bottom up approach can be effective and sustainable. Furthermore, the solution of introducing awareness campaigns through the collaboration with NGOs will tackle the issue of social fit, reducing the lack of understanding of polluter pays principle and importance of wastewater management. This will increase the community's willingness to cooperate and support the program through financial means as they deem themselves more responsible for keeping the rivers clean. With greater awareness raised during the campaign, it is likely that the government will also be more aware of the significance of the issue, and extend greater support towards such initiatives. When communities are able to handle waste treatment

initiatives themselves, it reduces the burden from the private company in managing the entire system, and improves efficiency of wastewater treatment for Jakarta as a whole.

Reference mode:



The new reinforcing loop that has been created causes pollution to decrease in an oscillating manner.

Q3. What are the motivations behind the new policy strategies, are they transferred from elsewhere or only based on your CLD? What do you think will the opportunities and challenges to implement such policies in Indonesia context? 20 marks

Based on our analysis of the NMP and the underlying issues, we came to a conclusion that the policies created under the NMP are largely adequate in addressing the managing wastewater in Jakarta. The only significant part we take issue with is regarding the zoning of the Jakarta landscape for the decentralised sewerage system. This is because of the spatial fit problem that it breeds, as elaborated on before.

The more pressing issues stem from the poor governance of Jakarta, which has led to the lack of progress on the decently well written policy. However, we chose not to tackle the governmental collaboration issue because we believe that it is far too complex and there is more value in empowering the community, who are the key people on the ground, while the government provides support in terms of finances and resources.

Our new policy strategies are therefore largely derived from case studies, mainly because case studies were a good reference point and the fact that sustainability or governance strategies should not be confined to a local context. Another element we considered was the issue of social fit, which was modelled in the CLD, in order to identify which variables should we focus more on.

An opportunity of implementing this in Jakarta is that from our fieldwork, we found that a large proportion of the local community have been expressing their desire for some large scale government supported efforts to empower their communities. It is evident that many people are concerned with the current state of affairs and hope that they can do something about it. Furthermore, the new policies are able to complement the existing community waste initiatives, by providing a more technical aspect and the funding given can increase the sustainability of those projects.

Building on the point above, even though the local community has expressed their desire for government intervention, the government has similarly looked to the local communities for implementation plans – which gave rise to the phenomenon of ‘shifting the burden’. In exacerbating the issue, this phenomenon reduces the sense of ownership and autonomy over Jakarta’s rivers, especially amongst villagers. Our solution hence tries to minimise the gap of responsibility shifts through fostering collaboration to ensure that both parties are aligned and hold the same sense of belonging and ownership.

A potential issue is the high levels of rural-urban migration in Jakarta annually. With the constant inflow of new residents, especially in the slum areas, there is a challenge of educating the masses. Education is usually most effective from long

term exposure since young, but many of these urban migrants only move to Jakarta in adulthood and come from all sorts of cultural backgrounds, complicating the task of instilling the value of proper waste management.

A large potential barrier to the implementation of these preliminary solutions would be the driving the government's collaboration and resources allocated to these projects. Firstly, especially with the move of the capital city from Jakarta to Nusantara, the Indonesian government is highly likely to focus its attention on large-scale or economically-pertinent projects such as increasing tourists and developing the economy. In doing so, wastewater or sustainability issues in Jakarta may take a backseat. Next, within the confines of the government, there are complex hierarchical issues especially with the long hierarchy chain of governing bodies that cannot be solved with a simple policy or research paper.

"The Indonesian government might be focusing most of its attention on the mega-projects, such as moving the capital, building a giant sea wall or making investments aimed to attract tourists, without considering the situation of the people of Jakarta and making little effort to help them in the situation they are in"

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