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Policy Proposal and Research Paper

Program Air Bersih Rainwater Filter (PAIR)

Rainwater Harvesting as a Solution to Protect Kampung Luar Batang Villagers in North Jakarta

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> *"I still extract the underground water although the colour is yellow... after using a filter, the colour looks better, but it is still not drinkable. However, I do not have any choice but [to] use it for brushing my teeth and taking a bath every day."*

— Shanti Wira, Jakarta Citizen

Introduction

Jakarta has been experiencing significant land subsidence (Batubara et al., 2023, 1). Jakarta's land subsidence is driven by several key factors: climate change, unregulated groundwater use, and high rates of urbanization and built area development (Hasibuan et al., 2023, 1). Due to the combined impact of these factors, clean water access in Northern Jakarta has become a pressing issue. Moreover, the city is vulnerable to extreme rainfall, sea level rises, and flooding, the effect of which has been exacerbated by climate change (Priyambodoho et al., 2021, 1; Firman et al., 2011,1).

Jakarta has been attempting to increase infrastructure for clean water provision for decades, but just 65 percent of Jakarta possesses adequate piped water networks as of 2022 (Hasibuan et al., 2023, 2; Rayda 2022). The government aims to increase piped water infrastructure to 100 percent by 2030 (Jensen and Khalis, 2020, 3). As a result of the lack of piped water networks, the majority of Jakarta's daily water needs are sourced from groundwater, aggravating the land subsistence issue and exacerbating flood risks (Hasibuan et al., 2023, 2). There is an urgent need for policies to combat land subsidence and mitigate the effects of extreme rainfall and floods — all issues that impact the availability of clean water in the region.

It is beyond the scope of this proposal to suggest mitigation strategies for every facet of the climate crisis impacting Indonesia. We have therefore decided to provide a strategy to combat a specific consequence of these factors which significantly impacts vulnerable communities: the lack of clean and accessible water sources.

The Problem and Background: The Vulnerable Population of Penjaringan

Coastal communities in Northern Jakarta immediately face the challenges of global sea level rise and intense rainfall brought about by climate change. *Penjaringan*, a subdistrict of Northern Jakarta, is densely populated with semi-permanent housing conditions (Aror et al., 2020, 2) and has high poverty rate (Kooy et al., 2018, 111; Wiratmo and Supatra, 2022, 3009). Due to the subdistrict's coastal location, the communities in Penjaringan are vulnerable to tidal floods, flash floods, and saline water (Kooy et al., 2018, 111)

Penjaringan experiences land subsidence rates of up to 85 millimetres annually because of illicit groundwater extractions (Abidin et al., 2011, as cited in Bott et al., 2021, 6). As a result, residents streamline their homes vertically by elevating their houses every five to ten years (Bott et al., 2021, 7). In low-income areas, the minimum elevation cost for a one-story house is about US$800 (Bott et al., 2021, 7). Despite coastal hazards and financial burdens, 93 percent of surveyed households expressed their intention to stay (Bott et al., 2021, 8). The vulnerable communities include Kamal Mura, Kapuk Muara, Pejagalan, Penjaringan village, Pluit, and other local settlements (*kampungs)* (Nomor, 2021).

Kampung Luar Batang has been categorised as unfit for habitation and is located 60–100 centimetres

below sea level (Aror et al., 2020, 2). The Kampung has 11,053 residents and 3594 households with an average family size of 5.65 (Putera, 2016; Funo et al., 2004, 178). High tides in Sunda Kelapa Harbour, heavy rainfall, land subsidence, and poor drainage infrastructures contribute to the Kampung's annual floods (Funo et al., 2004, 178). Excessive rainwater runoffs and floodings induced the elevation of *Gedong Panjang* road, as a result, several houses appear submerged (Kendall, 2020, 41, 43). Additionally, Kampung Luar Batang is home to the sacred *Luar Batang Mosque* – the tomb of Habib Husein – making it a focal point of pilgrimages and cultural identity (Funo et al., 2004, 173; Kendall, 2020, 49). Against this background, the Indonesian government has declared the kampung a cultural heritage (Decree No. 475/1993) and as "one of the important historical kampungs that should be rehabilitated and preserved" (Abbas et al., 2021, 2; Funo et al., 2004, 173).

Penjaringan residents have limited access to water sources such as wells and PAM Jaya, Jakarta's water corporation (Wiratmo and Supatra, 2022, 3009). 88.2 percent of low-income households without piped water access rely on purchasing overpriced water from their neighbours (Kooy et al., 2018, 114). Some residents turn to alternatives like illegal groundwater extraction, polluted sources, and unprotected shallow wells, leading to illness and high levels of salination (Kooy et al., 2018, 113; Wiratmo and Supatra, 2022, 3009).

Benchmarking: Existing Policies' Key Issues

Our analysis of the existing policies on water provision in Indonesia, such as rainwater harvesting (RH) projects, dams, and communal water reservoirs, has shaped our policy proposal and functioned as a benchmark to ascertain the needs of the community and the essential features of a successful rainwater harvesting system.

Notably, our research has identified that the rainwater harvesting trials involving the North Jakarta local government have been limited and not well-publicized, however, one project was run in a public flat in Muara Baru, North Jakarta (Wijayanti et al., 2019). We have not been able to find current rainwater harvesting projects run by a non-governmental organisation in the region — most trials are temporary programs initiated by academia (Maudisha, 2022). As such, our project aims to fill this gap and provide a comprehensive proposal for rainwater harvesting infrastructure that constitutes a long-term and durable solution for the population of Kampung Luar Batang.

Figure 1. An Overview of the Major Rainwater Harvesting Policies and Projects in Indonesia

Policy/Project	Issues
Instalasi Pemanen Air Huian (IPAH) in Semarang City (August 2023) (Pemerintah Daerah Kota Semarang, 2023, 1).	The low volume of water produced due to limited reservoirs and reservoir size — 3100-liter capacity of rainwater harvesting tank (Pemerintah Daerah Kota Semarang, 2023, 1). As a result, the functionality was limited as the reservoirs were not large enough to service a community, in addition not being large enough to store water for the dry season (Pemerintah Daerah Kota Semarang, 2023, 1).

52 units of rainwater harvesting devices installed by Semarang City Environment Agency (2010-2015) (Abadi et al., 2018, 12)	The limited technical and implementation guidelines of this project diminished the efficacy and efficiency of this project (Abadi et al., 2018, 12). Limited communication and cooperation with target group also meant that the technology was not tailored to the needs of the community, with this further impeding the likelihood of project success due to community mistrust of rainwater which cannot be superseded without robust community engagement and awareness and education campaigns (Abadi et al., 2018, 12). The low budget of the project further limited the scope and functionality of the project and its possibility for large-scale success (Abadi et al., 2018, 7).
Jakarta government building dams, communal water reservoirs in Jakarta in 2020 (Pradini & Kaswanto, 2020, 1-3) **and a water treatment plant in Hutan Kota, North Jakarta in 2020** (Loasana, 2020).	The constructed dams and water reservoirs risk being salinised by the rising sea levels and therefore must undergo a filtration process to be safe and available to use by the population (Aryadita, 2023, 2). The main issue in this case is that the technology to filter salt water is available but is expensive, especially on such a large scale (Aryadita, 2023, 1).
Rainwater harvesting trials in Muaru Baru, North Jakarta, conducted by Universitas Indonesia and DKI Jakarta Local Government (Wijayanti et al., 2019).	According to our correspondence with Mr Vittorio Kurniawan of Universitas Tarumanagara who is involved in RH project in North Jakarta, the Muara Baru project is not well publicized to the public. The limited scope and publication of this trial has meant that the project has been hamstrung by limited transferability and scalability — especially evident due to the project not being extended to other areas in the region (Wijayanti et al., 2019).
Rainwater harvesting systems in Wonosari and Tandang village in Semarang in 2020 (Mukaromah 2020)	The community mistrust of RH harvested water cleanliness level impeded project uptake and project success (Mukaromah 2020, 8). This highlighted the key importance of community consultation and education and awareness campaigns, as ultimately an organisation or the government can decide to make investments that would be significantly helpful, but if they go unused by the community, it is impossible for the project or the investment to make a meaningful impact (Mukaromah 2020, 8. This has a further consequence in hampering RH system maintenance — if there is limited interested and trust in the project to begin with, community members that may be only just interested enough to use the harvesting technology while it works, but do not have large enough degree of interest to invest time into maintaining or fixing the technology will simply stop using the technology once it breaks, thereby causing an abrupt end to the project.
RH system in Royal Mediterania Garden Apartment, West Jakarta conducted by Universitas Tarumanagara in 2020 (Kietowibowo et al. 2020)	In this case, the above-ground RH systems were vulnerable to installation theft, an issue identified by our correspondence with Mr Vittorio Kurniawan of Universitas Tarumanagara who was involved in this project. This indicates that above-ground systems should be avoided due to this potential complication to ensure the longevity of the project's infrastructure.

After reviewing the main RH policies and projects (Figure 1), it is evident that several general issues persist, notably the lack of enforced national standardisation in RH systems. In Jakarta, local regulations governing the size, building, and maintenance of RWH exist (Governor Regulation (PERGUB) of Jakarta Special Capital Region Province Number 109, 2021; PERGUB Prov. DKI Jakarta No. 60, 2022). However, they do not include any permission rule for standardisation of the RWH. In other words, people can still build installations without any regard for the rules. The existing rules also only apply to the DKI Jakarta provincial area. Moreover, a Standard Permit of RWH installation building in Indonesia still does not exist. Thus, building permits (IMB) for Rainwater Harvesting (RWH) installations is necessary to ensure safety in Jakarta and across Indonesia.

Furthermore, the use of above-ground systems — the structure of choice for the aforementioned tanks, reservoirs and projects — increases the risk of tank contamination as improperly maintained above-ground tanks are vulnerable to sediment and contaminants falling and accumulating in the reservoir (United Nations Industrial Development Organization 2023). Further issues with this choice of technology included the increased potential for the evaporation of water, which impacts the quantity of water available and therefore the overall functionality of the system (United Nations Industrial Development Organization 2023).

Methodology and Empirical Data

To gauge local perspectives and substantiate the policy fit, we used three types of data collection techniques directly involving the residents in Indonesia: (1) public opinion surveys, (2) ethnographic interviews, and (3) discourse analysis.

I. Public opinion surveys

Three surveys using a social networking platform were conducted on December 9, 2023. A total of 187 Indonesian people participated in the surveys. The details of empirical data are described in the figures below and in the appendices, section appended at the end of this paper.

The total number of followers of a Japan-based social networking account for Indonesian citizens between 5 December and 11 December 2023 was approximately 33,700. The majority, 21.8 percent, are residents in Jakarta. Out of the 1305 people who viewed the survey, 1300 people are classified as followers (please see the appendices section for further details).

Survey Results: According to our survey of 187 Indonesian residents (December 2023), 47 percent of Indonesian people still extract underground water instead of utilising the government's piped water service. Extracting underground water exacerbates land subsidence resulting in sea level rises, an issue which is already negatively impacted by global warming (Hasibuan et al., 2023, 1).

II. Ethnographic interviews

We conducted interviews with local stakeholders such as academia, non-government organisations (NGOs), and Indonesian residents. Below are selected excerpts from our interviews and responses provided by Indonesian citizens on January 26, 2024.

> *"Extracting underground water is cheaper than subscribing to the government's piped water service. In fact, the water is free; I only need to pay electricity fee for operating a pump that extracts the water out from our backyard."*

— Rita Oey, Underground Water User

> *"Underground water is relatively at a more reasonable cost. However, we cannot use it if the extracted underground water area is polluted in big cities such as Jakarta. I believe that the government water pipe is cleaner and safer."*

— Savanna Lim, Government Pipe Water User

III. Discourse analysis

We analysed several academic journals, papers, and news articles on rainwater harvesting policies and practices – both within and outside the context of Indonesia. Besides rainwater harvesting policies, we explored reading materials about rainwater harvesting technologies and Indonesian local communities in need of assistance. The materials were sourced and assessed in three languages: Bahasa Indonesia, English, and Japanese.

Policy Proposal

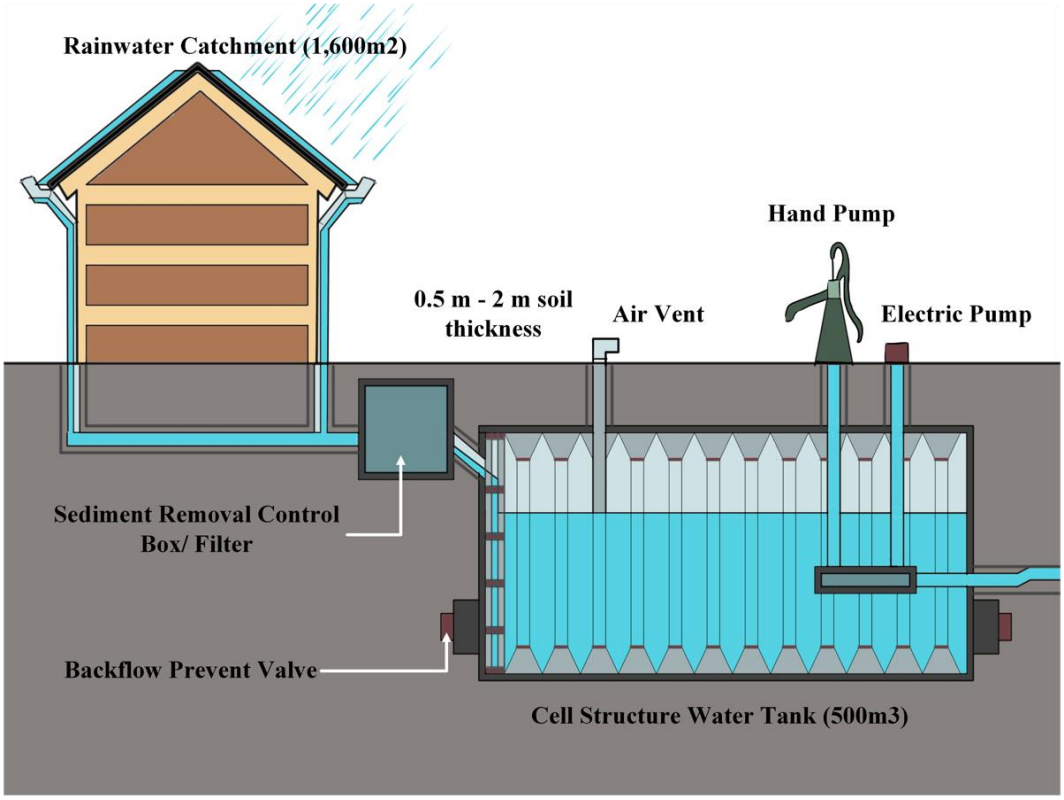
We propose the installation of an underground rainwater harvesting system in Kampung Luar Batang, RT15/RW1, at *SD Negeri Penjaringan 01* — a government-owned elementary school in North Jakarta. We have selected a government-owned site as this will alleviate some of the bureaucratic permits and documentation required when building on privately-owned land. Through our correspondence with government stakeholders, we have also identified that we must receive approval from the DKI Jakarta Education Provincial Board prior to commencing construction of the project at SD Negeri Penjaringan 01. Our selection of a community rainwater harvesting system also serves the aim of increasing community participation and interested in the project.

We propose to partner with *Totetsu MFG. Co., Ltd.,* a manufacturer of United Nations Industrial Development Organization-backed RH technology. We hope that this pilot project will provide an efficient and durable solution to the water access problems in North Jakarta.

We propose that a Government Taskforce implement and monitor the project, with the team conducting monthly check-ins with the community and project site for continuous feedback and monitoring, in addition to conducting RH system maintenance awareness and training courses with the local community. Strong community links and feedback are integral to project success, and so we suggest regular consultations with the RT15/RW1 community leader to voice community needs and concerns. We further suggest the implementation of a standardised RH permit to ensure RH system quality and safety. If the initial implementation measures are unsuccessful, we propose the introduction of a community remuneration scheme: for every 1000 litres of water harvested, each household would receive IDR 7000 (US$0.45), which will incentivise use and maintenance, and help alleviate community financial hardship. Our next suggestion is the introduction of a mobile app and website to track maintenance issues and feedback in real-time and thereby increase the likelihood of project success. We hope that this pilot project can be expanded to other districts in Northern Jakarta if this initial run is successful.

Benefits and Technicalities

Figure 2. Underground Rainwater Harvesting System PAIR Prototype



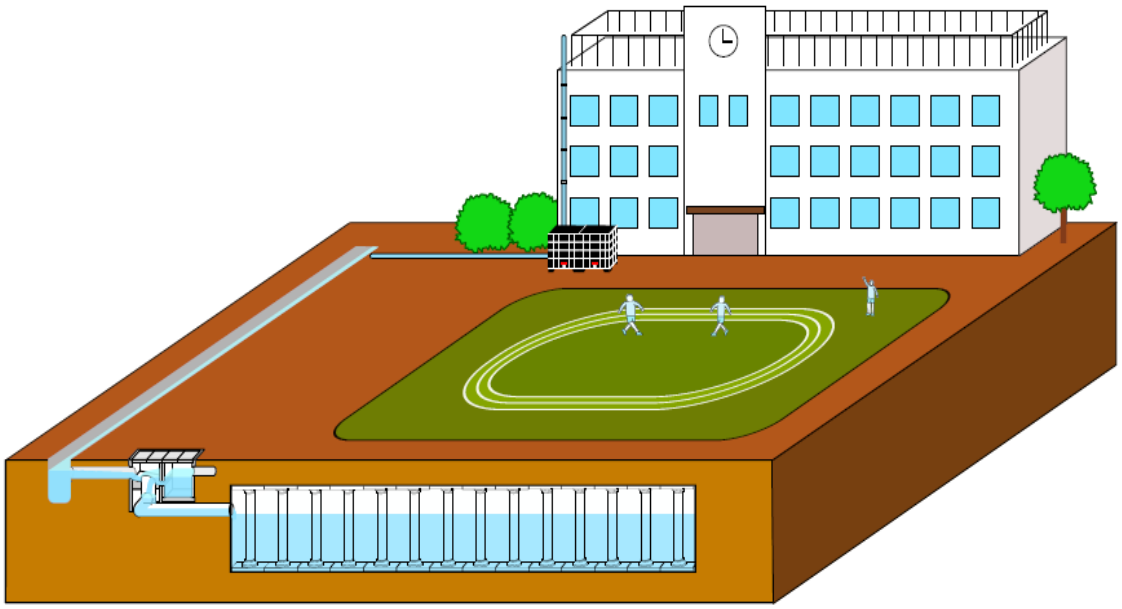
PAIR prototype modelled off Totetsu MFG. Co., Ltd.

The Totetsu underground rainwater harvesting system has been selected due to its durability, limited maintenance requirements and high standard of filtration (United Nations Industrial Development Organization 2023). The system removes 99.5 percent of contaminants and is more resistant to sediment and algae accumulation, in comparison to above-ground systems, as this RH system is secured underground and therefore the opportunity for sediment or debris to fall in is limited (United Nations Industrial Development Organization 2023). The underground system also ensures that evaporation of water is limited (United Nations Industrial Development Organization 2023). Furthermore, the operational cost of purifying rainwater is close to zero, a notable advantage over seawater and wastewater which must go through a more laborious and expensive purification process (United Nations Industrial Development Organization 2023). Sediment control box maintenance is required only once every three to six months, thereby limiting the maintenance needs of the community and enhancing the probability of project success (United Nations Industrial Development Organization n.d., 18).

Moreover, cost savings over time are higher with an underground system in terms of consumption, which can alleviate the increased initial cost of the rainwater harvesting system (Kartolo and Kusumawati 2017). In addition, industrial water costs can be reduced by approximately 20 percent using this system (United Nations Industrial Development Organization n.d., 18). It is also possible to adapt the system to community resource availability via the installation of a hand or electric pump system, indicating that even during extreme weather events or natural disasters where power supply may be impacted, it will be possible to keep using the system (United Nations Industrial Development Organization 2023).

Totetsu provides a product that is quality and price competitive, made possible through its use of the discarded formwork system in which formwork is not removed, reducing the price and cutting down the production time — this construction information has been gained from our correspondence with Totetsu. For a cost breakdown, please see the financial planning section of this paper.

Figure 3. Underground Rainwater Harvesting System Blueprint in A School Campus



Please see a blueprint based on our PAIR project provided by Totetsu MFG. Co., Ltd.

The use of rainwater, a plentiful resource in Indonesia — with annual average rainfall rates of 2,347 millimetres (mm) (Prihanto et al., 2018, 1) — is a key opportunity to recycle this freely available resource and convert it to a lifeline for vulnerable communities, such as Kampung Luar Batang (Prihanto et al., 2018, 1). In Northern DKI Jakarta alone, significant amounts of heavy rainfall begin from September to February with a thickness of 200 mm/month to a maximum of 500 mm/month (Tambunan, 2018, 5). The expected precipitation volumes will compensate for the drier seasons in June, July, and August. Nevertheless, heavy rainfall in Jakarta exacerbates urban flooding in the lowlands (Tambunan, 2018, 5), infrastructure damage, and the hotbed of waterborne diseases.

RH reduces the impact of heavy rainfall by capturing surface runoffs and diminishes the reliance on groundwater and traditional water sources from bodies of water — preventing further land subsidence (Rahman et al., 2014, 1; Angrill et al., 2012, 26). Rising sea levels and groundwater extractions have contaminated wells and dams with salinity in Jakarta (Rosid et al., 2019, 6). Compared to other sources, rainwater is less saline, requires inexpensive treatment systems, retains soil moisture, and reduces energy consumption — carbon dioxide (CO2) emissions — from conventional potable water systems (Rahman et al., 2014, 8). According to Ahmed et al (2015), rainwater harvesting in Dhaka, Bangladesh can save about 5.1 kilogram of CO2 per year per capita when used for potable consumption, such as cooking and drinking.

Implementation and Community Incentives

I. Community-centric Participation

Before constructing the RH system in Kampung Luar Batang (RT15/RW01), the designated government task force will conduct community needs assessment by engaging with the residents through interviews, surveys, and arranged public forums. This bottom-up approach is crucial to understanding the gaps in water access, informal water trade, and the average water consumption per household from the local perspective. Moreover, the successful socialization and implementation of the project will require RT15/RW01 neighbourhood associations (Dwianto, 2003, 42).

As the grass roots representatives of the locality, *Rukun Tetangga/Rukun Warga* (RT/RW) chiefs will aid in the integration of the RH system in the community by establishing trust through spearheading awareness campaigns and serving as the direct voice of the people. Other organizational structures in the Kampung, such as youth associations (*karang taruna*), night-watch groups (*siskamling*), cleaning volunteers, and community-based health care groups (*posyandu*), shall not be overlooked (Dwianto, 2003, 45). The RT/RW leaders will have full autonomy to determine whether additional local organizational structures are necessary for the policy implementation.

II. Policy Implementation

Following the construction of the rainwater harvesting system, we intend to enforce four key implementation schemes: (1) awareness campaigns, (2) RH taskforce maintenance, (3) KPI monitors, and (4) standardised RH permits. To mitigate community distrust toward the use of rainwater and promote day-to-day community-led maintenance, we will incorporate awareness campaigns, and RH maintenance and training courses at civic centres or classrooms in SD Negeri Penjaringan 01. The Indonesian *People's Coalition for the Right of Water* (KRuHA) will aid in the socialisation endeavour and endorsement of awareness campaigns. Moreover, the government-delegated RH taskforce will primarily be responsible for aggregate-system maintenance, such as cleaning filters and tanks, and conduct monthly check-ins. A total of four persons will be assigned. The taskforce will consist of government-assigned technical personnel (e.g., civil engineers, technicians), outsourced RH specialists of Totetsu MFG. Co., Ltd., and RT/RW associations. To manage daily operations, an RH taskforce office will be designated at either the civic centre or RH system site location.

Key performance indicators (KPIs) will be utilized to evaluate RH system operations, service quality, and calculate water costs saved. To assess the KPIs, community-based data collection techniques will be used (Berg, 2020, 9). Where consumer satisfaction surveys and consumer-support desk at the RH taskforce office will be made available for residents to report on reduced water bills, water quality, water reliance, impact on surface runoff, and future KPIs. Frequent empirical assessments by the RH taskforce, such as overall rainwater consumption and precipitation rate, will help evaluate the system's overall performance. In the future, more sophisticated KPI measures and data collection techniques will be explored.

Finally, we call for a standardised RH permit (*Izin Mendirikan Bangunan* [Building Construction Permit] (IMB)) to ensure the quality and safety of future RH systems in Indonesia. Although rainwater harvesting is generally encouraged in the country, a standardised construction permit under IMB does not exist. Establishing an RH permit enforces the rule of law, such as the legal compliance with building construction, quality standardisation, consumer confidence, and manufacturer accountability. These

implementation strategies are aimed at broadening the scope of RH systems as a viable and scalable water source throughout Jakarta and other regions with comparable climatic conditions.

III. Scenario B: Additional Plans

If this initial implementation model is unsuccessful, we suggest setting up a remuneration scheme for the community. First, for every 1000 litres of harvested water, each household could receive IDR 7000 (US$0.45). This will promote the use of the RH system and help alleviate the financial hardship of the community. As part of our awareness campaigns, we will also promote the cost-effectiveness of rainwater harvesting. The necessity for this is highlighted by the fact that 88.2 percent of low-income households with no access to piped water end up buying overpriced water from their neighbours at IDR 13,000 (US$0.84) to IDR 89,000 (US$5.76) per 1000 litres (Kooy et al., 2018, 114).

However, individuals with piped water connections, often in the upper-income range, spend only IDR 1059 (US$0.068) to IDR 9800 (US$0.63) (Kooy et al., 2018, 114). This suggests that households with lower socioeconomic status spend a higher percentage of their monthly income on water (2.56 percent to 14 percent) than wealthier households (0.73 percent to 6.34 percent) (Kooy et al., 2018, 114, 116). Given the abundance of rainwater as a resource, rainwater harvesting offers a cost-effective alternative to secure clean water regardless of income.

Second, we suggest that a mobile application and website be created and implemented to ensure more effective communication between the government task force and the community. This service will allow residents to log maintenance issues and concerns in real-time and ensure any issues that arise can be rectified in a timely and efficient manner. Inspiration for this app is drawn from the service provided by Well Aware, who have created an app that provides a similar water service in water accessibility and technology monitoring in East Africa (Well Aware 2023). This service will underpin and support the existing suggestion for taskforce staff to conduct monthly check ins to monitor and gather feedback on the project within the community.

The above additional suggestions will promote project uptake within the community and provide greater opportunity for project rectification, feedback and community input, thereby increasing the likelihood of project success. This will improve visibility and regular access to community needs, as well as trial and error efforts to improve the project.

Stakeholder Roles

I. The People’s Coalition for the Right to Water (KRuHA)

KruHA, "The People’s Coalition for the Right to Water", is an NGO founded in 2002 that campaigns for water accessibility in Indonesia through advocacy work aimed at water justice (KRuHA, 2020). This advocacy work aims to support struggling local communities. The goals of our project align with the goals of KruHA. We hope our collaboration will bring mutual benefit to both our project and KRuHa. KruHA's background in water accessibility can be utilised in our awareness campaigns and KruHA's water justice experience can help us make the RH standardised permit a reality.

II. Totetsu MFG. Co., Ltd.

Totetsu developed a UNIDO-backed technology for rainwater harvesting and filtration, and has completed similar work to our project proposal, including in overseas projects (State Ground & Surface

Water Resources Data Centre Water Resources Department 2019). We therefore believe that Totetsu is a practical suggestion for a construction and development contract in this context and could provide a great benefit to the community of Kampung Laur Batang. Moreover, through a partnership with our project, Totetsu has an opportunity to expand and cultivate their product to Indonesian market.

III. Jakarta Provincial Government

We will collaborate with the Jakarta Provincial Government in several main roles. First, we will consult with relevant government branches regarding standards and procedures for the introduction of RH systems. The primary government branches include, DKI Jakarta Provincial Water Resources Agency (DSDA) and DKI Jakarta Provincial Education Board. Second, we hope that the Jakarta Provincial Government can serve as a funding partner for this project. Jakarta citizen's access to water and quality of life will be ameliorated by the creation of cheaper and more sustainable water resources, and so it is in the direct interest of the government to be involved in this project. Third, the Jakarta Provincial Government is also the suggested base for our government taskforce that will implement and monitor the project in Kampung Laur Batang.

IV. Mr. Vittorio Kurniawan (Universitas Tarumanegara)

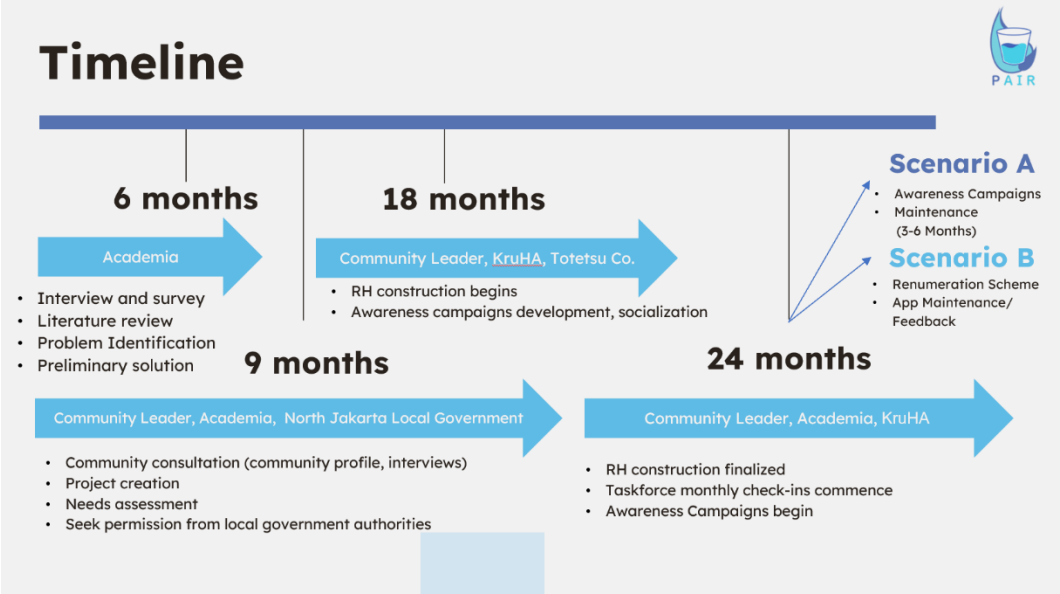
Mr. Vittorio Kurniawan is a scientist at Universitas Tarumanegara (Teknik Sipil/Civil Engineering work unit). He has conducted research on rainwater harvesting systems and has been involved in similar projects in Indonesia. He has provided us with an overview of the process and notified of us key stakeholders when considering a RH project. His advice will continue to help us going forward the project. This project may also provide Mr. Kurniawan with opportunities for research collaboration and project work with The University of Tokyo and Japanese companies.

V. RT15/RW01 Community Leader

They are a contact point for community issues and program socialisation. As representatives of the community, they are responsible for bringing various problems and difficulties to the taskforce team, as well as working with the taskforce to support the day-to-day management of the project and learning, thereby helping to keep the tasks on track.

Pilot Project Timeline

Figure 4. Overview of PAIR Pilot Project Timeline



Concerns and Risks

Several concerns and risks relating to the implementation of rainwater harvesting systems arose during our research for this project. One notable issue was difficulties relating to lengthy wait times in terms of bureaucracy, documentation and permit acquisition. As a solution to this, we suggest beginning the process of gaining the requisite government permits and permission as early as practical. Though it is of course not possible to seek permission for a project before the relevant details and project schematic have been decided on, as soon as these details have been confirmed, it is critical for the bureaucratic documentation and permit permission process to begin.

A second key issue is limited community cooperation and uptake of RH technology due community mistrust of rainwater quality and hygiene standards. This limited interest in rainwater use in turn caused previous RH systems to fall into disuse and disrepair, as there was little community incentive to use — and therefore maintain – the RH system.

As a solution to these issues, we suggest several solutions as part of our project. We suggest developing a strong relationship with the RT 15/RW 01 community leader to discuss logistics and needs for the community and provide a voice for any concerns that arise, thereby functioning as a mechanism to improve community trust of harvested rainwater. Our suggested awareness and maintenance campaigns further aim to alleviate this issue and improve community uptake levels of RH technology. Moreover, we hope that our community remuneration scheme will provide the needed incentive for ample community participation if our preceding measures are insufficient. Our further suggestion of an app and website for residents to log feedback and maintenance issues in real time to ensure that the taskforce is able to rectify issues where necessary and with optimal turnaround time. Our selection of the underground RH system is also an attempt to address the community mistrust issue: an underground system requires less maintenance than its aboveground counterpart, limits the accumulation of debris and growth of algae, and saves water from evaporation. These positive features of the underground system create a system that incites community

trust and can deliver a product that is accessible, safe and functional for the population of Kampung Luar Batang.

Financial Planning, Bureaucracy and Logistics

> *"There is a possibility that PAIR will be accepted for funding from JICA through the North Jakarta governmental collaboration."*

— Mr. Agung Suparjono, Section Head of Housing and Settlement Area Quality Improvement of the North Jakarta Mayor Office, Public Housing and Settlement Area Sub-agency (SDPRKP JU).

I. North Jakarta Government

The Housing and Settlement Area Quality Improvement of the North Jakarta Mayor Office, Public Housing and Settlement Area Sub-agency (SDPRKP JU) is a possible avenue for cooperation of our project. Through our correspondence with government officials Ms. Yulia Tri and Mr. Agung Suparjono, we have ascertained that emailing a formal letter of request with our rainwater harvesting program proposal is necessary. The letter should be addressed to the Head of the Public Housing and Settlement Areas office of the DKI Jakarta provincial government, which is in North Jakarta City's Mayor Office, with the following four people cc'd into the correspondence:

1. Mr. Ali Maulana Hakir, Mayor of North Jakarta
2. Ms. Marulina Dewi, Head of the Regional Cooperation Bureau of the DKI Jakarta Provincial Secretariat (Cooperation Bureau)
3. Mr. Iwan Kurniawan, Head of Development and Environment Bureau of DKI Jakarta Province (PLH Bureau)
4. Mr. Chairul Lantip, Head of Housing and Settlement Area of the North Jakarta Mayor Office, Public Housing and Settlement Area Sub-agency (SDPRKP JU)

The person in charge of administration for proposals is Ms. Yulia Tri, an employee of the Housing and Settlement Area Quality Improvement of the North Jakarta Mayor Office, Public Housing and Settlement Area Sub-agency (SDPRKP JU).

II. DKI Jakarta Provincial Water Resources Agency (DSDA)

Funding and RWH implementation are being discussed with Ms. Elisabeth Tarigan, Subgroup Leader, Sub-Coordinator of Planning for Geology, Raw Water Conservation & Clean Water Supply, DKI Jakarta Provincial Water Resources Agency (DSDA).

According to Ms. Tarigan, the DSDA is currently conducting dam filtering and water reservoir installation projects. These projects are fully funded by the government using the Regional Revenue and Expenditure Budget or Anggaran Pendapatan dan Belanja Daerah (APBD). We are communicating with her for cooperation possibilities.

We have also contacted the Acting Head of the DSDA, Ms Ika Agustin Ningrum, requesting a meeting to discuss the project and receive further feedback from the DSDA to improve project feasibility, but have not heard back yet.

III. Japan International Cooperation Agency (JICA)

Kaiya Kazuki is a staff member responsible for Indonesia in the Water Resources Group of JICA's Global Environment Department at JICA Headquarters in Tokyo, Japan. Following our correspondence with her, she shared two feasible pathways for registering PAIR to JICA's funding: (1) grassroots technical cooperation project and (2) bilateral cooperation between Indonesian and Japanese governments.

1. The *grassroots technical cooperation project* (Kusanone gijutsu kyōryoku jigyō) pathway provides budgetary, technical, and implementation support to projects proposed by Japanese universities, institutions, local governments, and NGOs/CSOs. JICA provides three types of grassroots technical cooperation projects: (1) cooperation support type (maximum 10 million yen), (2) partnership types (maximum 100 million yen), and (3) regional activation type (maximum 100 million yen) (JICA, 2023).
2. JICA accepts projects through the Indonesian local governmental body as a form of bilateral cooperation. Through this pathway, JICA provides direct technical assistance following an agreement exchange between the Indonesian and Japanese governments. However, the budgetary support, implementation, and maturity of the project are highly determined by the priorities of both the Indonesian and Japanese governments as informed by Kaiya Kazuki.

IV. DKI Jakarta Education Provincial Board

As our project is done at a Jakarta local school, Mr. Agung Suparjono from SDPRKP JU refers to the fact that we must partner and consult with the DKI Jakarta Education Provincial Board. The proposal must be submitted to the Leader Secretary of the DKI Jakarta Provincial Education Board, Mr. Anas.

The details of the people in charge of the process are listed below.

1. Acting Head of the DKI Jakarta Provincial Education Board: Mr. Purwosusilo
2. Leader Secretary the DKI Jakarta Provincial Education Board: Mr. Anas
   Phone: +62 856-8982-828
   Proposal Submission Address: DKI Jakarta Provincial Education Office, 1st Floor, Jl. Gatot Subroto Kav. 40 41, South Jakarta, Indonesia.

An application letter along with a proposal should be attached together and should be addressed to the Acting Head of the DKI Jakarta Provincial Education Board. The letter and proposal should explain the purpose, objectives, and the intended location of PAIR, and include the contact person for further coordination. After the proposal submission, Mr. Anas will provide another more specified field contact person for further coordination.

V. Totetsu MFG. Co., Ltd.

From our correspondence with Totetsu, we have received the following cost breakdown for our project: in the case of the school where we plan to build the rainwater harvesting system, the size of the reservoir will be 500m³ if the size of the roof of the building — the rainwater catchment area — is 1600m². The construction cost is assumed to be JPY50,000/m³. Therefore, the final cost is 500m³ x 50,000, which becomes JPY25 million (US$168,000).

This higher price point is due to their recommendation that storage tanks of this large scale should be made from concrete, not plastic, to prevent cave-in accidents and plastic sheet breakage. If a rainwater

harvesting system is only tens of cubic meters large, a cheaper plastic model is possible, but for a durable product to function reliably and effectively, concrete is recommended.

A Final Endorsement

We end our proposal with a final endorsement from one of our stakeholders, KRuHa, the Indonesian People's Coalition for the Right of Water:

> *"Our people have been fighting for **water rights since 2004** in various adjudication processes in the District and Supreme Court. Despite winning many trials, public services for **water still cannot be fully enjoyed.**"*
>
> *"**PAIR is feasible** to assist and strengthen our community organisations and social movements by promoting an alternative management of **water resource.**"*

— Muhammad Reza Sahib, National Coordinator of KRuHA

We hope that our proposal has convinced the jury of the urgency of this issue and the importance of endorsing our project as a means to help fight for the fundamental right of clean water access for the people of Jakarta.

Conclusion

Thus, it is evident that PAIR is a practical solution to the water accessibility issues facing Jakarta. Past rainwater harvesting initiatives have demonstrated the dire necessity for long-term, comprehensive investment in water accessibility solutions, with low-budget, low-resource models having limited success and impact, making investment in such projects an inefficient allocation of resources. Our project aims to improve awareness and maintenance knowledge of rainwater harvesting in the community through community-based participation, and thereby improve project community uptake and viability.

Furthermore, it aims to limit maintenance needs for the project to run as smoothly on the ground and includes a variety of avenues and mechanisms for community consultation and self-correction along the way to ensure the best possible product is tailored to the needs of the community. Therefore, the success of the project requires the central involvement of the district's community leader, the web and app real-time maintenance and feedback log, and the government taskforce's monthly community check-ins. We believe that PAIR is a viable project that can provide a lasting impact and improve the lives of people in Jakarta, and we hope that our pilot project can be extended to other districts following its run in Kampung Laur Batang.

Appendices

Figure 1. Follower count of social networking account survey.

Figure 2. Geographic distribution of survey respondents.

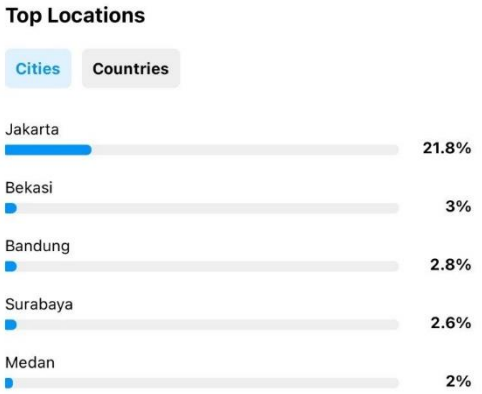


Figure 3. Gender breakdown survey respondents.

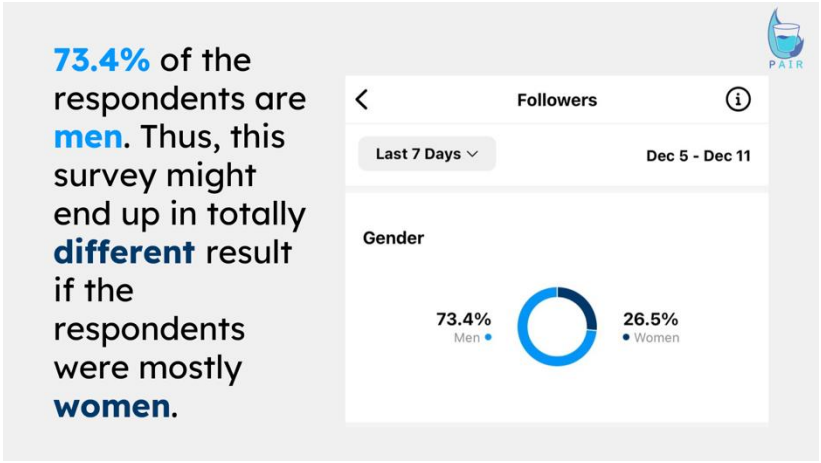


Figure 4. Results of Survey 1.

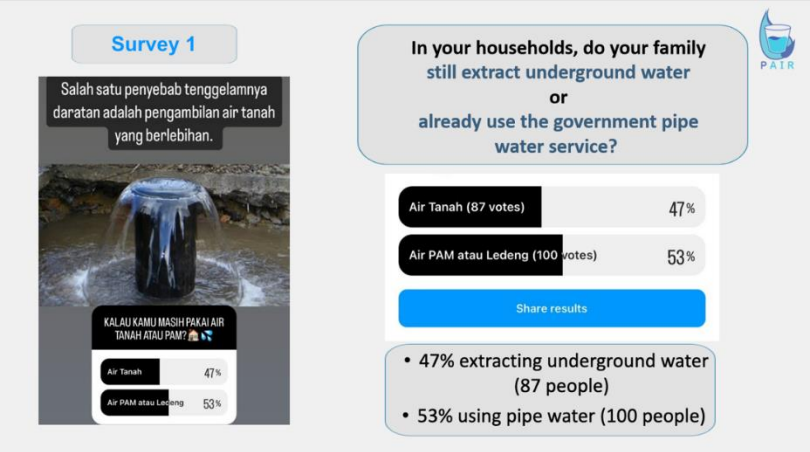


Figure 5. Results of Survey 2:

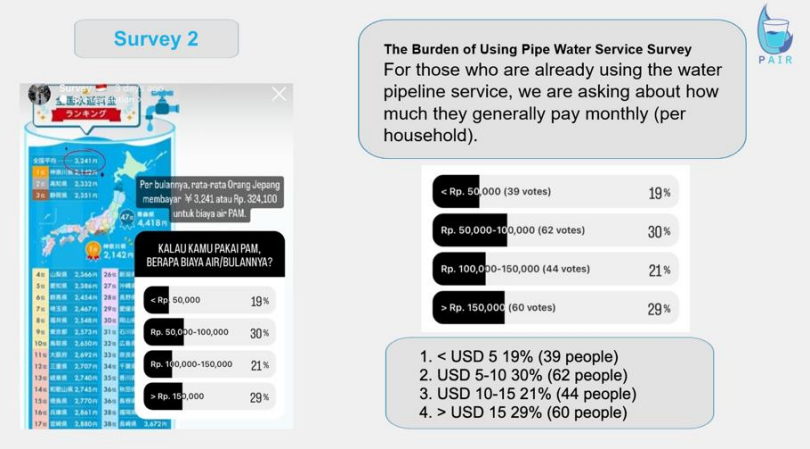
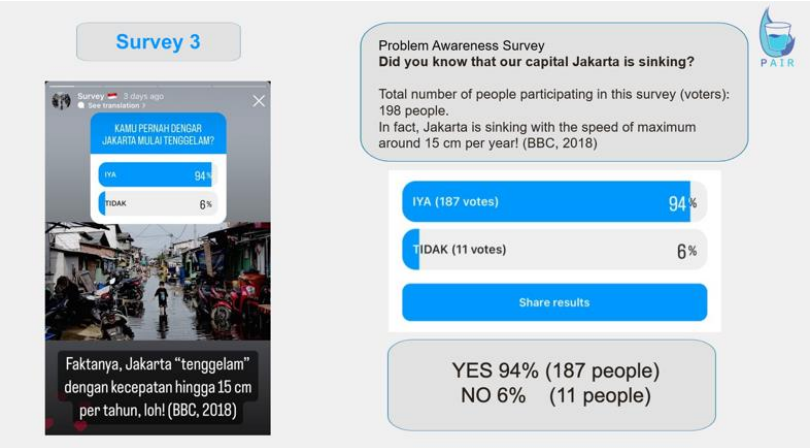


Figure 6. Results of Survey 3.



Summary of correspondence not mentioned in research paper:

PT. Penguin Indonesia

PT. Penguin Indonesia is a leading company that produces rainwater tanks for domestic houses rainwater harvesting installations (PT. Penguin Indonesia 2024). After some correspondence with them, we came to the conclusion that partnership might be possible through PT. Penguin Indonesia providing goods that we need during PAIR implementation in Jakarta. We ascertained the relevant person in charge for proposal submission from their CSR team.

Dion Notario, Atma Jaya Catholic University of Indonesia

Based on an email correspondence with Dion Notario (Atma Jaya Catholic University of Indonesia, Department of Pharmacy, School of Medicine and Health Sciences), he noted that rainwater harvesting systems were initially installed by Atma Jaya as a clean water source and temporary assistance before the government appointed a drinking water company to Muara Baru Flats. In an excerpt, Notario commented that "rainwater harvesting installations made by our institution are currently only for clean water needs when the supply from drinking water companies is hampered." Notario was a co-author of the article, "Towards Green Rusunawa: Clean Water Utilization, Composting, and Urban Farming in Muara Baru Flats", published by MITRA: Jurnal Pemberdayaan Masyarakat in 2021.

Dr Hayati Sari Hasibuan, University of Indonesia (UI)

Dr Hasibuan advised us that to the best of her knowledge, there was no program for rainwater harvesting run by the Indonesian government on a local or national government level. The government's main focus is funding and constructing piped water networks. Her team had several meetings with the Jakarta government, they planned to adopt their suggested rainwater harvesting project in several districts in North Jakarta but after a change in government, the projects were stalled and did not come to fruition.

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