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# Assistance for Construction of Rainwater Infiltration Wells through Rain Water Harvesting in Overcoming Flood Prone in Beji Village, Depok City

***Pembangunan Sumur Resapan Air Hujan melalui Rain Water Harvesting dalam Mengatasi Rawan Banjir di Kelurahan Beji, Kota Depok***

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**Abstract**

Beji Village is one of the villages in Beji District, Depok City. Currently, Beji Village is quite dense with residents. Most of the land is used as housing for residents, so it has an impact on depleting the availability of vacant land as water catchment areas. This causes the area to become prone to flooding. This service aims to assist the people of Beji, Depok, build rainwater infiltration wells through Rain Water Harvesting to overcome flood proneness. Participatory Rural Appraisal (PRA) is used in this assistance by inviting the community to participate in Extension and Education, Training and Guidance, Field Assistance, Community Involvement, Research and Monitoring, and Partnership Development. This service resulted in rainwater harvesting, which has absorption two times faster than before. It can be illustrated that rainwater will usually recede within half an hour at the service location. With this infiltration well, incoming rainwater can recede within 10-15 minutes for a field area of approximately 80 m2. With this infiltration well, rainwater that usually recedes within half an hour can recede within 10-15 minutes for a field area of 80 m2. This shows the success of community service in reducing the risk of flooding in Beji Village and providing effective solutions to address the problem of water availability and water management in the area.

**Keywords** floods; infiltration wells; population dense; rainwater; water infiltration.

## 1. INTRODUCTION

The environmental problem that the people of Indonesia often experience is the occurrence of flash floods, rainy season, and drought during the dry season. Based on disaster data in Indonesia issued by the National Disaster Management Agency (BNPB) in 2021, 1,794 floods, 1,321 landslides, 1,577 extreme weather, and 15 droughts occurred throughout Indonesia, with the majority of disasters occurring in West Java Province (National Agency Disaster Management, 2021). Several things have caused this disaster, some of which are the soil's decreased ability to absorb water due to environmental changes which impact the development process (Kusnaidi, 2011). A landslide disaster occurs because the shear force that occurs in the soil exceeds the soil shear resistance (Nurwidya- Ningrum et al., 2022), for the flood disaster itself occurs due to high rainfall caused by climatic factors or also due to illegal logging, which makes the soil around an area unable to absorb water properly (Verianty, 2022).

Figure 1. Disaster Infographics in Indonesia in 2021
(National Board for Disaster Management, 2021)

Beji Village is one of the villages in Beji District, Depok City (Service Depok City Communication and Informatics, 2022). MomentCurrently, Beji Village is quite dense with residents. Most of the land there has been used as housing for residents, impacting the depletion of vacant land as water catchment areas. This causes the area to become prone to flooding. When it rains with a high enough intensity for a long time, it is very likely that the area will be flooded (Sulaiman et al., 2019).

The head of the Community Empowerment Institute (LPM) of the Beji Village, Dahlan Iskandar, in his discussion with the chief proposer, Dyah Nurwidyaningrum, said that this problem was one of the urgent problems experienced by residents in the Beji Village. Therefore, the Basic Technical Expertise Group (KBK) for the Department of Civil Engineering proposed making rainwater infiltration wells to manage rainwater. This rainwater absorption well will later apply the concept of rainwater harvesting, namely, the utilization of rainwater can be used for clean water sources (Yulistyorini, 2011). The infiltration well is planned will be built on Jalan Nangka RT 07 / RW 15, Beji Village, Depok City.

One effort to overcome this problem is to build rainwater infiltration wells. Rainwater infiltration wells are infrastructure for collecting and absorbing rainwater into the ground (Body National Standardization, 2002,2017). More and more water that seeps into the ground means that more groundwater is stored. Groundwater can be reused through wells or springs.

Construction of infiltration wells in schools is proven can prevent puddles in the schoolyard, and the collected rainwater can be used for toilet purposes, cleaning the school terraces, and watering plants in the schoolyard (Herlambang et al., 2018). Rainwater is one of the energy conservation potentials (Nurwidyaningrum, 2014). Water collection rain is one of the efforts that can be made in the energy conservation of residential houses in urban settlements. Then, on community service (Nurwidyaningrum et al., 2019), researchers have researched communal sanitation network facilities in the form of MCK in the Bogor area. During the construction of the MCK, infiltration wells were also constructed, which could be used as a component of the sanitation network where the communal MCK is located. Public awareness of shared public facilities must be increased to maintain environmental quality (Treasure, 2018).

In several areas in India, rainwater utilization programs have been carried out through Rain Water Harvesting technology to overcome the problem of the availability of clean water. This program involves outreach, training, and guidance to the community on the design and construction of rainwater infiltration wells in homes and communities. The government and non-governmental organizations are involved in providing resources and technical support to citizens to implement this technology successfully.

Israel is one of the countries that has succeeded in managing rainwater well, especially in dry areas. They have adopted various technologies and strategies such as rainwater collection and storage, construction of drainage canals, and efficient water management. The government and non-governmental organizations provide assistance programs to educate and train the public to use this technology properly.

Australia has also carried out various rainwater management programs and Rain Water Harvesting technologies to address water crisis problems in several regions. Mentoring and counseling programs are carried out by local governments and related institutions to increase community awareness and skills in building and maintaining rainwater collection and storage infrastructure.

Rainwater management programs and the use of Rain Water Harvesting technology have been carried out in several areas in the United States, especially in areas with high rainfall. These programs include community training in building rainwater collection systems in homes and public facilities. Local governments, environmental agencies, and educational institutions assist and provide technical support to the community.

The assistance and similar programs above show that Rain Water Harvesting technology and rainwater management have become relevant solutions in overcoming the problem of clean water availability and flood management in various countries. Experiences from these regions can be used as inspiration and reference for developing similar assistance in addressing water supply and flood management problems in other areas.

Several similar services have been carried out, including implementing Rainwater Harvesting During the Covid-19 Pandemic in Serang City. Socialization of activities through the Participatory Rural Appraisal (PRA) method approach by inviting the community to participate. The results of the community service activities include 1) making rainwater harvesting tools for alternative needs for clean water for hand washing and recommended tool designs, 2) implementation of rainwater harvesting technology, 3) mass media publications 4) copyrights. An indicator of the success of this activity is increasing public understanding of sustainable urban development strategies by recycling rainwater into raw water (water circulating complex) and taking a direct role in promoting the national movement for water rescue partnerships (GNKPA) (Wigati et al., 2022).

His dissertation entitled Study of Rainwater Utilization as Fulfillment of Clean Water Needs in Small Islands Case Study: Concong Tengah Village, Concong District, Indragiri Hilir Regency. The study's main objective was to determine rainwater harvesting on an individual quantitative hydrological scale to meet water needs in Indragiri Hilir Village, Concong Tengah District. The method used is to use the Rain Cycle 2 program, which is simulated using community input data for roof area (m2), water needs based on the number of family members (m3/day), and daily rainfall data in one year (mm/year).

The research entitled Analysis of Rainwater Harvesting Potential Using Rainwater Harvesting Techniques for Domestic Needs. Gampong Leuhan is one of the West Aceh district areas where most people still use groundwater daily. Some people have used drilled wells or drilled wells, but if we look at the construction costs, it is costly. If more groundwater is used from the drilling system, it will impact land subsidence. Under these conditions, a more effective and efficient system is needed to address the problem of the need for clean water and water shortages in people's lives. One of the processes is to create a rainwater harvesting system from the rooftop of a building/housing by maximizing high rainfall. Field surveys show that the building area in Gampong Leuhan is in good condition and livable, with dominant roofs made of zinc so this condition will be optimal in the rainwater harvesting process. Analysis of the potential for rainwater absorption in Gampong Leuhan shows 887,892 liters/day, with an average potential for rainwater absorption per house of 862,031 liters/day. The comparison between the amount of water harvested is 887,892 liters/day, and the amount of water used for the needs of the people of Gampong Leuhan is 482,346.90 liters/day (Silvia & Safrriani, 2018) with an average potential of rainwater infiltration per house of 862,031 liters/day. The comparison between the amount of water harvested is 887,892 liters/day, and the amount of water used for the needs of the people of Gampong Leuhan is 482,346.90 liters/day (Silvia & Safrriani, 2018) with an average potential of rainwater infiltration per house of 862,031 liters/day. The comparison between the amount of water harvested is 887,892 liters/day, and the amount of water used for the needs of the people of Gampong Leuhan is 482,346.90 liters/day (Silvia & Safrriani, 2018).

The research titled Study of Utilization of Rainwater as Fulfillment of Clean Water Needs on Ende Island. Referring to the utilization of rainwater harvesting technology in various countries, the roof can be an alternative effort to use as a clean water supply system. The main objective of this research is to determine the quantitative hydrology of rainwater use on an individual scale to meet the clean water needs of residents in Pulau Ende District. The method used is to use the rain cycle two program, which is simulated by using community input data for roof area (m2), water demand based on the number of family members (m3/day), and daily rainfall data in one year (mm/year).

Meanwhile, this service continues the previous service model, namely carrying out community service in Beji Village, Depok, by making infrastructure in the form of infiltration wells to manage and reuse rainwater to water plants for residents.

## 2. METHOD

The method used in this service is Participatory Rural Appraisal (PRA) by inviting the community to participate. The steps in this service are as follows.

### *2.1. Counseling and Education*

Conduct outreach and education programs to the public regarding the importance of utilizing Rain Water Harvesting technology. This includes how to design, build and maintain rainwater catchment wells. Through counseling, the community will understand the benefits and appropriate implementation steps.

***2.2. Training and Guidance***

Provide training and guidance for residents to design, build and manage rainwater infiltration wells independently. By providing technical skills to the communities, they can carry out this project more effectively and sustainably.

***2.3. Field Assistance***

It assists the community while building and utilizing rainwater infiltration wells. This assistance helps overcome technical and non-technical obstacles that may be faced by the community so that the project can run smoothly.

***2.4. Community Engagement***

Involve the community in every project planning and implementation stage. This includes a participatory process in which the community plays an active role in determining the appropriate location, design of infiltration wells, and how they are managed. Infiltration wells will be better suited to local needs and conditions with their involvement.

***2.5. Research and Monitoring***

They are conducting research and monitoring of infiltration wells that have been built. The collected data will help understand the effectiveness and impact of the project in reducing the risk of flooding in Beji Village. Research results can be used to improve the future design and management of infiltration wells.

***2.6. Partnership Development***

We are building partnerships with local governments, non-governmental organizations, universities, and other parties involved in flood management and the environment. The synergy between stakeholders will sustainably strengthen the implementation and maintenance of rainwater infiltration wells.

Combining the above methods will help increase understanding, participation, and application of rainwater infiltration wells in Beji Village, Depok, to reduce flood hazards and provide long-term benefits for the local community. The flowchart of the implementation of the Expertise Group-Based Application of Science and Technology Service (PPIKBK) is shown in Figure 2. Method implementation is divided into three stages: pre-implementation, implementation, and evaluation. Pre-implementation begins with conducting a location survey to get the right location to construct Rainwater Harvesting.

The location is on Jalan Nangka in RT 07, Beji Village, Depok City, West Java. Simultaneously with the location survey, the servant coordinated with the head of LPM for the Beji Village, Depok City, intending to discuss permits related to the construction of rainwater harvesting in the Beji Village area.

The implementation stage is carried out at the service location if the permit has been obtained. The activity begins with making 3D (Detailed Engineering Design) drawings using Google SketchUp software. Activities continued with calculating costs and surveying materials following the budget and design specifications. The activity is continued by manufacturing rainwater harvesting until it can be functioned according to the plan/design.

The next activity is conducting trials of infiltration wells according to their function, namely having absorption two times faster than before. The activity ended with an evaluation of the construction of infiltration wells by the service team and residents. They were followed by the procession of handing over the infiltration wells to the chairman of the Beji Sub-District LPM, which residents and members of the KBK Basic Engineering Department of Civil Engineering, Jakarta State Polytechnic.

## 3. FINDINGS AND DISCUSSION

### *3.1. Drawing DED (Detailed Engineering Design)*

The upcoming Rain Water Harvesting plan was built in Beji Village using Google SketchUp software (Figure 5). The design shows that the yellow line shows infiltration holes that collect rainwater. The green line shows the foundation, and it can be seen that the foundation used is a river stone foundation, so it is expected to be stronger and has a long life. The purple color shows the machine used to pump water that has already been distilled, which can finally be flowed through the faucet on the red line. The cover of this infiltration well is indicated by a black line closed with a concrete work floor.

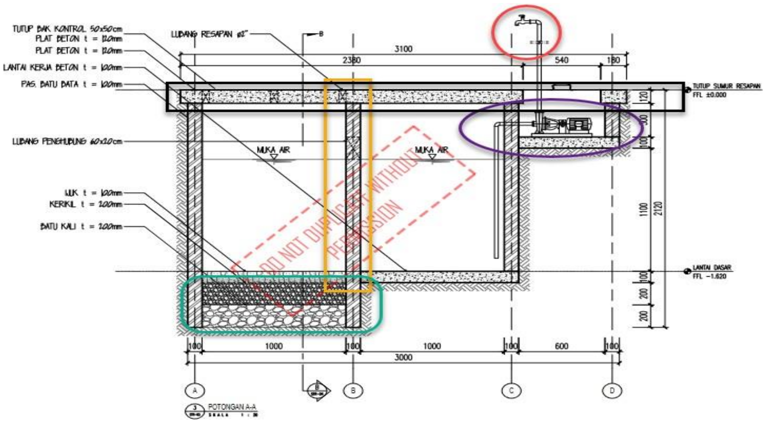

Figure 2. Rainwater harvesting design

The material used to manufacture infiltration wells uses buis walls (Klopmart, 2018), concrete with a diameter of 100 cm and a depth of 270 cm (Salen, 2022). Four types of concrete buses are mounted on the walls of the infiltration well. At the same time, the bottom wall is a river stone with a diameter of about 15-25 cm smaller than the diameter of the concrete buis above it. The well is also connected to a water pump. Then, there is a control tub measuring 50×50×50 cm. The control tub is connected to the infiltration well via a PVC pipe with a diameter of 3 inches and a 2 to 5 degrees slope toward the infiltration. It aims to drain water into infiltration wells through the ground (without being visible on the asphalt or sidewalk surfaces). Next, a wire filter is in the pipe hole on the control tub wall. It is hoped that the water that enters the infiltration well will have been filtered beforehand to be free from garbage and other clogging substances; this control tub is also given alum powder as a rainwater purifier. Suppose a rainwater channel comes from a house or street gutter. In that case, the rainwater will be connected to the control tub before finally being connected to the infiltration well via a 3-inch diameter PVC pipe. In addition, there is also a wire filter on the rain channel wall that is connected to the control tub.

### *3.2. Rain Water Harvesting Excavation*

Execution related to the manufacture of rainwater harvesting was carried out after calculating the cost of surveying materials. The first step is to dig the central hole for the water reservoir in the infiltration well (Figure 6). The excavation was carried out by two people using manual tools so that it could be completed within one week.

Figure 3. Excavation for making rainwater harvesting

The resulting rainwater harvesting has absorption two times faster than before. It can be illustrated that rainwater will usually recede within half an hour at the service location. With this infiltration well, incoming rainwater can recede within 10-15 minutes for a field area of approximately 80 m2.

Figure 4. Infiltration holes

### 3.3. *Results of Rain Water Harvesting*

The making of this infiltration well is relatively fast due to proper coordination between the community service team and the local community. Full support is given by the community so that this development is beneficial to residents.

Figure 5. Infiltration wells

Various case studies and community services that have been carried out show some of the successes and benefits of using rainwater using Rain Water Harvesting technology. The construction of rainwater catchment wells in Beji Village and other areas can prevent water stagnation and store rainwater, which can be used for toilet purposes, cleaning, and watering plants. In addition, rainwater management can also be one of the efforts in energy conservation and reducing the impact of environmental change.

Rainwater management with Rain Water Harvesting technology requires support and awareness from the community. The active participation of the community in the process of utilizing rainwater will increase the effectiveness and sustainability of the program. Good outreach and assistance can increase people's understanding of the benefits and importance of using rainwater and sustainably managing water.

Even though Rain Water Harvesting technology offers many benefits, there are still some challenges in its implementation, especially related to community awareness and participation, sufficient resources, and coordination between related parties. Further steps needed are to increase socialization campaigns, involve more parties in the rainwater management program, and conduct periodic evaluations of the program's success.

## 4. CONCLUSION

The capacity produced by the service team's infiltration wells or rainwater harvesting is the same as the volume capacity. Community Service activities produced infiltration wells that have absorption two times faster so that they can prevent flooding in Beji Village, Depok. Besides preventing flooding, it can be used as a water supply. Community service activities are carrying out maintenance of infiltration wells by carrying out education to residents, especially the heads of RT/RW, applying for funds to purchase alum/fiber so that clean infiltration well water is protected from diseases caused by collected dirty water.

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