Rainwater Harvesting as an Alternative Water Source in Semarang, Indonesia: The Problems and Benefits

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Abstract. One of the obvious impacts of climate change is the vulnerability of clean water availability due to uncertain weather conditions marked by the shift in periods of rainy and dry seasons. Semarang is a coastal city with a diverse topography that faces challenges of clean water supply. Semarang’s residents living in hilly areas still rely on non-piped water as a source of clean water which, in turn, affects ground water availability. On the other hand, rainwater runoff can cause flooding due to the limited extent of non-built-up areas for water infiltration. The Association of Cities Climate Change Resilience Network (ACCCRN) has initiated a pilot project to implement a rainwater harvesting (RH) system which could increase Semarang’s resilience in clean water provision. The communal RH model was applied in Tandang Village, while the individual RH model was implemented in Wonosari Village. This paper aims to explore the problems and benefits of the use of the RH system for both models. This study applies a mixed method approach via interviews with all relevant stakeholders and questionnaires for rainwater harvesting users. The study found that problems that arise are the perception that rainwater is only fit for non-consumption needs, the community’s willingness to utilize rainwater depends on the availability of other alternative water sources, the high installation costs for the poor especially for the individual models, and the challenge of the community's willingness in managing communal systems requiring collective participation. The benefits of using RH can be seen from the cost savings for clean water, the formation of social capital from collaborative efforts of managing the communal RH system, and the reduction of rainwater runoff as one of the factors that cause floods.

1. Introduction

The phenomenon of climate change has a significant impact on the environment. One effect is increasingly erratic weather patterns marked by shifts in periods of rainy and dry seasons. Ultimately, climate change causes irregular water supply and yearly variations. The constantly changing weather affects sensitive matters related to water resources, namely surface water, groundwater, flood and drought disasters, as well as water quality and availability [1]. During the rainy season, water precipitation is relatively high and flood risk increases because only approximately 30% of rainwater can be absorbed into the ground and accommodated by artificial water storage systems such as reservoirs. Meanwhile, the remaining runoff will cause flooding if it is not accommodated by the drainage system. On the other hand, the rise in the earth's temperature causes high evapotranspiration, particularly during the dry season which reduces the number of clean water sources, particularly...
surface water. Thus, clean water supply decreases in the dry season [2]. Therefore, the management of water resources, particularly rainwater, is needed to ensure its constant availability.

The Asian Cities Climate Change Resilience Network considers Semarang City as one of the cities in Indonesia that are vulnerable to climate change, particularly in relation to clean water supply. In 2025, the projected water demand will exceed the available supply. More than a quarter of the population of Semarang lives below the poverty line, which further limits their access to clean water. The Local Water Utility (PDAM) in Semarang can only serve 25% of households. Therefore, many people use groundwater and surface water as a source of clean water. One effort to increase the resilience of the people of Semarang City is through the supply of clean water via a pilot project for a rain water harvesting (RH) system. The RH system was chosen as an alternative clean water source because of the high average rainfall in Semarang City which is between 2000-3000 mm/yr.

The RH pilot project was developed in two locations, namely a communal model in Tandang Village and an individual model in Wonosari Village. The selection of these two locations is based on differences in supply and demand for clean water, the people’s willingness to use rainwater as a clean water source, and the socio-economic conditions of the poor. The development of the RH system is expected to reduce the community's need to purchase clean water and reduce groundwater use to be able to save clean water costs. In addition, there is an expected increase in public awareness about the possible use of rainwater for clean water, infiltration, and increase soil fertility. Rainwater utilization can reduce rainwater runoff (overland flow) and prevent or reduce flooding. Increased water infiltration is also expected to provide water reserves during the dry season.

Figure 1. Location of Wonosari and Tandang Village

The utilization of rainwater as a clean water source has been carried out by many developed and developing countries, including in the UK [3], Malaysia [4], Portugal [5] and many other cities in Indonesia such as Bandar Lampung [6], Banda Aceh [7], and Denpasar [8]. Helmereich [9] mentioned the potential of rainwater harvesting in developing countries for minimizing water scarcity. One of the issues of rainwater harvesting is the diverse public perception of the quality of rainwater as a source of
clean water. Rainwater quality is influenced by several factors, including the type of catchment area, topographic conditions, climate conditions, the level of air pollution around the catchment area, the type of storage material, and the management of the water before it was used [10].

From an economic perspective, the cost of installing and maintaining an RH system for drinking water cannot compete with the cost of clean water from the government pipeline. However, compared to the costs of building and maintaining wells, the installation of RH systems is inexpensive [11]. Greater financial savings are gained from the RH system for big buildings compared to the communal system in housing [3].

Previous studies have analyzed domestic individual and communal RH models separately. However, each location of RH implementation has different characteristics that affect which RH model is appropriate. The purpose of this article is to explore the problems and benefits from the use of each type of RH model, for both the communal and the individual model. This could determine the replicability of the RH and the appropriate type of model that could be applied at other locations.

2. Research Methods

This research used a mixed-method by combining qualitative and quantitative analysis. The research steps comprised: (1) examining the vulnerability and utilization characteristics of clean water in Wonosari and Tandang Village as locations for applying the rainwater harvesting system, (2) examining the utilization of the rainwater harvesting system for each model, and (3) analyzing the problems and benefits of using the rainwater harvesting system for each model.

The quantitative data were obtained through questionnaires for all relevant users of the rainwater harvesting model (five respondents for the individual RH and six respondents for the communal RH). The collected data are related to clean water utilization characteristics before and after the application of RH, namely the quantity and purpose of clean water utilization, the quality of clean water, the cost of fulfilling clean water needs, and the access to clean water. The qualitative data were obtained through interviews with eleven RH system users, RH system managers, the RH construction team, and the village government. The data collected are related to the people’s responses to pre and post utilization of the RH system and the RH system development process from the stages of information dissemination to utilization.

3. Result and Discussion

3.1. The vulnerability of clean water in Tandang and Wonosari Village

3.1.1. The vulnerability of clean water in Tandang Village. Tandang Village is one of the villages in Tembalang Sub-district, Semarang City. The village has an average density of 3,000 inhabitants per km$^2$ and most of the land use is for settlements. The morphology of this village is mostly hilly with slopes of 15-25%. As one of the villages in the hilly area, only parts of Tandang Village are served by the PDAM network, i.e., 8 out of 14 RWs (Rukun Warga or urban neighborhood). The RWs that are served by PDAM are RW 1, RW 2, RW 3, RW 4, RW 5, RW 6, RW 9, and RW 10. The PDAM water for Tandang village is sourced from Wungkal Kasap and Tegal Wareng. This PDAM water is of good quality, clear and has never caused water-borne diseases. The water supply is constant, even though reduced water debit occurs during the dry season. Even so, not all residents in the RW use water from PDAM. In RW 3, RW 4, RW 6, and RW 10, there are artesian wells funded by a local government project in 1975, the provincial government, and community development NGOs.

Tandang Village is situated in an area that is vulnerable to clean water supply. Tandang Village is one of the seven villages that have a large gap between clean water supply and demand, i.e., -25.86 liters/second in 2010 which is predicted to increase to ~48.36 liters/second in 2030 [12]. In the status quo, the gap between supply and demand has not been felt by the community and only occurs during the dry season. Apart from the quantity, the quality of clean water in Tandang Village is unclear, particularly from shallow wells. Thus, the vulnerability of clean water in Tandang Village is not only from the aspect of quantity, which is sometimes insufficient but also the aspect of quality that is not viable for consumption. Therefore, people use water from shallow wells only for non-consumption purposes. For consumption purposes such as for drinking and cooking, those not covered by PDAM
services use water from artesian wells or buy refill water. Meanwhile, some people in Tandang Village (RW 11 and RW 12) are poor which increases their difficulty of accessing clean water.

3.1.2. The vulnerability of clean water in Wonosari Village. Wonosari Village is one of the villages in Ngaliyan District at the western border of Semarang City. The village has an average density of 3,000 inhabitants per km² and most of the land use is for settlements, trade, and services. The morphology of this village is mostly hilly with slopes of 8-15%. The vulnerability of clean water in Wonosari Village is due to the gap between available clean water supply and the increasing demand for clean water by the people. Moreover, the vulnerability of clean water is caused by low clean water quality, which is turbid and foul, a lack of alternative water sources, and ground water pollution because of activities at the Mangkang Market, and flood risk from the Bringin River.

As one of the villages located in the border region and in the hills, Wonosari Village is not yet served by the PDAM network. Most clean water used by the people in Wonosari Village comes from shallow wells and artesian wells. The depth of the shallow wells is between 3-10 meters and the artesian wells are between 15-25 meters, depending on the depth of groundwater at the location. The clean water from shallow wells is turbid and smelt of iron so that it is only used for non-consumption purposes such as bathing and washing. For consumption purposes such as for drinking and cooking, the people choose to use artesian wells. In fact, not everyone has access to artesian wells that have better water quality compared to shallow wells.

There are only three RWs with artesian wells constructed by the PAMSIMAS (Community-Based Water Supply and Sanitation) program in Wonosari Village, namely RW 4, RW 5, and RW 6 serving a total of 230 households. Several other RWs already have their own artesian wells built by non-governmental organizations or housing developers. The management of artesian wells was transferred to the community that subsequently formed the Tirta Sari organization. The cost of using artesian wells is IDR 1,300.00/m³ and with a subscription fee of IDR 5,000.00 per household. These costs are used for well installation and piping maintenance, manager’s salary, and savings to construct new wells to increase access to clean water.

3.2. Utilization of Rainwater Harvesting

The development of rainwater harvesting systems in Wonosari and Tandang village is part of the ACCCRN pilot project to build Semarang City’s resilience to climate change [13]. Site selection begins with a feasibility study on the application of the RH system. The selection criteria are a location that lacks alternative water sources and is not served by the PDAM, the socio-economic conditions of the community are suitable, and the community has the willingness to adapt. The development process begins with disseminating information on the use of rainwater as a source of clean water because the community is not accustomed to using rainwater, mainly because of doubts about the quality of rainwater. The choice of location was directed to five households for the application of the individual model in Wonosari Village and one communal building for the application of the communal model in Tandang Village.

3.2.1. Individual Model. Five houses were selected for the pilot project for the construction of the individual system. The five houses are situated in RW 6, Wonosari Village. The houses chosen for the application of the rainwater harvesting system are owned by Mr. Jaelani in RT 02 (RukunTetangga or smaller urban neighborhoods), Mr. Puji in RT 03, Ms. Muidah in RT 03, Ms. Tumini in RW 04, and Mr. Sukis in RT 04. The development of the individual rainwater harvesting system in each house was carried out after disseminating information to all inhabitants of Wonosari Village. The location was selected based on the willingness of the homeowner and the physical condition of the building for installation. The selection of the installation model was also discussed with the house owner so that the rainwater harvesting system in each house varies in terms of the location of the reservoir, the filtering system, and the drainage system. The details of the components of the rainwater harvesting system in each house can be seen in Table 1.
Table 1. Components of the RH system in each house [12].

| Component                  | Mr. Jaelani | Mr. Puji | Mrs. Mu’idah | Mrs. Tumini | Mr. Sukis |
|----------------------------|-------------|----------|--------------|-------------|-----------|
| Gutter and filter          | √           | √        | √            | √           | √         |
| Pipe                       | √           | √        | √            | √           | √         |
| Water tank                 | √           | √        | √            | √           | √         |
| Frame                      | √           | √        | √            | √           | √         |
| Infiltration well          | √           | √        | √            | √           | √         |
| Slow sand filter           |             |          |              | √           |           |

Adjustment of the rainwater harvesting design in each household caused differences in the water collection capacity. The quantity of water that can be collected by the rainwater harvesting system is dependent on the roof area and the average rainfall per day (8.75 mm/day) as seen in Table 2.

Table 2. Rainwater quantity that can be collected by the system

| Respondent       | Roof area (m²) | Rainwater quantity that can be collected (liter/day) |
|------------------|---------------|----------------------------------------------------|
| Mr. Jaelani      | 31.73         | 277.73                                             |
| Mr. PujiRusdono  | 31.73         | 277.73                                             |
| Mrs. Muidah      | 31.73         | 277.73                                             |
| Mrs. Tumini      | 39.81         | 348.53                                             |
| Mr. Sukis        | 31.73         | 277.73                                             |

The capability of the rainwater harvesting system to meet clean water needs can be calculated by comparing the quantity of clean water based on the intended use pre-and post-rainwater harvesting system. The quantity of clean water use before applying the rainwater harvesting system can be seen in Table 3. After the application of the rainwater harvesting system, each household has different characteristics for the allotted use of the storage water as shown in Table 4.

Table 3. Clean water usage pre-RH utilization

| Respondent       | Toilet (liter) | Washing (liter) | Cooking (liter) | Drinking (liter) | Total (liter) |
|------------------|---------------|----------------|----------------|-----------------|--------------|
| Mr. Jaelani      | 1000.00       | 39.25          | 10.00          | 3.17            | 1052.42      |
| Mr. Puji         | 10.00         | 0.00           | 0.00           | 0.00            | 10.00        |
| Mrs. Muidah      | 360.00        | 78.50          | 15.00          | 5.00            | 458.50       |
| Mrs. Tumini      | 750.00        | 50.00          | 10.00          | 10.00           | 820.00       |
| Mr. Sukis        | 500.00        | 75.00          | 16.70          | 2.71            | 594.41       |

Table 4. Purpose of clean water use

| Respondent       | Activity | Toilet | Washing | Cooking | Drinking |
|------------------|---------|--------|---------|---------|----------|
| Mr. Jaelani      | ±       | ±      | -       | -       | -        |
| Mr. Puji Rusdono | +       | -      | -       | -       | -        |
| Mrs. Muidah      | -       | +      | -       | -       | -        |
| Mrs. Tumini      | -       | +      | -       | -       | -        |
| Mr. Sukis        | ±       | ±      | -       | -       | -        |
Based on the calculation of the quantity of water before and after the application of the individual RH system, the contribution of the RH system to the total use of clean water can be seen in Table 5.

| Respondent     | Total of clean water use (liter) | Total of rainwater use (liter) | Percentage |
|----------------|----------------------------------|-------------------------------|------------|
| Mr. Jailani    | 1052.42                          | 277.73                        | 26.43%     |
| Mr. Puji Rusdono | 10.00                           | 10.00                         | 100.00%    |
| Mrs. Muidah    | 458.50                           | 78.50                         | 17.12%     |
| Mrs. Tumini    | 820.00                           | 50.00                         | 6.10%      |
| Mr. Sukis      | 594.41                           | 277.73                        | 46.85%     |

The application of the rainwater harvesting system can indeed help meet the needs of clean water. Each household has a different water usage because the habits and clean water usage prior to the rainwater harvesting system also differs for each household. Reserved water is only used for non-consumption purposes. When viewed from the percentage of its contribution, the largest percentage is from Mr. Puji's household. Even so, the quantity of the reserved water used shows the least amount, which is only 10 liters/day. This happened because from the beginning, before the rainwater harvesting system, the quantity of water used by Mr. Puji was indeed relatively small and only used for latrine activities.

| Respondent     | Water cost (IDR/month) | Gap (IDR) | Percentage |
|----------------|------------------------|-----------|------------|
| Mr. Jailani    | 78,000                 | 16,000    | 20.51%     |
| Mr. Puji       | 0                      | 0         | 0%         |
| Mrs. Muidah    | 0                      | 0         | 0%         |
| Mrs. Tumini    | 20,000                 | 0         | 0%         |
| Mr. Sukis      | 14,000                 | 0         | 0%         |

Based on the contribution of the rainwater harvesting system to the cost of clean water, the greatest savings are obtained by the household of Mr. Jailani. This household was able to save up to IDR 16,000 per month or 20.51% of the total monthly cost of clean water. This savings comes from a cost reduction for the main clean water source (shallow well water pump), from IDR 60,000 to 44,000 per month. Meanwhile, the cost of purchasing refill water has not been reduced, which is IDR 18,000. The amount of cost savings is certainly influenced by the large quantity of reserved water that can be utilized by Mr. Jailani's household, which is 26.43%.

While Mr. Jailani's household could save up to 20.51%, the other four households did not reduce their costs for clean water. However, there are underlying differences that have caused this. The households of Mr. Puji and Ms. Mu'idah did not have any monthly clean water costs before the rainwater harvesting system was installed. The households of Ms. Tumini and Mr. Sukis also did not experience a reduction in the costs of clean water. This is because Ms. Tumini's household still must pay public well fees which are fixed regardless of the amount of water used. Mr. Sukis's household must still pay for refill water because the reserved water was not used for consumption. Although the four families did not gain financial savings, other benefits were obtained. The advantage is saving time and energy for pouring water as normally done by the families of Mrs. Muidah, Mr. Puji, and Mr. Sukis. This time saving can be used for productive work so that they have indirect economic benefits.
3.2.2. Communal model. Tandang Village was the selected location for the communal rainwater harvesting system, specifically at National Elementary School SDN 03. The use of the reserved rainwater is targeted for school activities and the people living around the school. The rainwater harvesting system component in Tandang Village consists of three reservoirs. Reservoir A has a volume of 47,250 liters which is used to collect rainwater from the roof which will be channeled to reservoir B with a volume of 31,500 liters. The water from these two reservoirs can be utilized by the people living in the vicinity of the school. The last is reservoir C with a volume of 24,000 liters specifically used to meet the clean water needs of the school. Water from reservoir C is directly channeled to the bathrooms and taps at the back of the school.

The management of the communal rainwater harvesting system is carried out by the community. Before the construction phase, information dissemination and community preparations were made to ensure the community is willing to utilize and manage the existing rainwater harvesting system. Based on the agreement with the people, the school principal of SDN 03 Tandang oversees the management. This is because the rainwater harvesting system is located in the school area. The management is handled by Mr. Syagiran as a teacher at SDN 03 Tandang who lives close to the school, making it easier to coordinate with the school and people living in the surrounding area who are also the target for utilizing the rainwater harvesting system.

The rainwater in reservoirs A and B are expected to be used by approximately 50-60 households, but it turns out that only five households are willing to use this rainwater. The five households are the residents of RT10/RW11 whose houses are located near reservoir A. The frequency, quantity, and purpose of using rainwater differ for each household. The details can be seen in Table 7.

| Respondent | Purpose               | Quantity (liter) | Frequency                  |
|------------|-----------------------|------------------|----------------------------|
| I          | washing               | 75               | once in the dry season     |
| II         | bathing, washing      | 105              | Everyday                   |
| III        | bathing, washing      | 50-75            | 3 times in the dry season  |
| IV         | washing               | 50               | 2-3 times in the dry season|
| V          | bathing for employee  | 105              | sometimes                  |

The rainwater harvesting system in Tandang Village has a capacity of up to 78,000 liters for reservoirs A and B and 24,000 liters for reservoir C. If the average consumption of clean water is 26 liters per day per individual, then --with a capacity of 78,000 liters (specifically reservoirs A and B targeted for people’s use), this rainwater harvesting system can be used for up to 600 households with an average of five family members. This is in accordance with the initial purpose of the development which is to meet the needs of 600 households in RW 11. However, data shows that from November to March in the last ten years, average rainfall in the rainy season has been around 8.56 mm/day. Thus, with a catchment area of 230,364 m², the reservoirs can only accommodate approximately 1975,627 liters or 2.53% of the capacity of the two reservoirs. This can meet the needs of approximately 75 people or 15 households. As for reservoir C, with a catchment area of 199.86 m² and rainfall of 8.56 mm/day, the reservoirs can accommodate 1714.022 liters or 7.14% of the reservoir capacity on average daily. The average water collected daily cannot be optimal because the catchment area is not proportional to the large reservoir capacity. To build a large reservoir will require a much higher cost. On the other hand, the advantage of making a large reservoir is that it can be used as a place to store rainwater reserves during the dry season.
Although the rainwater use is lower than expected, the community has been able to take advantage of this system. Initially, artisan wells were the main source of clean water of the people using rainwater. After participating in using rainwater as an alternative source of clean water, the community benefits from cost savings when they use rainwater as opposed to other paying alternative sources of clean water. The costs that can be saved by the community and the school after using rainwater can be seen in Table 8.

### Table 8. Financial savings after using the RH system

| Respondent | Water cost before using rainwater (IDR/month) | Savings after using RH (IDR) |
|------------|---------------------------------------------|------------------------------|
| I          | 40,000                                      | 5,000 every use              |
| II         | 0                                           | 0                            |
| III        | 37,500                                      | 6,000 every use              |
| IV         | 57,000                                      | 0                            |
| V          | 35,000                                      | 0                            |
| SDN 03 Tandang | 135,000                                 | 85,000 per month            |

#### 3.3. Problems and benefits of rainwater harvesting systems utilization

The first problem faced in the utilization of RH for both the communal and individual systems is the people's perception of the quality of rainwater. This causes rainwater to be used only for non-consumption purposes. Further, the selection of rainwater filter type and post-harvest processing should be adjusted to the quality of the rainwater harvested. The utilization of the RH system is novel for the community. Communities need an adaptation process both in terms of their perception of the quality of rainwater and transitioning from the existing system. Changes in the perception of rainwater quality occur after the process of information dissemination. People who were initially hesitant to use rainwater became willing to use it, even though it was still for non-consumption purposes. Society tends to be more adaptive after learning from their experiences [14]. The adaptation process can be through a learning process among individuals in a community and between communities. The learning process that occurs can be through knowledge transfer and learning from previous experiences.

The second problem is the community's willingness to use RH is influenced by other available alternative clean water sources. Both pilot project locations still have other alternative sources of clean water, so that rainwater is only viewed as a supplementary source of water rather than a substitute. The difference in the level of vulnerability to clean water supply affects the willingness of the community to utilize rainwater. Communities who live in areas with limited water sources will have incentives to use rainwater because of necessity. Whilst some people will not be willing to use rainwater as they live in areas with sufficient quantity and quality of clean water. This willingness is related to socioeconomic conditions and their awareness and interest in the use of rainwater.

The third problem is related to the investment costs of RH system installations which are relatively high especially for individual systems. The cost of developing an individual RH system is around IDR 3,100,000-4,000,000, while the communal model is IDR 16,000,000-20,000,000 for 33 households or IDR 484,848-606,061 per household. Compared with the Semarang City minimum wage, which is IDR 2,498,587, the cost of installing an individual system is 1.6 times of minimum wage, while for the communal system it is only a quarter of the minimum wage per household. The replicability of individual models for the poor who are more vulnerable to water scarcity is more difficult.

The fourth problem is related to RH system maintenance. The maintenance of individual models is easier for users because the system is in their own house so there is a sense of ownership and willingness to maintain it. On the other hand, the maintenance of a communal system presents a greater challenge because it must involve all members of the community who use the RH system. The communal RH system has the advantage of a community network, resulting in collaborative efforts for maintaining the RH system and collaborative opportunities for utilizing other public utilities.

In addition to the problems or challenges faced, RH also provides financial, environmental, and social benefits. Financial savings can be felt by both users of the RH model. The amount of savings.
varies depending on the type of main clean water source used before utilizing rainwater. Greater water cost savings are obtained from communal model users (up to 61%) as opposed to individual model users (21.05%). Communal utilization of RH also contributes to the formation of social capital which is related to collaborative efforts of the community for RH system management. In the end, the use of both RH models can reduce rainwater runoff and flooding risk.

Communal and individual RHs have their own advantages and disadvantages. The consideration for selecting the RH model is related to the cost of the installation, the characteristics of buildings, and the availability of vacant land for water tanks, the availability of communal buildings, and the willingness and ability of the community to manage public facilities collectively. Individual models can be applied if households are financially able and the required characteristics of the house are met (availability of a roof as a catchment area and land for a water tank). The communal model can be applied at locations that have communal buildings (with available land for catchment areas and water tank locations) and communities living in the surrounding as potential RH users who are willing to participate in the costs of building and managing RH collectively.

Replication of individual RH models has been carried out by the Environmental Agency of Semarang in several locations as recommended by the ACCCRN study. The potential for self-help replication by the community is affected by the heavy financial burden of installing the individual model compared to the more affordable communal model. However, community participation is needed to collectively manage communal RH. The involvement of the private sector in applying individual models to their offices or buildings is more financially feasible.

4. Conclusion
The use of rainwater as an alternative source of clean water is one of the efforts of dealing with the vulnerability of the clean water supply. The problems that arise are the perception that rain water quality is only suitable for meeting non-consumption needs; the community’s willingness to use rainwater is dependent on whether there are other alternative water sources available; the high installation costs for the poor especially for individual models, and the challenge of the community’s willingness for managing communal systems that require collective participation. The benefits of using RH can be seen from the savings in clean water cost, the formation of social capital as a result of collaborative efforts in managing the communal RH system, and reduced rainwater runoff which is one of the factors that cause floods.

Currently, rainwater harvesting in Semarang is still used as a supplementary source of clean water rather than the main source. The availability of other clean water sources with better quality can still be accessed by most people. This limits people's willingness to use rainwater for non-consumption purposes. The dissemination of information related to the use of rainwater needs to be continued to increase the awareness of the effect of excessive use of groundwater and surface water and the need for communities to begin to partake in preserving water resources by using rainwater.

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