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WOMEN RAINWATER HARVESTERS IN EDUCATION ON RAINWATER UTILIZATION

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Abstract: This research aims to describe the role of women in education on and utilization of rainwater to increase awareness and insight into water conservation in both the family and community environment. Women are faced with gender differences in the inclusion into the society. Nine respondents participated in this research which consisted of three female community members, three women residents, and three men residents around the Banyu Bening community, Sleman Regency, Yogyakarta, Indonesia. The triangulation of data sources included the community leader, community members, and one of the participating families. The data analysis model used was from Miles and Huberman. The results showed that women played a very important role in the utilization and teaching on rainwater utilization. Women are the main pillars in the success of education and environmental management, especially at the family level. They are the most capable of providing teaching and developing environmental attitudes in their children and the community, and they are also the agents of change and teaching on sustainable environment.

Keywords: education; rainwater harvesting; sustainable water supply; women; Indonesia

1. Introduction

The era of globalization has brought positive progress for society in the fields of education, technology, and development (Sahlberg, 2016). All the conveniences resulting from these advances require a large supply of electrical energy and have a more negative impact on human life itself because of the various consequences of the problems it causes. The decrease in the carrying capacity of the environment because of the low public awareness of the importance of environmental management reflects environmental problems that currently occur in various regions and countries (Wang et al., 2019). One example of environmental damage due to low public awareness in protecting the environment is the frequent occurrence of floods and forest fires in Indonesia (Gan et al., 2021). Moreover, this is exacerbated by the low awareness of the community in maintaining cleanliness, such as the discovery of a lot of garbage in river flows in developing countries such as India and

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Indonesia (Paleologos et al., 2020). Therefore, the factors that cause environmental damage include a decrease in the function and structure of the environment, a decrease in the carrying capacity and quality of the environment, and the lack of integration of human, natural, and artificial resource management in maintaining environmental sustainability. The increase of water usage is caused by the transformation of productive land into residential and industrial estates (Zhang et al., 2019). Large buildings that have been built since the 1980s are clear evidence of that increase in the built-up area which results in reduced space for water infiltration and can result in reduced groundwater reserves during the dry season and floods during the rainy season (Fitri & Ulfa, 2015).

The development of material and consumptive trends in community life has always been a debate on ecological ethics between anthropocentrism and eco-centrism (Kopnina, 2011). Furthermore, the arbitrary behavior of the community without the responsibility to protect the environment creates problems regarding the declining quality of the environment and natural disasters. Humans rely on natural resources and healthy ecosystems to ensure their survival. Women have historically contributed to the conservation, use, and management of natural resources by playing a different role than men: in managing agricultural land, growing crops, collecting, and managing water for their domestic household use (Mulyoutami et al., 2009). The extensive experience of women has made them a source of knowledge and invaluable expertise in environmental management (Dankelman & Davidson, 2013). Several studies show that the dual role of women in domestic and public affairs is closely related to their role in preserving environmental sustainability and education at both the household and community levels. By actively participating in activities in community organizations that care about the environment, women can have a significant impact on their families and other people in environmental preservation (Meinzen-Dick & Zwarteveen, 1998).

The role of women in the ecological pillar of sustainable development is very clear in their daily life in their families and communities. Over time, the presence of women in a community and society is well accepted and has a significant impact in empowering the community (Stiem & Krause, 2016). The role of women is also shown in the post-disaster recovery of Merapi in 2010 which involved women in the aspects of environmental improvement, reconciliation/conflict resolution, socio-economic recovery, culture, restoration of the availability of water, as well as in increasing the availability of sanitation (Hastuti & Widyastuti, 2019).

Currently, there are several trends in the drinking water consumption needs of Indonesian people. They prefer to use groundwater from dug wells and subscribe to the water supply by Regional Water Company (PDAM) which incidentally spends a lot of financial budgets to meet daily water needs (Manny et al., 2016). The data obtained by a survey on daily water use in major cities in Indonesia show that the daily water consumption rate per person reaches 144–155 liters, with the largest amount being used for bathing—60 liters/person/day (Shaikh et al., 2012). Even though in Sleman Regency, based on the analysis of the type of rain, according to Schmidt and Ferguson, the value of 7.35, which can be classified as a very wet climate type (as cited in Purwantara, 2018), with a large quantity of rainfall, it can be used if the community wants to accommodate and manage it.

Heavy rains in Indonesia could be a potential natural resource available through various sectoral activities that can make a real contribution to economic and regional development

(Tresnadi, 2019). This is because, according to the observations made in this study, there is still a lack of public education on the use of rainwater and people are less interested in using rainwater instead of drinking water every day. One way to preserve water is to store excess water when it rains so that it can be used when needed. To provide a specific description of the strategic role of women in educating their surroundings, this article will provide the answer to the following question: What is the extent of the roles of women and their involvement in education on the movement to harvest rainwater to support water security? This article will show the involvement and contribution of rural and urban women in supporting education on the consumption of rainwater utilization in the Sleman Regency.

In Indonesia, there have been several studies on rainwater harvesting. One of them is the study done by Song et al. (2009) who implemented rainwater harvesting as an option for sustainable water supply in Banda Aceh, Indonesia, which was affected by the severe tsunami waves in 2004. The people of province of Aceh began to realize that they could harvest rainwater to meet their daily needs during the severe tsunami impact. Rainwater harvesting has also been carried out in South Lampung community housing which shows that around 35% of their domestic water needs are met from rainwater harvesting activities (Susilo & Jafri, 2019).

The aim of this study is to describe the role of women in education on the use of rainwater to increase awareness and insight into water conservation both in the family and community environment. Women are faced with gender differences in the inclusion into the society. This study shows the involvement and contribution of women in supporting the use of rainwater in the Sleman Regency. In the context of education and empowerment of rainwater utilization, individual and community initiatives in contributing do not distinguish anyone from participating in various actions. This research is limited to the community surrounding the Yogyakarta rainwater harvesting community, namely Sleman's Banyu Bening community in Yogyakarta, Indonesia. This research was conducted during the dry season, so the participation of the Banyu Bening rainwater harvester community is less obvious. Similar research is needed during the rainy season. It is hoped that when the research is carried out in the rainy season, the participation of the Banyu Bening rainwater harvester community will be more visible to the community.

2. Conceptual framework

2.1. Rainwater harvesting

Rainwater harvesting has developed since ancient times using drums or barrels to collect rainwater. This is done because of the emergence of awareness in the community about the importance of rainwater, especially in areas that lack water. The technique of harvesting rainwater is an efficient effort in providing daily water needs for industrial and domestic household needs, especially in the areas that experience drought, while reducing water surplus when it rains, which usually causes water runoff to be wasted and the creation of puddles that can cause flooding (Devkota et al., 2015; Steffen et al., 2013). Indonesia already has legality that regulates the use of rainwater for the welfare of the community. This statement is contained in article 12 of the Regulations of the Ministry of the Environment of the Republic of Indonesia in 2009, and rainwater harvesting is an activity to collect, use and/or absorb rainwater into the soil, whereas in Article 3 it is stated that the rainwater

collection pool is a pool or a container used to collect rainwater that falls on the roof of a building which is channeled through gutters (Ministry of the Environment, 2009). Raising the awareness of the use of rainwater is a necessary condition to reduce dependence on the use of groundwater and on the water supplied by the PDAM.

In the attachment to the Regulation of the state minister of the environment of the Republic of Indonesia number 12 of 2009 regarding the use of rainwater (1st ed.) (Ministry of the Environment, 2009), it is stated that the basic principle of water conservation is to prevent or minimize water loss as surface runoff and store it as much as possible in the soil body. Based on this principle, excessive rainfall in the rainy season is not allowed to flow into a runoff but is accumulated in a container that allows water to re-infiltrate into the ground using rainwater by making rainwater collecting ponds, shallow infiltration wells, deep absorption wells, and holes. Utilizing rainwater as an alternative to meet the needs for clean household water besides groundwater and the water supplied by the PDAM can contribute to water conservation and save monthly expenses on water, especially the ones of the water bill of the Regional Water Company (Abdulla & Al-Shareef, 2006; Mukaromah, 2020; Susilo, 2018). The average water consumption from the PDAM in Ngaglik District, Sleman Regency is 213.2 l/person/day, and it is projected that until 2023 it will be 331,662 l/s (Wael, 2018). Thus, the use of rainwater as an alternative to the need for clean water can reduce dependence on groundwater and drinking water supply companies in the future (Che-Ani et al., 2009). Rainwater harvesting activities during the observations in Sleman are public education sessions on the importance of rainwater and rainwater harvesting. Rainwater harvesting is done by collecting the rainwater into a reservoir and filtering it using ultraviolet filtration.

Rainwater harvesting includes four key elements: a rainwater harvesting area, a water distribution system including pipes and downspouts, a reserved area, and utility systems such as faucets and pumps (Maftouni & Askari, 2019). People who have implemented rainwater consumption generally use the technique of harvesting rainwater using a roof from which it is flowed through gutters and collected into a storage container (Cahyono & Anwar, 2013). The utilization of rainwater can be understood to create availability and reduce dependence on the use of groundwater consumption by utilizing surplus water during the rainy season which is still rarely used (Hosterman et al., 2012; Moors et al., 2011). With the availability of the volume of rainwater, it can provide an alternative substitute for groundwater and the water supplied by the PDAM, the dependence on groundwater can be reduced, and the existing rainwater would not flow into runoff which is just wasted. This also provides the community with various benefits from consuming rainwater both in terms of health and in terms of monthly expenses because they do not need to pay water bills (Antunes et al., 2020; Domènech & Saurí, 2011; Stec & Słyś, 2017).

According to Worm and van Hattum (2006), there are several reasons why harvesting rainwater is important, some of which are the following: (a) Increased demand for water results in the increased underground water extraction, and thus in reducing groundwater reserves. Rainwater harvesting systems are a useful and inexpensive alternative. Harvesting rainwater can increase groundwater supply, reduce flooding and erosion, and regenerate ecosystem productivity; (b) The presence of water from water sources such as lakes, rivers, and underground water is very volatile. Collecting and storing rainwater can be a solution when the quality of surface water, such as a lake or river water, becomes low

during the rainy season. Harvesting rainwater can regenerate damaged landscapes, supply water for horticulture and livestock which, in turn, will increase income and food security; (c) Other water sources are usually located far from the homes of community members. Collecting and storing water near the house would increase access to water supplies and have a positive impact on health, especially of toddlers, and strengthen the users' sense of ownership of this alternative water source; (d) Water supplies can be contaminated by industrial activities and human activity waste, for example, the entry of minerals such as arsenic, salt, or fluoride. Meanwhile, the quality of rainwater is generally relatively good. Thus, it would instill a culture of water and soil conservation and improve the community welfare. Increasing access to water by harvesting rainwater means increasing access and capacity to carry out water conservation. Furthermore, the efforts to harvest rainwater that is being carried out both internationally and nationally have become an important part of the global environmental water resources management agenda in the context of overcoming inequality and surplus of water in the rainy and dry season, lack of clean water supply, and overcoming floods and droughts (Maryono & Santoso, 2006).

2.2. Women in rainwater harvest education

Women have an important role in protecting nature as well as in the decision-making and education of their family members. Teaching about the benefits of rainwater harvesting is expected to encourage the understanding of family members and the community in becoming more aware of their environment, especially of the problem of rainwater. With this assumption, it is only natural that women's actions in the effort to save and conserve the environment are very real and important. Various examples of the role of women in education and environmental protection in some countries can be seen in Burkina Faso, a village in drought-stricken Africa, where housewives are struggling to find water. These housewives joined an association that digs wells to get groundwater (Buhl, 1999). The work was carried out for months, with singing and joking. When entering the rainy season, even though it was not heavy enough, the dugout was already filled with water. The longer the water is collected, the more of it there was and then the men became aware and repaired the puddles that collected enough water.

In Sleman Regency, rural women have an important role in diversifying local food. These women have established micro and small businesses to make various and nutritious cassava-based products in the diversification of cassava-based foods. The success of women in enriching staple foods in providing food products allows people to consume a variety of local foods and can create food security at the local level (Suharko & Hudayana, 2020). Women, especially in the realm of the household, are the first and foremost educational media for their children. Through mothers, education and awareness about an environmental concern can be instilled in children from an early age (Sciaraffa et al., 2018). The experience gained from an educational process is then taught further to others (Fryer-Edwards et al., 2006; Oleson & Hora, 2014). Thus, education and the application of an environmentally friendly lifestyle, which implies utilizing rainwater in a family, will have an impact on the awareness of all the family members.

3. Study area

The rainwater harvesting in this study was carried out in the village of Sardonohaljo in the Special Region of Yogyakarta, Sleman Regency, Ngaglik district. Sardonoharjo village has an area of 986 ha and approximately 19,936 inhabitants (Department of Population of the Special Region of Yogyakarta, 2021). Sleman Regency is on the north side of Yogyakarta City with an area of 574.82 km^2 which is located at coordinates between 107°15'03"E and 107°29'30"E, 7°34'51"S and 7°47'30"S (Figure 1; Budisatria, 2006). The development of housing, economy, and education supports the high population growth of the Sleman Regency. The average population growth rate of the Sleman Regency is 0.99% per year (Department of Population of the Special Region of Yogyakarta, 2020). The existence of a university in the Sleman Regency has caused an increase in urbanites so that the growth rate in that area is quite high and daily water use must also experience a surge.

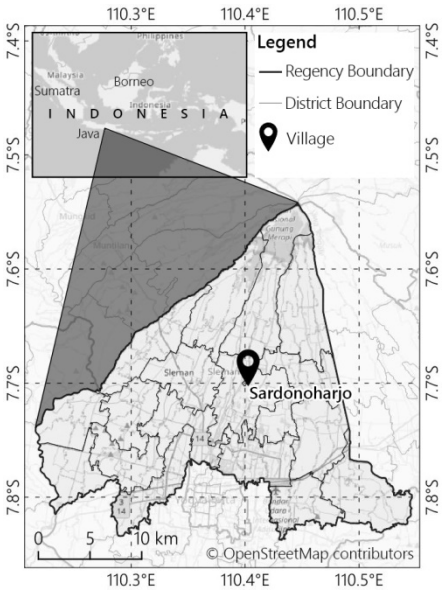

Figure 1. Research location map.

The population data in the study area ranged from 96,380 people in 2014 to 96,996 in 2019 (Department of Population of the Special Region of Yogyakarta, 2021). In addition, the data on the average water consumption range from 172 l/person/day (needs of children) to 221 l/person/day (adults' needs), and average actual use of consumers supplied by the PDAM is 213.2 l/person/day. The projected clean water needs that must be provided by the Sleman's PDAM for the next five years (until 2023) are estimated at 331,622 l/s (Wael, 2018).

4. Method

This research uses a phenomenological case study. It is research that investigates a phenomenon that occurs around the lives of groups of people who inhabit certain areas (Creswell & Creswell, 2017). This case study focuses on the role of women who are harvesting rainwater in educating rainwater utilization in the Banyu Bening Community. The Banyu Bening Community is an independent networking community that was formed in 2012. The rainwater harvesting community has around 250 members, consisting of 150 women and 100 men. This community started its activities by organizing training sessions related to rainwater harvesting procedures in the Special Region of Yogyakarta, either by making infiltration wells or storing them in containers. The lack of management and utilization of rainwater in the area sparked the enthusiasm of a woman named Sri Wahyuningsih (SW) to try to empower herself and others, both men and women, to try to overcome the problem of managing water resources in the region by focusing on the rainwater harvesting movement. Originally, rainwater harvesting activities aimed only at overcoming the environmental crisis caused by the insufficient use of rainwater and then it began to expand into a series of regional activities such as rainwater charity.

In the research process, the researchers described the following steps: (a) identifying research topics on the role of women in rainwater storage education, (b) reviewing the literature for indicators of what researchers were studying, (c) selecting the subjects or study participants, (d) collecting data in the form of interviews and observations, (e) performing of analyses related to the acquired data, and (f) integration of the acquired research data (Creswell & Creswell, 2017). The samples were determined using important sampling methods to obtain information and to illustrate examples of the phenomena that occurred in connection with the role of women in elucidating the rainwater harvesting movement. The critical sampling method is the process of selecting a small number of samples that are important and tend to produce the most information and have the greatest impact on the research being conducted (Patton, 2014).

The critical sampling method is appropriate if the sample in the field is limited. As in this study, the sample that harvests rainwater in Yogyakarta is limited to the Banyu Bening community, so the sampling method uses critical sampling. Critical sampling is also useful when a small number of population and cases that are more likely to provide a lot of information can be sampled (Struwig & Stead, 2001). To obtain clear research information regarding the role of women and rainwater harvesters, the researchers took several practitioners as well as members who would be sampled, namely community leaders, community members, and the husband of one of the women members who came to the Banyu Bening Community. Some of these individuals were selected with the belief that they could provide accurate information about the role of women in rainwater harvesting education. The number of informants who participated in the survey was nine, and the profile of the participants involved in this phenomenological research can be seen in Table 1.

Table 1. Participants' profiles in the phenomenological research

Initial	Status	Gender	
		Men	Women
SW	Community Leader	-	1
R	Community Participants	-	1
S	Community Participants	1	-
A	Participant Husband	1	-
CA	Participant Husband	1	-
D	Participant Husband	1	-
P	Participant Wife	-	1
KL	Participant Wife	-	1
PO	Participant Wife	-	1

The sample of the nine respondents consisted of three respondents from the Banyu Bening community, three women respondents from around the Banyu Bening Community, and three men respondents from around the Banyu Bening Community. The community around the Banyu Bening community means people who do not belong to the Banyu Bening community, but live side by side with members of the Banyu Bening community. All participants came from Sardonohaljo village, in Sleman Regency, Yogyakarta. The age range of the nine participants is between 37 to 45 years.

The interviews of the nine respondents involved in this study were carried out in November 2020 in three ways, including direct interviews with respondents at the Banyu Bening community location, interviews using voice notes, and via video calls. Interviews from the three methods were carried out for 45 minutes for each respondent. Respondents who were the members of the Banyu Bening community agreed to be interviewed at the Banyu Bening community location. This was also done to collect documentation of the implementation of rainwater harvesting by the Banyu Bening community. The interviews were conducted live at the Banyu Bening community location paying attention to the health

protocols to prevent the spread of COVID-19. Meanwhile, man and women respondents from around the Banyu Bening Community were interviewed through voice notes and video calls, because of the COVID-19 pandemic.

The latest data from the trusted online sources were used as statistical data. The data collection was performed by source triangulation. Data validation was performed by comparing the results of observations, interviews, and documentation between each research topic. The resulting data were analyzed using the steps of qualitative data analysis based on the Miles and Huberman model. It consisted of three main phases: data reduction, data presentation, and conclusion (or validation) (Miles & Huberman, 1994). Figure 2 shows the overall survey method. Data reduction in this study was carried out by centralizing and simplifying all the statements or information provided by each respondent. The information was about the benefits of rainwater harvesting and the benefits that can be obtained by the community from rainwater harvesting activities.

The data presentation phase of this survey repositions all important information provided by each respondent into complete and consistent information for the survey so that different readers can universally interpret it. The data presented in this survey were narrated for each important piece of information provided by each respondent. The final stage of this study was to combine all the important information gathered in the explanations and flow charts into one universal statement, which was accepted and implemented under different conditions than the study conditions.

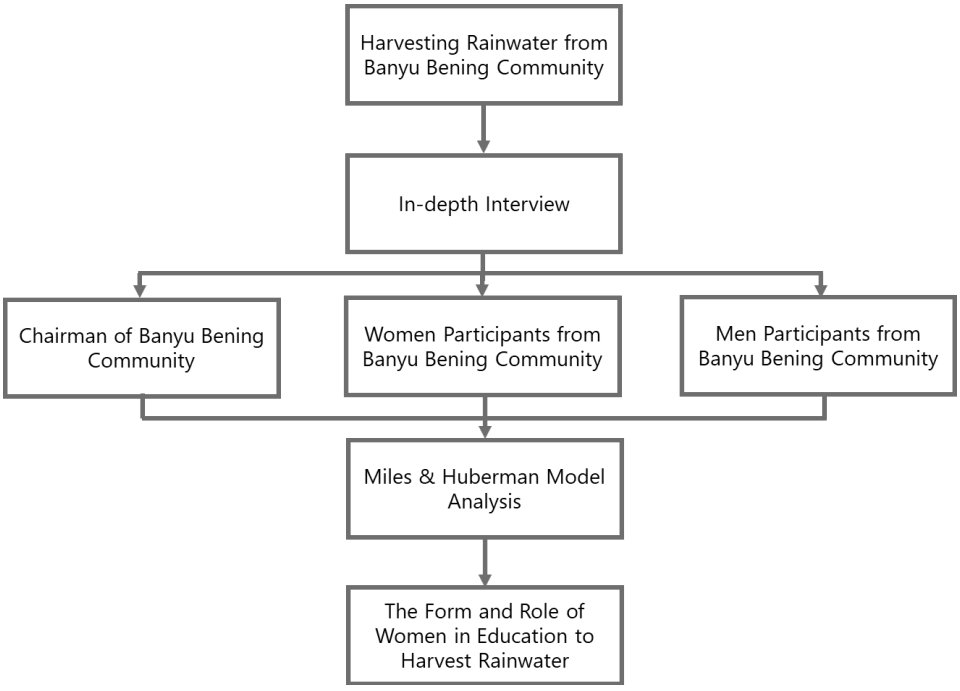

Figure 2. The research stage of triangulation data sources.

5. Result

5.1. Harvesting and benefits of rainwater

Several rainwater harvesting systems that can be applied include a roof system using individual roofs, allowing the collected water to be not too significant, but when applied massively, the collected water is very abundant. Ground-level systems are a simple method for collecting rainwater. In practice, rainwater harvesting is carried out by women who are members of the Banyu Bening community using roofing media. In the next step, rainwater is channeled through gutters and stored in a holding tank. Rainwater stored in a holding tank by the Banyu Bening Community can be seen in Figure 3.

Figure 3. Construction of rainwater harvester (A), Harvested rainwater (B), Monitoring of harvested rainwater (C), and Socialization of rainwater harvesting by the Banyu Bening Community (D).

Notes. Panel A: Adapted from *Banyu Bening Rainwater School 2020*, by P. Widiyantoro, 2020 (https://yayasanan-nuurcahayaumat.or.id/2021/01/02/sekolah-air-hujan-banyu-bening/). In the public domain. Panel B: Adapted from *Here are my 8 steps to create a healthier environment and life* 2021, by J. Muhammad, 2021 (https://www.kompasiana.com/janu_muhammad/6157904206310e3e0d7e7513/inilah-8-stepku-unjukkan-lingungan-dan-dunia-yang-dalam-sehat). In the public domain. Panel C: Adapted from *Invite the Banyu Bening Community, Tegalrejo to Initiate Drinking Water*, by M. Tonang, 2020 (https://tegalrejokec.jogjakota.go.id/detail/index/9299). In the public domain. Panel D: Adapted from *Drink rainwater so you don't get stressed* 2019, by Ernaningtyas, 2019 (https://jayakartanews.com/ngombe-banyu-udan-ben-ra-edan/). In the public domain.

Women in the Banyu Bening community started by providing various counseling about the benefits of rainwater for life. Some of the advantages of using rainwater as an alternative source of clean water are to minimize the environmental impact and assist the community in

facilitating the use of rainwater by utilizing available media such as house roofs (Ghisi, 2010). Women in the Banyu Bening community were processing rainwater into drinking water using the electrolysis method which produces alkaline water. This is reinforced by the findings which show that rainwater treatment using the electrolysis method results in water with a high pH, of 8.5–10.5 (Utama, 2019). Water with a high pH (alkaline water) can be directly consumed as healthy drinking water because it has a very low Total Dissolved Solids (TDS).

Although water resources are abundant when it rains, the rainwater is underutilized by the people in the area around the Banyu Bening Community. This is because there are still many sources of drinking water other than rainwater, such as springs and PDAM. The people of Ngaglik, Sleman, Yogyakarta, Indonesia, where the research was conducted, incidentally live in an area that has no water problems, both in the dry and rainy seasons. However, not all residents around the Banyu Bening Community location use rainwater. Participants CA and PO provided arguments such as, "I am aware that for now, water is very abundant and still cheap. However, in the future, you don't know, especially for drinking water you must pay for". The same thing was also conveyed by participants SW and R, "Since people in this area use only refilled water, it is also advisable to build osmotic wells to enhance groundwater storage. We do this so that the quantity of groundwater also increases".

Water that normally flows into drains without handling can cause problems such as floods. However, by storing it properly, it can be used according to daily needs and can maintain the stability of natural resources. This is also due to environmental factors in which the communities around the Banyu Bening community live and settle. Successful rainwater harvesting is influenced by everyone's perceptions about the benefits of rainwater. Several informants expressed interest and involvement in rainwater harvesting in the area. This is illustrated by the arguments of participants D and KL that, "Based on what is experienced and learned according to our belief, the use of rainwater is widely explained in various religious books. This makes us take the time, energy, and thought to be present to contribute to the use of water".

5.2. Involvement of women in education and pioneering rainwater harvesting movement

Rainwater harvesting women who are part of the Banyu Bening community educate on the usefulness of rainwater and provide examples of rainwater management. The experience and education obtained by them are then explained and practiced directly in the domestic sector of the household as well as to relatives and friends by word of mouth. The following is a brief description of three women who have taught, convinced, and shared the benefits of how to harvest rainwater in the family and community circles. In the interview, participant SW (51 years old), who is a founder and head of the Banyu Bening rainwater harvesting community, stated that "Taking the initiative to establish and create a rainwater harvesting movement was due to seeing the conditions and assumptions as well as the behavior of people who forget the benefits and waste rainwater".

Other interviews with participant SW revealed that "It is difficult to educate and invite people to use rainwater because they do not believe in the benefits of rainwater". Some of the benefits of rainwater could be refreshing the body, nourishing hair and skin, neutralizing blood pH, and overcoming digestive problems (Chung et al., 2020; Trienekens et al., 2022). Furthermore, participant SW also explained that "People are aware and want to consume, process, and harvest rainwater when they have experienced the results and the benefits of rainwater, so the role of women here is more emphasized on how to patiently educate and

take action by consuming rainwater that has been electrolyzed or simply processed". The interview with the same participant also showed that "Rainwater harvesting by the Banyu Bening people is done in two ways: using simple rainwater harvesting techniques by storing water and storing it in reservoirs and barrels and using the development of the rainwater harvesting method developed by Gadjah Mada University called GAMA Rain Filter". GAMA Rain Filter works by collecting rainwater in a reservoir. Above the water reservoir, a filter is provided to separate fine dust and dirt. Rainwater that has entered the reservoir is ensured to be clean and safe to use. GAMA Rain Filter generally uses a 1000-liter reservoir. To ensure that the incoming rainwater remains clean and safe to use, the filter used by the GAMA Rain Filter usually consists of several layers at once (Maryono et al., 2022). Participant SW also stated that "If there is no rain or during a dry season, we will focus more on introducing and educating about rainwater".

Participant R (58 years) stated the following: "I received information about harvesting rainwater in the Banyu Bening community from my friend when I attended the Family Welfare Education (PKK) event". She also explained that "The Banyu Bening Community provides training and proper rainwater treatment". Another response obtained during the interview with participant R was the following: "I have built and several rainwater harvesting reservoirs around my house and persuaded and educated my children to make rainwater harvesting reservoirs around my house. Monthly electricity expenditure has been reduced after collecting rainwater during the rainy season due to less use of a water pump".

During the interview with participant S's husband (62 years), i.e., participant R, explained that "Women better understand the needs of the family for clothing, food, and education and they provide knowledge and education about rainwater and its benefits". Meanwhile, through the Rainwater School Foundation, the Banyu Bening Community seeks to provide education to adults and children around the area to be more sensitive to the environment. The activities taught are aimed at providing education and perspectives on the benefits of rainwater, that is managing water resources, by paying attention to environmental cleanliness.

6. Discussion

The use of harvested rainwater can, in several ways, contribute to addressing qualitative and quantitative problems with rainwater. Judging from the qualitative problem, rainwater could be considered suitable for drinking, but with proper handling and processing. Tropical and subtropical regions such as Australia and Africa also rely on rainwater for drinking. Therefore, rainwater in areas with low levels of air and industrial pollution can be used as an alternative source of drinking water through a variety of filtration methods. By collecting rainwater, the community can reduce the waste of rainwater spills and even create puddles.

The findings of this study also show that rainwater can be suitable for drinking after adequate treatments. The health benefits obtained after consuming rainwater that has been processed in such a way include being able to detoxify toxins in the body and improve digestive health (Mousa, 2016). This is because the pH content of rainwater is more than 7 which makes it alkaline. However, it is important to emphasize that the knowledge of rainwater quality is critical for safeguarding public health. Epidemiological studies dealing with the consumption of rainwater to public health risks are scarce in developing countries. In general, harvesting rainwater before it hits the ground mostly from roofs implies that it is

safer than surface water in lakes and rivers, and groundwater from shallow wells. However, as several recent studies from Australia have shown, roof rainwater can be contaminated, so this water can be used only after adequate treatments (Gwenzi et al., 2015).

In addition to the health benefits derived from consuming rainwater, there are environmental and social benefits that can be received by the community. If you often collect rainwater, it will help reduce the risk of flooding. Rainwater that is used by the community can certainly reduce daily expenses. Besides that, by using rainwater optimally, it is possible to allocate costs that were originally for drinking water needs to other needs. People just take advantage of the rainwater using simple tools so that rainwater can be used for daily life.

Utilizing rainwater as an alternative source of daily drinking water requires the role of all the members in communities, both men and women, to unite their vision and interest in using rainwater as drinking water. Through the involvement of all communities without regard to gender aspects, it is one of the real efforts in realizing an anti-discrimination or emancipation attitude toward women (Dode, 2015). The involvement of women in the use of rainwater through rainwater harvesting can be observed from all the aspects, from the aspect of socialization, planning, preparation of rainwater harvesting tools, as well as the evaluation of rainwater harvesting activities. Women in rainwater harvesting have a role to socialize, disseminate, and teach other communities that have not yet harvested rainwater as an alternative source of drinking water. The role of women in education related to rainwater harvesting can be done by actively conducting socialization with family members and the surrounding community to utilize rainwater in meeting daily drinking needs.

The Banyu Bening Community is an example of a community that cares and is engaged in educating and empowering the community to take advantage of rainwater. Several women became the initiators and founders of the rainwater harvesting movement to utilize water. Women involved in the rainwater harvesting education movement are good examples for Indonesian women everywhere who can emulate this practice. This activity is a form of women's emancipation or anti-discrimination of women so that women can work on an equal footing with men. The role of women in educating on the rainwater harvesting movement can be achieved maximally if it is supported and facilitated by local governments, NGOs, universities, and other stakeholders related to disasters. Rainwater harvesting women in the Banyu Bening Community have had a great impact on both the community and the surrounding environment. They are involved in the process of education and empowerment both within the family and in the wider community. Women who are involved in the Banyu Bening Community gain knowledge, create relationships, and promote health benefits after participating in harvesting and in consuming rainwater that is harvested and filtered in such a way that it is fit for consumption. Through the experience that women get from the Banyu Bening Community program, it will be disseminated to other communities, so that other people are aware and care about their environment, especially in utilizing rainwater. Most of the women who are interested in coming to the Banyu Bening community then pass on the knowledge they get based on the recommendations of others. Rainwater harvesting training provides benefits to the community (Hafizi Md Lani et al., 2018). Even though rainwater can only be harvested during the rainy season, women harvesting rainwater can still educate and inspire not only on the importance of harvesting rainwater but more about water conservation. This can be seen from the existence of events such as the *Merti Times* (village care) and Rainwater Congress which are held every year.

The use of rainwater requires the participation of women to maximize its use. Women play a role in educating family and community members on the importance of rainwater on health and the environment (Mollaeva, 2018). The involvement of women in educating on the rainwater harvesting movement in various regions in Indonesia is important to be given a greater portion. Even in difficult conditions such as access, distance, social, and culture, the role of women can still be assumed to be able to exchange ideas, cultivate, and inspire other women and the wider community.

7. Conclusion

The practice of harvesting rainwater has been carried out by the Indonesian people since ancient times, especially in areas where access to water is difficult so they utilize and store rainwater for use when needed. The utilization of rainwater can have a positive impact on the dependence on groundwater use and water from PDAM. The role of women is also very important in the use of and teaching on rainwater utilization. This is evidenced by the success and concern for the environment in utilizing and harvesting rainwater, which was pioneered and driven by women.

The women who are members of the Banyu Bening community are part of several local communities spread throughout Indonesia and even in various countries that have contributed to educating and making people aware of the use of rainwater, as well as increasing water security when entering the dry season. The implication obtained from this research is that it needs to be massively promoted and become a habit in society for the issue of anti-discrimination of women. This rainwater harvesting activity can also be imitated by several regions in Indonesia or other countries such as in East Nusa Tenggara, Maluku, and Papua. These areas where droughts often occur or areas that have high rainfall use rainwater as a water source for daily life. Through massive use of rainwater, it can improve the welfare of the community, and the standard of living of its members.

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References

Abdulla, F. A., & Al-Shareef, A. W. (2006). Assessment of rainwater roof harvesting systems for household water supply in Jordan. In P. Hlavinek, T. Kukharchyk, J. Marsalek, & I. Mahrikova (Eds.), *Integrated Urban Water Resources Management* (pp. 291–300). Springer. https://doi.org/10.1007/1-4020-4685-5_30

Antunes, L. N., Sydney, C., Ghisi, E., Phoenix, V. R., Thives, L. P., White, C., & Garcia, E. S. H. (2020). Reduction of Environmental Impacts Due to Using Permeable Pavements to Harvest Stormwater. *Water*, *12*(10), Article 2840. https://doi.org/10.3390/w12102840

Budisatria, I. G. S. (2006). *Dynamics of small ruminant development in Central Java-Indonesia* [Unpublished doctoral dissertation]. Wageningen University.

Buhl, S. (1999). *Milk, Millett, and Mannerisms: Gendered Production Among Pastoral and Agropastoral Fulbe Households in Northern Burkina Faso* [Doctoral dissertation, University of London, University College London]. ProQuest. https://www.proquest.com/openview/5dc57006786f6323bee3b86da1ceff64/1?pq-origsite=gscholar&cbl=2026366&diss=y

Cahyono, Y., & Anwar, N. (2013). Teknologi pemanenan air hujan untuk mengatasi kekeringan dan penyediaan air bersih di Desa Sawitan [Rainwater harvesting technology to overcome drought and provide clean water in Sawitan Village]. *Journal of Omits Technical/Jurnal Teknik Pomits, 1*(1), 1–6. http://digilib.its.ac.id/public/ITS-paper-27014-3110106007-Paper.pdf

Che-Ani, A. I., Shaari, N., Sairi, A., Zain, M. F. M., & Tahir, M. M. (2009). Rainwater harvesting as an alternative water supply in the future. *European Journal of Scientific Research, 34*(1), 132–140. https://www.slideshare.net/V9X/w3k372

Chung, E. L. T., Nayan, N., Kamalludin, M. H., Alghirani, M. M., Jesse, F. F. A., Kassim, N. A., Azizi, A., Reduan, M. F. H., & Loh, T. C. (2020). The effects of alkaline water and rainwater on the production and health performance of commercial broilers under tropical conditions. *The Thai Journal of Veterinary Medicine, 50*(1), 65–73. https://he01.tci-thaijo.org/index.php/tjvm/article/view/243258

Creswell, J. W., & Creswell, J. D. (2017). *Research Design: Qualitative, Quantitative, and Mixed Methods Approach* (5th ed.). Sage Publications.

Dankelman, I., & Davidson, J. (2013). *Women and the Environment in the Third World: Alliance for the Future*. Routledge. https://doi.org/10.4324/9781315066219

Department of Population of the Special Region of Yogyakarta. (2020). *Statistics of the population of the Special Region of Yogyakarta by gender*. https://kependudukan.jogjaprov.go.id/statistik/penduduk/jumlahpenduduk/17/0/12/04/34.clear

Department of Population of the Special Region of Yogyakarta. (2021). *Geographic information system map of district population distribution of the Special Region of Yogyakarta*. Retrieved from https://kependudukan.jogjaprov.go.id/petagiskelurahan.clear

Devkota, J., Schlachter, H., & Apul, D. (2015). Life cycle-based evaluation of harvested rainwater use in toilets and for irrigation. *Journal of Cleaner Production, 95*(1), 311–321. https://doi.org/10.1016/j.jclepro.2015.02.021

Dode, E. (2015). Shaping the Gender Socialization Through Different Models of Behavior. *Academic Journal of Interdisciplinary Studies, 4*(2), 27–34. https://doi.org/10.5901/ajis.2015.v4n2p27

Domènech, L., & Saurí, D. (2011). A comparative appraisal of the use of rainwater harvesting in single and multi-family buildings of the Metropolitan Area of Barcelona (Spain): social experience, drinking water savings, and economic costs. *Journal of Cleaner Production, 19*(6–7), 598–608. https://doi.org/10.1016/j.jclepro.2010.11.010

Ernaningtyas. (2019). *Drink rainwater so you don't get stressed 2019*. https://jayakartanews.com/ngombe-banyu-udan-ben-ra-edan/

Fitri, A., & Ulfa, A. (2015). The Implementation of Zero Run-off and Agroforestry Concept Based on River Discharge in Belik Sub Watershed, Yogyakarta. *Journal of Regional and City Planning, 26*(3), 192–207. https://doi.org/10.5614/jpwk.2015.26.3.4

Fryer-Edwards, K., Arnold, R. M., Baile, W., Tulsky, J. A., Petracca, F., & Back, A. (2006). Reflective teaching practices: an approach to teaching communication skills in a small group setting. *Academic Medicine, 81*(7), 638–644. https://europepmc.org/article/med/16799286

Gan, C. C. R., Oktari, R. S., Nguyen, H. X., Yuan, L., Yu, X., KC, A., Hanh, T. T. T., Phung, D. T., Dwirahmadi, F., Liu, T., Musumari, P. M., Kayano, R., & Chu, C. (2021). A scoping review of climate-related disasters in China, Indonesia, and Vietnam: Disasters, health impacts, vulnerable populations, and adaptation measures. *International Journal of Disaster Risk Reduction, 66*, Article 102608. https://doi.org/10.1016/j.ijdrr.2021.102608

Ghisi, E. (2010). Parameters Influencing the Sizing of Rainwater Tanks for Use in Houses. *Water Resources Management, 24*(10), 2381–2403. https://doi.org/10.1007/s11269-009-9557-4

Gwenzi, W., Dunjana, N., Pisa, C., Tauro, T., & Nyamadzawo, G. (2015). Water quality and public health risks associated with roof rainwater harvesting systems for potable supply: Review and perspectives. *Sustainability of Water Quality and Ecology, 6*(1), 107–118. https://doi.org/10.1016/j.swaqe.2015.01.006

Hafizi Md Lani, N., Yusop, Z., & Syafiuddin, A. (2018). A Review of Rainwater Harvesting in Malaysia: Prospects and Challenges. *Water, 10*(4), Article 506. https://doi.org/10.3390/w10040506

Hastuti, & Widyastuti, M. (2019). Women's role in post-disaster recovery in South Merapi slopes. *IOP Conference Series: Earth and Environmental Science, 271*(1), 1–6. https://doi.org/10.1088/1755-1315/271/1/012001

Hosterman, H. R., McCornick, P. G., Kistin, E. J., Sharma, B., & Bharati, L. (2012). Freshwater, climate change and adaptation in the Ganges River Basin. *Water Policy, 14*(1), 67–79. https://doi.org/10.2166/wp.2011.065

Kopnina, H. (2011). Revisiting Education for Sustainable Development (ESD): Examining Anthropocentric Bias Through the Transition of Environmental Education to ESD. *Sustainable Development, 22*(2), 73–83. https://doi.org/10.1002/sd.529

Maftouni, N., & Askari, M. (2019). Building Energy Optimization: Implementing Green Roof and Rainwater Harvester System for a Residential Building. *Journal of Renewable Energy and Environment, 6*(2), 38–45. https://dx.doi.org/10.30501/jree.2019.96023

Manny, L., Atmaja, R. R. S., & Putra, D. P. E. (2016). Groundwater Level Changes in Shallow Aquifer of Yogyakarta City, Indonesia: Distribution and Causes. *Journal of Applied Geology, 1*(2), 89–99. https://doi.org/10.22146/jag.27584

Maryono, A., Nuranto, S., Sembada, P. T. S., & Petrus, H. T. B. M. (2022). GAMA-RainFilter: a modified rainwater harvesting technique to meet the demand for clean water in Indonesia. *International Journal of Hydrology Science and Technology, 13*(1), 1–22. https://doi.org/10.1504/IJHST.2022.119272

Maryono, A., & Santoso, E. N. (2006). *Metode memanen dan memanfaatkan air hujan untuk penyediaan air bersih, mencegah banjir dan kekeringan. Petunjuk praktis pembangunan penampung air hujan, standar dinas pekerjaan umum* [Methods of harvesting and utilizing rainwater for clean water supply, preventing floods and drought. Practical guidelines for the construction of rainwater storage, public works agency standards]. Kementerian Negera Lingkungan Hidup.

Meinzen-Dick, R., & Zwarteveen, M. (1998). Gendered participation in water management: Issues and illustrations from water users 'associations in South Asia. *Agriculture and Human Values, 15*(4), 337–345. https://doi.org/10.1023/A:1007533018254

Miles, M. B., & Huberman, A. M. (1994). *Qualitative data analysis: An expanded sourcebook* (2nd ed.). Sage Publications.

Ministry of the Environment. (2009). *Peraturan menteri negara lingkungan hidup Republik Indonesia nomor 12 tahun 2009 tentang pemanfaatan air hujan (edisi 1)* [Regulation of the state minister of the environment of the Republic of Indonesia number 12 of 2009 regarding the use of rainwater (1st ed.)]. https://luk.staff.ugm.ac.id/atur/sda/PermenLH12-2009PemanfaatanAirHujan.pdf

Mollaeva, E. A. (2018). Gender Stereotypes and the Role of Women in Higher Education (Azerbaijan Case Study). *Education and Urban Society, 50*(8), 747–763. https://doi.org/10.1177/0013124517713613

Moors, E. J., Groot, A., Biemans, H., van Scheltinga, C. T., Siderius, C., Stoffel, M., Huggel, C., Wiltshire, A., Mathison, C., Ridley, J., Jacob, D., Kumar, P., Bhadwal, S., Gosain, A., & Collins, D. N. (2011). Adaptation to changing water resources in the Ganges basin, northern India. *Environmental Science & Policy, 14*(7), 758–769. https://doi.org/10.1016/j.envsci.2011.03.005

Mousa, H. A.-L. (2016). Health Effects of Alkaline Diet and Water, Reduction of Digestive-tract Bacterial Load, and Earthing. *Alternative Therapies in Health & Medicine, 22*(1), 24–33. https://pubmed.ncbi.nlm.nih.gov/27089527/

Muhammad, J. (2021). *Here are my 8 steps to create a healthier environment and life 2021*. https://www.kompasiana.com/janu_muhammad/6157904206310e3e0d7e7513/inilah-8-stepku-unjukkan-lingungan-dan-dunia-yang-dalam-sehat

Mukaromah, H. (2020). Rainwater Harvesting as an Alternative Water Source in Semarang, Indonesia: The Problems and Benefits. *Earth and Environmental Science, 447*(1), Article 012059. https://doi.org/10.1088/1755-1315/447/1/012059

Mulyoutami, E., Rismawan, R., & Joshi, L. (2009). Local knowledge and management of Simpukang (forest gardens) among the Dayak people in East Kalimantan, Indonesia. *Forest Ecology and Management, 257*(10), 2054–2061. https://doi.org/10.1016/j.foreco.2009.01.042

Oleson, A., & Hora, M. T. (2014). Teaching the way, they were taught? Revisiting the sources of teaching knowledge and the role of prior experience in shaping faculty teaching practices. *Higher Education, 68*(1), 29–45. https://doi.org/10.1007/s10734-013-9678-9

Paleologos, E. K., O'Kelly, B. C., Tang, C.-S., Cornell, K., Rodríguez-Chueca, J., Abuel-Naga, H., Koda, E., Farid, A., Vaverková, M. D., Kostarelos, K., Goli, V. S. N. S., Guerra-Rodríguez, S., Leong, E.-C., Jayanthi, P., Shashank, B. S., Sharma, S., Shreedhar, S., Mohammad, A., Jha, B., … Singh, D. N. (2021). Post Covid-19 water and wastewater management to protect public health and geoenvironment. *Environmental Geotechnics, 8*(3), 193–207. https://doi.org/10.1680/jenge.20.00067

Patton, M. Q. (2014). *Qualitative Research & Evaluation Methods: Integrating Theory and Practice* (4th ed.). Sage Publications.

Purwantara, S. (2018). Konservasi Sumberdaya Air Tanah di Wilayah Ngaglik Sleman [Conservation of Groundwater Resources in the Ngaglik Sleman Region]. *Geomedia: Majalah Ilmiah dan Informasi Kegeografian, 16*(2), 59–70. https://journal.uny.ac.id/index.php/geomedia/article/view/25202/12173

Sahlberg, P. (2016). The global educational reform movement and its impact on schooling. In K. Mundy, A. Green, B. Lingard, & A. Verger (Eds.), *The Handbook of Global Education Policy* (pp. 128–144). John Wiley & Sons. https://doi.org/10.1002/9781118468005.ch7

Sciaraffa, M. A., Zeanah, P. D., & Zeanah, C. H. (2018). Understanding and Promoting Resilience in the Context of Adverse Childhood Experiences. *Early Childhood Education Journal, 46*(3), 343–353. https://doi.org/10.1007/s10643-017-0869-3

Shaikh, N. U., Siddiqui, M. A., & Allaudin, U. (2012). Integrated solar water-heater and solar water cooler performance during wintertime. *NED University Journal of Research, 43*(14), 61–72. https://inis.iaea.org/search/search.aspx?orig_q=RN:43028022

Song, J., Han, M., Kim, T.-I., & Song, J.-E. (2009). Rainwater harvesting as a sustainable water supply option in Banda Aceh. *Desalination, 248*(1–3), 233–240. https://doi.org/10.1016/j.desal.2008.05.060

Stec, A., & Słyś, D. (2017). Rainwater potential use in dormitory building: Drinking water savings and economic costs. *Ecological Chemistry and Engineering A, 24*(1), 43–64. https://doi.org/10.2428/ecea.2017.24(1)4

Steffen, J., Jensen, M., Pomeroy, C. A., & Burian, S. J. (2013). Water Supply and Stormwater Management Benefits of Residential Rainwater Harvesting in U.S. Cities. *JAWRA Journal of the American Water Resources Association, 49*(4), 810–824. https://doi.org/10.1111/jawr.12038

Stiem, L., & Krause, T. (2016). Exploring the impact of social norms and perceptions on women's participation in the customary forest and land governance in the Democratic Republic of Congo—implications for REDD+. *International Forestry Review, 18*(1), 110–122. https://doi.org/10.1505/146554816818206113

Struwig, F. W., & Stead, G. B. (2001). *Planning, designing, and reporting research*. Pearson Education South Africa.

Suharko, S., & Hudayana, B. (2020). Rural Woman and Food Security: Diversification of Cassava-Based Foods in Gunungkidul District, Yogyakarta. *Sodality: Jurnal Sosiologi Pedesaan, 8*(2), 123–135. https://doi.org/10.22500/8202029845

Susilo, G. E. (2018). Rainwater Harvesting as Alternative Source for Wudlu Water in Indonesia. *Civil and Environmental Science Journal (CIVENSE), 1*(2), 62–69. https://doi.org/10.21776/ub.civense.2018.00102.3

Susilo, G. E., & Jafri, M. (2019). The analysis of rainwater harvesting carrying capacity on water domestic supply for dwelling areas in Indonesia. *Civil and Environmental Science Journal (CIVENSE), 2*(1), 67–75. https://doi.org/10.21776/ub.civense.2019.00106

Tonang, M. (2019). *Invite the Banyu Bening Community, Tegalrejo to come up with safe drinking water*. https://tegalrejokec.jogjakota.go.id/detail/index/9299

Tresnadi, H. (2019). Pengelolaan DAS dengan pendekatan ekosistem: Studi kasus analisis debit Sungai Bone dan Bolango di Kabupaten Bone Bolange, Propinsi Gorontalo [Watershed management using an ecosystem approach: a case study on debit analysis of Bone and Bolango River in Bone Bolange District, Gorontalo Province]. *Indonesian Journal of Hydrosphere/Jurnal Hidrosfir Indonesia, 3*(3), 95–104. http://103.224.137.161/index.php/JHI/article/view/652/497

Trienekens, S. C. M., Faust, C. L., Besigye, F., Pickering, L., Tukahebwa, E. M., Seeley, J., & Lamberton, P. H. L. (2022). Variation in water contact behaviour and risk of *Schistosoma Mansoni* (re)infection

among Ugandan school-aged children in an area with persistent high endemicity. *Parasites & Vectors, 15*(1), Article 15. https://doi.org/10.1186/s13071-021-05121-6

Utama, T. B. (2019). Memanen dan mengolah air hujan menjadi air alkali siap minum [Harvesting and treating rainwater into alkali water ready to drink]. *Annual Scientific Meeting/Pertemuan Ilmiah Tahunan, 36*(1), 76–86. https://hathi-pusat.org/ejournalv2/index.php/pit-36/article/view/229

Wael, R. R. (2018). *Identifikasi tingkat kebutuhan air bersih masyarakat pengguna PDAM di Kecamatan Ngaglik Kabupaten Sleman, Yogyakarta* [Identification of clean water needs of the PDAM using community in Ngaglik District, Sleman Regency, Yogyakarta]. Universitas Islam Indonesia. https://dspace.uii.ac.id/handle/123456789/13087

Wang, B., Hong, G., Qin, T., Fan, W.-R., & Yuan, X.-C. (2019). Factors governing the willingness to pay for air pollution treatment: A case study in the Beijing-Tianjin-Hebei region. *Journal of Cleaner Production, 235*(1), 1304–1314. https://doi.org/10.1016/j.jclepro.2019.07.046

Widiyantoro, P. (2020). *Banyu Bening rainwater school 2020*. Retrieved March 02, 2022. https://yayasanan-nuurcahayaumat.or.id/2021/01/02/school-air-hujan-banyu-bening/

Worm, J., & van Hattum, T. (2006). *Rainwater harvesting for domestic use* (Agrodok-series No. 43). Agromisa Foundation; CTA. https://www.pseau.org/outils/ouvrages/agromisa_rain_foundation_rainwater_harvesting_for_domestic_use_2006.pdf

Zhang, F., Wang, Y., Ma, X., Wang, Y., Yang, G., & Zhu, L. (2019). Evaluation of resources and environmental carrying capacity of 36 large cities in China based on a support-pressure coupling mechanism. *Science of the Total Environment, 688*(1), 838–854. https://doi.org/10.1016/j.scitotenv.2019.06.247