

# Women's Vulnerability on Household Water Management During COVID-19 Pandemic

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**Abstract:** Human population growth, the rapid development of urban areas, and climate change were causing a scarcity of freshwater resources. Providing water and sanitation is important to protect the health during a pandemic. However, North Jakarta still faces problems in meeting the water demands of its residents. The COVID-19 pandemic expands the challenges faced by vulnerable individuals living in poverty and without access to health services, water, sanitation, and adequate housing, especially for women. During the COVID-19 pandemic, woman's responsibilities became even heavier; aside from paying attention to their safety and health, women were often burdened with domestic roles towards their families and their responsibility for collecting water supplies for the household. This study examines the situation of women's vulnerability in household water management in the urban environment of North Jakarta, especially during the COVID-19 pandemic. A quantitative approach with descriptive statistical analysis was used in this study. The result of this study portrays women's vulnerability in household water management during the COVID-19 pandemic in North Jakarta in two categories, 49.26% have a high level of vulnerability, and 50.74% have a low level of vulnerability. The level of exposure, sensitivity, and response capacity assessed the vulnerability components. This study is expected to be a reference for sustainable water management, considering gender roles and conditions in urban environments, especially during disasters.

**Keywords:** COVID-19; Household water; Urban; Vulnerability; Women

## Introduction

In the Anthropocene era, understanding the dynamic interactions between humans and water is essential to support human welfare and sustainable resource management (Gain et al., 2021). Human activities have become the dominant factor affecting climate and the environment, significantly changing the global water system and resulting in water scarcity and drought in several regions. Currently, the global scarcity problem of freshwater resources is exacerbated by the increasing demand for water in line with the growth of the human population, the rapid development of urban areas, the intensification of agriculture, and climate change. WHO & UNICEF (2019) stated that in 2017 the global population that uses safely managed drinking-

water services only reached 71%. In urban areas with a global population of around 5.3 billion, 15% still need safe drinking-water services.

The problem of limited access to water will impact poor sanitation and consequently increases the tendency to spread disease (Metwally et al., 2006; Haddout et al., 2020). Meanwhile, 55% of the world's population still needs safely managed sanitation facilities (UN, 2018). Providing clean water, sanitation, and a hygienic environment is vital to protect human health, especially in outbreaks of infectious diseases. In recent years, the world community has been facing a global crisis caused by an outbreak of a new infectious disease called Coronavirus Disease (COVID-19). The emergence of acute pneumonia cases in China at the end of 2019 increasingly spread worldwide and was later declared a pandemic by WHO in April 2020. The COVID-19

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pandemic has spread globally, with 95% of cases and the highest death rate occurring in urban areas. Davenport et al. (2020) describe the characteristics of cities that led to expanded covid cases, including good international connectivity, high population density, and people's dependence on public transportation.

Many countries have been prompted to implement social distancing and regional quarantine (lockdown) policies during the COVID-19 pandemic. People are also encouraged to wear masks and wash their hands frequently. These policies pose problematic difficulties because they are not easy to implement for millions living in overcrowded urban settlements with poor sanitation and a lack of access to clean water (The Lancet, 2020). As the second largest urban agglomeration in the world and has high population growth and density, Jakarta is the epicenter of the COVID-19 spread in Indonesia. It is one of the areas with the highest number of confirmed cases of COVID-19 in Indonesia. Based on Jakarta's COVID-19 monitoring data, in February 2022, positive confirmed cases of COVID-19 in Jakarta had accumulated up to 1 million cases. On the other hand, Jakarta, especially North Jakarta, still needs to meet the clean water needs of the population driven by rapid urbanization and high population growth. Meanwhile, the combination of household waste pollution, solid waste disposal, and industrial waste cause most of the river water in Jakarta to far exceed quality standards, which results in a reduced raw water supply for clean water availability (ADB, 2016).

The COVID-19 pandemic increases the challenges encountered when limited access to water is insufficient for washing hands and implementing hygienic living behaviors. Dependence on water sources outside the household increases the potential for contact between households in water collection, especially exposing women to social distancing restrictions during the pandemic (Howard et al., 2020). Sommer et al. (2015) also stated that vulnerability to water creates security challenges and risks women face in meeting their daily water and sanitation needs for themselves and their families. In some areas, women periodically travel long distances to find water sources, even at night. These gender roles, expectations, and responsibilities are often embedded in patriarchal cultural norms and expectations related to unequal access to resources. The social and economic costs of insecure sanitation and access to clean water faced by women and girls are worsened by COVID-19 (Adams et al., 2021). Women also encounter social and economic vulnerabilities, which tend to be more significant even though men's mortality from COVID-19 is higher than women's (Komnas Perempuan, 2020). The increased household workload and parenting burden for women during the

COVID-19 pandemic also caused women's physical and psychological fatigue, making them increasingly vulnerable to getting infected by COVID-19 (UN Women, 2020).

Studies on women's vulnerability, especially related to water management in urban areas, are important to examine. Women's studies in urban areas are still limited, whereas most women's and environmental studies are in rural areas (Husein et al., 2020). Identifying the components that cause vulnerability and water insecurity among urban women can support policymakers and planners in designing effective adaptive strategies, especially for poor urban women (Kher et al., 2015). Gender issues and water management in Indonesia are still under-researched, specifically regarding women as household water collectors (Irianti & Prasetyoputra, 2019). Analysis of women's vulnerability is expected to promote and build back better Sustainable Development Goals, especially concerning household water management (Goal 6) in urban environments that are more effective and sustainable (Goal 11), as well as gender-responsive (Goal 5). Hence, this paper aims to examine the situation of women's vulnerability in managing household water in the urban environment of North Jakarta, especially during the COVID-19 pandemic. This study is expected to be a reference in sustainable water management in urban environments, especially during outbreaks of infectious diseases.

## Method

This study uses a quantitative approach with descriptive statistical analysis. Descriptive statistical analysis in this paper is used to assess the Women's Vulnerability to Household Water Management During the Covid-19 Pandemic in North Jakarta. North Jakarta encounters the problems of piped water network distribution. The availability of piped clean water is not evenly spread throughout all settlements. Clean water services from the Regional Drinking Water Company (PDAM) in North Jakarta only cover 409,381 customers, or 65.85% of the total households in North Jakarta {Formatting Citation}. In 2019, most North Jakarta residents, by the top 20% of expenditure, used tap/piped water for hygiene needs (92.39%), and a small proportion used drilled wells/pumps (6.90%). Meanwhile, residents with the lowest 40% expenditure used tap water (75.59%), and the rest used drilled/pumped wells (15.74%) and protected wells or springs (8.67%) (BPS Kota Jakarta Utara, 2021). This illustration shows there is still an inequality in the coverage of piped water services in North Jakarta, where around 32% of the population still needs piped clean

water services. Besides that, residents with better economic status mainly utilize the piped water services.

The research population used in this study is female residents (per household) domiciled in North Jakarta. The sample was selected from women of productive age based on BPS (aged 15 to 64). The sampling technique uses the Isaac and Michael formula, with an error rate of 10%. Primary data was collected from September 2022 to January 2023 in five sub-districts in North Jakarta: Penjaringan; Pluit; Koja; Cilincing; and Pademangan sub-districts with a total of 270 female respondents. This research is a cross-sectional study, and quantitative data was collected through a survey using a questionnaire as an instrument. Statistical analysis was used to determine the women's vulnerability in urban environments concerning household water management during the COVID-19 pandemic using the SPSS (Statistical Package for the Social Sciences) software.

## Result and Discussion

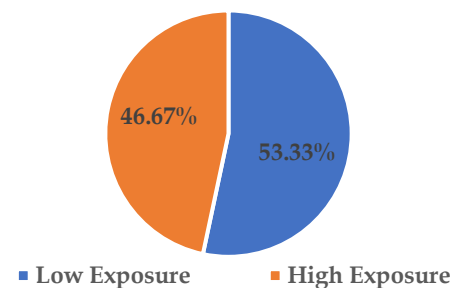
### *Women's Vulnerability on Household Water Management During COVID-19 Pandemic*

The context of vulnerability in the COVID-19 pandemic is exceeding the risk of infection transmission. An individual or group may not be vulnerable at the pandemic initiation but may enhance vulnerability later. External groups that are epidemiologically defenseless to COVID-19 (the elderly and individuals with comorbidities) have different socioeconomic backgrounds that become vulnerable when struggling to cope with the crisis, whether financial, mental, or even physical (Acharya & Porwal, 2020). The COVID-19 pandemic has deepened the double burden carried by women. In undertaking the impact and preventing the transmission of COVID-19 at the household level, knowledge and understanding of women's vulnerability are needed, in this case also related to access to water. Women may be a vulnerable group enduring the impacts of a pandemic, who may need to consider their needs in local response and support planning sufficiently. The concept of vulnerability used in this study follows Gallopín (2006), which states that the components of vulnerability are exposure, sensitivity, and capacity of response.

### *Exposure to Limited Water Conditions during the Pandemic*

In general, a principal concept correlated to vulnerability is exposure, which means the degree, duration, and/or extent to which a system is exposed to or subject to perturbation (Adger, 2006; Gallopín, 2006). Based on this viewpoint, a system not exposed to interference will be defined as non-vulnerable. Hahn et al. (2009) describe the components of vulnerability

related to exposure measured by disaster events and climate variability over a certain period. Furthermore, Taylor et al. (2013) identified exposure in two indicators, likelihood, and impact, to determine which hazards are considered the most serious for the population and require consideration in adaptation strategies. The likelihood is defined as how likely they are to feel that they are affected by danger. The impact is defined as how big the perception of the impact is caused by the hazard that occurs. Exposure to water shortage and the COVID-19 pandemic in this study was measured based on the degree or frequency of scarcity/limited water events and the COVID-19 impact encountered by women in the research location. The results of the combined exposure scores are then divided into low-exposure and high-exposure categories based on statistical formulas. The results are shown in the graph below.

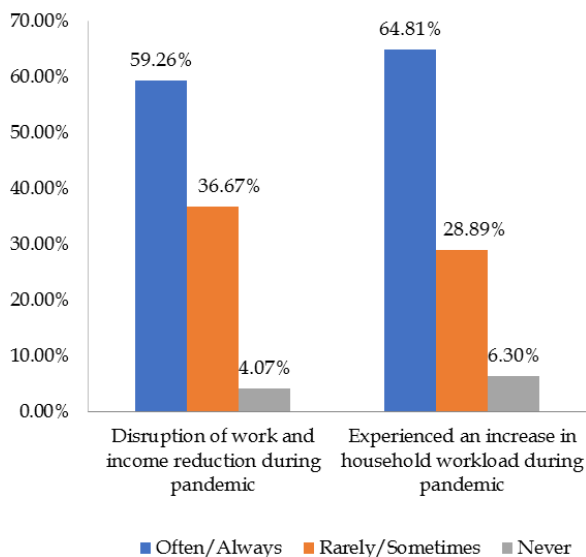


**Figure 1.** Exposure to limited water conditions during the COVID-19 pandemic

Based on the results analysis of the limited water conditions during the Pandemic in Figure 1, it can be witnessed that out of a total of 270 respondents, 53.33% of female respondents were in the low exposure category, and 46.67% of female respondents were in the high exposure category. These results show that from the percentage value, although the overall level of women's exposure to limited water conditions during the COVID-19 Pandemic tended to be low, 46.67% of respondents still experienced a high level of exposure. The level of women's exposure measured in this study is divided into two disturbances: women's exposure to the COVID-19 Pandemic and women's exposure to limited water conditions.

Most women's exposure to the COVID-19 Pandemic was in the high category (56.7%). This is because most women in the study locations experienced a significant impact of the COVID-19 Pandemic. The COVID-19 Pandemic has increased the household workload for most female respondents; for example, they are more likely to clean the house and manage family hygiene, cook healthy meals more often for the whole family, and have a longer time to take care and

educate children during school from home. The occurrence of the COVID-19 Pandemic also had an impact on disrupting work and reducing family income for the majority of women in the study locations. This is in accordance with Diderichsen et al. (2021), which state that during disease outbreaks, caring for children, especially those infected, creates a heavy emotional and economic burden for families, specifically for poor women.



**Figure 2.** Women's exposure to COVID-19 pandemic

Figure 2 show that 64.81% of respondents often and always experience an increase in household workloads during a pandemic. In addition, as many as 59.26% admit that pandemics almost often and always cause work disruptions, and most of them experienced a reduction in income. Some respondents tried to increase their family income by opening a small business (warung) or working as daily wage laborers in a factory. Meanwhile, in coastal areas, such as Kalibaru, more women are working as green mussel peelers. This shows that the double burden faced by women has deepened with the occurrence of the COVID-19 Pandemic. On the other hand, due to the PSBB policy and a negative stigma against positive COVID-19 patients, most respondents did not comprehend the condition of the COVID-19 cases in their surroundings because the information was very limited and closed.

Based on exposure to water-strained conditions, 55.6% of female respondents had a low level of exposure, and 44.4% of respondents had a high level of exposure. These results show that most female respondents have a low risk of experiencing barriers to limited clean water. This condition is supported by the fact that as many as 56.7% of respondents already have private piped water networks. On the other hand, even though most

respondents already have a private piped water network, only 24.4% of female respondents have never experienced difficulties/limited access to clean water during the pandemic. The rest stated that they rarely (17.40%), sometimes (20.40%), often (33%), and always (4.8%) experience difficulties/limited access to clean water during a pandemic. This shows that the piped water network in some communities in North Jakarta is not reliable enough to meet the needs of the entire community. In addition, even though they do not have a pipeline network or if there is interference with piped water, most respondents are still able to meet their clean water needs by looking for other alternative sources of water, such as purchasing water from a public hydrant or retailers, using groundwater wells/pumps, connecting rubber tube from neighbors or other public facilities, such as mosques and public hydrants, and accomplish rainwater harvesting.

Some respondents admitted that the disturbance to clean water access during the COVID-19 pandemic could disrupt household activities. During the COVID-19 pandemic, most people took out work and study activities from home, so the need for water increased. People are also encouraged to wash their hands and clean themselves frequently, but the policy creates difficulties because it is challenging to implement when there is a water shortage. Government Regulation No 21 of 2020 concerning Large-Scale Social Restrictions could restrain people who rely on water sources from outside the household; based on survey results, there are still 45.19% of respondents whose water sources come from outside the household.

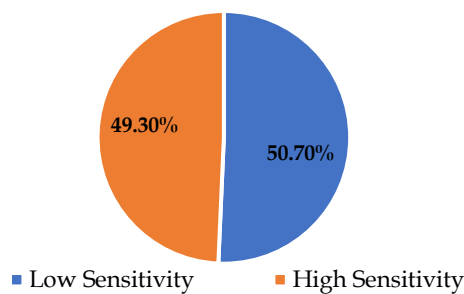
*Sensitivity to Limited Water Conditions during a Pandemic*

The vulnerability relates to highly exposed systems, sensitive and less adaptable (Apan et al., 2008). Furthermore, Adger (2006) and Gallopín (2006) define the concept of sensitivity as the limit to which individual or natural systems can absorb impacts without suffering long-term damages or other significant differences in circumstances. Sensitivity refers to all non-climatic or man-made factors affecting a community's vulnerability. Some examples include the community's economy, education, access to basic services, or the population's structure. These man-made factors make it harder for people to prepare for or recover from climate events, making communities more vulnerable to their damaging effects (Taylor et al., 2013). Hahn et al. (2009) examined sensitivity based on assessing health status, water, sanitation, hygiene, and food security. Related to this research, the sensitivity component will be measured based on accessibility, adequacy, safety, and lifestyle related to water. Apart from that, it also



captured how sanitation, hygiene, and health status related to water conditions.

Based on the survey results in Figure 3, 49.30% of respondents experienced high sensitivity to limited water conditions during the pandemic. Meanwhile, 50.70% of respondents experienced low sensitivity to limited water conditions during the pandemic. This nearly balanced value indicates an inequality regarding water access, adequacy, and security.



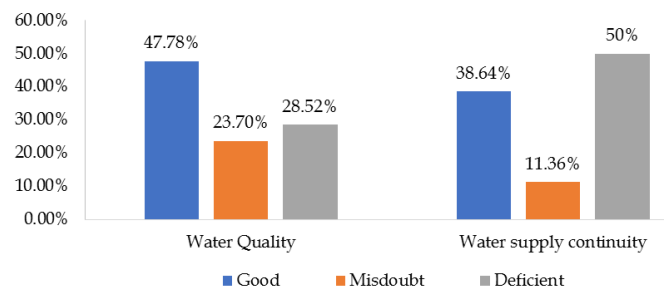
**Figure 3.** Sensitivity to limited water conditions during the pandemic

Regarding water accessibility, to meet the water needs of residents in the North Jakarta area, it is divided into two necessities: hygiene (bathing, washing, and toilet) and consumption (drinking and cooking). The main water source supply to fulfill personal and household hygiene is achieved from private piped water (56.7%). Meanwhile, most respondents still use drilled wells/pumps (23%) and buy water from water retailers/porters (18.5%) as the main and alternative source of clean water supply for hygiene. Inequality distribution of the piped water network in North Jakarta, especially in areas with high population density, implies that some citizens have to pay more to get clean water because they must purchase it from agents or mobile retailers at varying prices. In addition, even though they already have a private water network or private wells/pumps, most respondents still require a supplementary water source supply due to the erratic water supply. Based on 18.50% of respondents still buy water from water retailers, and 2.2% use water from public water supply facilities as a source of additional water supply. Some other households obtain clean water by channeling/distributing it from neighbors or public facilities such as mosques and public hydrants and collecting rainwater.

To meet water needs for consumption, 50.37% of respondents use non-branded refill water, 33.30% use branded bottled/refillable water (factory production/packaged drinking water producer), and 13% use plumbing from a private pipe water network. This is in accordance with BPS Kota Jakarta Utara (2022) data that shows that most households in North Jakarta use bottled

water as a source of drinking water because it is practical, the price varies and is driven by the difficulty in finding clean water because groundwater (wells) and rivers -as the source of raw water- has been polluted by household and industrial waste. Contaminated water can cause digestive diseases such as cholera, typhus, dysentery, intestinal worms, symptoms of diarrhea, and others. On the other hand, even though it has a relatively lower price, using water from refilled drinking water depots, not from bottled drinking water factories/producers, can pose health risks due to unsafe water quality assurance. Several studies have found that many refilled drinking water depots are contaminated with bacteria and do not meet health standards. Contamination is due to the low-tech filtration process and the depot location, which is less sterile.

According to most respondents, observations related to water safety show that the water quality is quite good (47.78% in Figure 4). However, 28.52% of respondents admit that water quality in their households could be better. This can be seen from some of the water-well having murky colors. During the rainy season, the water from the well smells muddy because it is contaminated with domestic wastewater. Sometimes, pipeline leaks make the water not clear and smelly. Conversely, 50% of respondents still complain that water supply (especially piped water) is not always available smoothly, interruptions often occur, it is only available at certain times, and water often comes out at night. This is a challenge for women because they are considered responsible for collecting water, so women often have to sacrifice their rest time to meet water needs in the household.



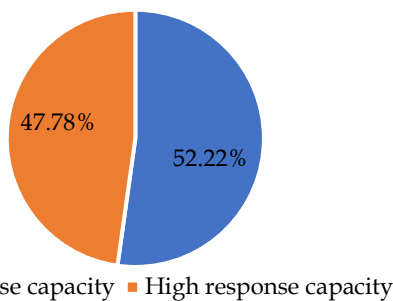
**Figure 4.** Water safety indicators that measured by water quality and water supply continuity

This research found that most household water management (ordering water, collection, payment, or arrangement for daily household needs) is mainly done by women (80.37% of the total respondents). This shows that the rationalization of urban space sharpens the gender order by setting limits on the role of women, restricting their economic activities (public role), and defining them as housewives who are responsible for

cleanliness (domestic role). In addition, a survey conducted by UN Women (2020) also shows that the COVID-19 pandemic in Indonesia has caused more women (22%) than men (16%) to spend more time getting clean water due to an increased need for water and food supply for the family. This is in line with PAM JAYA's report that the Large-Scale Social Restrictions (PSBB) policy established by the Government of DKI Jakarta to prevent the spread of COVID-19 has increased water consumption in the household sector because the majority of the population carries out work and study activities from home (Umasugi, 2020).

*Response Capacity to Water Shortages Risks during the Pandemic*

In general, the capacity of response is the ability to adjust a change or disturbance, moderate possible harm, take benefit opportunities, and cope with the transformation outcomes (Gallopín, 2006). Cardona et al. (2012) see that response capacity mainly refers to the ability to react after a disaster, especially post-emergency response. Meanwhile, Hajibabae et al. (2014) stated response capacity as a set of components and activities associated with the crisis response and recovery from a disaster's short- to long-term impacts. Based on these concepts, indicators of planning in dealing with disasters, resource support, and the ability to handle the respondents were determined to obtain a score of response capacity to the risk of water shortages. Figure 5 shows that 47.78% of respondents are in the high response capacity category. As a comparison, as much as 52.22% is classified as low response capacity.



**Figure 5.** Response capacity to water shortages risks during the pandemic

One state of planning in response capacity can be witnessed from the respondents' knowledge of dealing with the water shortage. Based on this, about 30% of respondents know the use of rainwater as a water source. On the other hand, only a few respondents have collected rainwater. Collecting rainwater in densely populated settlements are challenging; it requires enough area and a large container. Besides that, most of the settlements have attached roofs that cause more

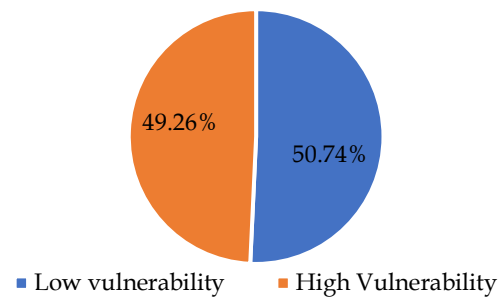
accumulation of dirt. On the other hand, respondents assume that rainwater is dirty and unhealthy and often becomes a breeding ground for mosquito larvae. Other respondents' limited knowledge related to how to filter water (18.52%), plant trees and make water infiltration (7.41%), save water use (8.15%), and search for other alternative water sources (8.15%). Meanwhile, there are still quite a lot of respondents who need to learn how to deal with limited water (27.78%).

Based on Cardona et al. (2012), response capacity refers to the ability to react after a disaster occurs, in this case, related to the respondent's handling capacity in water shortage during the pandemic, as displayed in Table 1. Most respondents often make savings in water use (35.56%). This is due to their experience of often facing limited access to water. Others prefer to search for other alternative water sources and add more costs to get water.

**Table 1.** Respondent's Handling Capacity in Water Shortage during the Pandemic

Handling capacity	Frequency	Percentage (%)
Save water usage	96	35.56
Search for alternative water sources	52	19.26
Add extra cost/ expenses for water	44	16.30
Rainwater harvesting	32	11.85
Purifying/filtering water	12	4.44
No answer/ don't know	34	12.59
Total respondents	270	100.00

Based on the description above, the level of women's vulnerability in household water management during the COVID-19 pandemic in North Jakarta was almost balanced (Figure 6).



**Figure 6.** Women's vulnerability status on household water management during pandemic

As many as 49.26% of respondents have a high vulnerability category, while 50.4% are in a low vulnerability category. This shows that even though there are slightly more respondents with a low level of vulnerability, almost half of the respondents still need attention because they have high vulnerability in

household water management. The division of labor based on gender (gender division of labor) in the household, which is more borne by women, causes the fulfillment of food, water, and family hygiene needs often to be the responsibility of women (Mosse, 2018). In conditions of limited access to water, women often make sacrifices to protect their families by diverting the limited household water supply by ignoring the need for personal hygiene. This important role of women in the family and environment shows the potential for women's resilience in dealing with pandemic disasters. Women's empowerment and gender equality in environmental management are important things to strive for in realizing sustainable development and dealing with disasters such as the COVID-19 pandemic.

## Conclusion

Women's vulnerability in household water management during the COVID-19 pandemic in North Jakarta can be observed as an absence of the right to household water security, such as water accessibility, affordability, quality, and adequate water. Access limitations and dependence on water sources outside the household during the pandemic create challenges in fulfilling the need for clean water and implementing health protocols. It may also raise contact risk and cause the potential for the virus to spread between households, especially in a dense settlement. Limited access to pipe water networks, which currently still become the major problem in the urban area of North Jakarta, can increase women's vulnerabilities due to inequality and the double burden they encounter. The contribution of this research is that the analysis of women's vulnerability can improve policy recommendations to encourage the rebuilding of better Sustainable Development Goals, especially related to more effective and gender-responsive urban water management. Identifying the components that cause vulnerability and water insecurity among urban women is expected to help policymakers and planners develop effective adaptive strategies, especially for poor urban women. Water management strategies must be gender sensitive and consider the roles, needs, and relationships between different actors at the household and community levels. Women play an essential role in determining the family's lifestyle and the environment, and it significantly impacts adaptation to the behaviour of the pandemic that is being faced. Equal participation between men and women is indispensable for sustainable development. Furthermore, due to the lack of community knowledge in preventing and overcoming water scarcity, community-based environmental education specific to water management

is needed to broaden the equitable involvement of women in climate change adaptation activities and water-related policy development. Moreover, equitable access to clean water through piped water networks that are affordable and easily accessible is an absolute requirement by the community to minimize the vulnerability that occurs.

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## Author Contributions

Conceptualization, E.S. and H.H.; methodology, E.S. and D.A.; software, E.S.; validation, E.S., H.H. and D.A.; formal analysis, E.S.; investigation, E.S.; resources, E.S.; data curation, E.S.; writing – original draft preparation, E.S.; writing – review and editing, H.H. and D.A.; visualization, E.S.; supervision, H.H. and D.A.; project administration, E.S. All authors have read and agreed to the published version of the manuscript.

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## Conflicts of Interest

The authors declare no conflict of interest. The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript; or in the decision to publish the results.

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