

Urban–Rural Inequality in Access to Safe Drinking Water in Indonesia: A Literature Review

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ABSTRACT

Access to safe drinking water remains a crucial public health and development issue in Indonesia, particularly as disparities between urban and rural areas persist. This article reviews the literature on inequality in drinking water access, focusing on causal factors, health and social impacts, and policy responses. Using a descriptive qualitative literature review approach, this study synthesizes previous findings related to water infrastructure, socioeconomic conditions, community participation, water quality, and public health outcomes. The review shows that urban communities generally have better access to piped water systems managed by Regional Drinking Water Companies (PDAM), whereas rural communities often rely on wells, springs, rivers, rainwater, or other traditional sources that are more vulnerable to contamination and seasonal variability. The main factors contributing to this inequality include uneven infrastructure development, limited technical and financial capacity, geographical constraints, low public awareness, and weak community involvement in water resource management. Limited access to safe drinking water increases the risk of waterborne diseases, worsens child health outcomes, and reinforces broader social and economic inequalities among rural households. The findings highlight the need for integrated and equitable policy responses, including strengthening PDAM performance, expanding community-based programs such as PAMSIMAS, improving water quality monitoring, enhancing public education, and promoting cross-sector collaboration. Locally responsive water governance is essential to achieve universal access to safe and affordable drinking water in line with Sustainable Development Goal 6.1.

KEYWORDS: Public health; Rural communities; Safe drinking; Urban-rural inequality; Water access

1. INTRODUCTION

Access to clean and safe drinking water is a fundamental prerequisite for human health, social welfare, and sustainable development. Drinking water is not merely a basic household need, but also an essential determinant of public health, educational opportunity, economic productivity, and environmental sustainability. In the global development agenda, the importance of safe drinking water has been explicitly recognized through Sustainable Development Goal 6.1, which aims to achieve universal and equitable access to safe and affordable drinking water for all by 2030. However, despite substantial progress in water infrastructure development, unequal access to drinking water remains a persistent challenge in many developing countries, including Indonesia.

In Indonesia, disparities in access to drinking water are closely associated with differences in geographical location, infrastructure availability, socioeconomic status, and institutional capacity. Urban areas generally benefit from more developed water supply systems, including piped water networks

managed by Regional Drinking Water Companies or Perusahaan Daerah Air Minum (PDAM). In contrast, rural communities often depend on traditional and non-piped water sources such as dug wells, springs, rivers, and rainwater, which are more vulnerable to contamination, seasonal fluctuation, and inconsistent quality. Previous studies have shown that access to improved or safe drinking water varies considerably across regions and between urban and rural populations in Indonesia (Afifah et al., 2018; Wanda & Kurniawati, 2024).

The urban–rural gap in drinking water access reflects broader structural inequalities in basic service provision. In urban areas, the concentration of population, public investment, regulatory support, and institutional management tends to facilitate better access to drinking water infrastructure. Meanwhile, rural and remote areas frequently face geographical barriers, limited financial resources, weak technical capacity, and inadequate maintenance of water supply systems. Studies have indicated that the performance and productivity of PDAMs remain uneven across regions, with many local water providers still facing challenges related to efficiency, service coverage, and water quality (Muftiadi & Fordian, 2020; Rahim & Muchlisoh, 2021). This situation demonstrates that inequality in drinking water access is not only a matter of physical infrastructure, but also a governance and resource allocation issue.

Socioeconomic factors also play an important role in shaping household access to safe drinking water. Households with higher income and educational attainment are more likely to use improved and safer drinking water sources, while low-income households often experience financial barriers in accessing reliable water services. In rural areas, limited public awareness of water quality, sanitation behavior, and household water treatment may further increase exposure to unsafe water sources. Research in Indonesia has shown that education level, household characteristics, and regional conditions influence the use of proper drinking water sources (Rahim & Muchlisoh, 2021; Putri & Yuniasih, 2022). Therefore, the problem of drinking water inequality should be understood as a multidimensional issue involving infrastructure, economic capacity, knowledge, behavior, and local governance.

Inequality in drinking water access has serious consequences for public health and social welfare. Unsafe drinking water increases the risk of waterborne diseases such as diarrhea, cholera, typhoid, and parasitic infections. These health risks are particularly severe for children, who are more vulnerable to infection and malnutrition. Several studies have linked poor access to drinking water and sanitation with child health problems, including diarrhea and stunting (Ariyanto et al., 2021; Astuti, 2022; Nurhayati et al., 2022). Although stunting is a multifactorial condition influenced by nutrition, infection, sanitation, maternal education, and household poverty, inadequate access to safe drinking water can contribute to repeated infections and poor environmental health conditions that affect child growth and development.

Beyond health outcomes, limited access to drinking water also produces social and economic burdens. In many rural communities, women and children

often bear the responsibility of collecting water, which may reduce time available for education, productive work, and household care. Poor access to water can also affect agricultural activities, food security, and local economic resilience. Similar patterns of geographical inequality in access to improved drinking water and sanitation have been documented in other developing regions, indicating that the urban–rural water access gap is not only a national issue but also a broader development concern (Pullan et al., 2014; Muniyapillai et al., 2022).

Although many studies have examined access to drinking water, sanitation, health outcomes, and water infrastructure in Indonesia, the literature remains fragmented. Some studies focus on regional inequality, others emphasize PDAM performance, household determinants, sanitation, or child health outcomes. However, there is still a need for a more integrated review that synthesizes the causal factors, impacts, and policy responses related to urban–rural inequality in drinking water access. Such a review is important to identify recurring patterns, compare findings across different regional contexts, and formulate more inclusive policy recommendations.

Therefore, this article aims to review existing literature on inequality in the availability and access to drinking water between urban and rural areas, with a particular focus on Indonesia. Specifically, this review examines the factors contributing to inequality, the health and social impacts of unequal access, and the policy strategies that have been proposed or implemented to address the problem. By synthesizing previous findings, this article is expected to contribute to the development of more equitable, inclusive, and sustainable drinking water policies, particularly in supporting the achievement of SDG 6.1.

2. MATERIALS AND METHODS

This study employed a descriptive qualitative approach using a literature review method. This approach was selected to identify, analyze, and synthesize previous findings related to inequality in the availability and access to drinking water between urban and rural areas, particularly in Indonesia. The review focused on studies discussing safe drinking water, improved water sources, sanitation, PDAM performance, rural water supply, community-based water programs, waterborne diseases, stunting, and Sustainable Development Goal 6.1.

Relevant literature was obtained from scientific journal articles, government publications, policy reports, and institutional documents. The search used combinations of English and Indonesian keywords, including “safe drinking water,” “drinking water access,” “urban–rural inequality,” “rural water supply,” “water access disparity,” “PDAM,” “PAMSIMAS,” “sanitation,” “waterborne diseases,” “stunting,” “Indonesia,” “SDG 6.1,” “akses air minum layak,” “air minum aman,” and “ketimpangan wilayah.”

The inclusion criteria were sources that discussed drinking water access, water quality, sanitation, public health impacts, water governance, or disparities between urban and rural areas. Priority was given to studies focusing on

Indonesia, while selected international studies were included for comparative context. Sources were excluded if they were not directly related to drinking water access or did not provide sufficient information for thematic analysis.

The collected literature was analyzed using thematic synthesis. The findings were grouped into five main themes: patterns of inequality in drinking water access, causal factors, health and social impacts, coping strategies, and policy implications. The synthesis was conducted narratively by comparing findings across studies to identify recurring patterns and formulate recommendations for more equitable and sustainable drinking water governance.

3. RESULTS AND DISCUSSION

3.1 Urban–Rural Inequality in Drinking Water Access

Inequality in access to drinking water in Indonesia remains a complex and multidimensional issue. The disparity is shaped by differences in infrastructure availability, geographical conditions, socioeconomic capacity, institutional performance, and public policy implementation. Existing studies indicate that access to improved and safe drinking water is generally higher in urban areas than in rural areas. In 2016, access to piped drinking water systems in urban areas reached 42.12%, while access in rural areas remained significantly lower, indicating persistent challenges in fulfilling basic water needs among rural households (Khoirunnisa, 2019; Wanda & Kurniawati, 2024).

At the national level, access to safe drinking water has also not been achieved equally across regions. Muftiadi and Fordian (2020) reported that in 2017, only 72.04% of Indonesians had access to safe drinking water. This figure reflects the continuing gap between national development targets and actual household access, especially in rural and remote areas. The problem is not only related to the physical availability of water sources, but also to the reliability, safety, affordability, and continuity of drinking water services.

Urban communities generally benefit from better water infrastructure, including piped networks managed by Regional Drinking Water Companies or Perusahaan Daerah Air Minum (PDAM). However, the performance of PDAMs varies across regions. Some PDAMs remain sub-productive and face challenges related to efficiency, distribution coverage, service continuity, and water quality (Muftiadi & Fordian, 2020). This uneven performance contributes to unequal service provision, particularly in areas where PDAM networks are limited or unable to reach rural communities. Other studies also show that many rural households still depend on water sources whose quality is not guaranteed, including wells, springs, rivers, and other non-piped sources (Yumanda & Vidriza, 2022; Mushthofa et al., 2024).

The gap between urban and rural areas is also influenced by household characteristics. Education and economic capacity play important roles in determining whether households can access safer drinking water sources. Households with higher educational attainment tend to have better knowledge of safe water use and are more likely to use improved drinking water sources (Ariyanto et al., 2021; Angraini et al., 2021). Meanwhile, low-income households

often face financial barriers in accessing reliable water services, purchasing treated water, or improving household-level water storage and treatment facilities.

Empirical studies in Indonesia confirm that access to proper drinking water varies significantly across regions. Putri and Yuniasih (2022) found that access to proper drinking water in Bengkulu Province in 2021 reached only 67.39%, which was below the national average. Similarly, Wanda and Kurniawati (2024) emphasized that the characteristics of drinking water conditions differ between urban and rural areas, reflecting disparities in infrastructure, service systems, and household water source choices. Afifah et al. (2018), using data from the 2015 Indonesian National Socioeconomic Survey, also demonstrated subnational inequalities in access to improved drinking water and sanitation in Indonesia.

International evidence shows that urban–rural disparities in drinking water access are not unique to Indonesia. Muniyapillai et al. (2022) found that rural households often rely on communal or less secure water sources, while urban households tend to have better access to improved water collection and storage systems. Pullan et al. (2014) also reported significant geographical inequalities in access to improved drinking water and sanitation across Sub-Saharan Africa. These findings suggest that unequal access to drinking water is a broader development issue that commonly affects regions with uneven infrastructure investment and socioeconomic disparities.

Overall, the literature indicates that urban–rural inequality in drinking water access is not caused by a single factor. Rather, it results from the interaction between infrastructure limitations, institutional capacity, household socioeconomic conditions, geographical barriers, and public awareness. Therefore, efforts to reduce inequality should address both technical and non-technical dimensions of drinking water provision.

3.2 Factors Contributing to Inequality in Drinking Water Access

The inequality of access to safe drinking water in Indonesia can be explained through several interrelated factors. These factors include infrastructure disparities, socioeconomic conditions, institutional capacity, environmental constraints, education, and community participation.

The first and most visible factor is infrastructure inequality. Urban areas usually have more developed water supply systems, including piped networks, treatment facilities, distribution systems, and institutional support from PDAM. In contrast, rural areas often lack adequate piped systems and depend on decentralized or traditional water sources. Rahim and Muchlisoh (2021) emphasized that access to proper drinking water is influenced by household and regional characteristics, including the availability of adequate infrastructure. In many rural areas, water providers also face limitations in technical capacity, maintenance, and service quality, which makes water access less reliable and less safe.

The second factor is the uneven performance of water service institutions. PDAM has a central role in providing drinking water services, but its performance differs significantly across regions. Inefficiency in management, limited investment, water loss, poor maintenance, and inadequate monitoring may reduce the quality and coverage of services. This condition is particularly problematic in

rural and peri-urban areas where service expansion requires higher costs and stronger institutional capacity. As indicated by Muftiadi and Fordian (2020), improving PDAM productivity is essential for supporting universal access to drinking water in Indonesia.

Socioeconomic conditions also strongly affect household access to drinking water. Poor households often face limited ability to pay for piped water connections, water treatment technologies, or safe drinking water from refill stations. This situation forces many households to rely on unsafe or less reliable water sources. Sopianti et al. (2024) highlighted that clean water and healthy sanitation are closely related to child health and growth, particularly in developing countries. Similarly, Pateda et al. (2023) emphasized that limited access to clean water and sanitation can increase the risk of stunting, showing that water inequality has long-term consequences for human development.

Environmental and geographical factors further intensify inequality. Rural and remote areas often face difficulties due to dispersed settlements, hilly landscapes, drought-prone environments, flood risk, or limited groundwater quality. These conditions increase the cost and complexity of water infrastructure development. Haisa et al. (2023) showed that environmental health factors and flood vulnerability can influence diarrheal disease patterns, indicating that environmental conditions are closely linked to water safety and health risks.

Education and public awareness are also important determinants of drinking water access. Communities with limited knowledge about water quality, sanitation, and household water treatment may continue to use unsafe sources even when safer alternatives are available. Barid et al. (2023) emphasized the importance of community assistance and education in improving understanding of clean water quality. Therefore, improving water access requires not only infrastructure development but also behavioral change, public education, and local community empowerment.

Based on these findings, inequality in drinking water access should be understood as a structural and multidimensional problem. Infrastructure development alone is insufficient if it is not supported by institutional strengthening, household economic capacity, environmental adaptation, education, and community participation.

3.3 Health, Social, and Economic Impacts of Drinking Water Inequality

Unequal access to safe drinking water has serious implications for public health, social welfare, and economic development. The most immediate impact is the increased risk of waterborne diseases. Households that depend on contaminated or untreated water sources are more vulnerable to diarrhea, typhoid, cholera, parasitic infections, and other water-related diseases. Rahayu and Erika (2023) showed that access to clean drinking water and sanitation facilities contributes positively to community health by reducing the risk of disease. Herawati et al. (2018) also emphasized that household drinking water sources are important determinants of public health outcomes.

Children are among the most vulnerable groups affected by unsafe drinking water. Several studies have linked poor drinking water access, sanitation, and diarrheal disease with child growth problems, including stunting. Ariyanto et al.

(2021) found a relationship between maternal education, drinking water sources, and stunting among children. Angraini et al. (2021) also showed that maternal knowledge, access to clean water, and diarrhea were associated with stunting. In Papua and West Papua, Astuti (2022) found that sanitation and drinking water conditions were related to stunting prevalence. Nurhayati et al. (2022) similarly reported that drinking water, sanitation, and diarrhea history were associated with stunting among young children.

Nevertheless, the relationship between drinking water access and stunting should be interpreted carefully. Stunting is a multifactorial condition influenced by nutrition, infection, sanitation, maternal education, household income, and health services. Unsafe drinking water contributes to stunting indirectly by increasing exposure to pathogens, causing repeated infections, and worsening environmental health conditions. Therefore, improving access to safe drinking water should be integrated with sanitation, nutrition, maternal health, and poverty reduction programs.

The social impacts of drinking water inequality are also significant. In rural communities, limited access to nearby and reliable water sources often increases the burden on women and children, who are commonly responsible for collecting water. This reduces the time available for education, income-generating activities, childcare, and rest. Daytana and Salmun (2021) showed that gender inequality affects household water availability, particularly in rural contexts. Faiqah and Puspitasari (2023) also highlighted that inadequate access to basic needs can contribute to broader social vulnerability.

Economic impacts are equally important. Limited access to safe water can increase household expenditure for health care, reduce productivity, and affect agricultural activities and food security. For rural households, water is closely linked not only to drinking needs but also to livelihoods. Wardani et al. (2020) showed that socioeconomic conditions and food security are related to child health outcomes, including stunting. This indicates that drinking water inequality can reinforce poverty and reduce household resilience.

Thus, drinking water inequality is not merely an environmental or infrastructure issue. It is also a public health, gender, education, economic, and social justice issue. Addressing this inequality requires integrated interventions that recognize the multiple consequences of unsafe and unequal water access.

3.4 Coping Strategies and Solutions

Various strategies have been proposed to reduce inequality in drinking water access in Indonesia. These strategies include improving infrastructure, strengthening PDAM performance, expanding community-based programs, improving public education, enhancing water quality monitoring, and promoting cross-sector collaboration.

One important strategy is prioritizing infrastructure development based on regional needs. Yumanda and Vidriza (2022) showed that grouping provinces based on the efficiency and allocation of special funds for sanitation and drinking water can help determine development priorities. This approach is important because regions differ in terms of infrastructure gaps, fiscal capacity, geographical

challenges, and service coverage. By using data-based prioritization, the government can direct investment to areas with the most urgent needs.

Strengthening PDAM capacity is also essential. PDAM plays a major role in urban water supply, but many service providers still face technical, managerial, and financial challenges. Hastiaty et al. (2023) found that the quality of PDAM drinking water requires regular examination to ensure compliance with health standards. Therefore, improving PDAM performance should include infrastructure rehabilitation, leakage control, staff training, water quality monitoring, financial management improvement, and service expansion to underserved areas.

Community-based drinking water programs are another important solution, especially for rural areas that are not yet reached by piped systems. Programs such as PAMSIMAS and other community-based water supply initiatives can support local participation, ownership, and sustainability. Djaja et al. (2022) emphasized the importance of developing community-based drinking water access in rural areas to achieve safer drinking water. Such programs can be more effective when communities are involved from the planning stage to operation and maintenance.

Public education is also necessary to improve household water safety. Even when improved water sources are available, unsafe storage, poor sanitation, and limited awareness can still lead to contamination. Erni et al. (2023) highlighted the importance of hygiene and sanitation in relation to refill drinking water quality. Education programs should therefore focus on safe water handling, household water treatment, sanitation behavior, and the health risks associated with contaminated water.

Technological innovation may also support water quality monitoring and service improvement. Wijaya and Sukarni (2019) discussed the use of Internet of Things-based water quality monitoring systems, which can help monitor water conditions more efficiently. Although technological solutions may not be equally feasible in all rural areas, they can support local governments and service providers in improving monitoring systems and responding more quickly to water quality problems.

Overall, effective solutions require a combination of physical infrastructure development, institutional strengthening, community empowerment, behavioral change, and technological innovation. No single strategy is sufficient to eliminate drinking water inequality. Policies must be adapted to local conditions and supported by adequate funding, monitoring, and community participation.

3.5 Policy Implications and Recommendations

The findings of this review indicate that reducing inequality in drinking water access requires inclusive, data-based, and locally responsive policies. The government should not only expand infrastructure but also ensure that water services are safe, affordable, continuous, and accessible to vulnerable populations.

First, improving PDAM infrastructure and performance should be a priority. Pressure management and leakage control are important strategies to reduce water loss and improve service efficiency. Muliawati et al. (2023) showed that the District Meter Area approach can support the control of water loss in drinking water distribution systems. This indicates that technical improvements can directly contribute to better service quality and efficiency. In addition, PDAM staff

training, infrastructure maintenance, and regular quality testing should be strengthened.

Second, community-based drinking water supply programs should be expanded in rural and underserved areas. Programs such as PAMSIMAS can help address infrastructure gaps by involving local communities in planning, implementation, and maintenance. Sari et al. (2022) emphasized that drinking water and sanitation-related interventions can contribute to improving community health and supporting stunting reduction efforts. Therefore, community-based water programs should be integrated with sanitation, nutrition, and public health interventions.

Third, public education and awareness programs should be strengthened. Nurhayati et al. (2022) showed that drinking water, sanitation, and diarrhea history are related to stunting among children. This finding highlights the need for educational programs that promote safe water use, sanitation behavior, and household hygiene. Schools, health centers, village governments, and community organizations can play important roles in disseminating information and encouraging behavior change.

Fourth, inclusive financing policies are needed to ensure that poor and remote households are not excluded from safe drinking water services. Ashari et al. (2024) showed that education, unemployment, and poverty contribute to income inequality in Indonesia. Since economic inequality affects households' ability to access safe water, water policies should be connected to poverty reduction, education improvement, and regional development strategies. Subsidies, targeted infrastructure investment, and support for low-income households may be required to ensure equitable access.

Fifth, cross-sector collaboration is essential. Drinking water access is related to health, environment, infrastructure, education, poverty, gender, and regional development. Damayanty (2024) emphasized the importance of accelerating water and sanitation planning in regional development documents. Therefore, collaboration among government agencies, PDAM, village governments, NGOs, private sectors, academic institutions, and local communities is necessary to create integrated and sustainable water governance.

Sixth, monitoring and evaluation systems must be strengthened. Periodic monitoring of water quality, service coverage, infrastructure performance, and program effectiveness is necessary to ensure that policies produce measurable improvements. Haisa et al. (2023) demonstrated the relevance of environmental health factors in understanding disease distribution, which implies that water quality monitoring should be integrated with public health surveillance and disaster risk management.

In summary, policy efforts to reduce urban-rural inequality in drinking water access should move beyond infrastructure expansion alone. They should combine technical improvement, institutional reform, community participation, public education, inclusive financing, and continuous monitoring. Such an integrated approach is essential to support the achievement of Sustainable Development Goal 6.1, which calls for universal and equitable access to safe and affordable drinking water for all.

4. CONCLUSION

This review concludes that inequality in access to drinking water between urban and rural areas in Indonesia remains a serious and multidimensional development challenge. Urban communities generally have better access to piped water systems and more established water service institutions, particularly through Regional Drinking Water Companies (PDAM). In contrast, many rural communities still rely on traditional and non-piped water sources, such as wells, springs, rivers, and rainwater, which are more vulnerable to contamination, seasonal variability, and inconsistent quality.

The findings indicate that this inequality is shaped by several interconnected factors, including uneven infrastructure development, limited institutional and technical capacity, socioeconomic disparities, geographical constraints, low public awareness, and weak community participation in water resource management. These factors show that unequal access to safe drinking water is not merely an infrastructure problem, but also a governance, public health, and social justice issue.

Limited access to safe drinking water has significant consequences for public health and social welfare. Rural households that depend on unsafe water sources face a higher risk of waterborne diseases, including diarrhea and other infections. In children, poor water access and sanitation may contribute indirectly to stunting through repeated infections and unhealthy environmental conditions. In addition, the burden of water collection often affects women and children, reducing opportunities for education, productive work, and social participation.

Therefore, reducing urban–rural inequality in drinking water access requires an integrated and locally responsive policy approach. Priority should be given to strengthening PDAM performance, expanding community-based drinking water programs such as PAMSIMAS, improving water quality monitoring, enhancing public education, and ensuring inclusive financing for underserved communities. Cross-sector collaboration among government institutions, local communities, private sectors, NGOs, and academic institutions is also essential.

Achieving equitable access to safe and affordable drinking water requires more than expanding physical infrastructure. It requires sustainable water governance that combines technical improvement, community empowerment, environmental protection, and continuous monitoring. Such efforts are crucial to support the achievement of Sustainable Development Goal 6.1, which aims to ensure universal and equitable access to safe and affordable drinking water for all by 2030.

5. CONFLICT OF INTEREST

The authors declare No. conflict of interest in relation to this article

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