

Challenges of Drinking Water Supply in Indonesian Cities: A Brief Review

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Abstract—The supply of safe drinking water in the developing world, particularly in Indonesia, has remained one of the major challenges. Millions are still without access to clean water, which inflicts public health and has negative implications for socioeconomic development. This issue significantly hinders the overall progress of the nation. This paper elaborates on the multifaceted challenges facing the drinking water supply in Indonesian cities, from inconsistent policies and lack of autonomy for Water Agencies to aging infrastructure, unreliable power supply, and inadequate investment. Brief case studies from Jakarta, Surabaya, and Padang plainly bring out the specificity of issues in various cities. The paper suggests that solutions can lie in policy reform, empowering the water agencies, fighting corruption, greater investment in infrastructure, making the most of pricing and cost recovery, and strategic engagement with the private sector. Unless these are addressed, such challenges will persist in hindering the progress of Indonesia toward the universal access goal for all urban residents to sufficient, safe, reliable, and affordable drinking water.

Keywords: drinking water, Indonesia cities, urban challenges, water supply

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1. Introduction

Adequate provision of water, in quality and quantity, is important to all living organisms, with particular importance in human use. Indeed, water is needed for any use at the domestic level, agricultural, industrial, or for any other need whenever required. Without this vital resource, human survival would not be possible. The presence of faeces in drinking water sources is also documented by the United Nations to further give impetus to the urgency of this matter: at least 1.7 billion people use drinking water sources contaminated with faeces [1].

Water safety is a public health concern, and with this, in Indonesia, seven out of ten households drink water with a finding of *E. coli*. It indicates that, although the most recent report by UNICEF/WHO [2] on Progress in Drinking Water and Sanitation shows that the rate increased from 61.29% to 90.7% of the population, this is in fact not entirely satisfactory according to target 6 of the Sustainable Development Goals (SDGs). It is estimated that in 2023, only 11.8% of Indonesian households have access to drinking water services, whereas the 100% target is to reach safe drinking water without exception. More than half of Indonesian households lack direct access to the national water company network and do not have optimal access to drinking water. Astonishingly, Jakarta, the capital of Indonesia, lies among the 10 provinces in Indonesia with the lowest percentage of households that have access to drinking water [3].

It is quite clear that this is a critical global health challenge, particularly taking into consideration the consequences that are attached to failure in accessing safe drinking water

supplies. This situation is echoed in the Indonesian Health Profile [4], which states that diarrhea is among the leading cause of post-neonatal mortality in Indonesia at 14%, especially in areas with poor environmental sanitation and the use of potentially contaminated drinking water, for example, from rivers. This further highlights the fact that if general access to drinking water supply is considered, Indonesia is one of the nations in Southeast Asia with a poor record.

The aim of the Indonesian government has been expressed, from the central to the regional level, to improve access to drinking water supply within Indonesia. Donors, NGOs, and the private sector can to some extent fill this gap. This is in line with Indonesia's commitment to the implementation of the SDGs, whose goal 6 targets reducing by half the proportion of people without access to sustainable access to safe drinking water and basic sanitation by 2030 [5]. Successes in water supply coverage at present can be seen from consistent efforts exercised by various governments at all levels. The major drop in this contribution is attributed to the huge socio-economic development and high growth in population in Indonesia, which surpasses the rate of water supply development. The other factors that have been identified by Pambudi and Kusumanto [6] include lack of proper management of water resources within the country, and low investment in operation and maintenance, which results in the production facilities breaking down very frequently. As an example, about 85% of such people in rural communities do not have access to safe water supply [7]. The rest of the population is forced to get water supply from other sources – stream, river, spring water, dam, and rain water, etc – whose quality is not guaranteed [8].

At the national level, the Ministry of Public Works and Housing (KPUPR) is a central advisory and regulatory body responsible for policy formulation, data collection, monitoring, and coordination activities in regard to water resource development; meanwhile, the local government is the owner of the District-owned Tap Water Company (PDAM), a regional-owned enterprise, which normatively carries out activities to develop, operate, and manage clean water supply services in the District [9]. This charge extends over urban and semi-urban water supply. In rural areas, it is made known through the Community Based Drinking Water Supply and Sanitation or PAMSIMAS program. However, the World Bank [10] observed that in some local government areas in the country, there is ineffective implementation of this role because of lack of funds and lack of manpower. This is one of the reasons why the provision of the supply of drinking water in rural areas in Indonesia remains low.

Most of the drinking water supply schemes are funded by the government of Indonesia, both national and regional, through budget allocations to PDAM under the National Budget, Regional Budget, Special Allocation Funds, and Grants. The funds provided are largely intended for capital projects, staff salary payments, and major operation and maintenance of the water schemes, while PDAM is expected to generate routine operation and maintenance revenue through the collection of water tariffs. However, they collect inadequate revenue, as the tariff fixing is mostly of a populist nature and hence they are even denied the opportunity to charge economical water tariffs by the government itself [11].

All district/city/municipality governments have welcomed the initiation of making PDAM a sound, healthy and independent entity, and mandated regarding drinking water supply provision to the citizens/residents. However, this mandate has not been effectively and efficiently implemented by the water companies due to several problems, including but not limited to low budget allocation by local governments, subsidy on water services, unstable electricity supply, old and mostly damaged pipes, poorly motivated staff, and highly politicized tariff-setting regime [12]. Increase in population and sprawling growth of the urban centers raises demand for services. In this regard, preventive maintenance has not been a common practice, while limited funds have precluded investment in new capacity and expansion, as well as prevented the periodic replacement of aging components of existing facilities [13].

Elsewhere and as a result, most water companies/agencies in Indonesian regions can't meet the existing demand for clean water in its respective area at this present time. For instance, Jakarta, the capital of Indonesia, has not been able to provide enough drinking water and household water supply due to an increase in population, despite the reforms and investments by the government. According to the provincial government's own report, in 2023, PDAM was able to supply on average only 67.1% to consumers per day against the demand of 700 thousand gallons per day, creating a demand gap of nearly 300 thousand gallons per day. It is this demand gap that has seen residents increasingly resort to private wells or water vendors, both drinking water depots and bottled drinking water, for their drinking water and general household use [14]. Such dependence further exposes consumers to bacterial and heavy metal contamination because the water quality from these sources is below local regulatory standards.

Many urban-dwelling residents have been dissatisfied with regional drinking water supply systems [15]. Reportedly several cases concerning water supply with high levels of turbidity, intermittent supply, and even days when it does not exist at all [16]. These challenges place increasing pressure on women's work, health, and well-being, as well as children's education, bearing in mind that the main burden of fetching water falls on women and girls [17]

In most cities in Indonesia, urbanization is so fast, yet the coverage of public water supply is still at a low percentage [18]. This has resulted in an increase in the number of population without access to public water provision and thereby threatening the sustainability of the supply of drinking water in Indonesia. There is, however, a limited scientific literature base to guide policymakers and drinking water promotion agencies on how to effectively address the various challenges facing the drinking water sector in Indonesia. If current challenges faced by the water sector can be identified, highlighted, and raised effectively, hopefully it would trigger each government agency to take the required actions which, in general, may help reposition the water sector in the Indonesian economy to a sustainable path. This paper, therefore, reviews the scientific literature on challenges of drinking water supply in Indonesian cities and makes recommendations of strategies toward improved drinking water provision in that country. Specifically, these range from administrative to technical down to commercial challenges.

2. Method

This research fundamentally involves a review of the past research efforts focused on understanding the factors that challenge drinking water supply in Indonesia. Therefore, a critical review of the literature from the available materials on this subject was considered. The methodology employed in this review involved a systematic search across various academic databases and information sources to ensure comprehensive coverage of the topic. These main sources of information (in English and *Bahasa Indonesia*) were based on journal articles, such as PubMed, Scopus, Embase, Wiley, ProQuest, Directory of Open Access Journals/ DOAJ, Digital research reference platform (Garuda), and Google Scholar. The search strategy involved using combinations of keywords such as "drinking water supply Indonesia," "urban water challenges Indonesia," "water management Indonesia," "PDAM challenges," and "water infrastructure Indonesia." Literature was obtained from textbooks, research reports, conference proceedings, works done by commissions, internet sources, and studies published up to July 1st, 2024.

The selection criteria prioritized studies that directly addressed challenges in urban drinking water supply in Indonesia, including administrative, technical, and financial aspects. All the same, despite these sources, it is noted that there are not so many works and data available on this topic due to the scarcity of information, especially on case studies of the different SWAs in Indonesia. This limitation highlights the need for more focused research in specific regional contexts within Indonesia.

3. Result and Discussion

3.1 Administrative Challenges

3.1.1 National Water Supply and Sanitation Policy Inconsistencies

Indonesia's policies regarding drinking water and sanitation provisions have long passed and are basically grounded on Law No. 17 of 2019 [19] concerning Water Resources. The most recent National Drinking Water and Sanitation Policy followed in Indonesia was introduced through Presidential Regulation No. 37 of 2023 [20]. In Indonesia, there are a number of problems that lie ahead of them despite developments made in the provision of drinking water and sanitation. The policy making to progress with the drinking water and sanitation provision industry in Indonesia needs to be done deliberately and targeted through several factors, such as water resource availability, costs, climate change, and, more importantly, through community behavior.

Water and sanitation policies in Indonesia are not exactly ad hoc mechanisms that only emerge due to an event in emergency or international pressure [21]. It may be true that some sort of development policies and programs are crisis-induced or pressure-driven from externalities, but then again, there is a systematic and continuing effort by the government to work on the issues of water and sanitation. Indonesia is possessed of a relatively complete policy and regulation framework on water supply and sanitation, from laws and government regulations to a national strategy. The government has implemented some programs and initiatives to enhance access to clean water supplies and adequate sanitation supported by ministries on the matter in question. It shows government commitment towards the achievement of water supply and sanitation sustainability.

Some of the policies related to drinking water and post-independence sanitation issues are: the National Policy and Strategy for developing the Drinking Water Supply System – 2006 [22]; Law No. 26/2007 concerning Spatial Planning [23]; the Pamsimas Program of 2008 (Community Scale Drinking Water and Sanitation Provision) [24] and Law No. 36/2009 concerning Health [25]. It is important to note that such a policy document was prepared by different ministries in the government, for example, Ministry of Public Works and Housing, Ministry of Environment and Forestry, and Ministry of Health, in a way explaining the importance of integration and coordination, leaving space for conflicts of ideas, responsibilities, and policy directions. This is a view shared by Elysia [26] and Retnowati et al. [27] who reported that the content of most of the policy does not really differ much from the past regulation.

These goals have lately been focused on recent policies orientating to improve levels of service, maintain the quality of water while ensuring it is affordable, building national capacity, and encouraging participation by the private sector [28]. Realizing these goals has, however, been problematic. Unrealistic targets have often been set, driven largely by political considerations, and financial backing has often fallen short of requirements. Indeed, unrealistic targets, many a time politically driven, coupled with inadequate financial support, have been a constraint. The lack of a unified policy approach has made it difficult to prioritize investments, allocate resources effectively, and ensure coordinated action across different levels of government.

The situation is further complicated by an intricate web of policies and regulations that characterize the water sector. In most cases, these regulations are very inconsistent, overlap, and most of the time clear delineations of responsibility are absent. Such a fragmented legal framework may be a source of confusion, betterment, and inefficiencies in the planning, implementation, and management of water and sanitation supply projects. The other problem is the far-reaching impacts of the absence of coherent national policy. Efforts to reach full universal access to clean water and sanitation, with reductions in service provisioning, can be frustrated by this and prove to be adverse for the sector's sustainability as a whole.

3.1.2 Lack of Autonomy for Water Agencies

Regional water agencies also enjoy very limited autonomy, which exacerbates this problem. They normally lack adequate decision-making powers in such key areas as setting tariffs, choosing staff, and developing infrastructure [29] – [31]. Such interference by the government—often politically motivated rather than guided by good management principles—can result in policy inconsistency and financial instability.

Consequently, an inability to respond to increasing demands for water ensues, and the cumulative effect brings the service to a standstill. For example, in most agencies, water rates cannot be set at economically viable levels, generating inadequate revenue to cover the required maintenance and upgrading. This reduces their autonomy not only regarding the efficiency and effectiveness of the delivered water service but equally undermines accountability. If agencies are not given the power to make decisions based on needs and circumstances defined locally in their areas, they cannot be held liable for the quality of service provided or the financial performance.

3.1.3 Corruption

Corruption is one of key factors that weakens water supply in Indonesia; monies allocated to infrastructure maintenance and development are regularly siphoned off [32], [33]. This has led to frequent service disruptions and poor service quality. Reducing corruption is important to enhance the efficiency of water agencies and to ensure that resources allocated bring desired services towards them.

In Indonesia, corruption is still systemic, and this includes the water sector. Money is stolen through bribery, embezzlement, and other such corrupt activities that reduce funds for investment in infrastructure and its maintenance; this implies the general lowering of the quality and reliability of provided water services. Ultimately, this implies the general lowering of the quality and reliability of provided water services.

3.2 Technical Challenges

3.2.1 Aging Infrastructure and Inefficient Pipe Distribution Networks

Much of Indonesia's water infrastructure is old and has yet to undergo serious repairs or be replaced. Indeed, the pipes have grown old, pumping stations inefficient, and treatment works inadequate, resulting in loss of water and contamination besides unpredictable service [32], [34], [35]. Poor, deteriorating, and badly managed distribution networks directly affect the quality and quantity of water supplied to the consumer [36], [37].

Leaking pipes and lack of maintenance lead to an immense loss of precious treated water and equally allow contaminants' entry into the system [38], [39]. For example, studies done on Jakarta's water distribution network indicate that a reason unable to meet safety levels concerning coliform bacteria in a large number of water samples due to reasons/risks associated with their distribution network [40]. Addressing these infrastructure deficiencies is crucial for improving water supply reliability and safety.

3.2.2 Insufficient Power Supply

One major issue in Indonesia's water supply is the unreliable power supply. A number of water agencies require a constant power supply, as pumping and distribution must proceed without any hitch [28]. Continuous power outages disrupt these very vital operations, leading to an intermittent water supply, and higher operational costs related to backup generators.

To operate treatment plants and pumping stations, a reliable electricity supply is required. This is so common in most parts of Indonesia: power outages and fluctuations may easily affect the continuity of the supply and thus the quality of water produced [41]. Such instances not only are an inconvenience to consumers but also entail public health risks if there are interruptions to

treatment processes. Moreover, the financial load of running backup generators further burdens the water agency, reducing its capacity to make long-term investments in the improvement and expansion of water services.

3.3 Financial and Commercial Challenges

3.3.1 Poor Water Infrastructure Investment and Maintenance

The water sector in Indonesia epitomizes the result of chronic under-investment. Inadequate financial commitment to the water infrastructure and its maintenance consequence is low capacity utilization and coverage, hence inadequate supplies [28]. A huge disparity characterizes the demand for water and investment in water supply. There is an aged water facility in Indonesian cities that needs urgent modernization for capacity expansion to cope with increasing demand [30]. Inadequate funds to develop, maintain, and expand infrastructure form a major constraint to the water service providers in their quest to increase capacity so as to meet the ever-increasing demands for services. Underinvestment perpetuates—nay, worsens—the existing problems and constrains the sector from adapting to emerging challenges such as growth in population and climate change [42].

3.3.2 Water Pricing and Cost Recovery

The case of Indonesia illustrates a challenge that is utility-wide: how to set water tariffs at cost-recovery levels without making them unaffordable [30]. This is an equitably balanced struggle between the need for cost recovery and issues of affordability among low-income households. Inequitable pricing structures only underscore inequalities in access and make the services even less affordable, which puts poor populations at even greater disadvantage [43].

A number of water agencies cannot recover the cost of providing service. Of these, the share of the largest proportion lost is due to leakages or unbilled consumption, while the rest is due to low collection rates and weak billing systems [38]. Not only does this have a financial implication for every water agency, slowing its financial sustainability, but it is also linked with a cycle of underinvestment and corresponding poor service provision. These challenges, among others, would have to be addressed with tariff reform, improved infrastructure maintenance, and enhanced billing and collection mechanisms pertaining to services rendered.

3.3.3 Private-Public Partnership in Water Provision

This has increased the trend towards private providers of water in Indonesia. However, the quality of the provided water, including the cost, remains highly variable. Here, the question arises as to the equity and accessibility of the matter [44] – [46]. Much is expected to be a solution from strengthened public-private partnerships (PPPs), for they would demand the strengths of the two sectors while solving the respective limitations pertaining to each one. Successful collaborative projects, where private operators have contributed to infrastructure development and maintenance in Jakarta and Surabaya, can be cited as examples of what PPPs can bring if well-managed.

By combining the public sector's regulation overview and concern for social welfare with the efficiency and expertise of the private sector in managing its infrastructure, PPPs could be one way to enhance service delivery and broaden access to safe, affordable water [47], [48]. However, careful consideration of regulatory frameworks, transparency, and accountability is needed if PPPs are to benefit all parties and not exacerbate existing inequalities.

3.4 Case Studies

The above-described challenges are illustrated with brief case studies from three major Indonesian cities as follows:

1. Jakarta
The capital city faces enormous water scarcity, and this is coupled with a high population growth rate together with land subsidence and contamination of the available water sources. Due to inadequate city water infrastructure, most inhabitants turn to unsustainable extraction of groundwater, which further worsens land subsidence [49] – [51]. This over-reliance on groundwater exacerbates the city's environmental challenges and long-term water security.
2. Surabaya
Despite the fact that the conditions of access to water have been well improved by infrastructure investment and innovative management practices, the second-biggest city still has many challenges to its equitable access, especially for those living in informal settlements [52] – [54]. Ensuring fair access for all residents, particularly in underserved areas, remains a critical goal for Surabaya's water management. These informal settlements often face inadequate infrastructure and limited resources, making consistent water supply a significant hurdle.
3. Padang
Being on the coast of Sumatra, Padang faces peculiar challenges with regards to water due to predisposing factors of earthquakes and tsunamis, which can cause serious damage to water infrastructures and disrupt their services [55]. Topography in the city and limited intake of water in the treatment process also contribute to problems in the distribution of water, more specifically, to people residing in elevated areas. Water security enhancement efforts on Padang focus on disaster preparedness, resilience of the infrastructure, and quest for alternate supplies, such as rainwater harvesting and desalination [56]. These efforts are crucial to mitigating the impact of natural disasters on the city's water supply.

3.5 Potential Solutions

Such contending will require a multi-faceted strategy to address the complexities of Indonesian cities' public water provision, comprising the following:

1. Policy Reform
A more complete and integrated national water policy specific to urban areas is critically needed. Infrastructure spending must underpin such a policy with incentives for water conservation and equity in access across the city. This reform should aim to create a cohesive and effective framework for sustainable water management.
2. Empowering the Water Agencies
The role played by water agencies is in need of empowerment, in terms of enhancing their autonomy and increasing accountability with regard to efficiency and effectiveness in service delivery; restoration to them in powers of tariff setting, personnel management, infrastructure upgrading investment is another way. Granting greater autonomy will enable these agencies to respond more effectively to local needs and challenges.
3. Corruption Control
Indeed, the water sector is challenged by rampant corruption, and strict anti-corruption measures should thus be applied. This means developing a mechanism for transparency and accountability, ethics and ethical behavior, and prosecuting corrupt officials. Combating corruption is essential to ensuring that resources are utilized efficiently and benefit the public.
4. Infrastructure Investment
There is an extreme need to increase investments in water infrastructure to meet increasing demands for services related to water. This shall include the modernization of existing infrastructure, extending the same to unserved parts, and exploring innovative technologies that can be applied both underwater in treatment and distribution. Sustained and strategic investment is fundamental for improving the quality and reach of water services.
5. Optimizing Pricing and Cost Recovery

Any reform process should build equitable and sustainable pricing mechanisms that recover costs without putting low-income households at risk. This may include the introduction of tiered pricing structures, the development of efficient billing and collection systems, and the reduction of non-revenue water. Balancing affordability with financial sustainability is key to long-term success.

6. Strategic Private-Sector Engagement

This can mobilize additional private investment and expertise if the private sector is engaged in the water sector. However, this participation should be made in a transparent and accountable manner, aligned with broader public-interest objectives. Well-managed private-public partnerships can significantly contribute to bridging the water supply gap

4. Conclusion

The questions are administrative, technical, and financial that the urban public water sector in Indonesia poses to the continued service delivery. Improvement calls for an integrated policy; reduced corruption; the empowerment of the water agencies; ensured power availability; and motivated workers. Other stakeholders should include utilities, NGOs, and private companies. No less universal metering and fair pricing have to bring new policies in the front line, public-private partnership being encouraged to bridge the supply-demand gap among others. This might increase efficiency and effectiveness in providing public water. These solutions will ensure that Indonesia moves towards a situation in which safe, reliable, and affordable services will be available to all. For future research, it is recommended to conduct more localized case studies on the implementation and impact of proposed policy reforms and investment strategies in various Indonesian cities. Additionally, exploring the effectiveness of different community-based water management models and their potential for scaling up could provide valuable insights. Further investigation into sustainable financing mechanisms beyond traditional government funding and private sector engagement, such as green bonds or impact investing, would also be beneficial to address the chronic underinvestment in the sector.

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