



# Regulation of Community-Based Groundwater Management in Fulfillment of the Right to Clean Water

In'am Zaidi<sup>1</sup>

<sup>1</sup> Faculty of Law, Universitas Sebelas Maret, Surakarta, Indonesia  
inamzaidi@student.uns.ac.id

**Abstract.** This research aims to identify the existing conditions of groundwater management arrangements in Indonesia, as well as formulate ideal arrangements by comparing groundwater arrangements in Australia. The type of research used is normative legal research with primary and secondary legal materials. The results of this research show that: First, after the issuance of Law No. 17 of 2019 jo. Law No. 6 of 2023, Indonesia does not yet have special regulations related to planning, conservation, utilization and control of groundwater damage. This condition has caused water security not to be fully realized; several regions have been threatened with a water crisis with further impacts in the form of a decrease in groundwater levels, including groundwater in several areas prone to fecal contamination. Second, strengthening legal and institutional aspects needs to be done in the form of water management arrangements based on community participation. Participation here includes three elements, namely community access to information, community participation in decision-making and community access to justice. These three elements must be included in the regulation of groundwater in Indonesia so that it has binding legal force, and is responsive in resolving current and future groundwater governance issues.

**Keywords:** Water resources; groundwater; water security; community participation

## 1 Introduction

Limited groundwater and groundwater use that exceeds the threshold have accelerated the region's water crisis. A water crisis is a condition of imbalance between the availability of water in an area and the demand for water from the community. In a global context, groundwater is the main source of water most people use. UNESCO noted that almost half of the worldwide population uses groundwater as their main daily water source [1]. In fact, in sub-Saharan countries, the use of groundwater as a source of drinking water reaches almost 70 to 90 percent. [2].

Of the various countries in the world, Indonesia is one of the countries that uses a high percentage of groundwater, namely 46 percent [3]. This means that almost the population in Indonesia uses groundwater as the main source of water to fulfill their daily needs. In 2021, 33 percent of Indonesians used groundwater independently, with 28 percent in urban areas and 37 percent in rural areas [4]. The high percentage of groundwater use in Indonesia is a challenge in realizing water resilience. Resilience is the ability of a system to adapt to a changing environment without changing the

© The Author(s) 2024

D. B. Kharisma et al. (eds.), *Proceedings of the International Conference for Democracy and National Resilience (ICDNR 2024)*, Atlantis Highlights in Social Sciences, Education and Humanities 30,

[https://doi.org/10.2991/978-94-6463-634-5\\_4](https://doi.org/10.2991/978-94-6463-634-5_4)

system's operating system [5]. Water resilience is the ability of the system to increase the groundwater recharge process as part of maintaining the system balance [6].

Historically, groundwater regulation in Indonesia began during the Dutch era through *Staatsblad* 1871 and *Algemene Water Reglement* 1936. The latest regulation is contained in Law No. 17 of 2019 as amended by Law No. 6 of 2023. Although Indonesia already has legal instruments in water resources management, at the level of implementation, this law has not fully realized groundwater security. The imperfection of water security can be seen based on anthropic impacts on groundwater resources, both influenced by human activities. [7] and due to the impacts of climate change [8]. Both are factors that significantly affect the availability of ground resources. [9], [10], [11].

Research conducted [7] Note that 76.92 percent of land subsidence was caused by humans, of which 59.75 percent was due to groundwater extraction. The human activity factor is also closely related to the regulation of groundwater management in Indonesia, which is not yet oriented towards the principles of good governance. Research [12] Noted that the regulation of groundwater management in Indonesia has not fully emphasized aspects of transparency, accountability and community participation, so several areas of Indonesia have experienced land subsidence, such as DKI Jakarta. [13], [14].

Recognizing the negative impacts of excessive groundwater use, Indonesia needs to transition to wise water use as Australia has done. Australia has a legal framework that identifies the right of communities to participate in groundwater governance as set out in the Water Allocation Plan or WAP. The recognition of participatory rights in the WAP enables engagement between communities and government in any regulation of groundwater resources. By comparing water governance in other countries, it is hoped that we can emulate best practices to overcome current and future challenges in water management. The purpose of this article is to analyze how groundwater management is regulated in Indonesia after the issuance of Law No. 6 of 2023 and to find the ideal groundwater management regulation to achieve water security in Indonesia.

## 2 Method

This research is a normative-legal research with primary and secondary legal materials. Primary legal materials are obtained by literature study of laws and regulations and Indonesian government policies related to groundwater management. Secondary legal materials are sourced from scientific writings and institutional reports. The majority of scientific articles used as references in this writing are international scientific publications indexed by Scopus in the last 5 (five) years so as to provide the latest and relevant references. Data analysis in this study was conducted in three stages: Firstly, looking at the current groundwater management arrangements in Indonesia. The second stage is to compare groundwater management arrangements in Australia. The third stage is to formulate an ideal groundwater management arrangement in order to fulfill the community's right to clean water.

### **3 Discussion**

#### **3.1 Regulation of Groundwater in Indonesia**

In the context of the 1945 Constitution of the Republic of Indonesia, the regulation of water resources, including groundwater, is regulated based on Article 33 Paragraph (3) of the 1945 Constitution of the Republic of Indonesia, which grants the right to control water resources to the state with the aim of providing the greatest prosperity for the people. [15]. The state is positioned as a trustee that manages water resources because water is a public good with limited availability. The regulation of water resources has a positive relationship with Article 28 H Paragraph (1), namely the state's guarantee of a good and healthy environment for its citizens. [16], [17]. This is because the environment is a unified ecosystem that focuses not only on humans but also non-humans, such as water, land, air and other natural resources. [18].

Historically, the regulation of groundwater management in Indonesia began during the Dutch era through *Staatsblad* 1871 with derivative regulations in the form of the *Algemene Water Reglement* 1936. Groundwater regulation in this regulation is focused on early geological mapping in Indonesia. After Indonesia's independence, the regulation of groundwater management used Law No. 11 of 1974 with a derivative regulation of PP No. 22 of 1982 concerning Water Management. Both of these regulations focus on hydrogeological mapping, permits and underground water conservation. Due to the complex needs of water regulation, Law No. 11 of 1974 was amended with the enactment of Law No. 7 of 2004 with a derivative regulation in the form of PP No. 43 of 2008 on Groundwater. In this regulation, groundwater management is conducted based on Groundwater Basin (CAT). CAT is an area bounded by hydrogeological boundaries, including the place where all hydrogeological events in the form of groundwater recharge, flow and release take place. In its development, through Constitutional Court Decision No. 85/PUU-XI/2013, Law No. 7 Year 2004 was declared contrary to the 1945 Constitution and has no binding legal force. Therefore, to fill the legal vacuum in regulating water resources in Indonesia, Law No. 11 of 1974 was re-enacted.

In its development, the regulation of groundwater management is regulated in Law No. 23 of 2014 concerning Regional Government, CC Division of government affairs in the field of Energy and Mineral Resources Geological Sub Affairs, which gives authority to the central government and provincial governments. First, the authority of the Central Government includes the establishment of CAT establishment of groundwater conservation zones in CATs across provinces and countries. As for the authority of the provincial government, it is to establish groundwater conservation zones in CATs within the provincial area, issuance of drilling permits, groundwater excavation permits, groundwater use permits, and groundwater exploitation permits within the provincial area, and determination of groundwater acquisition value within the provincial area.

In addition, the government also enacted GR 121/2015 to implement the mandate of Article 11 of Law No. 11/1974, as well as to respond to Constitutional Court Decision No. 85/PUU-XI/2013. Under this regulation, permits for the exploitation of water resources and groundwater are held by the Central Government and Provincial Government. However, because the enactment of Law No. 11 Year 1974 was deemed

not in accordance with the times, the government then enacted Law No. 17 Year 2019 jo. Law No. 6 of 2023 is the legal basis for regulating water resources, including the regulation of groundwater management. In this Law, the main priority of water is used to fulfill domestic, irrigation and commercial needs. The parties in charge and authorized to regulate and manage water resources here are the central government and local governments.

Although Indonesia already has legal instruments for regulating water resources, until now the implementing regulations related to groundwater management have not been regulated in detail. Therefore, Government Regulation No. 121/2015 is still the reference in the exploitation of water resources, which authorizes the Ministry of Energy and Mineral Resources (ESDM) as an important factor in the implementation of groundwater use approval in Indonesia. This is in line with Presidential Regulation No. 97 of 2021 and the Joint Decree of the Minister of Energy and Mineral Resources, Minister of Public Works and Housing, and Minister of Investment/Head of the Investment Coordinating Board No. 225. K/GL.01/MEM.G/2022, No. 07/PKS/M/2022, Number 188 of 2022.

The implementation of groundwater use approval by the Ministry of Energy and Mineral Resources is aimed at maintaining the sustainability of groundwater by establishing standards for groundwater use approval as stated in the Decree of the Minister of Energy and Mineral Resources No. 291. K/GL.01/MEM.G/2023. That is the obligation for individuals, community groups, government agencies, legal entities or social institutions to have groundwater use approval when using groundwater for daily needs with a total of more than 100 cubic meters per month. Groundwater use approval is also applied to agriculture outside the irrigation system, water tourism for public interest or non-business activities, groundwater use for research activities or city parks, houses of worship, public facilities, social facilities, boreholes, and government agencies. The implementation of groundwater use approval that is not under the authority of the Central Government is regulated by the Regional Government.

In the context of groundwater quantity conservation, the regulation refers to the provisions of Law No.37 of 2014; for example, in order to improve the soil function on land, groundwater conservation buildings in the form of absorption wells are required. However, in the context of groundwater quality regulation in Indonesia, it has not been regulated explicitly and in detail. [14]. The current regulation of groundwater quality is limited to preventive efforts, for example, the use of Indonesian National Standard 2398:2017 on how to plan septic tanks with advanced treatment such as infiltration ponds. The regulation of groundwater quality has not been regulated in detail as the regulation of surface water quality in PP No. 22 of 2021 [14]. In addition, Indonesia is also faced with a legal vacuum regarding the regulation of groundwater planning, conservation, utilization and damage control. The consequences of the Constitutional Court's decision No. 85/PUU-XI/2013 led to the inapplicability of PP No. 43 of 2008 because it is a derivative regulation of Law No. 7 of 2004, which has been declared by the Constitutional Court to be contrary to the 1945 Constitution and has no binding legal force.

Responsibility for groundwater planning and conservation in Indonesia also remains problematic. This is because two different authorities manage the responsibility for groundwater conservation. Under Law No. 23/2014, groundwater planning and conservation are considered geological affairs, so the Geological Agency

under the Ministry of Energy and Mineral Resources is responsible for groundwater across provincial boundaries. The Dinas ESDM is the party responsible for groundwater management within provincial boundaries. In fact, Law No. 17 Year 2019 has eliminated the division of responsibilities from Law No. 23 Year 2014. Therefore, it is necessary to regulate who is responsible for groundwater in Indonesia [3].

### 3.2 Aspects of Water Security in Groundwater Management in Indonesia

In the Indonesian context, national water security has been regulated in Article 1 Point 5 of Presidential Regulation No. 37 of 2023 on the National Policy on Water Resources. Water security is the fulfillment of sustainable water needs. The indicator of water security is seen from the achievement of the Sustainable Development Goals (SDGs) and the Medium-Term Development Plan (RPJMN) target of 100 percent access to safe drinking water as stipulated in Article 4 paragraphs (1) and (2) of Presidential Regulation No. 37 of 2023. However, efforts to achieve 100 percent safe water are still constrained by the uneven availability of clean water in every region in Indonesia.

Several regions in Indonesia are threatened by the clean water crisis, namely Java, Bali and East Nusa Tenggara. [3]. The practice of massive groundwater use is one of the causes of several regions in Indonesia experiencing water scarcity. Water use in Indonesia is still dominated by groundwater at 46 percent, while only 9 percent use clean water companies (Danareksa Research Institute, 2023). Excessive groundwater use results in environmental risks in the form of decreased groundwater quality due to seawater intrusion (UNESCO, 2022), as well as the phenomenon of water shortages during the dry season [19].

Another impact of excessive groundwater use is land subsidence. For example, DKI Jakarta is one of the cities in the world that is experiencing the fastest land subsidence, with some areas in Jakarta sinking more than 4 meters and North Jakarta being the area with the highest land subsidence of 2.5 meters in the last ten years. [20]. The rate of land subsidence in other areas is mostly more than 1 cm per year, as shown in Figure 1.

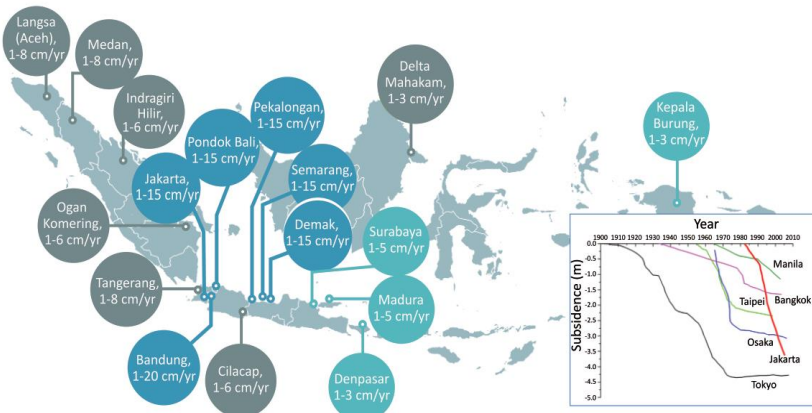


Fig. 1. Rate of Land Subsidence in Indonesia

The imperfection of water security is also evident in the uneven development of clean water infrastructure and the imbalance between urban and rural areas. Clean water services through the Regional Public Water Company (PDAM) only touch urban communities, while rural communities often use groundwater as a source of drinking independently. [21]. However, the independent use of groundwater is prone to microbial contamination. [22], so some people choose to subscribe to refill water as a source of drinking, which has an impact on increasing expenditure [21].

In addition, water security in Indonesia is faced with health risks because safe drinking water is not accessible to all levels of society. Well, water and boreholes are often contaminated with feces. [23], [24]. Therefore, regular monitoring is needed along with sanitation inspections so that all risks related to water can be managed properly. This monitoring can be done with the help of monitoring tools that not only focus on safety but also security, as in the study conducted by Charles. Charles dkk., (2020).

### **3.3 Groundwater Management Regulations in Australia**

The regulation of water resources management (surface water and groundwater) in Australia is set out in the National Water Initiative (NWI) of 2004 and the Water Act of 2007. The Australian Government pays attention to community participation in water resources management as stated in Paragraph 36 of the NWI. Paragraph 40 of the NWI also mandates the provision of regular public reports on progress in implementing water plans to assist governments and water users in managing risk.

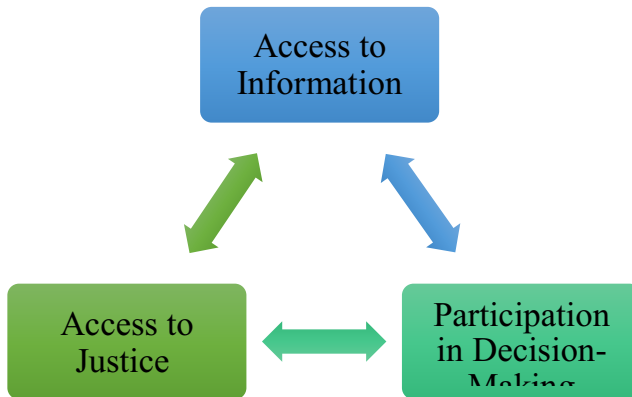
In the state of South Australia, for example, the government included the rights of communities to participate in groundwater management through the Natural Resources Management Act (NRMA) 2004. The South Australian government focuses on access to information and participation in decision-making. In the context of groundwater protection, the South Australian government provides funding for information provision through open community meetings. For example, the results of open discussions include irrigation initiatives such as metering, monitoring, annual reporting and revegetation in the Water Allocation Plan or WAP [26]. The success of participatory groundwater management in South Australia is not only due to the participatory policy and legal framework. In addition, other factors influence it, namely the phenomenon of the water crisis that has awakened the community, leadership that is able to mobilize the community, and involvement and funding from the government [26].

In the state of Western Australia, efforts to fulfill participatory rights are included in the Rights in Water and Irrigation Act (RWIA) of 1914, which provides access to information and participation in decision-making through the WAP. The Western Australian government has also invested substantial funds to facilitate the involvement in WAP development. However, Western Australia's WAP differs from South Australia's in that it is not based on legislation and, therefore, does not create legally binding obligations. [26].

### 3.4 Regulation of Groundwater Management in the Fulfillment of Community Right to Clean Water

Talking about water resources cannot be separated from justice. Justice issues arise when water resources are limited or access to water resources is restricted. [27]. Therefore, preventing injustice requires a regulation to manage water resources from allocation to distribution. In regulating water resources management, the problem that arises is the limited availability of water and unequal access to clean water services between urban and rural areas. Limited water resources are influenced by the increasing population, which has an impact on the use of more water. In addition, suboptimal water resources governance also accelerates the water crisis in certain areas, resulting in community injustice in terms of access to clean water. Often, the losers in water resources governance are powerless individuals or groups, as well as the environment.

Around the world, groundwater is the most widely used primary source for both domestic and industrial use. [28]. In addition, groundwater is a hidden resource, making the impacts of its use difficult to identify and evaluate. Ideal groundwater governance is challenging due to its interdependence with other systems. Of the various interdependent systems, legal and institutional aspects play an important role in the delivery of current and future groundwater management. Good laws and policies guarantee the recognition of people's rights to participate in groundwater management. Participation is the redistribution of power to all people so that they have the same opportunity to be part of a decision or policy-making process. [29]. Community participation in the regulation of groundwater management in Indonesia can be done with three key elements as applied in Australia, namely guaranteeing community access to information, community participation in decision-making and community access to justice. [26].



**Fig. 2.** Three Elements of Community-Based Groundwater Management Regulation

The first element, public access to information, must be done in order to realize the General Principles of Good Governance, namely transparency. The government should provide an integrated groundwater data and information network covering the entire territory of Indonesia. The aim is to serve as a tool in planning, managing and

supporting decision-making related to groundwater management. The government must be responsive to take corrective measures when groundwater use has a negative impact on the environment. This is because several regions in Indonesia are threatened with a water crisis due to the effects of excessive groundwater use, such as Java Bali and East Nusa Tenggara. [30], [3].

The second element is the existence of regulations that ensure community involvement in groundwater management decision-making. Existing rules should encourage consultation with local communities in any water resources planning. Consultation can be done by holding open meetings between communities and representatives so that a balance of interests can be achieved. In addition, community involvement in decision-making should also be based on awareness and knowledge of groundwater vulnerabilities, including the peculiarities of groundwater as an invisible resource and the natural recharge process that takes a long time. Considering this, the government should not only be an administrative regulator but also a key driver in inclusive and sustainable water management.

The third element is an arrangement that ensures people's access to justice, especially in relation to groundwater governance. Often, the lower strata of society become victims of massive groundwater utilization by the private sector. As a result, the availability of groundwater gradually decreases, and a water crisis occurs in the area. Such conditions need the government's attention in order to stop development that is not inclusive and sustainable. Community access to justice in groundwater utilization must be encouraged in order to realize the 2030 Sustainable Development Goals agenda.

## 4 Conclusions

Based on the discussion above, the author concludes two things: First, the regulation of groundwater in Indonesia is still problematic; although the licensing of groundwater use has begun to be regulated, the regulatory aspects of groundwater planning, conservation, utilization and damage control have not been strictly regulated. Groundwater regulation in Indonesia has not yet realized water security; several regions are experiencing a water crisis with further impacts in the form of a decline in groundwater levels, including groundwater in several areas prone to fecal contamination. Second, regulatory strengthening needs to be encouraged to accelerate the realization of water security, namely through water management arrangements based on community participation. Participation here includes three elements, namely community access to information, community participation in decision-making and community access to justice.

## References

- [1] UNESCO, *The United Nations World Water Development Report 2022: Groundwater: Making the Invisible Visible*. UNESCO, 2022.
- [2] J. Grönwall and K. Danert, 'Regarding Groundwater and Drinking Water Access through A Human Rights Lens: Self-Supply as A Norm', *Water*, vol. 12, no. 2, 2020, doi: 10.3390/w12020419.



- [3] Bappenas and World Bank Group, 'Indonesia Visi 2045 Menuju Ketahanan Air', Washington D.C., 2021.
- [4] T. Foster, C. Priadi, K. K. Kotra, M. Odagiri, E. C. Rand, and J. Willetts, 'Self-supplied drinking water in low- and middle-income countries in the Asia-Pacific', *npj Clean Water*, vol. 4, no. 1, p. 37, 2021, doi: 10.1038/s41545-021-00121-6.
- [5] F. Mao, J. Clark, T. Karpouzoglou, A. Dewulf, W. Buytaert, and D. Hannah, 'HESS Opinions: A conceptual framework for assessing socio-hydrological resilience under change', *Hydrology and Earth System Sciences*, vol. 21, no. 7, pp. 3655–3670, 2017, doi: 10.5194/hess-21-3655-2017.
- [6] N. Zeydalinejad, 'An overview of the methods for evaluating the resilience of groundwater systems', *MethodsX*, vol. 10, p. 102134, 2023, doi: 10.1016/j.mex.2023.102134.
- [7] M. Bagheri-Gavkosh *et al.*, 'Land subsidence: A global challenge', *Science of The Total Environment*, vol. 778, p. 146193, 2021, doi: 10.1016/j.scitotenv.2021.146193.
- [8] A. C. Amanambu *et al.*, 'Groundwater system and climate change: Present status and future considerations', *Journal of Hydrology*, vol. 589, p. 125163, 2020, doi: 10.1016/j.jhydrol.2020.125163.
- [9] B. S. Mapani, R. N. Shikangalah, and A. L. Mwetulundila, 'A review on water security and management under climate change conditions, Windhoek, Namibia', *Journal of African Earth Sciences*, vol. 197, p. 104749, 2023, doi: 10.1016/j.jafrearsci.2022.104749.
- [10] P. U. Dao *et al.*, 'The impacts of climate change on groundwater quality: A review', *Science of The Total Environment*, vol. 912, p. 169241, 2024, doi: 10.1016/j.scitotenv.2023.169241.
- [11] J. Senent-Aparicio, L. Peñafiel, F. J. Alcalá, P. Jimeno-Sáez, and J. Pérez-Sánchez, 'Climate change impacts on renewable groundwater resources in the andosol-dominated Andean highlands, Ecuador', *CATENA*, vol. 236, p. 107766, 2024, doi: 10.1016/j.catena.2023.107766.
- [12] P. H. Herlambang, Y. J. Utama, A. Putrijanti, and S. S. Prayogo, 'Land Subsidence Policy in the Context of Good Governance Principles (Comparing Indonesia and Japan)', *Lex Scientia Law Review*, vol. 7, no. 2, pp. 871 – 904, 2023, doi: 10.15294/lesrev.v7i2.75347.
- [13] R. Taftazani, S. Kazama, and S. Takizawa, 'Spatial Analysis of Groundwater Abstraction and Land Subsidence for Planning the Piped Water Supply in Jakarta, Indonesia', *Water*, vol. 14, no. 20, 2022, doi: 10.3390/w14203197.
- [14] C. R. Priadi *et al.*, 'Policy and regulatory context for self-supplied drinking water services in two cities in Indonesia: Priorities for managing risks', *Environmental Development*, vol. 49, p. 100940, 2024, doi: 10.1016/j.envdev.2023.100940.
- [15] S. A. Pramita, I. G. A. K. R. Handayani, and L. Karjoko, 'The Model Of Mineral And Coal (Minerba) Authority Arrangement In Realizing Ecological Justice', *Baltic Journal of Law & Politics*, vol. 15, no. 3, pp. 25–34, 2022.
- [16] L. Karjoko, I. G. A. K. R. Handayani, A. K. Jaelani, and M. J. Hayat, 'Indonesia's Sustainable Development Goals Resolving Waste Problem: Informal to Formal Policy', *International Journal of Sustainable Development and Planning*, vol. 17, no. 2, pp. 649–658, 2022, doi: 10.18280/ijspd.170230.
- [17] F. U. Najicha, I. G. A. K. R. Handayani, Hartiwiningsih, L. Karjoko, Waluyo, and R. N. Pramugar, 'The Construction of Law System in the Field of Environmental Governance in Realizing Justice and Green Legislation in Indonesia', *International Journal of Psychosocial Rehabilitation*, vol. 24, no. 7, pp. 8629–8638, 2020, doi: 10.37200/V24I7/19094.
- [18] J. A. Y. Wattimena, 'Pemenuhan Hak atas Air Bersih dan Sehat , Serta Hak Menggugat Masyarakat', *Balobe Law Journal*, vol. 1, no. 1, pp. 1–16, 2021.

- [19] N. Carrard, T. Foster, and J. Willetts, 'Groundwater as a Source of Drinking Water in Southeast Asia and the Pacific: A Multi-Country Review of Current Reliance and Resource Concerns', *Water*, vol. 11, no. 8, 2019, doi: 10.3390/w11081605.
- [20] USAID and SWP, *Indonesia Water Resources Profile Overview*. 2021.
- [21] C. R. Priadi *et al.*, 'A longitudinal study of multiple water source use in Bekasi, Indonesia: implications for monitoring safely-managed services', *Journal of Water, Sanitation and Hygiene for Development*, vol. 12, no. 11, pp. 770–781, 2022, doi: 10.2166/washdev.2022.049.
- [22] Ghaudenson, Rioneli, Priadi, Cindy Rianti, and Foster, Tim, 'Effectiveness of Groundwater Boiling as Household Water Treatment in Metro and Bekasi Cities, Indonesia', *E3S Web Conf.*, vol. 277, p. 4002, 2021, doi: 10.1051/e3sconf/202127704002.
- [23] F. Genter, J. Willetts, and T. Foster, 'Faecal contamination of groundwater self-supply in low- and middle income countries: Systematic review and meta-analysis', *Water Research*, vol. 201, p. 117350, 2021, doi: <https://doi.org/10.1016/j.watres.2021.117350>.
- [24] A. Cassivi, E. Tilley, E. O. D. Waygood, and C. Dorea, 'Household practices in accessing drinking water and post collection contamination: A seasonal cohort study in Malawi', *Water Research*, vol. 189, p. 116607, 2021, doi: <https://doi.org/10.1016/j.watres.2020.116607>.
- [25] K. J. Charles, S. Nowicki, and J. K. Bartram, 'A framework for monitoring the safety of water services: from measurements to security', *npj Clean Water*, vol. 3, no. 1, p. 36, 2020, doi: 10.1038/s41545-020-00083-1.
- [26] G. Cuadrado-Quesada and J. Gupta, 'Participation in groundwater governance – outlining a path to inclusive development', *Water Policy*, vol. 21, no. 5, pp. 1050–1064, Sep. 2019, doi: 10.2166/wp.2019.209.
- [27] M. J. Neal (Patrick), F. Greco, D. Connell, and J. Conrad, 'The Social-Environmental Justice of Groundwater Governance BT - Integrated Groundwater Management: Concepts, Approaches and Challenges', A. J. Jakeman, O. Barreteau, R. J. Hunt, J.-D. Rinaudo, and A. Ross, Eds. Cham: Springer International Publishing, 2016, pp. 253–272.
- [28] M. N. Fienen and M. Arshad, 'The International Scale of the Groundwater Issue BT - Integrated Groundwater Management: Concepts, Approaches and Challenges', A. J. Jakeman, O. Barreteau, R. J. Hunt, J.-D. Rinaudo, and A. Ross, Eds. Cham: Springer International Publishing, 2016, pp. 21–48.
- [29] S. R. Arnstein, 'A Ladder Of Citizen Participation', *Journal of the American Institute of Planners*, vol. 35, no. 4, pp. 216–224, Jul. 1969, doi: 10.1080/01944366908977225.
- [30] I. Zaidi and I. G. A. K. R. Handayani, 'Clean Water Crisis in Bali : An Analysis of Regional Policy in Realizing Ecological Justice-Based Water Security', 2024, doi: 10.2991/978-2-38476-218-7.

**Open Access** This chapter is licensed under the terms of the Creative Commons Attribution-NonCommercial 4.0 International License (<http://creativecommons.org/licenses/by-nc/4.0/>), which permits any noncommercial use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license and indicate if changes were made.

The images or other third party material in this chapter are included in the chapter's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the chapter's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder.

