The Role of Filtration Technology in Guaranteeing Citizens' Right to Health through the Provision of Clean Water

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Abstract: *Access to clean water remains a serious problem in various regions of Indonesia, despite the development of various technological innovations to improve water quality. Limited infrastructure, resources, and low public awareness of the importance of filtration technology are the main factors hindering the provision of potable water. This study uses a literature study method by analyzing various sources such as books, journals, and articles that discuss the issue of clean water access and the application of filtration technology in Indonesia. The results of the study indicate that most water sources in Indonesia are polluted by industrial, agricultural, and household waste, where 7 out of 10 households still consume water contaminated with Escherichia coli. The government, through various policies such as the PAMSIMAS and SPAM programs, is striving to expand access to clean water, in line with the targets of the 2024 RPJMN and the 2030 Sustainable Development Goals (SDGs). In addition, the application of filtration technologies such as biofiltration, reverse osmosis, ultrafiltration, slow sand filtration, and ultraviolet (UV) purification has proven effective in reducing harmful contaminants and improving drinking water quality.*

Keywords : *clean water, filtration technology, public health, right to water*

Abstrak: Akses terhadap air bersih masih menjadi permasalahan serius di berbagai wilayah Indonesia, meskipun berbagai inovasi teknologi telah dikembangkan untuk meningkatkan kualitas air. Keterbatasan infrastruktur, sumber daya, serta rendahnya kesadaran masyarakat terhadap pentingnya penggunaan teknologi filtrasi menjadi faktor utama yang menghambat penyediaan air layak konsumsi. Penelitian ini menggunakan metode studi literatur dengan menganalisis berbagai sumber seperti buku, jurnal, dan artikel yang membahas permasalahan akses air bersih serta penerapan teknologi filtrasi di Indonesia. Hasil kajian menunjukkan bahwa sebagian besar sumber air di Indonesia mengalami pencemaran akibat limbah industri, pertanian, dan rumah tangga, di mana 7 dari 10 rumah tangga masih mengonsumsi air terkontaminasi *Escherichia coli*. Pemerintah melalui berbagai kebijakan seperti program PAMSIMAS dan SPAM berupaya memperluas akses air bersih, sejalan dengan target RPJMN 2024 dan Tujuan Pembangunan Berkelanjutan (SDGs) 2030. Selain itu, penerapan teknologi filtrasi seperti biofiltrasi, *reverse osmosis*, ultrafiltrasi, filtrasi pasir lambat, dan pemurnian ultraviolet (UV) terbukti efektif dalam mengurangi kontaminan berbahaya serta meningkatkan kualitas air minum.

Kata kunci: air bersih, teknologi filtrasi, kesehatan masyarakat, hak atas air

Introduction

Water is a primary need for human life. Water quality is a primary concern for humans, as it affects human health (Gafur et al., 2022). The availability of clean water is linked to public health. The availability of clean, drinkable water helps prevent various diseases such as diarrhea, cholera, and skin infections. Therefore, the state has a crucial role in ensuring the availability of safe, drinkable water and its equitable distribution to every citizen. Fulfilling the right to clean water embodies the human right to life and health. Efforts to provide clean water equitably also reflect social justice and the government's responsibility to improve the welfare of the people.

However, with rapid population growth and global climate change, the availability of clean water is decreasing in various parts of the world. Consequently, many regions are experiencing water crises due to overexploitation, pollution of water resources, and a lack of adequate water management infrastructure.

Through technological innovation, these problems can be addressed. Today, many modern technologies are being developed to improve the supply of clean water, such as filtration technology, nanotechnology-based water purification, Internet of Things (IoT) sensors, and the implementation of smart water management systems. Filtration technology is one of the most widely implemented technological innovations. Filtration technology is a process of filtering water to separate solid particles and other harmful substances. This filtration technology not only improves water quality but also offers an alternative for areas with limited access to clean water sources.

Although many technological innovations have emerged as innovative solutions to improve water quality, the reality is that many areas in Indonesia still struggle to obtain potable water. This demonstrates that access to clean water remains an unresolved issue. This is due to limited resources and inadequate water management infrastructure. Furthermore, the problem is exacerbated by low public understanding of the importance of using filtration technology as a simple solution to filter contaminated water. Many people still rely on raw water without proper filtration, putting them at risk of various diseases. Meanwhile, the government also plays a crucial role in guaranteeing citizens' right to health. This issue presents a real challenge in realizing social justice and the basic right to health for all citizens.

This research aims to identify the role of filtration technology in providing clean water and supporting citizens' right to health. Furthermore, this research is expected to demonstrate that filtration technology directly contributes to fulfilling citizens' right to clean water, which in turn ensures public health.

Research Method

The method applied in this research is a literature study. A literature study is a research method that collects information and analyzes various written sources, such as books, journals, and articles, to compile this research journal. According to Zed (2014), literature research is a series of activities related to library data collection methods, reading and taking notes, and managing research materials.

Results and Discussion

Problems with Clean Water Access in Indonesia

The problem of access to clean water in Indonesia is a critical issue affecting various aspects of life, such as public health and social welfare. Clean water is not only a basic human need but also crucial for agriculture, industry, and the environment. Although Indonesia has abundant water resources such as rivers, lakes, and high rainfall, many areas still struggle to access clean water. Many rivers are polluted by industrial, agricultural, and household waste. According to 2019 data from the World Wide Fund for Nature (WWF) Indonesia, approximately 82% of the 550 rivers spread across Indonesia are in a polluted or critical condition.

In addition to availability, water quality is also a major issue. Many water sources are polluted by household, agricultural, and industrial waste. The Ministry of Health, through its 2020 Household Drinking Water Quality Study (SKAMRT), found that 7 out of 10 households in Indonesia consume water contaminated with Escherichia coli (E. coli) bacteria. The study also showed that 31% of households used refilled water, 15.9% used protected dug wells, and 14.1% used water from drilled wells or pumps. Overall, 93% of households have access to improved drinking water, but only 11.9% actually obtain safe drinking water. This unsafe water quality leads to increased diseases such as diarrhea, cholera, typhoid, and stunting in children.

According to data from the Indonesian Drinking Water Companies Association (PERPAMSI) in 2023, only around 19.47% of households in Indonesia have access to piped water. This situation is due to the continued significant gap in funding for clean water access across Indonesia. In the 2024 National Medium-Term Development Plan (RPJMN), the government set targets to achieve 100% access to safe drinking water, 15% access to safe drinking water, and 30% of households enjoying piped water services. Meanwhile, the 2030 Sustainable Development Goals (SDGs) aim for all people to have full access to safe, potable water (100%).

Efforts to Realize the Right to Health through the Provision of Clean Water

The right to clean water is closely linked to the right to good health, as poor water quality can lead to infectious diseases such as diarrhea, cholera, and typhoid. According to a World Health Organization (WHO) report, approximately 80% of diseases in developing countries originate from unsafe water and inadequate sanitation. In Indonesia, the right to clean water is protected by Law Number 36 of

2009, which covers health and states that the government is obliged to provide a healthy environment, including safe drinking water.

Ensuring that everyone has the right to clean water is also part of achieving the Sustainable Development Goals (SDGs), specifically Goal 6, which aims to ensure everyone has access to clean water and sustainable sanitation. So, providing clean water is not only something we should do because it's the right thing to do, but it's also the government's legal obligation to protect its citizens.

To demonstrate its commitment to this responsibility, the Indonesian government has developed various plans and programs to ensure communities have access to clean water. One important program is the PAMSIMAS (Community-Based Drinking Water and Sanitation) program, which began in 2008. This program focuses on community engagement, ensuring active participation in every step of the process—from planning and construction to management and maintenance of clean water and sanitation facilities. To date, PAMSIMAS has reached more than 27,000 villages across Indonesia and has become a crucial tool in providing clean water access to more people in rural and remote areas.

In addition to PAMSIMAS, the government also has a Drinking Water Supply System (SPAM) policy, regulated through Government Regulation Number 122 of 2015, which serves as the legal basis for national drinking water management. Through SPAM, the government aims to build a clean water distribution network managed by the Regional Drinking Water Company (PDAM) or by private companies through public-private partnerships (PPP). This policy is supported by the Special Allocation Fund (DAK) and Village Funds, which are used to build clean water facilities in underdeveloped, border, and remote areas. This approach demonstrates the government's dedication to incorporating clean water into the country's long-term development plan.

Private companies also play a significant role in helping more people gain access to clean water. Clean water in Indonesia. By working with the government and communities, these companies can help finance various needs, develop new technologies, and create better, more efficient, and sustainable water distribution systems. Therefore, various new technologies are being developed to address limited access to clean water. Some examples include affordable water filters, such as those using activated charcoal and silica sand, to make water safe for drinking; small desalination plants, used in island regions to convert seawater into freshwater; rainwater harvesting, which can be used as a supplemental water source for homes and agriculture in areas with frequent rainfall; and water quality monitoring systems that use digital sensors and the Internet of Things (IoT) to monitor water conditions in real time.

These new ideas are crucial to accelerating the achievement of the SDGs, particularly for clean water and toilets, and to improving the performance of the national water system. When the government, communities, and businesses work

together effectively, this will help ensure that everyone in Indonesia has the right to clean water that is both beneficial and sustainable.

The Role of Filtration Technology in Providing Clean Water

Various types of water contaminants can be found in the environment, ranging from bacteria and viruses, heavy metals, pesticides, and industrial chemicals. These pollutants can enter water sources through natural processes such as erosion and surface runoff, or through human activities, such as industrial waste disposal and the use of agricultural chemicals. For example, heavy metals like lead and mercury can contaminate water due to corrosion of old pipes or industrial discharges, while pesticides and agricultural fertilizers have the potential to leach into groundwater and degrade its quality.

Consuming contaminated water can cause various health problems, both short-term and long-term. In the short term, the effects often appear in the form of gastrointestinal illnesses such as diarrhea and vomiting, which are usually caused by E. coli bacteria or norovirus. Meanwhile, prolonged exposure to heavy metals and industrial chemicals can lead to more severe health consequences, such as nervous system disorders, stunted growth and development in children, and chronic diseases including cancer. Vulnerable groups, such as children, pregnant women, and individuals with weakened immune systems, are at higher risk and therefore need to pay serious attention to the quality of the water they consume.

Filtration technology plays a crucial role in providing clean water by filtering out various water contaminants, resulting in water that is safe for consumption and reuse. Methods such as biofiltration, reverse osmosis, ultrafiltration, slow sand filtration, and ultraviolet (UV) purification are used to remove particles, microorganisms, and harmful chemicals from water. Biofiltration is a biological filtration method in which water or air is passed through a porous medium (such as sand, gravel, activated charcoal, or synthetic materials) inhabited by microorganisms. These microbes decompose organic matter, chemical compounds, and pollutants contained in the water or air.

Reverse osmosis (RO) is a water purification process using a semipermeable membrane. The purpose of this process is to remove various particles, ions, bacteria, organic compounds, dissolved salts, and other undesirable molecules from water. The RO process is also used to reduce mineral levels in water. Ultrafiltration is a water filtration technology that uses a membrane with very small pores to separate particles, colloids, microorganisms, and macromolecules from water. This membrane is semipermeable, allowing only water and a few small dissolved molecules to pass through, while larger particles are retained.

Slow sand filtration (SSF) is a simple and environmentally friendly water purification method that filters suspended particles, dirt, and microorganisms from water. This process uses a layer of fine sand as the primary filter medium, where the biological activity of microorganisms helps purify the water.

Ultraviolet (UV) water purifiers work by utilizing UV light to kill bacteria, viruses, and other microorganisms in water without changing its taste or chemical composition. UV light penetrates the cells of microorganisms and damages their DNA, preventing them from multiplying. This method is highly effective for water disinfection and is often combined with other filtration systems for more comprehensive water treatment. However, UV cannot remove chemicals or dissolved solids, so It is not optimally used as part of a multi-stage filtration process.

The use of water filtration systems has been proven to reduce the health risks arising from consuming contaminated water. Various studies have shown that filtration systems can remove harmful pollutants, thereby reducing the incidence of waterborne diseases and other health problems. For example, reverse osmosis (RO) systems are effective in removing heavy metals and dissolved salts, while UV-based purifiers can kill bacteria and viruses. Therefore, the application of filtration technology not only protects public health from waterborne diseases but also supports the fulfillment of citizens' right to health. Providing clean water through an effective filtration system is a strategic step in ensuring equitable access to safe water, reducing the risk of disease, and improving the quality of life for the community. Therefore, the application of filtration technology not only protects public health from waterborne diseases but also supports the fulfillment of citizens' right to health. Furthermore, public participation in monitoring the implementation of clean water provision is crucial for optimal public services in the field of environmental health. Forms of citizen participation in monitoring public services can be carried out by providing input, reports, evaluations of the implementation of public service standards, monitoring the implementation of policies, monitoring improvements to public services, and socialization (Chotimah & Affandi, 2018).

Conclusion

Filtration technology also plays a crucial role in ensuring citizens have access to safe and clean water. The use of technologies such as biofiltration, reverse osmosis (RO), ultrafiltration, slow sand filtration, and ultraviolet (UV) water purifiers to remove harmful biological and chemical contaminants from water has been driven by growing concerns about water pollution caused by industrial activities, agriculture, and domestic waste. The quality of life has improved as a result of the use of these technologies, which also reduce the risk of waterborne diseases. However, the implementation of filtration technology depends on government support in terms of policy, infrastructure, and other aspects.

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