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# Risk management: Clean water crisis mitigation efforts in Indonesia with rain water harvesting and reverse osmosis innovations

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## ABSTRACT

**Latar Belakang:** Water is an important component for living things on earth, so water cannot be separated from human life. This is because the human component consists of 70% water in it. The increase in population and polluted water sources has caused humans to experience a clean water crisis, thereby hampering human socioeconomic life on earth. **Findings:** Considering that Indonesia has a fairly high rainfall, namely 2,702 mm<sup>3</sup> per year, and has polluted water sources and a large sea area, the innovative idea of using rainwater harvesting and reverse osmosis is a solution to overcome problems and be able to overcome the risk of a clean water crisis in the future. **front.** Discussing the clean water crisis in Indonesia, the area that has this problem is one of the DKI Jakarta areas, namely, Muara Angke, Pluit, and North Jakarta. **Methods:** In writing this idea, systematic literature reviews and article reviews were used. The systematic method of the literature review is collecting metadata obtained according to the journal database via <https://scholar.google.com/> and visualizing it using VOSviewer. This is intended to show research trends regarding clean water technology. **Conclusion:** Three blocks have a water shortage crisis, namely the Waste Block, the Eceng Block, and the Empang Block. The scarcity of clean water in this area is caused by illegal land issues which makes it difficult to obtain permits for piping systems from the PDAM and the contamination of springs due to the influence of geographical location. The implementation of this technology is considered quite simple in the community so it can be a solution to the clean water crisis problem. Of course, the treated water is expected to meet the parameters of clean water, namely the Ministry of Health Regulation Number 32 of 2017 concerning sanitation water and the Ministry of Health Regulation Number 492 of 2010 concerning drinking water quality standards. So that the water can be utilized by the people of Indonesia.

**KEYWORDS:** clean water crisis; muara angke; rainwater harvesting; reverse osmosis; water.

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## 1. Introduction

Water is an important component for continuing life on earth, without water there will be no life on this planet. Humans as the living things that live on earth, cannot be separated from the water. This is because the components of the human body itself consist of 70% water in it (Ambarwati, 2022). Apart from being consumed by humans, water itself has the function to support various human activities such as cooking, washing, bathing, and even

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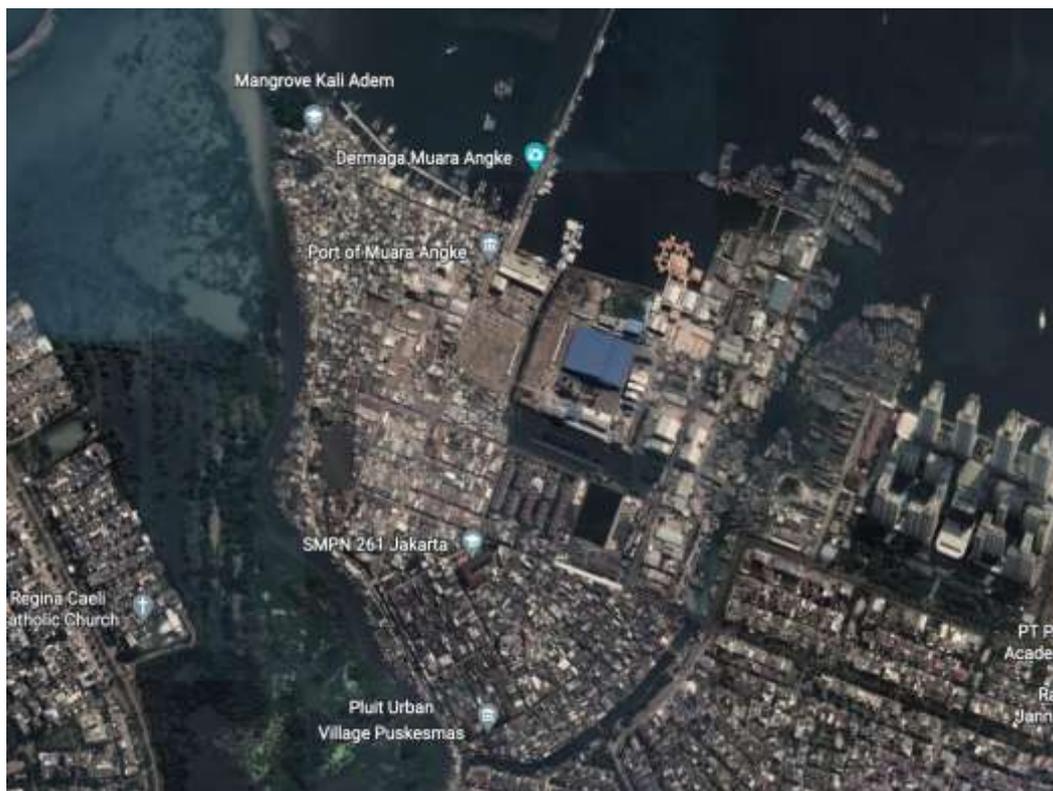


supporting activities that can improve the human economy (Ambarwati, 2022). These activities cover the agricultural, livestock, textile, and other industrial sectors.

Then, discussing water is very important to discuss the availability of water so that it can be used by all people. Abundant water availability will affect the welfare of the people in that area. However, in Indonesia, the availability of clean water with sanitation tends to be low, namely only around 7% in 2020. Of course, this figure is still relatively low compared to countries such as Thailand and India where the percentage of sanitation in these countries reaches 26% and 46% (Ambarwati, 2022). Whereas the availability of clean water is very important for people's lives. This greatly affects the sustainability of life and the health conditions of the local community.

The problem of the availability of clean water in Indonesia is caused by several factors, such as an increase in population growth. For Indonesia, based on the results of the population census conducted by the Indonesian Central Bureau of Statistics in 2020, the total population of Indonesia is 270.20 million, which has increased by 32.56 million since the last census in 2010 (Ambarwati, 2022). In addition to population growth, other problems behind the clean water crisis are excessive use of groundwater sources, polluted water sources, and the legality of land, making it difficult to access pipes from drinking water companies (Envihsa, 2022).

Even though the Law of the Republic of Indonesia Number 17 of 2019 Article 6 states "The state guarantees the people's right to water to meet minimum daily basic needs for a healthy and clean life in sufficient quantity, good quality, safe, sustainable, and affordable." (Envihsa, 2022). In addition, the 1945 Constitution (UUD) article 33 paragraph 3 states that "the land, water and natural resources contained therein are controlled by the state and used for the greatest prosperity of the people" (Alihar, 2018).



(Figure 1. Muara angke area at google earth)

Discussing the clean water crisis in Indonesia, the area that has this problem is one of the DKI Jakarta areas, namely, Muara Angke, Pluit, North Jakarta ( $6^{\circ}6'21''S$ ,  $106^{\circ}46'29.8''E$ ). Three blocks have a water shortage crisis, namely the Waste Block, the Eceng Block, and the Empang Block. The condition of scarcity of clean water in this area is caused by illegal land issues which makes it difficult to obtain permits for the pipeline system from the PDAM.

Then, considering the geographical conditions of Muara Angke which is in a coastal area where there is a meeting between the river and the sea which makes the water brackish. In addition, due to the misuse of natural resources, the water in the Muara Angke area has become polluted and unfit for consumption. So people are forced to buy clean water supplies from water carts with prices that vary, starting from Rp. 5,000 to Rp. 7,000 per 40 liters of water (Ambarwati, 2022).

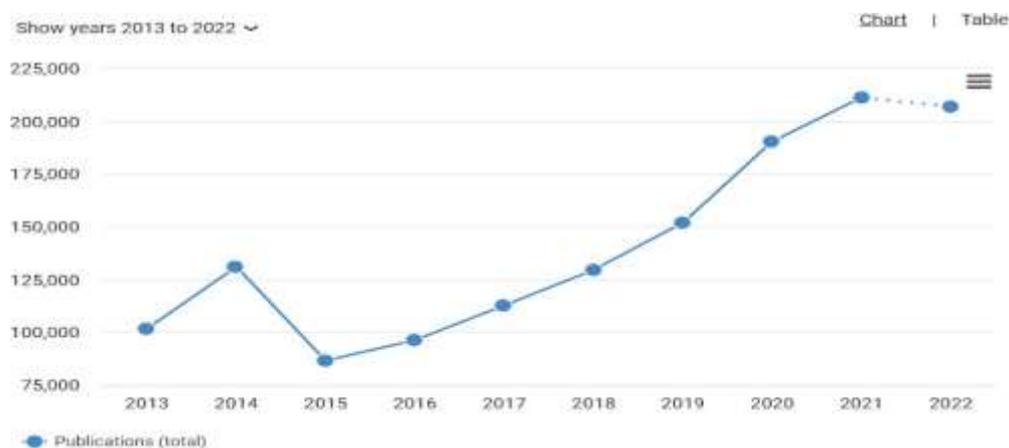


(Figure 2. Sustainable development goals, 2030)

Therefore, technology and innovation are needed that can be a solution to overcome these problems and can be applied by the community and assisted by the government. The technology in question is Rainwater Harvesting and Reverse Osmosis. The selection of these innovations is considered to be able to support several goals of the 2030 Sustainable Development Goals. The availability of clean water supports SDGs 2030 goal number 3, namely, good health and well-being, number 6, namely, access to clean water and sanitation, number 7, namely clean and affordable energy, number 11 namely, us and sustainable communities, and number 15, protecting terrestrial ecosystems (Envihsa, 2022).

## 2. Methods

In writing this idea, systematic literature reviews and article reviews were used. The systematic method of the literature review is collecting metadata obtained according to the journal database via <https://scholar.google.com/> and visualizing it using VOSviewer. This is intended to show research trends regarding clean water technology.



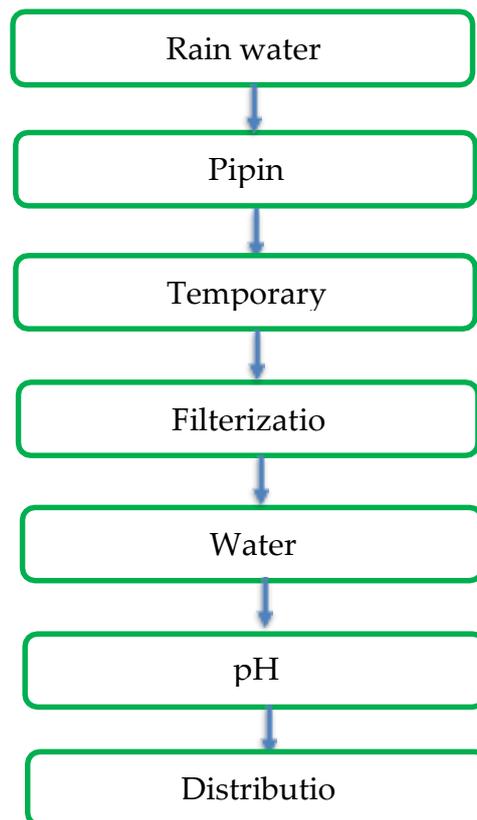
(Graph 1. Analysis of trends of topic clean water technology)

Based on observations made by the VOSviewer application, the topic of clean water technology will still be a topic of much research. This can be seen in the graphical images showing the years 2013-2022 research on clean water technology. Trends in this research will continue to increase in 2015-2021 worldwide. Research data on clean water technology as of December 2022 has reached 206,971 publications, which will continue to increase until the end of 2022 and is predicted to exceed research figures from 2021, namely 211,315. Thus, this topic continues to be the focus of future research, and from these results, the concept "Risk Management: Clean Water Crisis Mitigation Efforts in Indonesia With Rain Water Harvesting and Reverse Osmosis Innovations" was chosen to be raised.

### 3. Result and Discussion

#### 3.1 Rain Water Harvesting

Rainwater harvesting is an innovative concept that utilizes rainwater by collecting rainwater in a tub which is then used as an alternative source of water for the community to meet their needs (Littaqwa et al., 2021). The choice of the rainwater harvesting concept is based on Indonesia's tropical climate which has a rainfall of 2,702 mm<sup>3</sup> per year (Littaqwa et al., 2021). In addition, the concept of rainwater harvesting was chosen because of its simple application and can be implemented by the community. The following diagram shows the process of processing rainwater into clean water.



(Figure 3. Flowchart of the concept of implementing rain water harvesting)

The water treatment is carried out to fulfil existing parameters according to the existing Ministry of Health, namely Ministry of Health Regulation Number 32 of 2017 concerning sanitation water (Ambarwati, 2022) and Ministry of Health Regulation Number 492 of 2010 concerning drinking water quality standards. So that the water can be utilized by the people of Indonesia (Envihsa, 2022).

### 3.2 Reverse Osmosis

Nature certainly has provided a supply of water for humans, but not all water is suitable for human consumption. This is due to the presence of harmful pollutants or contamination due to water pollution. Recently, the Indonesian virtual world was shocked by the news that around 70% of water in Indonesia has been contaminated by fecal contamination (Littaqwa et al., 2021). If this continues, people who continue to consume this water will experience diseases caused by bacteria contained in the water (Ambarwati, 2022). For this reason, reverse osmosis technology can be a solution to solve this problem.

Reverse osmosis is a filtering method that can filter various large pollutants and ions from water by putting pressure on the water when the water is on one side of the filter membrane (Chairunnisa et al., 2021). Reverse osmosis works by using a high pump pressure to increase the pressure on the pollutant-containing side so that water is forced to pass through a semi-permeable membrane, a reverse osmosis membrane can separate almost all dissolved pollutants from almost all of the water (about 95% to 99%). Furthermore, water that has gone through a reverse osmosis process is called permeate, which is water that contains very few contaminants (Akbar et al., 2020). Next, the working mechanism of reverse osmosis will be explained through the following flow chart.



(Figure 4, Reverse osmosis process)

## 4. Conclusion

Water is a very important need for living things on a earth. Apart from being consumed, water is used for daily needs, water is also utilized for the socio-economic needs of the community. Due to the increase in population, the need for water it is increasing, and the a condition of the water, which is a heavily polluted, has created a crisis for the need for clean water. For this reason, using the rainwater harvesting method and processing polluted water into clean water using reverse osmosis technology is also planned. Which aims to meet the needs for clean water in which the sad water standard can meet the parameters of clean water quality standards for sanitation and drinking water following the regulations of the Ministry of Health of the Republic of Indonesia.

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## Ethical Review Board Statement

Not applicable.

## Informed Consent Statement

Not applicable.

## Data Availability Statement

Not applicable.

## Conflicts of Interest

The author declare no conflict of interest.

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## References

- Akbar, D. R., Kuspambudijaya, A. D., and Utami, I. "Deminalisasi Air Ac Dengan Membrane Reverse Osmosis," *J. Tek. Kim.*, vol. 15, no. 1, pp. 28–33, 2020, [https://doi.org/10.33005/jurnal\\_tekkim.v15i1.2300](https://doi.org/10.33005/jurnal_tekkim.v15i1.2300).
- Alihar, F. "Penduduk dan Akses Air Bersih di...| Fadjri Alihar PENDUDUK DAN AKSES AIR BERSIH DI KOTA SEMARANG (POPULATION AND ACCESS TO CLEAN WATER IN SEMARANG CITY)," *J. Kependud. Indones.* |, vol. 13, no. Juni, pp. 67–76, 2018.
- Ambarwati, R.D. "Air bagi Kehidupan Manusia." <https://www.studocu.com/id/document/universitas-riau/pengantar-ekonomi/1-2-artikel-air-bersih-rda-editor/45614237>
- Badan Pusat Statistik. <https://www.bps.go.id/pressrelease/2021/01/21/1854/hasil-sensus-penduduk-2020.html> (accessed Dec. 03, 2022).
- BERANDA |. <https://sdgs.bappenas.go.id/> (accessed Dec. 19, 2022).
- Chairunissa, A. A., Prasetyo, D. and Mulyadi, E. "Pembuatan Air Demineral Menggunakan Membran Reverse Osmosis (Ro) Dengan Pengaruh Debit Dan Tekanan," *J. Tek. Kim.*, vol. 15, no. 2, pp. 66–72, 2021. [https://doi.org/10.33005/jurnal\\_tekkim.v15i2.2544](https://doi.org/10.33005/jurnal_tekkim.v15i2.2544).
- Clean water tec... in Publications - Dimensions. [https://app.dimensions.ai/discover/publication?search\\_mode=content&search\\_text=e-anwatertechnology&search\\_type=kws&search\\_field=full\\_search](https://app.dimensions.ai/discover/publication?search_mode=content&search_text=e-anwatertechnology&search_type=kws&search_field=full_search) (accessed Dec. 19, 2022).
- Dampak Konsumsi Air yang Tercemar bagi Tubuh, Perhatikan Standar Kualitas Air Bersih | merdeka.com. <https://www.merdeka.com/sumut/15-dampak-konsumsi-air-yang-tercemar-bagi-tubuh-jika-dikonsumsi-terus-menerus-klm.html> (accessed Dec. 19, 2022).
- Google Earth. <https://www.google.co.id/intl/id/earth/> (accessed Dec. 19, 2022).

- Krisis Air Bersih – Envihsa FKM UI 2022. <https://envihsa.fkm.ui.ac.id/2021/09/30/krisis-air-bersih/> (accessed Dec. 19, 2022).
- Littaqwa, L. A. A., De Side, G. N., and Azmiyati, U. "Rain Water Harvesting Sebagai Alternatif Pemenuhan Kebutuhan Air Bersih," *Indones. J. Eng.*, vol. 2, no. 1, pp. 52– 64, 2021.
- Manfaat Minum Air Bagi Tubuh Kita. <https://www.djkn.kemken.go.id/kanwil-jateng/baca-artikel/15163/Manfaat-Minum-Air-Bagi-Tubuh-Kita.html> (accessed Dec. 19, 2022).
- 10 Negara Ini Miliki Curah Hujan Tertinggi di Dunia, Ada Indonesia? <https://databoks.katadata.co.id/datapublish/2022/03/24/10-negara-ini-miliki-curahhujan-tertinggi-di-dunia-ada-indonesia> (accessed Dec. 03, 2022).
- 40 Tahun Krisis Air Bersih, Warga Muara Angke Tagih Janji Anies! <https://news.detik.com/berita/d-5955536/40-tahun-krisis-air-bersih-warga-muaraangke-tagih-janji-anies> (accessed Dec. 03, 2022).
- Permenkes No. 32 Tahun 2017 tentang Standar Baku Mutu Kesehatan Lingkungan dan Persyaratan Kesehatan Air Untuk Keperluan Higiene Sanitasi, Kolam Renang, Solus Per Aqua, dan Pemandian Umum [JDIH BPK RI]. <https://peraturan.bpk.go.id/Home/Details/112092/permenkes-no-32-tahun-2017> (accessed Dec. 19, 2022).
- Permenkes 492 Tahun 2010 Persyaratan Kualitas Air Minum - KESEHATAN LINGKUNGAN. <https://www.kesehatanlingkungan.com/2019/01/permenkes-492-tahun-2010-persyaratan.html> (accessed Dec. 19, 2022).
- 70 Persen Air Indonesia Tercemar Tinja? Ini Penjelasan Pakar Unair." <https://www.detik.com/edu/detikpedia/d-6381238/70-persen-air-indonesiatercemar-tinja-ini-penjelasan-pakar-unair> (accessed Dec. 19, 2022).
- Ragetisvara, A. A., Titah, H. S. "Studi Kemampuan Desalinasi Air Laut Menggunakan Sistem Sea Water Reverse Osmosis (SWRO) pada Kapal Pesiar," *J. Tek. ITS*, vol. 10, no. 2, 2021. <https://doi.org/10.12962/j23373539.v10i2.63933>
- Teknologi dan Krisis Air – Pusat Studi Lingkungan Hidup UGM." <https://pslh.ugm.ac.id/teknologi-dan-krisis-air/> (accessed Dec. 19, 2022).
- UU No. 17 Tahun 2019 tentang Sumber Daya Air [JDIH BPK RI]. <https://peraturan.bpk.go.id/Home/Details/122742/uu-no-17-tahun-2019> (accessed Dec. 19, 2022).

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