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THE POTENTIAL UTILIZATION OF RAINWATER AS A RESERVE SOURCE FOR ABLUTION AMONG MADRASAH STUDENTS IN MEDAN CITY: AN ECOTHEOLOGICAL AND ENVIRONMENTAL RESILIENCE PERSPECTIVE

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ABSTRAK

Krisis air bersih merupakan permasalahan global yang juga dialami oleh Indonesia akibat peningkatan populasi, urbanisasi, serta penurunan daya dukung lingkungan. Di Kota Medan, meskipun curah hujan relatif tinggi, potensi air hujan belum dimanfaatkan secara optimal, termasuk di lingkungan madrasah. Penelitian ini bertujuan untuk menganalisis potensi pemanfaatan air hujan sebagai air cadangan untuk berwudhu bagi peserta didik madrasah dalam perspektif ekoteologi dan ketahanan lingkungan. Metode yang digunakan adalah pendekatan campuran (mixed methods) dengan analisis kualitatif melalui kajian literatur teologis dan ekoteologis, serta analisis kuantitatif terhadap potensi volume air hujan berdasarkan luas atap madrasah. Data curah hujan diperoleh dari BMKG (2024) dengan rerata tahunan sebesar 3.320 mm. Hasil perhitungan menunjukkan bahwa tiga Madrasah Aliyah Negeri di Kota Medan (MAN 1, MAN 2 Model, dan MAN 3) memiliki potensi penampungan air hujan antara 1,9 hingga 8,8 juta liter per tahun, mampu memenuhi kebutuhan air wudhu harian peserta didik hingga lebih dari 100%. Secara teologis, air hujan dipandang sebagai karunia dan amanah Tuhan yang suci dan mensucikan, sehingga pemanfaatannya untuk berwudhu memiliki nilai spiritual sekaligus ekologis. Dari perspektif ekoteologi, praktik ini mengajarkan keseimbangan antara manusia, alam, dan Tuhan, sedangkan dari sisi ketahanan lingkungan, pemanenan air hujan berkontribusi dalam konservasi sumber daya air dan pengurangan eksploitasi air tanah. Dengan demikian, integrasi nilai-nilai ekoteologi dalam praktik konservasi air di madrasah dapat memperkuat ketahanan lingkungan sekaligus membentuk karakter religius-ekologis peserta didik.

Kata kunci: *air hujan, wudhu, ekoteologi, ketahanan lingkungan, madrasah*

ABSTRACT

The clean water crisis is a global issue that also affects Indonesia, driven by rapid population growth, urbanization, and environmental degradation. In Medan City, despite its relatively high annual rainfall, the potential of rainwater has not been optimally utilized, including within Islamic educational institutions. This study aims to analyze the potential use of rainwater as a supplementary source for ablution (wudhu) among madrasa students from the perspectives of ecotheology and environmental resilience. A mixed-methods approach was employed, combining qualitative analysis through theological and ecotheological literature reviews with quantitative analysis of rainwater volume potential based on school roof areas. Rainfall data from the Meteorology, Climatology, and Geophysics Agency (BMKG, 2024) indicate an annual average of 3,320 mm. The results show that three Islamic senior high schools in Medan City (MAN 1, MAN 2 Model, and MAN 3) have rainwater harvesting potential ranging from 1.9 to 8.8 million liters per year sufficient to meet more than 100%

of their daily ablution water needs. Theologically, rainwater is regarded as a divine blessing both pure and purifying so its use for ablution carries spiritual as well as ecological significance. From an ecotheological perspective, this practice reflects harmony between humans, nature, and God, while from an environmental resilience standpoint, rainwater harvesting contributes to water conservation and reduces groundwater exploitation. Therefore, integrating ecotheological values into water conservation practices in madrasas not only strengthens environmental resilience but also cultivates students' ecological awareness and spiritual responsibility.

Keywords: *rainwater, ablution, ecotheology, environmental resilience, madrasah*

INTRODUCTION

The amount of water on Earth is abundant. In the other hand, the availability of clean water sufficient to meet human needs, resulting in many people suffering from water scarcity. This shortage is triggered by increasing demand due to population growth, unequal water distribution, rising water pollution, inefficient water use, and deforestation or land conversion that reduces the role of forests as natural water reservoirs.

The availability of clean water for domestic needs plays a central role in human life. In Indonesia, rainwater is often wasted, even though its potential use is significant in reducing groundwater extraction for daily activities. Rainwater can be utilized directly or through simple treatment processes to make it suitable for human use.

In the context of human life, water is not only required for biological needs such as drinking and hygiene but also has a spiritual dimension, especially in Islamic teachings. One of the uses of water in religious practice is for *wudhu* (ablution), which is a prerequisite for performing *shalat* (prayer) (Ministry of Religious Affairs of the Republic of Indonesia, 2010). However, amidst growing pressure on water resources caused by urbanization, climate change, and environmental degradation, the availability of clean water in many urban areas—including Medan City has become increasingly limited (Central Bureau of Statistics of Medan City, 2023).

One potential alternative solution is the utilization of rainwater as a reserve water source. Medan City experiences relatively high rainfall throughout the year, with an annual average exceeding 2,000 mm (BMKG, 2024). This total rainfall presents a considerable opportunity to implement a rainwater harvesting system. By using simple and environmentally friendly technology, rainwater can be collected, filtered, and utilized for non-consumptive purposes such as washing, watering plants, and especially as a reserve source for *wudhu* within madrasah environments (Sari & Hidayat, 2021).

The utilization of rainwater is not only a practical solution to the shortage of clean water but also reflects the values of Islamic ecotheology, which emphasizes the balance between humans and nature as an

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expression of obedience to Allah SWT (Nasr, 1996). Rainwater is also believed by some communities to possess purifying and healing properties, making it suitable for spiritual practices such as *ruqyah* and *wudhu*.

Muslims are obliged to perform prayers five times a day, and each prayer requires *wudhu* using pure and purifying water. Rainwater falls under this category. Each madrasah has relatively similar school hours across levels. Generally, *Madrasah Ibtidaiyah* students perform *Dhuhr* prayers, while *Madrasah Tsanawiyah* and *Madrasah Aliyah* students also perform *Asr* prayers in congregation. In Islamic boarding schools (*pesantren*), students perform all five daily prayers within the school environment. Therefore, it is essential to allocate and manage water resources effectively and efficiently—whether sourced from the ground or from rainwater—to support ablution practices. Consequently, it is important to view water not only from a utilitarian perspective but also through a spiritual–ecological (ecotheological) lens.

Based on the issues described above, the research question of this study is as follows:

"*How can the potential of rainwater as a reserve water source be optimized through an ecotheological perspective to support environmental resilience?*"

Therefore, the aim of this research is to determine the potential sources of rainwater that can be used for ablution which can replace the use of groundwater.

Theoretical Framework

1. Water in Theological Perspective

Water plays a role in life not only from a social perspective but also within the realm of religion. In Islam, water is strongly associated with purification rituals (*taharah*), including *wudhu* (ablution), *istinja'* (cleansing after defecation), bathing the deceased, ritual baths after menstruation or postpartum bleeding, and purification of clothes or areas contaminated by *najis* (impurities) or *hadath* (states of ritual impurity). The Qur'an contains numerous verses that discuss water; the word *al-ma'* (water) appears at least 63 times (Amiruddin, 2019). Many *hadiths* also emphasize the importance of water conservation, the etiquette of water use, and warnings against wastefulness.

In Christianity, water holds deep symbolic significance in the sacrament of baptism, representing the cleansing of sins and the rebirth of the soul. Biblical narratives also recount how Prophet Moses (Musa) led his people through the Red Sea, portraying water as a symbol of salvation and divine miracles.

In Hinduism, the concept of *Tri Hita Karana* underscores the importance of balance in achieving human well-being. One of its three elements, *Palemahan*, emphasizes harmony with the environment. In religious practice, Hindus perform *Upakara*, a ritual involving the use of natural elements such as plants and animals as offerings to God—without causing harm to

the environment (Mighfar, Munadi, & Chesoh, 2025). Hindus in India also regard the Ganges River (*Sungai Gangga*) as sacred, using it for spiritual purification and blessings.

In the Buddhist perspective, according to Amiruddin et al. (2025:8736), water is often used in offering rituals and meditation. It symbolizes tranquility, purity, and wisdom. In several traditions, such as in Japan, water ceremonies are performed to honor ancestors and express reverence through purification rituals.

2. Rainwater as a Natural Resource

According to Amron (2010) in Sutrisno (2015), water security encompasses more than just water availability—it includes efforts to ensure access to water, protection against water-related disasters, and sustainable water management. Water security is defined by four main factors: accessibility, sustainability, safety, and the availability of potential water resources.

As the fifth-largest freshwater resources in the world (Hasan, 2012; Kirmanto, 2012), Indonesia faces many challenges in … in achieving national water security, which directly affects development and social welfare. The *Asian Water Development Outlook 2013* (Sutrisno, 2015) identified Indonesia as a nation with concerning levels of water security. Without immediate intervention, a water crisis could occur in the near future.

Indonesia's total water potential is estimated at 700 trillion m³ per year, yet the country's approximately 300 reservoirs can only store around 200 billion m³ annually—equivalent to just 0.02% of its total water potential (Sutrisno, 2015). The rest flows uncontrolled into natural systems, such as rivers, which are increasingly degraded. External factors such as the reduction of green open spaces (RTH), air pollution affecting rainwater quality, and improper waste management practices also contribute to the declining quality of groundwater and rainwater resources.

3. Water Resilience: Definition, Indicators, and the Role of Rainwater in Ecological Systems

a. Water Resilience

Water resilience refers to the sustainable fulfillment of safe and sufficient water needs for human life and development, alongside effective management of water-related risks (Government of Indonesia, 2023). Environmental resilience is defined as the capacity of ecological, social, and economic systems to absorb disturbances, adapt to changes, and maintain their essential functions and structures without undergoing irreversible damage (Folke, 2016). A resilient environment can recover from ecological stressors such as climate change and resource degradation while transforming toward sustainability (Walker & Salt, 2012). It emphasizes the interdependence between humans and ecosystems, where human survival depends on maintaining the

ecological balance of the planet (Holling, 1973).

b. Indicators of Water Resilience

Water resilience—an integral aspect of environmental resilience—refers to a community's or region's ability to ensure long-term availability, quality, and accessibility of water despite facing pressures such as droughts, floods, or pollution (UNESCO, 2019). Key indicators include: **(1) Water availability** – encompassing the quantity and sustainability of surface and groundwater sources; **(2) Water quality** – measured by pollution levels and suitability for consumption and ritual use; **(3) Efficiency and conservation** – the extent to which water is used wisely and wastewater is managed effectively; **(4) Accessibility and equity** – fair and easy access to clean water across communities; **(5) Innovation and local adaptation** – implementation of eco-friendly technologies such as rainwater harvesting and water recycling (OECD, 2013; United Nations Water, 2022).

Strong water resilience signifies that both social and ecological systems are capable of adapting to climatic uncertainties while safeguarding water availability for future generations

c. The Role of Rainwater in Ecological Systems

Rainwater plays a vital role in maintaining ecological balance. It regulates the hydrological cycle, replenishes groundwater reserves, and supports vegetation growth and microclimate stability (Peters et al., 2011). In urban areas, rainwater utilization helps reduce surface runoff, minimize flood risks, and promote water conservation (Zhang et al., 2020). From an ecotheological perspective, rainwater symbolizes divine purity and blessing, highlighting the spiritual interconnection between humanity and nature (Nasr, 1996). Thus, optimizing rainwater as a supplementary water source is not merely a technical effort but also a reflection of religious values that uphold ecological harmony.

4. Ecotheological Perspectives on Water Management in Madrasahs

a. Definition and Foundations of Ecotheology

Ecotheology is a branch of theology that explores the relationship between humans, God, and nature through moral and spiritual responsibility for environmental sustainability (Conradie, 2011). In Islam, ecotheology is grounded in the concept of *khalifah fil ardh*—humans as stewards of the Earth who are entrusted to preserve its balance and refrain from corruption (*la tufsidu fi al-ardh*), as stated in the Qur'an (Surah Al-A'raf, 56). This principle affirms that protecting natural resources, including water, is an act of worship and a manifestation of faith (Nasr, 1996). Islamic theology thus carries a profound ecological message: the use of natural resources must

harmonize human needs with environmental preservation.

b. Ecotheological Values in Water Management

In Islamic ecotheology, water holds both material and spiritual significance. The Qur'an describes water as the origin of all living things: *"And We made from water every living thing"* (Qur'an 21:30). Water symbolizes purity and divine mercy, underscoring the importance of physical and spiritual cleanliness (Ministry of Religious Affairs, 2010). Therefore, all water management practices—such as conservation, reuse, and preservation—are viewed as acts of fulfilling God's trust.

Ecotheological principles in madrasah-based water management can be implemented through: (1) Spiritual ethics toward water, fostering awareness that water is a divine blessing not to be wasted; (2) Ecological justice, ensuring equitable and proportional use of water without harming other creatures; (3) Intergenerational responsibility, managing water wisely to ensure availability for future generations (Izzi Dien, 2000; Khalid, 2002).

c. Implementation of Ecotheology in Madrasahs

Madrasahs play a strategic role in cultivating environmental awareness rooted in religious values. By integrating ecotheology into learning activities and daily practices, students can understand that conserving water is an expression of faith and moral responsibility. One concrete application is the adoption of rainwater harvesting systems to provide alternative water sources for ablution (*wudhu*).

This initiative serves not only as an ecological solution to reduce dependence on groundwater but also as a spiritual practice—performing *wudhu* with rainwater directly bestowed by God. Additionally, this program aligns with Indonesia's *Profil Pelajar Pancasila* and *Pelajar Rahmatan lil 'Alamin* initiatives, fostering religious and ecological character among students (Fitria & Nurhayati, 2021). Consequently, ecotheology-based water management in madrasahs represents a holistic implementation of Islamic teachings that integrate knowledge (*ilmu*), faith (*iman*), and action (*amal*) in maintaining environmental sustainability.

RESEARCH METHODS

This study employs a mixed-methods approach, integrating both qualitative (literature and theological studies) and quantitative (rainwater volume potential analysis) methods. According to the *Climate Data* report (2025), the average annual rainfall in Medan City is 3,320 mm per year. Although variations exist between wet and dry months, the differences are not significant.

The qualitative component of this research adopts a literature-based and theological study approach, focusing on Islamic perspectives regarding water use and ecotheology. The quantitative component

involves an analysis of the potential rainwater volume in Medan City and its feasibility for ablution (*wudhu*) use within madrasahs.

The study focuses on madrasahs as the unit of analysis because these institutions embody the integration of social piety and environmental piety, a concept currently promoted by Indonesia's Ministry of Religious Affairs. The research covers both *Madrasah Tsanawiyah* (Islamic Junior High Schools) and *Madrasah Aliyah* (Islamic Senior High Schools), including both public and private institutions, as students at these levels typically remain in school during the *Dhuhr* prayer period.

A saturated sampling technique was employed, considering that the total number of *Madrasah Tsanawiyah* and *Madrasah Aliyah* in Medan City is relatively small. However, the study primarily focuses on *Madrasah Aliyah* because these institutions have longer study hours, allowing students to perform *Dhuhr* prayers in congregation within the school environment.

As of 2023, Medan City has three public Madrasah Aliyah and twenty-six private ones. For the purpose of this study, the analysis is limited to public madrasahs to ensure homogeneity, as private institutions often share buildings across different educational levels.

The calculation of rainwater harvesting potential considers the total roof area of school buildings connected or adjacent to mosques (*masjid*) or prayer halls (*mushalla*) used for *Dhuhr* prayers. These roof surfaces are treated as the primary rainwater catchment areas in estimating potential rainwater collection volumes.

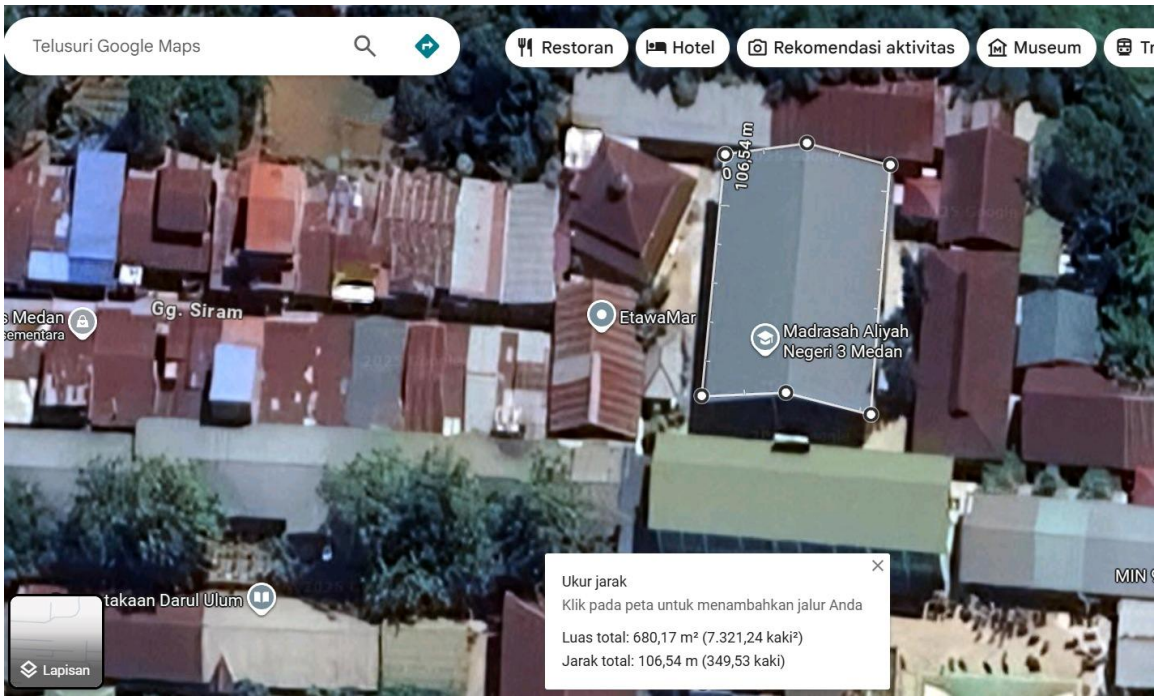
Table 1. List of Public Islamic Senior High Schools (*Madrasah Aliyah Negeri*) in Medan City for the 2025–2026 Academic Year

School	Number of Students
MAN 1 Medan	2.092
MAN 2 Model	2.184
MAN 3 Medan	1.081

Source: Directorate of KSKK Madrasah (processed data)

The table above shows the number of male and female students enrolled in Public Islamic Senior High Schools (*Madrasah Aliyah Negeri*) in Medan City. MAN 1 Medan has a total of 2,092 students, MAN 2 Model Medan has 2,184 students, and MAN 3 Medan consists of 1,081 students.

Figure 1. Measurement of the Main Building Roof Area of MAN 3 Medan Using Google Maps



Source: Google Maps

DISCUSSION

Rainwater Potential

The potential of rainwater can be calculated using a simple formula.

$$\Sigma Q = a \; x \; R \; x \; A$$

Where:

ΣQ : Total volume of harvested rainwater (liters per year)
a : Runoff coefficient (dimensionless)
R : Annual rainfall (mm per year)
A : Catchment area (m²)

This equation is used to estimate the potential amount of rainwater that can be utilized annually. The calculated value is not absolute but serves as an effective approximation to determine the volume of water that could substitute groundwater usage. The schematic illustration of the simple rainwater harvesting system employed in this study is shown in Figure 2.

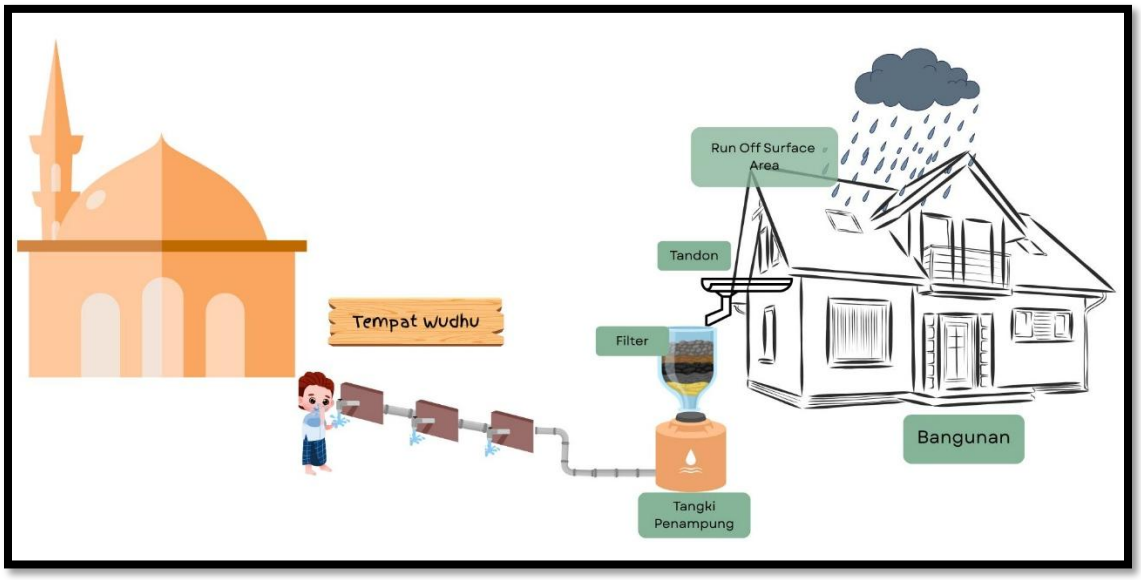


Figure 2. Sketch of a Simple Rainwater Harvesting System Connected to the Ablution Area

This study utilizes faucets as the outlet system to ensure that the harvested rainwater is used more efficiently compared to conventional storage methods such as ponds or tanks. In general, each *madrasah* has a potential rainwater storage capacity as follows:

Table 2. Calculation of Ablution Water Requirements for Students in Public Islamic Senior High Schools in Medan City

Name of School	Number of Students	Average Water Used per Ablution (L)	Daily Water Requirement for One Prayer (L)	Monthly Ablution Water Requirement (Effective Days) (L)	Annual Ablution Water Requirement (L)
MAN 1 Medan	2.092	4,5	9.414	188.280	2.259.360
MAN 2 Model	2.184	4,5	9.828	196.560	2.358.720
MAN 3 Medan	1.081	4,5	4.864.5	97.290	1.167.480

Source: Google Map and Google Earth Pro with Data Processing

Table 2 shows the ablution water requirements for students in each Islamic senior high school (*madrasah aliyah*) in Medan City. Based on Naja (2017) and Mafra

et al. (2018), the average amount of water used for ablution using a faucet is approximately 4.5 liters per student. Assuming 20 effective school days per month, the monthly ablution water requirements are as follows: MAN 1 Medan requires 188,280 liters, MAN 2 Model requires 196,560 liters, and MAN 3 Medan requires 97,290 liters of water. Consequently, over the course of one academic year (240 effective days), the annual ablution water requirements are estimated to be 2,259,360 liters for MAN 1 Medan, 2,358,720 liters for MAN 2 Model, and 1,167,480 liters for MAN 3 Medan.

Table 3. Calculation of Rainwater Potential

Name of School	Main Building Roof Area (m^2)	Runoff Coefficient	Annual Rainfall (mm/year)	Total Collected Rainwater (L/year)	Annual Ablution Water Requirement (L)	Fulfillment Percentage (%)
MAN 1 Medan	3.099	0,85	3.320	8.745.378	2.259.360	387,073
MAN 2 Model	3140,13	0,85	3.320	8.861.446,86	2.358.720	375,688
MAN 3 Medan	680.17	0,85	3.320	1.919.439,74	1.167.480	164,409

Source : Google Map and Google Earth Pro with Data Processing

Based on the analysis of rainwater harvesting potential at three *madrasahs* in Medan City - **MAN 1 Medan**, **MAN 2 Model Medan**, and **MAN 3 Medan -** it can be concluded that all schools possess significant potential to utilize rainwater as an alternative and backup water source for students' ablution needs.

With an average annual rainfall of **3,320 mm/year** and a **roof runoff coefficient of 0.85**, the estimated annual volume of collected rainwater is as follows: (1) MAN 1 Medan has the potential to collect approximately 8,745,378 liters of rainwater per year, while its annual ablution water requirement is 2,259,360 liters, resulting in a fulfillment rate of 387.07%; (2) MAN 2 Model Medan can collect 8,861,446.86 liters of rainwater annually, compared to an annual ablution requirement of 2,358,720 liters, yielding a fulfillment rate of 375.69%; (3) MAN 3 Medan can collect 1,919,439.74 liters of rainwater per year, while its annual ablution requirement is 1,167,480 liters, achieving a fulfillment rate of 164.41%.

These results indicate that the rainwater collected from school rooftops

can fully meet—and even exceed—the annual ablution water needs in all observed *madrasahs*. The table demonstrates that each institution has a rainwater fulfillment potential exceeding **100%**, even reaching **three to four times** the actual annual requirement. This finding suggests that a **Rainwater Harvesting (RWH)** system can not only provide sufficient water for ablution but also supply additional water for other purposes, such as garden irrigation, facility cleaning, and environmental sanitation. Hence, the utilization of rainwater in *madrasahs* is both **feasible and efficient**, in terms of quantity and ecological benefits.

From a technical perspective, the abundant rainwater volume can be utilized not only for ablution but also for sanitation and environmental maintenance within the school—such as watering plants, cleaning toilets, and washing school equipment. The implementation of RWH systems in *madrasahs* can significantly **reduce** dependence on groundwater and municipal water (PDAM), contributing to local water resilience.

From the perspective of **Islamic ecotheology**, this practice also reflects the principle of *"rahmatan lil 'alamin"*—that rainwater is a blessing from Allah SWT, meant to be used wisely for the benefit of all living beings. Managing rainwater for religious purposes (ablution) embodies both **spiritual and ecological values**, maintaining the balance between humans and nature as emphasized in the Qur'an (QS. Al-Furqan [25]:48–49).

The findings further show that all three public *madrasahs* in Medan City possess a very high rainwater harvesting potential compared to their annual ablution water requirements. However, several **limitations and assumptions** should be taken into account when interpreting these results. First, the rainfall data used represent the **annual average from a single rainfall station**, which may not fully capture the **spatial and temporal variability** of precipitation across Medan City. Microclimatic conditions around each *madrasah* may influence the actual volume of harvested rainwater. Furthermore, the calculations assume that the **entire roof area functions effectively** as a catchment surface, without accounting for possible water losses caused by gutter leakage, initial runoff contamination, or evaporation—factors that can realistically reduce system efficiency by **10–30 percent**.

Table 4. Average Monthly Rainfall at Deli Serdang Station

Bulan	Curah Hujan	Jumlah Hari Hujan	MAN 1 (L/bulan)	MAN 2 (L)	MAN 3 (L)
Januari	164	23	432000.6	437734.1	13297.32
Februari	128	17	337171.2	341646.1	9828.457
Maret	228	19	600586.2	608557.2	10984.75
April	196	14	516293.4	523145.7	8094.023
Mei	175	18	460976.3	467094.3	10406.6
Juni	256	12	674342.4	683292.3	6937.734
Juli	303	19	798147.5	808740.5	10984.75
Agustus	586	28	1543612	1564099	16188.05
September	598	21	1575222	1596128	12141.03
Oktober	271	25	713854.7	723328.9	14453.61
Nopember	190	23	500488.5	507131	13297.32
Desember	326	22	858732.9	870130	12719.18

Source: Processed from Climate Data (2025)

The next limitation lies in the quality aspect of rainwater. This study focuses solely on the quantitative potential of rainwater harvesting, without conducting physical, chemical, or biological water quality testing. In fact, the quality of harvested rainwater can be influenced by several factors, including roofing materials and air pollution levels in the surrounding environment. Therefore, further analysis is necessary to ensure that the harvested water meets the hygiene and purity standards required for *wudhu* (ablution).

Another limitation concerns the storage infrastructure capacity at the field level, which has not been calculated in real conditions. Theoretically, the volume of harvested rainwater may reach millions of liters per year; however, due to space constraints and the limited size of storage tanks—typically ranging from 5,000 to 11,000 liters—not all of this water can be optimally utilized. Given the large amount of potential harvestable water, assuming negligible evaporation losses from closed storage systems, *madrasahs* should ideally employ larger-capacity tanks to maximize utilization.

In addition, the analysis of *wudhu* water requirements in this study assumes a constant number of students and effective learning days throughout the year. In practice, the number of students may fluctuate each academic year, and religious activities in *madrasahs* may vary from month to month. Such assumptions may introduce slight deviations between estimated and actual water consumption. Moreover, this study does not account for non-ablution water needs, such as cleaning, laboratory activities, or other domestic uses, which

should be integrated into a comprehensive assessment of *madrasah* water resilience.

Considering these limitations, the findings of this study still provide an important initial overview of the potential application of Rainwater Harvesting Systems (RWH) in *madrasahs* as a water conservation strategy. Nevertheless, for more accurate and implementable estimates, future research should incorporate monthly rainfall data, field-based efficiency measurements, and rainwater quality analyses in accordance with national clean water standards (SNI 06-6989.11-2019).

Technical Practices to Ensure Rainwater Safety for Ablution

Rainwater is naturally a relatively clean source of water; however, it may become contaminated by dust, airborne pollutants, or roof debris before entering the storage system. Therefore, specific technical practices must be applied to ensure that harvested rainwater meets the standards of cleanliness and purity required for ablution purposes. According to the World Health Organization (WHO, 2022), a safe Rainwater Harvesting (RWH) system should include four main components: (1) Selection of hygienic roof and gutter materials; (2) Implementation of a first flush diverter system; (3) Closed and light-proof storage; and (4) Regular filtration and maintenance.

1. Roof and Gutter Selection

The roof should be made from non-toxic materials, such as clay tiles, galvanized zinc, or concrete. Roofs made of asbestos, lead-based paints, or PVC coated with chemical compounds should be avoided, as they may leach harmful substances into the water (Rahman et al., 2021). Gutters should be cleaned regularly to prevent the buildup of leaves, dust, or bird droppings.

2. First Flush Diverter System

This system is designed to discard the first 1–2 mm of rainfall, which typically contains accumulated dust and pollutants from the roof surface. After this initial runoff is diverted, cleaner water is directed into the main storage tank (UNEP, 2020). Implementing this system has been shown to reduce Total Suspended Solids (TSS) by up to 70%.

3. Water Storage and Quality Control

The storage tank should be made of food-grade polyethylene or watertight concrete, equipped with a tight-fitting lid to prevent insect intrusion and sunlight exposure, which can promote algal growth (Aravinthan & Tilley, 2022). The tank capacity should be adjusted according to the catchment area and water demand—for example, a 5,000–10,000-liter tank is suitable for medium-sized school buildings.

4. Filtration and Disinfection

Before use, rainwater can be filtered through simple multi-layer media, consisting of sand, gravel, activated charcoal, and fibers (ijuk), to remove suspended particles. If

necessary, additional disinfection can be performed using UV light or boiling, ensuring the water is free from pathogenic microorganisms (WHO, 2022).

5. Maintenance and Monitoring

Gutters and filters should be cleaned at least every three months, particularly at the beginning and end of the rainy season. Routine pH and turbidity tests should also be conducted to maintain compliance with clean water standards (SNI 06-6989.11-2019).

From the perspective of Islamic ecotheology, these technical practices are not only hygienic measures but also a form of moral responsibility toward the environment. Proper utilization of rainwater reflects the principles of *thaharah* (purity) and *ihsan* (benevolence) toward nature. This aligns with QS. Al-A'raf [7]:31, which commands Muslims to maintain cleanliness and avoid excess in all aspects of life.

CONCLUSION

Rainwater has significant potential as an alternative water source. Considering the limited availability of groundwater and green open spaces serving as natural infiltration areas, rainwater plays an essential role as a substitute for groundwater for ablution purposes. With proper filtration, harvested rainwater can also be effectively utilized for school garden irrigation and other non-potable uses.

An ecotheological perspective provides moral and spiritual grounding in water management, emphasizing that water is not only a practical necessity but also a divine trust (amanah). This approach supports contextual learning in *madrasahs*, integrating ecological awareness, character education, and spiritual values.

Integrating rainwater utilization with ecotheological values strengthens environmental resilience and sustainability, thereby contributing to the alleviation of ecological burdens and fostering harmony between humans and nature.

RECOMMENDATIONS

As institutions entrusted with shaping future generations, *madrasahs* hold a strategic role in embedding character education and ecotheological values through habitual water conservation programs, such as Rainwater Harvesting (RWH). It is hoped that *madrasahs* can serve as models and catalysts for developing simple RWH technologies at the household and community levels. Further research is encouraged to explore the relationship between ecotheology, water conservation policies, and sustainability practices, as this study primarily focuses on potential analysis.

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