UNIVERSITI TEKNOLOGI MARA Cawangan Perak

KUTAI

GRESAFE_CITIES
Green Safe Cities, Research Group

6th UNDERGRADUATE SEMINAR ON BUILT ENVIRONMENT AND TECHNOLOGY (USBET) 2023

SUSTAINABLE BUILT ENVIRONMENT

25 - 27 SEPTEMBER 2023

E-PROCEEDING

USBET 2023

e-Proceeding

6th UNDERGRADUATE SEMINAR ON BUILT ENVIRONMENT AND TECHNOLOGY (USBET) 2023

SUSTAINABLE BUILT ENVIRONMENT

Published by,
Department Of Built Environment Studies And Technology
Faculty Of Architecture, Planning & Surveying
Universiti Teknologi MARA Perak Branch, Seri Iskandar Campus
usbet.fspuperak@gmail.com

eISSN 2821-3076

02 October 2023 | Perak, Malaysia
Universiti Teknologi MARA, Perak Branch, Seri Iskandar Campus

EDITORIAL BOARD

Editors-in-Chief

SR. NORAZURA MIZAL AZZMI (BS)

NADIRA AHZAHAR (BS)

Editors

TS. ZURAIHANA AHMAD ZAWAWI (BS)

SR. NAZHATULZALKIS JAMALUDIN (BS)

SR. SITI ZUBAIDAH HASHIM (BS)

NURHIDAYAH SAMSUL RIZAL (BS)

SR DR. NURUL FADZILA ZAHARI (BS)

NUR FADHILAH BAHARDIN (BS)

SR TS. DR. ALIA ABDULLAH SALLEH (BS)

SR TS. DR. SURIANI NGAH WAHAB (BS)

SR TS. DR. HASNAN HASHIM (BS)

SR NOORAZLINA KAMARUZZAMAN (BS)

SR MARIATY MOHD BAHARI (BS)

SR AIDA AFFINA ABDUL GHANI (BS)

DR. NOR DIANA AZIZ (BS)

SR AMIR FASHA MAT ISA (BS)

SR DR. NOR AMIN MOHD RADZUAN (BS)

PROF. MADYA SR DR. MOHD FADZIL YASSIN (BS)

SR TS. KHAIRUL AMRI RAMLY (BS)

SR. MOHD ASRUL HASIN (BS)

SR TS. MOHD KHAZLI ASWAD KHALID (BS)

SR MOHD DZULKARNAEN SUDIRMAN (BS)

SR DR. IRWAN MOHAMAD ALI (BS)

SR DR. MOHAMMAD HASZIRUL MOHD HASHIM (BS)

DR NURHASYIMAH BT AHMAD ZAMRI (BCT)

DR. PUTERI YULIANA SAMSUDIN (TP)

Editors-in-Chief

6th Undergraduate Seminar on Built Environment and Technology 2023

- E- Proceedings-

Organized by,

College of Built Environment (KAB) UiTM Perak Branch

A STUDY OF THE CHARACTERISTICS OF RAINWATER HARVESTING FOR MOSQUES IN KLANG VALLEY

Nurul Afiqah Rohim[1], Aida Affina Abdul Ghani[1*]

[1] Department of Built Environment Studies and Technology, College of Built Environment, Universiti Teknologi MARA Perak Branch, Seri Iskandar Campus, 32610, Seri Iskandar Perak, Malaysia

2021606778@student.uitm.edu.my, *aidaa017@uitm.edu.my

ABSTRACT

This research report explores rainwater harvesting systems in Klang Valley mosques, Malaysia, as a solution for water security in a region with high annual rainfall. Two case studies, the National Mosque of Malaysia (Masjid Negara) and Al-Muttaqin Mosque (Masjid Al-Muttaqin), are examined to understand their adoption and effectiveness. Qualitative methods, including on-site observations and interviews, are used to gather data. The findings indicate that rainwater harvesting systems are currently implemented in only two Kuala Lumpur mosques, highlighting limited adoption in the region. The National Mosque employs a gravity-fed system with a small tank for its office building, while Al-Muttaqin Mosque uses an indirect pumping system with a larger tank for ablution, toilets, and gardening. The study recommends wider adoption of rainwater harvesting in mosques and public buildings, particularly in areas with ample rainfall. This approach can lead to reduced water bills, raise community awareness of sustainable water management, and support water conservation efforts. States like Taiping, with high rainfall density, are encouraged to implement rainwater harvesting systems in all buildings to ensure water availability during scarcity episodes. Furthermore, mosques, as influential community centers, have a crucial role in promoting sustainable water practices among their congregations and communities. By setting an example through rainwater harvesting adoption, mosques can inspire broader implementation of this eco-friendly approach in Malaysia. Overall, utilizing rainwater as an alternative source is essential to mitigate water scarcity and contribute to environmental conservation efforts.

Keywords: *mosques, rainwater harvesting system, water scarcity, water security, rainfall*

INTRODUCTION

Clean water supplies are vital for fulfilling human life's daily needs as people depend on water for various purposes. Given Malaysia's substantial rainfall throughout the year, careful consideration of rainwater storage as an alternative water source is essential (Che Ngah et al., 2014). With Malaysia experiencing high annual rainfall, resulting in more frequent rains and increased water capacity in rivers and dams, rainwater harvesting becomes a viable solution (Shaari, 2020). However, climate change poses challenges in predicting water levels, leading to potential water scarcity in some states. To address this, optimizing and conserving water consumption is crucial. Rainfall can be harnessed for both potable and non-potable uses, including drinking, cooking, bathing, toilet cleaning, and gardening (Mat Zain, 2014).

Rainwater harvesting, a simple technique of collecting and conserving rainwater from roofs and surfaces, proves effective in combating water crises. The success and safety of this approach depend on careful choices regarding materials, size, and positioning. In public buildings like mosques, where water is extensively used for various practices, rainwater harvesting plays a vital role, ensuring a sufficient water supply for ablution, washing, and other needs (Yusof et al., 2020).

LITERATURE REVIEW

Rainwater harvesting is crucial for sustainable living by cutting down water waste and decreasing reliance on clean water. With a growing population, the demand for drinkable water increases, resulting in potential water shortages. This makes rainwater harvesting vital for controlling water crises and serving as an alternative water source during shortages. This issue is magnified by global water scarcity and a lack of community awareness about water crises. To address these challenges, the study aims to explore Rainwater Harvesting System implementation in Klang Valley mosques, understand the systems' features, and determine the most effective approach for mosque water harvesting.

Rainwater Harvesting System (RWH)

The rainwater harvesting system, also known as the "rainwater catchment system," is a method used to collect and store rainwater for human use. It can range from simple storage reservoirs to more complex setups involving pumps, tanks, and purification systems. The collected non-potable water can be utilized for various purposes, including drinking, toilet flushing, car washing, and landscape irrigation. This system proves particularly valuable in densely populated areas facing water shortages, as it offers a reliable backup water source even during dry seasons (Ogale, 2023). Rainwater harvesting has a long history and is widely practiced in

Asia, where small-scale collection from rooftops and brush dams originated in rural South and Southeast Asia centuries ago. In countries like Malaysia, the abundance of water tanks helps store rainwater during heavy rainfall. However, growing demands in sectors like industry, agriculture, commerce, and residential use pose challenges to the current water supply system, making a backup source like rainwater harvesting essential. By utilizing pure rainwater that falls on rooftops, rainwater harvesting practices play a crucial role in preventing wastage, potential flooding, soil degradation, and allowing the utilization of one of nature's cleanest water sources (Sehgal, 2005).

Mosque

The mosque, a place of worship for Muslims, has been a significant community gathering spot throughout Islamic history. Today, mosques are prevalent in countries with sizable Muslim populations, facilitating the five daily prayers for Muslims everywhere. These mosques vary in design to suit different locations and needs, and in the past, skilled local artisans and architects were commissioned to build magnificent structures (Stacey, 2009). Over the centuries, the number of mosques has substantially increased, reaching even arid desert nations. The interiors of mosques exude tranquillity, offering worshippers a sanctuary from the outside world to find inner peace (Stacey, 2009). Besides worship, mosques serve as educational resources for those seeking to learn more about Islam. Men usually perform their obligatory prayers in congregation at the mosque, while women are welcome to pray there or at home. Muslims can worship anywhere except unclean or immoral places (Stacey, 2009). The term "masjid," derived from "sa-ja-da," signifies a place to bow down in submission to God, drawing believers closer to Him through prayer (Stacey, 2009). The English term "mosque" likely originated from the French word "mousquaie" and has become synonymous with a place where Muslims unite in devotion to God (HarperCollins Publishers, 2022

Component of Rainwater Harvesting System

- Catchment Area

A catchment area refers to a designated space or structure that is designed to collect rainfall and divert it away from runoff. The effectiveness of the catchment area relies on its cleanliness, which can either be paved (such as rooftops, yards, and roads) or unpaved (like grass, playgrounds, and open spaces) (DTE Staff, 2019). When implementing a rainwater harvesting system using tanks, the catchment area typically refers to the surface of the roof. To ensure the successful implementation of this system, several crucial factors related to the roof need to be considered. Firstly, it is advisable to avoid using materials like metal for the roof, as they tend to shed pollutants rapidly. Similarly, it is important to steer clear of lead-containing wood or metal flashing (The Texas A&M AgriLife Extension Service, 2023). The slope of the roof also plays a significant role in determining the speed of water flow during heavy

rainfall. A steeper roof facilitates quicker runoff and easier cleaning of pollutants, while a flatter roof slows down water movement, increasing the likelihood of pollutants lingering on the catchment area (The Texas A&M AgriLife Extension Service, 2023). Additionally, the size of the catchment area or roof directly affects the amount of rainwater that can be harvested. The area is determined by calculating the building's surface area and incorporating any uncovered roof area (The Texas A&M AgriLife Extension Service, 2023).

- Conveyance System

The conveyance system, also referred to as a channel system, plays a vital role in directing the flow of water from the catchment area to the storage location. Typically, a pipe is employed to transport water from the surface of the roof to a storage container. Therefore, when selecting a conveyance system, three important factors need to be considered: size, proper installation, and aesthetics (The Texas A&M AgriLife Extension Service, 2023). In terms of size, it is essential to choose gutters that are wide enough to effectively divert rainwater runoff, with a minimum width of 5 inches (The Texas A&M AgriLife Extension Service, 2023). To ensure adequate drainage, it is recommended to provide one square inch of downspout space for every 100 square feet of roof area (The Texas A&M AgriLife Extension Service, 2023). Proper installation is crucial for the functionality of gutters and downspouts, as well as for ensuring safety (The Texas A&M AgriLife Extension Service, 2023). Furthermore, to enhance the aesthetic appeal, PVC pipes can be painted to match the colour of the building, and the old drain can be placed over the PVC pipe on the metal structure to conceal it (The Texas A&M AgriLife Extension Service, 2023).

- First Flush Device

Systems that use a separation device to filter and remove debris and pollutants (MSMA. DID, 2011).

- Storage Tank

Storage tanks, such as tanks and cisterns, are prominent components of a rainwater harvesting (RWH) system. These containers serve as the visible aspect of the system, responsible for collecting and storing rainwater for future utilization. The key purpose of storage tanks is to prioritize safety. They should be designed to prevent access by children or animals, and they must maintain water quality suitable for consumption (The Texas A&M AgriLife Extension Service, 2023).

- Distribution

The distribution aspect involves various elements, including pipes, pumps, and devices, which have the responsibility of conveying water from its storage and treatment location to the intended point of use. When implementing gravity flow drip

irrigation systems with rainwater harvesting (RWH), the distribution system may utilize a section of a drip tube. Critical components within this distribution system are the pump and the pressure tank, carefully selected to meet the specific volume and pressure requirements of the system.

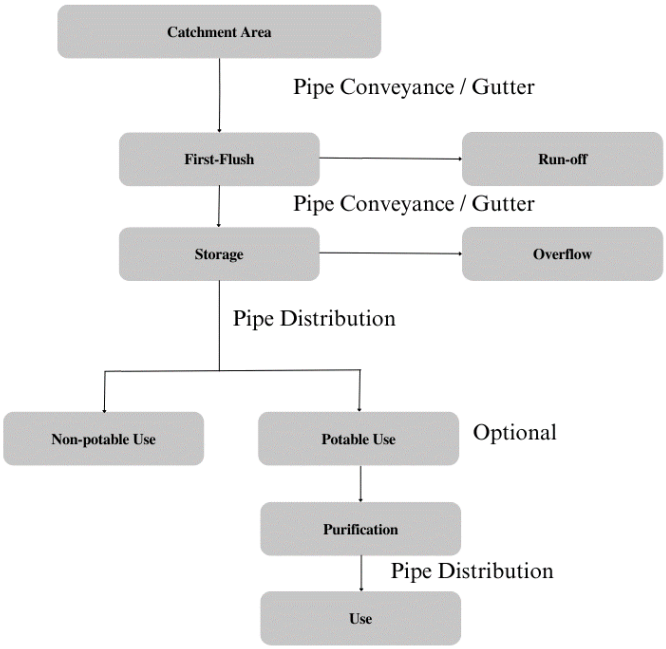


Figure 1: Rainwater Harvesting System

- Sizing Storage Tank

Choosing the right size for the water storage tank is of utmost importance to fulfill the building's water storage needs. The rainwater demand depends on several factors, including the total population relying on water, the average water consumption per person, and the various purposes for which water is used, such as drinking, restroom usage, laundry, toilet flushing, and garden watering.

Application of Rainwater Harvesting System for Mosque

Rainwater harvesting in mosques offers several advantages, aiding communities in effective water management (Shaheed et al., 2017). The systematic installation of rainwater collection and storage systems allows mosques to maintain a long-term water supply for various applications like landscaping and toilets, ensuring water quality through appropriate processing and filtering (Mohd Nordin & Ahmad, n.d.).

The challenges posed by population growth and environmental requirements in modern water infrastructure design make rainwater harvesting systems, whether gravity-based or pump-assisted, a valuable solution to optimize water flow for mosques (Raimondi & Becciu, 2014).Malaysia's tropical climate with heavy rainfall throughout the year, averaging 2400mm in Peninsular Malaysia, 2360mm in Sabah, and 3830mm in Sarawak, makes rainwater harvesting an apt choice (Che-Ani et al., 2009). These systems prove adaptable to climate change and can be deployed effortlessly, highlighting their positive impact (Shaheed et al., 2017; Mohd Nordin & Ahmad, n.d.). The primary objective of mosque rainwater harvesting is to enhance available water by collecting and distributing it locally, thus reducing the consumption of clean water, particularly for non-potable purposes like toilet flushing and landscaping, enabling versatile water usage (Adham et al., 2016; Mohd Nordin & Ahmad, n.d.).

METHODOLOGY

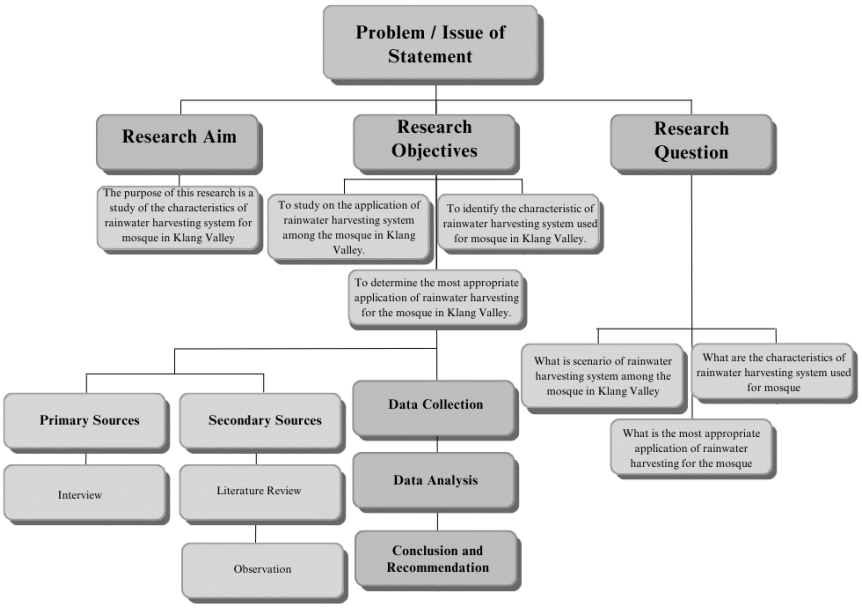


Figure 2: Research Methodology

In this research, a qualitative method is employed through combination of research techniques and methods, including literature review and observation and interview, were employed by the researchers to investigate rainwater harvesting systems in mosques. The researchers obtained information not only from the selected mosques but also through interviews with contractors and mosque committee members. During these interviews, the participants were questioned about their perspectives on the research topic. The survey aimed to identify the specific characteristics of rainwater harvesting systems used in mosques and determine their most suitable applications.

Rainwater harvesting is widely acknowledged as a valuable solution for addressing water shortages, allowing for water conservation and future utilization. Regarding the literature review, the researchers collected relevant information from articles, newspapers, and journals to support the study's objectives. The observational aspect of the research involved unbiased observations by the researchers, with no interference or manipulation of research volunteers and no use of control or treatment groups.

FINDING AND DISCUSSION

The research primarily employs qualitative and observational methodologies to understand how mosques are using rainwater harvesting systems. The purpose is to explore the features and applications of these systems, with a specific focus on mosques. The findings indicate that rainwater harvesting is not widely utilized in mosques in the Klang Valley. Only two mosques have implemented this technique, suggesting a lack of knowledge about the advantages of such systems among other mosques. These two mosques are: the National Mosque of Malaysia (Masjid Negara) and Al-Muttaqin Mosque (Masjid Al-Muttaqin).

Case Study 1: National Mosque of Malaysia (Masjid Negara)

Figure 3: National Mosque of Malaysia (Masjid Negara)

According to an interview with the head of maintenance personnel at Masjid Negara Malaysia, the mosque began implementing the rainwater harvesting system in 2019 by constructing a new national mosque office. Due to its registration as a national historic site under the National Heritage Act of 2005 (Act 645) (Jabatan Warisan Negara, 2015, 19), making modifications to link all current systems with the original mosque construction is not feasible. As a result, the system is exclusively used in the office spaces. Being a recent addition, the mosque has yet to establish a comprehensive plan for the system. The present water tank is still in use for providing

water for ablution, gardening, and toilets, alongside the water collected through the rainwater harvesting system.

Case Study 2: Al-Muttaqin Mosque (Masjid Al-Muttaqin)

Figure 4: Al-Muttaqin Mosque (Masjid Al-Muttaqin)

During an interview with the deputy chairman of Al-Muttaqin mosque, it was revealed that this mosque is the first in Kuala Lumpur's Wangsa Melawati neighbourhood to adopt and implement the rainwater harvesting technology. The initiative to implement the rainwater harvesting system (RWHS) at Al-Muttaqin Mosque was in response to the national water conservation initiative. Additionally, the project, led by Dr. Aznah Nor Anuar from the Malaysia-Japan International Institute of Technology, UTM Campus Kuala Lumpur, aims to educate the community about sustainable water management and provide university students with an opportunity to contribute back to society using their acquired knowledge (Fatimahzarah, 2018).

To find out the characteristics of the rainwater harvesting system used in mosques, which was the objective of the study, the study was done on both case studies. Next, the study discovered that both varieties of mosques in Kuala Lumpur employ different characteristics.

- National Mosque of Malaysia (Masjid Negara)

The mosque has a rainwater harvesting system in its office building, which was constructed in 2019. Due to its status as a national historical site, linking the system with the original mosque structure is not possible. Next, the roof size of the office section, where rainwater is collected, is approximately 1/5 of the mosque's prayer area. The mosque uses a rainwater tank with an estimated capacity ranging from 1500 to 3000 Litres, and the water is primarily used for public toilets (cafes), hand-washing sinks, and multi-purpose taps. Lastly, the rainwater harvesting system at this mosque operates on a Gravity Fed System, using natural gravitational force for water distribution.

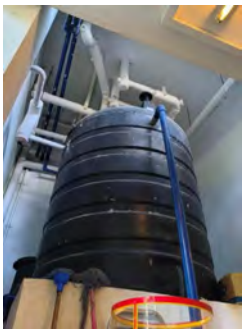


Figure 5: Rainwater Harvesting's Mosque at National Mosque

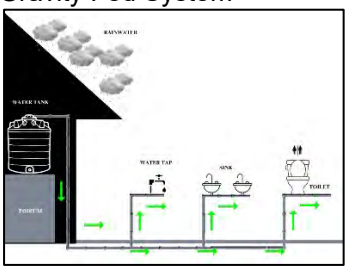
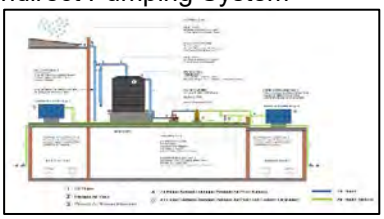
- Al-Muttaqin Mosque (Masjid Al-Muttaqin):

The mosque started using rainwater harvesting technology as part of a national water conservation initiative. The mosque's rainwater harvesting system utilizes a large tank with a capacity of 3090 litres. The type of tank used is the Aura-Lite PE Cylindrical Tank, and the system employs an indirect pumping system. Next, the water harvested is used for toilet flushing, ablution, and gardening purposes.

Figure 6: Rainwater Harvesting's Tank at Al-Muttaqin Mosque

Table 1: Comparison of Rainwater Harvesting Systems.

	National Mosque of Malaysia (Masjid Negara)	**Al-Muttaqin Mosque (Masjid Al-Muttaqin**
Size of roof	Around 4,500 square feet	Around 6,000 square feet
Coverage Area	For office's workers only	1,200 at a time

Capacities of tank	1500-3000 Liters	3090 Liters
Type of Tank	using a plastic or polyethylene water tank	the Aura-lite PE Cylindrical Tank with a diameter of 1.45m, a height of 2.07m, and a CT600 model
Type of RWH system	Gravity Fed System 	Indirect Pumping System 

Limitations

While carrying out this research, there are several difficulties to overcome. The primary goal is to comprehend the unique attributes of rainwater harvesting systems utilized in mosques and to find the most effective method for introducing these systems to mosques. Achieving this will require discussions with individuals who are well-acquainted with the design and traits of these systems within the mosques. Furthermore, a thorough examination of rainwater harvesting techniques will be essential to pinpoint the most appropriate approach for mosques. However, potential delays caused by countrywide impacts of COVID-19 or the interviewees' busy schedules could result in their unavailability for the sessions.

Implications

The study provides insights into rainwater harvesting practices in mosques and highlights the benefits and challenges of implementing such systems. It emphasizes the need for knowledge dissemination and awareness-raising to encourage wider adoption of rainwater harvesting technology in religious and public buildings. Overall, the study sheds light on the current state of rainwater harvesting practices in mosques, particularly in the Klang Valley, and highlights the importance of sustainable water management and conservation efforts. The findings could be valuable for policymakers, architects, and religious authorities in promoting eco-friendly practices in religious buildings and addressing water scarcity concerns.

CONCLUSION

In conclusion, this research delves into the implementation and characteristics of rainwater harvesting systems in mosques located in the Klang Valley. The study primarily focuses on two case studies: the National Mosque of Malaysia (Masjid Negara) and Al-Muttaqin Mosque (Masjid Al-Muttaqin). These two mosques represent the limited adoption of rainwater harvesting practices in religious buildings within the region.

Through qualitative and observational methodologies, the study provides valuable insights into the rainwater harvesting practices employed by these two mosques. The National Mosque, being a national historic site, faced constraints in integrating the rainwater harvesting system with its original structure. As a result, it utilizes a relatively small tank with a gravity-fed system, primarily serving the needs of the office building. On the other hand, Al-Muttaqin Mosque stands as an exemplar of embracing rainwater harvesting technology as part of a national water conservation initiative. The mosque employs a substantial rainwater tank with an indirect pumping system, facilitating the utilization of rainwater for toilet flushing, ablution, and gardening purposes.

One significant finding of the study is the lack of widespread adoption of rainwater harvesting systems in other mosques within the Klang Valley. With only two mosques having implemented this eco-friendly technology, there remains a substantial opportunity to promote sustainable water management and conservation practices in religious and public buildings. The research also points out certain limitations encountered during the study, such as the unavailability of precise data and detailed information due to the novelty of the rainwater harvesting systems and new personnel managing them. Despite these limitations, the study provides valuable insights into the benefits and challenges of implementing rainwater harvesting systems in mosques.

Overall, this research serves as a crucial starting point for understanding the potential of rainwater harvesting technology in religious buildings and public spaces. It emphasizes the need for knowledge dissemination and awareness-raising among religious authorities, architects, and policymakers to encourage wider adoption of rainwater harvesting practices in mosques and other public buildings.

The findings of this study underscore the importance of sustainable water management in religious establishments to alleviate water scarcity concerns and contribute to environmental preservation. By harnessing rainwater as a valuable resource, mosques and other public buildings can set a positive example of responsible water usage and contribute to the broader efforts of conserving our planet's precious natural resources. Moving forward, it is essential to further promote research and awareness initiatives to encourage the integration of rainwater

harvesting systems in mosques and other religious institutions across the Klang Valley and beyond. Embracing such eco-friendly practices will not only benefit the environment but also serve as a testament to the commitment of religious communities towards sustainable living and responsible stewardship of the Earth.

ACKNOWLEDGEMENT

First and foremost, praise and thanks God, the Almighty, for showing His blessings throughout my research work to complete the investigation successfully and make all efforts to be meaningful. I would like to thank my lecturer at the place of study, Puan Aida Affina Binti Abdul Ghani for helping me a lot and giving some opinions to me throughout the process of compiling this assignment. It is a great privilege and honour to work and learn under the guidance of. I am very grateful to my parents for their love, prayer, attention, and sacrifice for educating for provide support for the completion of this assignment. I want to thank my friends and my colleagues for their constant encouragement. Finally, my thanks to all those who have supported me to complete this paper.

REFERENCES

Adham, A., Riksen, M., Quessar, M., & Ritsema, C. (2016, April 9). *Identification of suitable sites for rainwater harvesting structures in arid and semi-arid regions: A review*. ScienceDirect. https://doi.org/10.1016/j.iswcr.2016.03.001

Che Ngah, M. S. Y., Othman, Z., Hashim, M., Nayan, N., & Saleh, Y. (2014, April 30). Rainwater as a Potential Alternative Source of Water in Tanjong Malim, Perak. *(Vol. 2 No. 1 (2014): GEOGRAFI*). *https://ojs.upsi.edu.my/index.php/GEOG/article/view/464/323*

Che-Ani, A.I., Shaari N, & A. Sairi. (2009). Rainwater Harvesting as an Alternative Water Supply in the Future. *Research Gate. https://www.researchgate.net/publication/237821822_Rainwater_Harvesting_as_an_Alternative_Water_Supply_in_the_Future*

DTE Staff. (2019, July 3). Catch water where it falls: Urban rainwater harvesting. *DownToEarth. https://www.downtoearth.org.in/news/water/catch-water-where-it-falls-urban-rainwater-harvesting-65422*

Fatimahzarah. (2018, January 17). Launching Ceremony Project on 'Installation of Rainwater Harvesting System at Masjid Al-Muttaqin, Wangsa Melawati, Kuala

Lumpur'. *People@UTM. https://people.utm.my/shaharil/2018/01/21/launching-ceremony-project-on-installation-of-rainwater-harvesting-system-at-masjid-al-muttaqin-wangsa-melawati-kuala-lumpur/*

HarperCollins Publishers. (2022). American Heritage Dictionary Entry: mosque. *American Heritage Dictionary*. *https://ahdictionary.com/word/search.html?q=mosque*

Mat Zain, N. A. F. B. (2014, June). Comparative Study on the Effectiveness of RWH System In Different Types Of Building. *https://core.ac.uk/download/pdf/159186008.pdf*

Mohd Nordin, M. M. N. M. A. A., & Ahmad, N. A. (n.d.). A feasibility study on rainwater harvesting system for mosque in Perak Tengah / Muhammad Amirul Asraf Mohd Nordin and Nur Azfahani Ahmad. *UiTM Institutional Repository. https://ir.uitm.edu.my/id/eprint/47794/*

MSMA. DID. (2011). Rainwater Harvesting. *Chapter 6 Rainwater Harvesting. https://jkt.kpkt.gov.my/jkt/resources/user_30/2016_OKU/Chapter_6_-_Rainwater_Harvesting.pdf*

Jabatan Warisan Negara. (2015). Department of National Heritage in brief. Jabatan Warisan Negara. *https://heritage.gov.my/muat-turun/category/16-penerbitan.html?download=80:in-brief-ringkasan-jabatan-warisan-negara*

Ogale, S. (2023). Rainwater harvesting system | Description, Uses, Quality, & Configurations. *Encyclopedia Britannica*. *https://www.britannica.com/technology/rainwater-harvesting-system*

Raimondi, A., & Becciu, G. (2014). *Probabilistic modeling of rainwater tanks.* ScienceDirect*. https://doi.org/10.1016/j.proeng.2014.11.437*

Sehgal, J. D. (2005). A Guide to rainwater Harvesting in Malaysia. *Rotary International District 3310*. *https://pt.ircwash.org/sites/default/files/Sehgal-2005-Guide.pdf*

Shaari, S. M. (2020, Jun 25). An Overview of Rainwater Harvesting for Sustainable Future in Malaysia. View of An Overview of Rainwater Harvesting for Sustainable Future, *https://ebpj.e-iph.co.uk/index.php/EBProceedings/article/view/2232/1162*

Shaheed, R., Wan Mohtar, W. H. M., & El-Shafie, A. (2017, May 31). *Ensuring water security by utilizing roof-harvested rainwater and lake water treated with a low-cost integrated adsorption-filtration system.* ScienceDirect. https://www.sciencedirect.com/science/article/pii/S1674237017300534?via%3Dihub

Stacey, A. (2009, September 21). What is a Mosque? The Religion of Islam. *https://www.islamreligion.com/articles/2748/what-is-mosque/*

The Texas A&M AgriLife Extension Service. (2023). Catchment Area | Rainwater Harvesting. *Rainwater Harvesting. https://rainwaterharvesting.tamu.edu/catchment-area/*

Yusof, A. F., Mohd Zaki, M. Z., AbdulHamid, H., & Husain, F. H. (2020, September 3). A Study of Mosque Water Consumption using Self Closing Tap*. (Vol 21 No 2 (2020)). https://doi.org/10.37231/jimk.2020.21.2.497*

Pejabat Perpustakaan
Librarian Office

Universiti Teknologi MARA
Cawangan Perak
Kampus Seri Iskandar
32610 Bandar Baru Seri Iskandar,
Perak Darul Ridzuan, MALAYSIA
Tel: (+605) 374 2093/2453 Faks: (+605) 374 2299

UNIVERSITI TEKNOLOGI MARA

Surat kami : 700-KPK (PRP.UP.1/20/1)
Tarikh : 20 Januari 2023

UNIVERSITI TEKNOLOGI MARA PERAK
TERIMA
25 JAN 2023
Tindakan
Universiti Teknologi MARA Perak
PEJABAT REKTOR

Prof. Madya Dr. Nur Hisham Ibrahim
Rektor
Universiti Teknologi MARA
Cawangan Perak

Tuan,

PERMOHONAN KELULUSAN MEMUAT NAIK PENERBITAN UiTM CAWANGAN PERAK MELALUI REPOSITORI INSTITUSI UiTM (IR)

Perkara di atas adalah dirujuk.

2. Adalah dimaklumkan bahawa pihak kami ingin memohon kelulusan tuan untuk mengimbas (*digitize*) dan memuat naik semua jenis penerbitan di bawah UiTM Cawangan Perak melalui Repositori Institusi UiTM, PTAR.

3. Tujuan permohonan ini adalah bagi membolehkan akses yang lebih meluas oleh pengguna perpustakaan terhadap semua maklumat yang terkandung di dalam penerbitan melalui laman Web PTAR UiTM Cawangan Perak.

Kelulusan daripada pihak tuan dalam perkara ini amat dihargai.

Sekian, terima kasih.

"BERKHIDMAT UNTUK NEGARA"

Saya yang menjalankan amanah,

SITI BASRIYAH SHAIK BAHARUDIN
Timbalan Ketua Pustakawan

nar

Setuju.

27.1.2023

PROF. MADYA DR. NUR HISHAM IBRAHIM
REKTOR
UNIVERSITI TEKNOLOGI MARA
CAWANGAN PERAK
KAMPUS SERI ISKANDAR