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Research paper



Consumer Awareness Towards Rainwater Harvesting System in Selangor, Malaysia

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Abstract

Reusing water and implementing rainwater-harvesting system are an effective way to reduce the usage of treated water at home. A study on consumer's awareness towards Rainwater Harvesting System (RWHS) in urban areas of Malaysia is less explored among researchers. This study was to identify the level of consumer's awareness on RWHS among domestic water users in Gombak District, Selangor. Quantitative approaches were applied through individual distribution of structured questionnaires to 397 domestic water users in the study area from December 2016 to February 2017. The data was analyzed using SPSS version 21. Based on the results of quantitative analysis, four major constructs emerged namely 'the advantages of RWHS', 'alternative water sources', 'consumers' concern' and 'consumers' willingness'. The total mean scores (total average score) for each construct in ascending order are 3.48 for consumers' readiness, 3.81 for advantages of RWHS, 3.98 for alternative source, and 4.09 for consumers' concern. The findings provide important contribution to water conservation practices in the country as RWHS is considered greener, more efficient, more self-reliant with sound technology.

Keywords: *Consumer awareness; Rainwater harvesting system; Alternative water source; Water saving.*

1. Introduction

Water is a fundamental individual basic necessity. In Malaysia, the sources of water are considered abundant but due to the contamination of water resources, water wastage, urban sprawl and climate change, the availability of clean and safe water is devastatingly declining [1-3]. Therefore, the consumers' behaviour towards water resources and an efficient management system are important in ensuring that domestic and non-domestic water users are aware of water savings principles.

The Indian Institute of Technology Guwahati defined RWHS as the technique of collecting and storing surface rainwater (storage tanks) before it is lost as surface water runoff. Generally, the rainwater can be used both for drinking and non-drinking purpose. The rainwater used for consumption should firstly be treated, especially the rainwater in the urban areas. The rainwater harvesting system (RWHS) is the earliest proven technology originating from India and dated as early as the third millennium BC. Throughout history, civilisations around the globe had used rainwater to supply their water demands.

This research aims to examine the level of consumers' awareness on the rainwater harvesting system (RWHS) in Gombak District, Selangor, Malaysia. The notion of consumers' awareness has been chosen as a study theme due to consumers' reckless behaviour of water usage. This has worsen due to the rising domestic water consumption per capita and lack of efficient water management, especially in Malaysia [3-6].

2. Literature Review

Green technology as part of environmentally friendly technology outlines various methods to reduce negative environmental impact. It is an application of knowledge towards enhancing human activity practically [7]. Hence, green technology can be formulated as a knowledge application to improve the rules to mitigate and curb the negative impacts on the environment caused by human activities.

Green technology has multiple branches and it encompasses resource extraction from the environment on how to manage daily waste. Among these are green acquisitions, green manufacturing, green packaging, and zero waste base [8]. In short, green technology is interconnected in various ways to consumer's daily life. Among the essence of Green Technology Policy related to water conservation is to conserve and minimize the impact of human activity on the environment. Users can also improve their quality of life by implementing all Green Practices such as 3R or Reduce, Reuse, Recycle as it minimizes the natural resource devastation [7].

Water reuse and rainwater harvesting are an effective way to reduce the use of clean water at home [9]. Rainwater, snow, and hail are natural waters that fall from the sky and they are available in large volume. Malaysia is located entirely in the equatorial zone which climate is controlled by the Northeast Monsoon and the Southwest Monsoon. Heavy rains that struck the East Coast of Peninsular Malaysia often caused major floods due to the Northeast Monsoon from October to March and it also caused rainy seasons in Sabah and Sarawak.

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On the contrary, the Southwest Monsoon occurs between May and September causes hot climate in the whole country. The period between the two monsoon seasons in April was attended by heavy rain. The current movement of water through various stages in the hydrological cycle is not subject to space and time, resulting in extreme climatic conditions such as floods or droughts [10].

Climate change adaptation measures need to be increased to minimize the impact of extreme weather that is increasingly frequent and severe. This effort reduces the risk of socioeconomic growth, ensures the water, food and energy needs and ultimately protects the development outcome. The RWHS is a green technology instrument and an alternative to hydraulic engineering systems that promote the use of rainwater as an additional source of non-portable water use [7, 11-13].

According to the Town and Country Planning Department [12], the initial initiative of the implementation of the RWHS in Malaysia began in 1998 following the water crisis in Selangor and Federal Territory of Kuala Lumpur. Furthermore, the government has approved the implementation of RWHS at the Local Authority level (PBT) to minimize water supply problems. Agencies involved such as the Ministry of Housing and Local Government, the Department of Irrigation and Drainage (DID), the National Hydraulic Research Institute of Malaysia (NAHRIM) as well as local governments such as Municipal Council in each state have been directed to implement RWHS in their administrative areas.

Based on a recent study done by NAHRIM, the rainwater in urban areas contains toxic metallic of plumbum that exceeds the limit accepted as stated in the guideline issued by the World Health Organization (WHO) and it is too acidic. The accepted reading should be between pH 6.5 to pH 8.5 [17]. The rainwater that flow through RWHS is usually used for toilet, floor washing, watering plants and general cleaning works, as well as in reducing the use of treated water resources for general use [9, 13-15].

The installation of RWHS is also aimed at instilling awareness amongst society member in order to conserve more water resources and also support the Green Neighborhood Action Plan that is being communicated by Ministry of Housing and Local Government. Table 1 shows the rainwater demand for domestic use issued by the Department of Irrigation and Drainage, Malaysia [14].

Table 1: Rainwater Demand for Domestic Use

Purpose	Type	Average Usage	Average Number of Rainwater Demand
A. Internal			
Toilet	Single Flush	9 liters per flush	120 liters per day
	Dual Flush	6 or 3 per flush	40 liters per day
Washing Machine	Twin Tub (semi-auto)		40 liters per day
	Front Loading		80 liters per laundry
	Top Loading		170 liters per laundry
Dishwasher	-		20 – 50 liters per laundry
General cleaning	-	10 - 20 liters per minute	150 liters a day
B. External			
Sprinkler / Handheld Hose	-	10 – liters per minute	1000 liters per hour
Drip System	-		4 liters per hour
Hosing Path / Driveways	-	20 liters per minute	200 liters per hour
Washing the Car with Running Hose	-	10 – liters per minute	100 – 300 liters per hour

The researchers categorized RWHS projects that have been implemented in Malaysia according to the types of buildings. Based on the Center for Water Resources Studies (PKSA) sources, NAHRIM and the Department of Irrigation and Drainage (DID), (2016), there were 61 rainwater harvesting projects implemented, including 11 residential building projects, 50 non-residential projects comprising 31 offices such as government offices, seven educational institutions and 12 public-sector occupations. The cost of a RWHS project varies according to the size or capacity of the built-in storage tank. It also depends on the user's use or intent [9, 14].

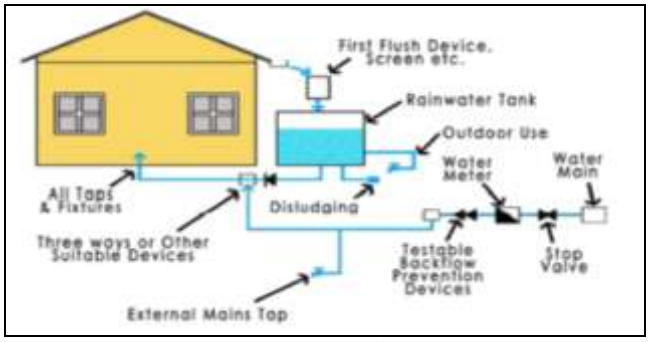

Fig. 1: Component of RWHS

Based on the researchers' review, among 31 office buildings installed with RWHS in Malaysia, almost half of the total number of projects (office building), 51 percent of the RWHS are used for cleaning purposes, toilet flushing, watering trees and landscapes. The lowest percentage, which is 11 percent with only seven buildings, is derived from educational institution compound which are mostly located in the state of Selangor [9, 14]. This means that the implementation of RWHS for educational buildings such as schools or universities should be more encouraged by stakeholders. The study shows that the RWHS for government office buildings is implemented more systematically than other building projects.

In the 11th Malaysia Plan, the country will implement notion shifting from a conventional development trajectory to a more sustainable green growth. The transition will put Malaysia among other developed countries in 2020 with a strong economy but highlight awareness against the impact of climate change as well as the supply of natural resources such as adequate, safe water, food and energy. Collaboration and sharing of responsibilities across all walks of life including individuals are important in protecting the environment and biodiversity. The success of green growth not only widens economic opportunities but also increases inclusivity and reduces disaster risk [23, 7].

For the purpose of spreading the notion of the green technology use, the government launched the Green Building Index (GBI) in May 2009. GBI is a green rating index of environmentally friendly buildings. Eco-friendly buildings are available to save utility costs and preserve the quality of the environment. Among the criteria in GBI is effective water management, which recognizes two marks for green building ratings. The criteria for Green Building for Township also emphasize the efforts to minimize water use for overall development. A total of four marks are set for water use reduction initiatives through urban planning [7].

To facilitate individuals (consumers) and housing developers who are interested or involved with the installation of RWHS, government agencies have issued guidelines on rain harvesting systems. Among the existing guidelines pertaining to the RWHS are set out in Table 2.

Table 2: Guidelines on Implementation of RWHS in Malaysia [9, 14, 7]

	List of Guidelines	Description
1.	Guidelines for Installing a Rainwater Collection and Utilization System (1999)	Provided by the Ministry of Housing and Local Government. Provides RWHS installation guidance for buildings that contain RWHS installation components, rainwater quality and affordable RWHS de-

		signs.
2.	Rainwater Harvesting Guidebook Planning and Design (2009)	Provided by the Department of Irrigation and Drainage (DID). Provides technical guidance for RWHS implementation for buildings and RWHS for Landscape.
3.	Urban Stormwater Management Manual for Malaysia: 2nd Edition (2011)	Provided by the Department of Irrigation and Drainage (DID) MSMA 2nd Edition: Chapter 6 describes RWHS designs in Malaysia for the use of rainwater for non-drinking purposes.
4.	Guideline on Eco-Efficiency in Water Infrastructure for Public Building in Malaysia	Provided by NAHRIM. Provides effective water management guidance in public buildings both for new or retrofit buildings

3. Methodology

The Gombak district was chosen for the study area due to its frequent water supply disruption as compared to other states in Peninsular Malaysia. The data collection was carried out in December 2016 until January 2017 from 400 respondents in Gombak, Selangor using simple random sampling and 397 respondents returned the questionnaires. The data were analyzed using SPSS version 21. In determining the level of awareness, the researcher used the Woo Mean Determination Scale (2008) as the measurement [16].

4. Results and Discussion

A total of 180 male and 217 female respondents was involved in the study, who were Malays (71%), Chinese (23%) and India (6%). Based on Table 3, there are 14 items representing the dimensions of the RWHS divided into four main constructs namely the advantages of rainwater harvesting systems, alternative water sources, consumer concerns and consumer readiness. The Likert Scale (5 points) has been used to evaluate the score from 1 = Strongly Disagree, 2 = Disagree, 3 = Not Sure, 4 = Agree and 5 = Strongly Agree.

Table 3: Percentage of distribution, item mean, standard deviation and level of RWHS dimension according to construct

Statement	Mean (Item)	Total Mean	Std. Dev.	Level
1. The advantages of RWHS				
i. I agree RWHS help save the cost of households	3.76			
ii. I agree RWHS is one of the water crisis solution	3.80			
iii. I agree RWHS help overcome the problem of water supply in rural areas	3.88	3.81	.59	High
iv. I agree RWHS can reduce the demand of treated water supply	3.77			
v. I agree RWHS help can reduce the cost of water treatment	3.82			
2. Alternative Resources				
i. I agree rainwater collected are high quality if it is collect in the right way	3.94			
ii. I agree if rainwater is used as your water supply during water crisis	3.92	3.98	.58	High
iii. I agree rainwater can be used for a variety of usages	4.08			
3. Consumer Concerns				
i. I extremely concerned about water pollution in my country.	4.40			
ii. Malaysia government's laws should restrict water pollution	4.28	4.09	.56	High
iii. I followed the 3R campaign - Reuse, Reduce and Recycle in everyday life	3.75			
iv. Green practice involve own role is significant compared to government role	3.92			
4. Consumer Willingness				
i. I agree to install a system that is expensive but it gives a lot of benefits	3.44	3.48	.78	Moderate
ii. I agree installation cost of RWHS is high because it involves a lot of basic components	3.52			

** Std. Dev. = Standard deviation.

In general, most respondents in the district of Gombak, Selangor recognise the advantages of RWHS (Total mean value = 3.81, standard deviation = 0.59) and RWHS function as alternative water source (Total mean value = 3.98, standard deviation = 0.58 when each score is high). Table 3 also shows that consumer awareness is high when the mean value of the RWHS is the highest value compared to other constructs with the total mean value reading = 4.09 and the standard deviation = 0.56. In this construct, the analysis also found that 367 respondents or 92.4 percent were very aware about water pollution in Malaysia. This attitude is the individual's tendency in giving a positive response in assessing what s/he experienced.

However, these findings contradict the study conducted by [19] who found that the level of awareness of the Malaysian society on the importance of maintaining the environment is still at a very low level and almost disappointing. Campaigns to raise awareness are important because awareness campaign is able to increase the level of water saving practices. The findings are supported by previous studies that awareness campaign factors significantly influence the practice of water conservation [4, 17-21]. Previous study in the developed country reconfirm that awareness campaign and behavioural promotional efforts on water conservation have positive impact to reduce water consumption by 57% in Melbourne, Australia [24], 18 % or about 17 liters per person per day in Zaragoza, Spain [25] and 20% in California, U.S. [26].

In the context of Selangor, the residents in Gombak have provenly shown that they are concerned about the environmental issue. However, consumers' willingness to install RWHS at their own residences is still at moderate level. Only half of the total number of respondents, 205 or 51.7 percent, agreed to install expensive systems if they think it would benefit them. While other residents explain that more than half, 222 respondents or 55.9 percent opined that the cost of installing RWHS is costlt as it involves many basic components. Researchers argue that one contributing factor of residents' reluctance to install RWHS is lack of detailed an accurate information about RWHS. A previous study by [22] proves that the average cost of installing RWHS requires a minimum amount of RM1,000 (or equivalent to USD250) per household, which is considered affordable and beneficial in the long term to offset the rising utility bills.

5. Conclusion

Urban residents need to be exposed to the diverse advantages of rainwater harvesting technique for various usages. Rainwater can be used for watering trees, washing yard, washing car and drainage. For expanded use, the Research Center for Water Resources and Climate Change (NAHRIM) has conducted a study on the potential use of rainwater for drinking (bottled drinking water) through the implementation of an incubator system research project built at the Hydraulic and Instrumentation Laboratory Building [9]. The government also needs to increase campaigns to increase consumers' awareness, which can be done through printed

and electronic media. Community centers in Selangor should be equipped with RWHS facilities as reference models for surrounding communities to see the benefits and eventually increase their awareness to install the facilities.

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