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RESEARCH ARTICLE

Water pollution potential and management strategies of UTM skudai food courts greywater system : A questionnaire – based study

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Abstract

Rapid urbanisation and population expansion in Malaysia have resulted to both an ever need for water use and an increase in water pollution. Supply of water in general, as well as water quality, is a key challenge in Malaysia. Lakes and reservoirs serve as residential, commercial, agricultural, navigational, hydroelectric, and recreational water supplies. As rivers provide 98 percent of the world's water, river pollution is a serious issue as more rivers get contaminated. This study is focusing on the public awareness on the potential of the greywater discharge from the café and laundry to the nearest river at UTM Skudai. Generally, about 64 sets of survey questionnaires were distributed to students and university personnel who commonly visit Arked Cengal. Arked Meranti and Arked Angkasa. Also there will be interview session with the stall workers to interview about the management of the greywater discharge.

Keywords: Public Awareness, Water Pollution, Greywater, Average Index Analysis Method, Frequency Distribution Analysis Method.

INTRODUCTION

Malaysia is a fast expanding country capable of competing with other Asian nations like Singapore and South Korea. As a result of this accomplishment, there has been an upsurge in development in regions along rivers throughout the country. Peninsular Malaysia has 150 significant rivers running through it, according to the Department of Environment (2008). The Sungai Pahang, Kelantan River, and Perak River are among Peninsular Malaysia's longest rivers.

The water pollution in Malaysia may be traced back to both point sources and non-point causes of contamination. The sewage treatment plants, manufacturing and agro-based businesses, and animal farms that have been identified as potential point sources are as follows: The majority of pollution coming from non-point sources comes from scattered activities like farming and surface runoff.

Wastewater produced by sinks, showers, bathtubs, and washing machines is referred to as greywater. Greywater is often not treated in Malaysia before it is utilised for irrigation or toilet

flushing. To make the greywater safe for reuse, greywater treatment facilities are in place in several Malaysian buildings and communities.

Problem Statement

River pollution refers to the contamination of the water bodies that rivers drain into, which is often the consequence of activities carried out by humans. When toxins are released into the natural ecosystem, river pollution is the inevitable effect. The contamination of water can be attributed to a broad variety of factors, such as physical characteristics, chemical agents, and infectious agents. Both organic and inorganic compounds might be classified as contaminants.

The pollution of water that comes from factories is called point source pollution, however the majority of the water that comes from nonpoint sources is contaminated by everyday people. This is how fresh water turns into waste water in the first place. Almost everyone puts some kind of chemical down their drains or toilets, and the types of chemicals vary. Even the detergents that are used in our washing machines and dishwashers make their way into our rivers and seas in the long run.

Arked Cengal, Arked Meranti and Arked Angkasa were one of the food court in Universiti Teknologi Malaysia located inside the campus. It produced the effluent that mostly consists of kitchen wastewater, and laundry discharge where it is being drawn directly into the river. The study is being held to identify the awareness among the public that frequently visit to those food courts on the potential of water pollution from greywater discharge. Moreover, this study performed to find out the best strategies to manage the greywater discharge from the food courts in UTM Skudai.

In Malaysia, greywater is not typically treated before it is used for irrigation or flushing toilets, but there are a number of buildings and communities that have implemented greywater treatment systems in order to make the greywater safe for reuse. These systems can include physical, chemical, and biological treatment methods to remove pollutants and make the greywater safe for reuse.

Objectives

The objectives of this study are:

1. To compare the awareness about the greywater between the food courts users in UTM Skudai.
2. To identify the level of awareness among the public about the potential for water pollution because of greywater discharge from the food courts in UTM Skudai.
3. To propose the strategies to manage the greywater waste discharge from the food courts in UTM Skudai.

Scope of Study

Based on the problem statement and questions that have been identified, the scopes of the study are ;

1. Data collection will be focused on the public awareness about the potential water pollution from greywater at three different food courts in UTM Skudai which is Arked Cengal, Arked Meranti, and Arked Angkasa.
2. Questionnaire to be distributed among the students and staff.
3. Interview survey which aim to get the opinion from the students and also the stall workers at the studied food courts.

Literature Review

Global water pollution is mostly a consequence of industrialization and population increase. Numerous anthropogenic and industrial activities, including agriculture, mining, and sewage discharge, as well as the accumulation of chemicals, oil, and pesticides, represent a major threat to surface water quality(Khatri et al., 2020).

Water pollution reduces the amount of exploitable resources, raises the cost of water treatment for humans and the environment, and endangers human and animal life. Therefore, it is necessary to protect the water's supplies and maintain its superior quality. The deteriorating condition of several bodies of water is becoming more and more apparent. Humans are especially vulnerable to water pollution(Zeber-Dzikowska et al., 2022).

Malaysia has a significant problem with water pollution, which poses a danger to water supply management. One of the issues is when the cost of purifying polluted water is significant and restricts the overall water supply. In 2019, the Kim River in Pasir Gudang (Johor) is contaminated with toxic chemicals, interrupting the water supply for over 20,000 households.

The control of pollution and the purity of river water need prompt attention. Because the river provides 98% of the community's total water consumption. The quality of river water in Malaysia tends to degrade as the economy and population develop. During the monsoon season, when there is hardly enough water to dissolve the items dumped into the river, the river itself encounters a number of challenges. Consequently, there are water contamination problems (Rahman, 2021).

The Kim Kim River is one of the largest cases of water pollution in Malaysia. During the March incident of pollution, prepared waste was unlawfully thrown into the Kim Kim River, according to the National Police Chief. Outside of Pasir Gudang, a tanker truck dumped 2.43 tonnes of chemical waste, discharging a variety of dangerous chemical waste. The contamination of the Kim Kim River resulted in substantial economic losses. A length of 1.5 kilometres of the river was cleaned at a cost of around RM10 million. In addition to Kim Kim River cleaning efforts, the government has established a scientific committee to investigate the toxins' origins, environmental fate, and impact on human health and the ecosystem (Abdo Alkhadher et al., 2016).

Greywater is urban wastewater generated from showers, bathtubs, washing and drying basins, domestic appliances, dishwashers, and kitchen sinks, but not toilets. 50–80% of all household wastewater is greywater. In terms of organic content, greywater has characteristics with all municipal wastewater. As greywater does not include urine, it contains a negligible amount of nitrogen, mostly as organic nitrogen particles. Globally, several greywater treatment systems have been implemented, with varying degrees of complexity and effectiveness. However, the majority of greywater treatment systems include a biological stage, and the performance of biological treatment may be affected, especially on a small scale, by fluctuations in greywater concentration and velocity (Li et al., 2008).

Decentralized restoration and reuse of domestic effluent is regarded one of the possibilities to improve water accessibility for irrigated agriculture and lessen the health hazards associated with a lack of improved hygiene in rural settlements of agriculturally- dependent developing countries. Greywater reclamation is particularly important for resource recovery in household gardens or restricted irrigation systems, since it has a smaller percentage of organic compounds and pathogens than conventional wastewater (Funamizu, 2019).

MATERIALS AND METHODS

In this chapter, the process of the research will be discussed to achieve the aim and objectives of the research about public awareness of potential water pollution from greywater discharge in Arked Cengal, Arked Meranti, and Arked Angkasa, UTM Skudai. Besides, the method use throughout the study have been identified according to the literature study in chapter 2. The method also can be referred as the instruments to analyze data into statistic or sampling such as graphs or charts. The method of this research started with the initial discussion in selecting the research topic and ended with the final report documentation.

All the information used in this study are from various type of source such as journals, books, websites, previous research and study and conference paper. The information will be used in literature review to gather secondary data and information related to research study. The methodology of the research plays an important role to give a good and quality data for the outcome of the research.

Furthermore, the research methodology has been set to make sure that it achieved the objective of study such:

1. Questionnaires survey form will be used to classify the awareness about the greywater and then compared between the studied food courts to accomplish the first objectives.
2. Questionnaires survey form will be used to identify the level of awareness about the potential for water pollution because of the greywater discharge from the food courts in order to achieve the second objectives.
3. Interview survey will be carried out to propose the strategies to manage the wastewater discharge from the food courts in order to achieve the third objective.

The information from the survey will be gathered in Microsoft Excel and the outcome will be calculated using mathematical approach such as frequency distribution method and mean value method. Then, the data will be illustrated in pie charts, bar charts and tables.

Methodology Flow Chart

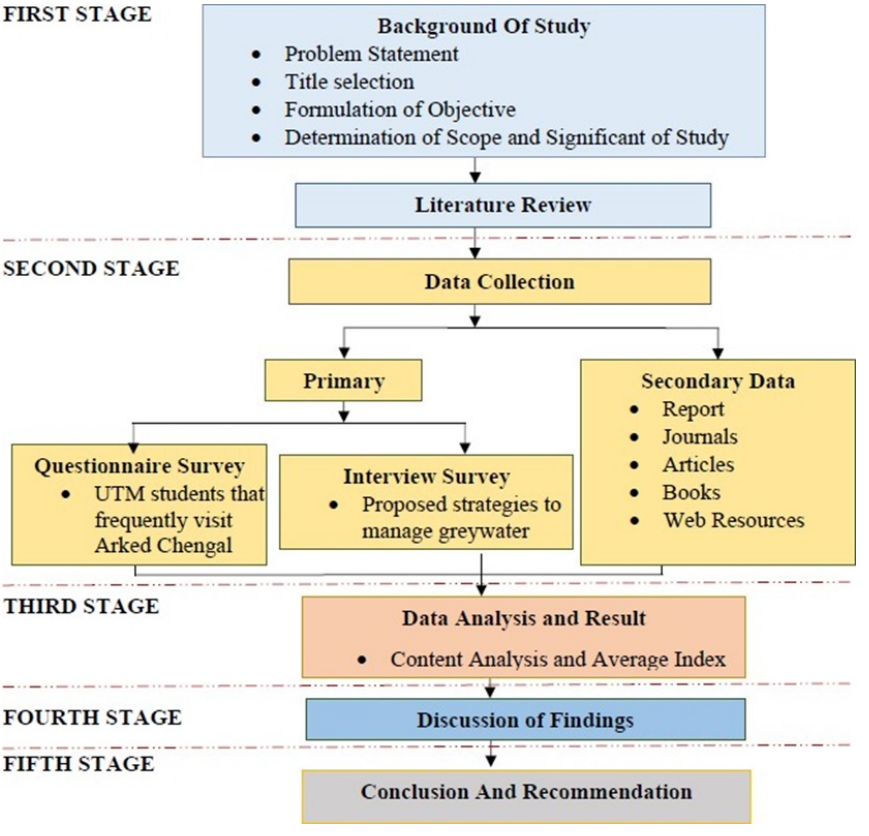

Figure 1. Research methodology flowChart.

Operation for Achieving Objective

Table 1. Operation used to achieve the study

No	Objectives	Method	Tools	Analysis	Expected Outcomes
1	To compare the awareness about the greywater between the food courts users in UTM Skudai.	L,S,Q	Questionnaire	a. Content analysis b. Distribution of frequency c. Average Index	The level of awareness about the greywater among the students, staffs, and stall workers
2	To identify the level of awareness among the public about the potential for water pollution because of greywater discharge from the food courts in UTM Skudai.	L,S,Q	Questionnaire	a. Content analysis b. Distribution of frequency c. Average Index	The various opinion and level of awareness of greywater might polluted the river among the students, staffs, and stall workers
3	To propose the strategies to manage the greywater waste discharge from the food courts in UTM Skudai.	L,Q,I	Questionnaire	a. Content analysis b. Distribution of frequency c. Average Index	The potential strategies to manage the greywater discharge from the food courts

L= Literature Review; S= Survey; Q=Questionnaire; I=Structured Interview

Structure of Questionnaire

The purpose of questionnaires is to accomplish the aims and goals of the research project, as described in Chapter 1. Therefore, the layout of the questionnaire is one of the crucial factors for obtaining accurate and superior findings. A good questionnaire should comprise the following three components: general structure, question sequence, and phrasing or language of the question. The overall form of the questionnaire addressed the question's structure, which demanded that it be rigorous and particular.

Next, the sequence of the question needs to be clear and continuous. It is important to make sure all the questions can easily understand by the respondents. The attitude of the respondents can be influence by the early question, so it is important to avoid question that need high use of memory, question about personal wealth and character. It is suggested to start the question with general information followed by specific question.

For this research, the aims are to study about the public awareness among the people at Arked Cengal, Arked Meranti and Arked Angkasa about the potential of greywater pollution to come out with the strategies to overcome the problem. Therefore, the questionnaire form will be divided into three section which are:

Part 1 : Respondents' Background
Part 2 : Awareness about the potential for water pollution from the food courts by greywater discharge
Part 3 : Greywater discharge management
Part 4 : Recommendations for proper greywater discharge management

Questionnaire Distribution

The data that have been collected using the questionnaires survey form will be analyzed using frequency distribution and average index methods. The results obtained will be presented using charts, table, and graphs to get a better understanding and more systematic. Next, the discussion based on the results obtained will be carried out to compare with the data from literature review that have been discussed in Chapter 2. In addition, the factors that lead to high percentage or low percentage in the result obtained will be discussed further in Chapter 4.

Frequency Distribution Analysis Method

This method is a frequent method used to organize data or statistics in graphical or tabulation to show number of individuals for each observation in the selected interval. The method can help researchers to see the overall data accurately and understand it easily. The frequency for each segment can be obtained by using the formula:

$$\textbf{Frequency} = (n/N) \times 100\%$$

Where:
n = Frequency of Respondents
N = Total of Respondents

Average Index Analysis Method

This method is the most suitable method to analyze data because usually, questionnaires survey form used Likert Scale that consist of five-point scale to know the percentage of the respondents agree or not with the statement. The calculation of Average Index Analysis will be done using software like Microsoft Excel. The formula of Average Index shows as below:

$$\textbf{Average Index} = \sum \alpha\alpha\alpha \sum \chi\alpha\alpha / \sum \chi\alpha\alpha$$

Where;
$\alpha\alpha\alpha$ = Constant represents the weight for i
$\chi\alpha\alpha$ = Variable represents the frequency of respondents for i
i = 1, 2, 3, 4, 5,…

The average point obtained according to the type of data that have been analyzed are referring the data from Table 3.2 below that illustrates the Likert Scale and Average Index Classification for Objective 1, 2 and 3.

Average Index Classification Range

Table 2. Average index classification range

Scale	AI Classification Range	Attribute for Objective 1	Attribute for Objective 2	Attribute for Objective 3
1	1.00 a < 1.50	Don't know	Very Disagree	Very Disagree
2	1.50 a < 2.50	Once heard	Disagree	Disagree
3	2.50 a < 3.50	Neutral	Neutral	Neutral
4	3.50 a < 4.50	Maybe	Agree	Agree
5	4.50 a 5.00	Know	Very Agree	Very Agree

RESULTS AND DISCUSSION

The were total 64 respondents from all the mentioned food courts - Arked Cengal, Arked Meranti, and Arked Angkasa. At least there were 20 respondents from each of the food court. Eventhough the respondents were not many as expected, but we still can make some conclusions from the data collected.

Table 3. Socio – demographic characteristics of the respondents

Demographic Information	Response	Cengal		Meranti		Angkasa		Total	
		n	%	n	%	n	%	n	%
Gender	Male	14	60.9	10	47.6	10	50.0	34	53.1
	Female	9	39.1	11	52.4	10	50.0	30	46.9
	Total	23	100.0	21	100.0	20	100.0	64	100.0

Age Group	< 20 years old	5	21.7	3	14.3	4	20.0	12	18.8
	20-30 years old	18	78.3	15	71.4	14	70.0	47	73.4
	31-40 years old	0	0.0	3	14.3	2	10.0	5	7.8
	41-50 years old	0	0.0	0	0.0	0	0.0	0	0.0
	> 50 years old	0	0.0	0	0.0	0	0.0	0	0.0
	Total	23	100.0	21	100.0	20	100.0	64	100.0

In Table 3, there are some of the socio – demographic characteristics of the respondents collected. As example, there were more male respondents (53.1%) than female respondents. Also, there were variety of age group of the respondents.

To meet the first objective, the data obtained from the survey questionnaire were compared between the respondents from three different food courts in UTM Skudai.

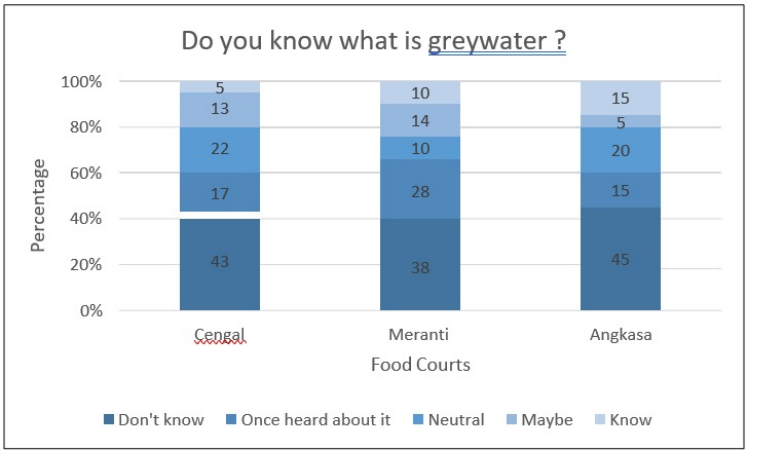

Figure 2. Respondents knowledge about the greywater.

According to the data from Figure 2, at least more than 40% of the respondents from each of the food courts were do not even know what is greywater actually was. As the majority of them does not even know what is greywater actually, this can be concluded that the respondents were mostly having less awareness on greywater. This conclusion came out as the term 'greywater' itself is quiet rarely used in daily life practices. Instead, they just know about the source of the greywater like kitchen sink water, showers and washing machines water. Among this three studied food courts, more percentage of the respondents from Arked Meranti were heard and know about the greywater compared to the respondents from Arked Cengal and Arked Angkasa.

For the second objectives, the data obtained from the survey questionnaires were further analyzed using Microsoft Excel and Average Index Analysis Method to gain the average results from the total respondents. Then, we can make a conclusion from the average data.

Table 4. Respondents frequency saw greywater discharge directly to the river

	Frequency	Percentage (%)	Valid Percentage (%)	Cumulative Percentage (%)
Never Saw	17	26.6	26.6	26.6
Saw at least once	10	15.6	15.6	42.2
Neutral	20	31.3	31.3	73.4
Sometimes	7	10.9	10.9	84.4
Most of the times	10	15.6	15.6	100.0
Total	64	100.0	100.0	

From the survey questionnaire, the respondents were asked if they might saw the greywater being discharge directly to the nearest river. Referring to Table 4.4, most of the respondents (31.3%) were neutral about the frequency saw the greywater being discharge directly to the river. There were 26.6% of the respondents that never saw the greywater being discharge to the river. Meanwhile, the respondents who saw at least once and the respondents who most of the times saw the greywater being discharge to the river shared the same percentage which both were 15.6%. However, only 10.9% of the respondents sometimes saw the greywater waste being discharge directly to the nearest river.

For the last objectives, the respondents were asked to choose the best current practices to manage the greywater discharge. Then there were also an open ended question to ask respondents opinion on improvement that can be made to have better greywater discharge management.

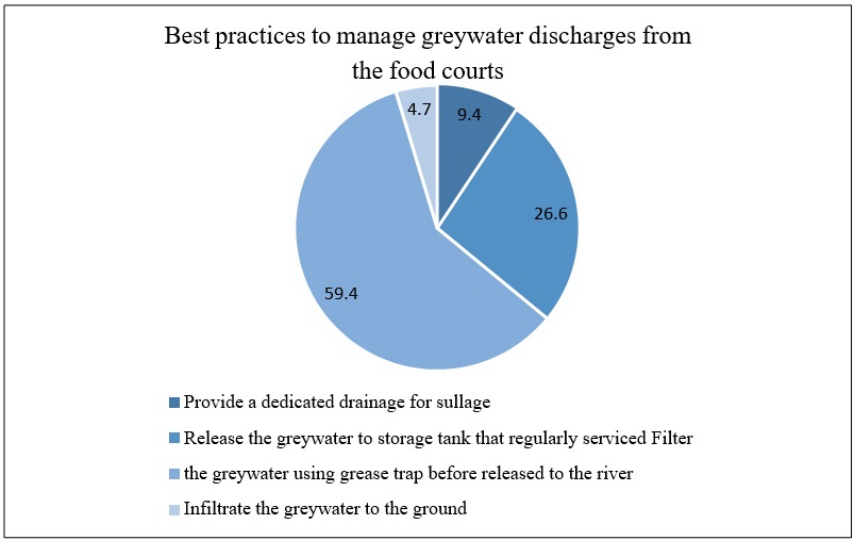

Figure 3. Current practices to manage greywater discharge from the food courts.

According to the Figure 3, all the provided practices were the current doing at the studied food courts. As we can see, majority of the respondents (59.4%) agreed that the greywater waste should be filter using the grease trap before released to the river. Next, 26.6% of the respondents chose release the greywater to the storage tank that regularly serviced. Th rest of the respondents chose provide dedicated drainage for sullage and infiltrate the greywater to the ground with 9.4% and 4.7% respectively.

CONCLUSIONS

In this paper, results of the analysis are that respondents that from Arked Angkasa seemed to be more about with the greywater compared to the respondents from Arked Cengal and Arked Meranti. Even though the results might have just slight different, but still the data is comparable.

For the level of awareness among the public about the potential of water pollution from greywater discharge, the results shows that people were at the middle level of awareness where they seemed concerned about the potential of water pollution. But still, the data shows that people tend to care and being more concern about the environment.

Last, the best current practices to develop more was filter the greywater waste using the grease trap before release it to the nearest river. While for improvement, the authorities should enforce the law for the stall operator who do not follow the proper ways to manage the greywater.

Author Contribution

Muhammad Aiman Bin Ponniran: Conceptualization, writing draft, writing review dan editing; Mohamed Zuhaili Bin Mohamed Najib: Data curation, formal analysis.

Conflict of Interest

There is no conflict of interest in this study.

Acknowledgment

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Data Availability

We thank all respondents involved in this research project.

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