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ORIGINAL RESEARCH ARTICLE

INVOLVEMENT OF THE GENERAL PUBLIC IN THE MANAGEMENT OF WATER POLLUTION IN Johor Bahru MALAYSIA

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ABSTRACT

Water is undoubtedly the most delicate component of the ecosystem, but it is essential for human and industrial advancement. As the population grows, so does the demand for water supplies and drinkable water. Water covers roughly 71percent of the total earth's surface and highly vital natural resource for humans. However, only 2.5 percent of the world's water is pure and thus drinkable. It is everyone's fundamental human right to have access to clean water. The purpose of this study is: to identify the current level of public involvement in water pollution management and to assess people's desire to participate towards reducing water pollution. The study's methodology is a quantitative approach for achieving the research objectives. A total of sixty-three (63) responses were reordered from the distribution of the questionnaires. The data collected were analysed using Microsoft Excel (2019) and simple percentage distribution tables and charts. The findings revealed that most of the participants have sewerage connections in their residences and that the water quality of their rivers is acceptable for majority of the participants. The study also indicated that water pollution is a grave concern for environmental and social health. In addition, it was observed that community involvement in water pollution decision-making processes was currently low on average, implying that authorities still have room to improve concerning water pollutant information delivery. Majority of respondents agreed that investing more money in water and waste management, and educating the public, are strategies to enhance water quality. Eventually, the findings revealed that the general public is enthusiastic about taking part in the fight against water pollution and are ready to participate in water pollution management in their community. The study recommends building a solid foundation to allow greater public involvement in decision-making and to enacting strict water pollution control policy.

1.0 Introduction

One of the most serious challenges facing the World today is the issue of environmental contamination. Water is perhaps the most fragile element of the ecosystem, yet it is necessary for human and industrial progress. The demand for water supply and drinkable water rises as the population grows (Afroz, *et al*., 2014). Water and its long-term usage had become strongly intertwined to advancements in other sectors such as industry, agriculture, and other services, also energy, environmental protection, and hygiene. Increased water consumption, poor discharge quality, and climate change have developed numerous water pollution problems that can only be addressed via concerted efforts of diverse stakeholders with collaboration and public participation (Teodosiu *et al.*, 2013). Water covers roughly 71percent of a total of the earth's surface and highly vital natural resource for humans (National Environment Research Council, 2007). However, only 2.5 percent of the world's water is pure and thus drinkable. It is everyone's fundamental human right to have access to clean water. Water pollution has consequences on drinking

water, rivers, lakes, and oceans around the globe, putting human health and the ecosystem at risk. Sewage and wastewater pollution, effluent, oil pollution, industrial discharges, anthropogenic activities, toxic chemicals, underground storage leakages, and global climate change are examples of water pollution (Gambhir *et al*., 2012). Polluted water would not harm an individual's health instantly, but it can be deadly over time. Toxic metals from industrial processes can build up in adjacent lakes and rivers posing a threat to marine species, and animals that consume the contaminated water, and human beings who consume animal products. Immunity repression, reproductive problems, and acute poisoning can all be caused by pollutants found in industrial waste. Infectious illnesses like cholera and typhoid fever, which are the leading causes of infant mortality, are frequently caused by microbial contaminants found in wastewater (Juneja and Chaudhary, 2013). Water is necessary across all life, including health, spiritual beliefs, safety, livelihood, and the global ecology. Individuals may place different values on the services supplied by an aquatic ecosystem. Climate change, population expansion, increasing agricultural output, and greater extraction are only a few of the factors hampering the world's water supply (Rolston *et al*., 2017). Sustainable Development Goal (SDG6) focuses on improving water quality by decreasing pollution, removing the discharge of dangerous chemicals, limiting the discharge of untreated wastewater, and enhancing waste management. SDG6 states that, "Ensure availability and sustainable management of water and sanitation for all." Population increase, expansion of agricultural, urban, factory output and pollution, and environmental degradation, on the other hand, are becoming to overburden and threaten nature's capacity to supply essential resources and activities. According to projections, in 2050, nearly half of the worldwide gross domestic product, 52 percent of the world's population, and 40 percent of total agricultural production will be at risk if the natural environment continuing to be polluted and excessive stresses continue on worldwide water supplies. Polluted water is a big challenge that plagues people across the globe. It affects the world's drinking water, rivers, lakes, and seas. As a result, it harms human health and global ecosystems. Water pollution does affect not only the current generation and future generations since its effects last a long time. If a body of water becomes contaminated in a particular region, all living things and humans become forced to consume the contaminated water because they have no other choice (Khatun, 2017). Water is polluted by hazardous and toxic chemical emissions, resulting in several issues such as human food safety and irrigation operations. It causes water shortages because it reduces the amount of water available to people and the environment. Polluted water is the primary cause of the water problem. Water should not be polluted beyond a specific level to utilize for irrigation and drinking purposes (Singh *et al*., 2020). According to (WHO, UNICEF ans GLAAS, 2021), universally, an " estimated 2.2 billion people do not have access to safe drinking water, and 4.2 billion do not have access to safe sanitation." The factors vary and are due to a variety of causes and conditions. Physical water shortages are the most common cause in extreme semi-arid lands that are prone to climatic changes that jeopardize their liveability. Unfortunately, the bulk of these 2.2 billion people are poor people who live near rivers or on polluted groundwater, not thirsty people without water in their living surroundings. Pollution has come at substantial risk, impacting water supply concerning quantity and quality for agriculture, navigation, recreation, and tourism, causing flooding and pollutants (Chan, 2012).

Water is the most vital source of survival that enables us to exist and keeps people alive. Everyone must drink fresh, pure water. Water becomes polluted because of natural and artificial sources, resulting in the emergence of various water contaminants. For people's health and protection against infectious illnesses, various water pollutants require removal from the water supply (Singh *et al*., 2020). Pollution of water is typically known as a change in the physical, chemical, or biological features of water that can affect aquatic and human life (Khatun, 2017).

In Malaysia, water pollution is a significant concern that harms the long-term viability of water resources. It also affects plants and organisms, as well as people's health and the nation's economy. It significantly

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affects the total water supply since the expense of treating polluted waterways is prohibitively expensive, and in some cases, wastewaters are unfit for human consumption. Because of river contamination, the vast amount of water resources available in the catchment doesn't assure enough distribution to all users (Afroz and Rahman, 2017). Within the river catchments, urbanization has increased urban density life activities. The quality of run-off inside a catchment usually alters because of urbanization, which affects the water quality of water bodies. Rainfall discharges toxins deposited on land surfaces into stormwater systems in developed areas. Sewage from residential, commercial, and industrial locations has a terrible odour, specifically when rubbish is present, degrades stormwater quality, and contaminates the present river basin. Although some pollutants originate from natural causes, the majority of pollution is dependent on human action (Afroz *et al.*, 2014). Water pollution has become a more serious concern, with data signifying a declining pattern year after year. On the other hand, Water contamination is not a new environmental problem; it had long become associated with development and modernity. Primarily the source of Malaysia's freshwater supplies 97 percent of the country's overall water supply (Afroz and Rahman, 2017). Malaysia has an abundance of rainfall and water resources. With an annual average rainfall of 3,000 mm, the river basin receives an estimated 566 billion m^3 of water (Afroz *et al*., 2014).

In recent times, public involvement in water management has grown exponentially. Multiple interconnected causes have propelled the rise of participatory decision-making procedures around the universe. Increasing public knowledge and awareness about links across environmental health and human well-being are the key drivers. People's expectations of participation in policy-making have risen as human rights have gained momentum in legal and political structures (Razzaque, 2009). The European Commission recognizes the significance of public involvement (PP) in water management in its Water Framework Regulation, which was the first regulation to ask member countries to engage and educate the public (European Enviroment Agency, 2014). Public involvement is commonly known as yielding individuals to have a say in the design and execution of a project. In general, there are three types of involvement: information dissemination, engagement, and active participation (European Comission, 2003). According to European Enviroment Agency (2014), the primary goals of public participation in water policy are to strengthen water management and raise awareness of environmental challenges through decision-making procedures. On the other hand, water specialists showed that the planet is not experiencing a catastrophe due to physical water shortages but rather a consequence of continuous poor supervision of its water management (Biswas and Tortajada, 2011). In most Western nations, the involvement of the public is a critical means of enhancing water quality through minimizing pollution, removing hazardous chemical discharges, lowering untreated wastewater discharges, and improved the management of waste (Li et al., 2018). Participation of the public has been proved to be efficient in a wide range of development activities, including preventing water pollution in previous studies (Dungumaro and Madulu, 2003; Kaji, 2012; Özerol and Newig, 2008).

Therefore, the aim of this study is to identify the current level of public involvement in water pollution management, and to assess people's desire to participate in efforts aimed at reducing water pollution.

1.1. Factors of Water Pollution

One of the most critical challenges nowadays is water contamination. Water is the most polluted of all-natural resources. The following are some of the contributing elements to water pollution: industrial development, plastics, and polythene bags, pesticides and fertilizers, sewage and other oxygen-demanding pollutants, residential sewage, population increase, urbanization, eutrophication, mining, agrochemical wastes, nutrient enrichment, thermal pollution, oil spillage, sediment disruption, acid rain pollution, radioactive waste, climate change (Afroz *et al*., 2014; Haseena *et al*., 2017; Kılıç, 2021). Domestic sewage is said to be responsible for 75 to 80 percent of water pollution. Pesticides, sugar, textile, paper, and pulp

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waste from electroplating industries pollute the water (Kamble, 2014). Water pollution and water resources have an unpleasant odour and are devoid of flora and animals. Water security is critical for 80 percent of the planet's population (Owa, 2013). A large amount of domestic sewage becomes discharged into the river, most of which is untreated. Solid trash, toxicants, plastic litter, and bacterial pollutants are all found in domestic sewage, and these toxic items pollute the water supply. One of the principal sources of water in various industrial waste becomes emptied into rivers without being treated (Kaprada and Valsad, 2014). The factors that contribute to water pollution as summarized in Figure 1.

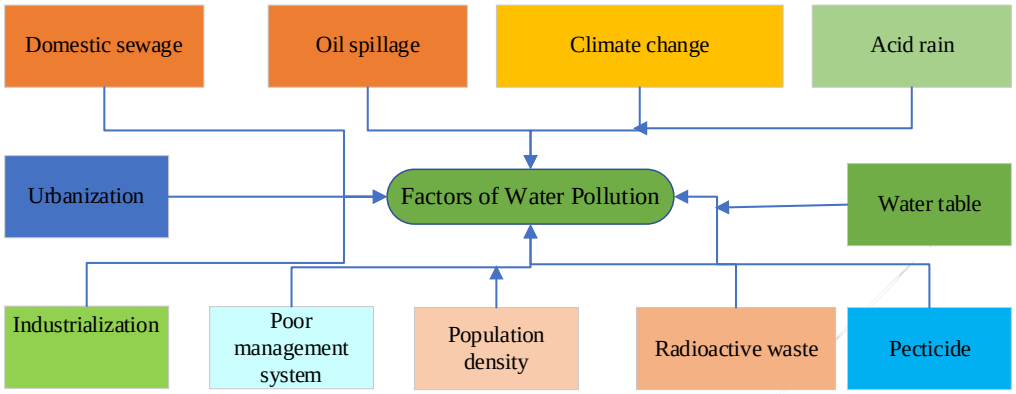

Figure 1: Factors of water pollution

Water pollution can be divided into two types: point sources and non-point sources. Pipelines and pipes are examples of point sources with discharges that enter a body of water at a selected point. Industries, sewage treatment plants, and animal farms are all examples of point sources. Non-point sources typically obtained from diffuse sources, such as agricultural activities and surface runoff, have no examples of discrete release locations (Afroz and Rahman, 2017). According to (Afroz *et al*., 2014), residential sullage, sewage systems, and industrial sites became considered as the fundamental point sources. Apart from these, the river system gets polluted by additional point sources such as a market, restaurant, workshop, residential area, solid waste disposal sites, soil and sand extraction, huge development area, aquaculture, commercial lots, gas station, cattle, and many others. Non-point source pollution impacts a water body through dispersed sources, and it can originate from a range of places. Non-point source pollution is more difficult to control than point source pollution. The distinction between point source pollution and non-point source pollution has depicted in Table 1.

Table 1. Point Sources and Non-point sources (Kılıç, 2021).

Point Sources	Non-point sources
Mine, oil-field, and unsewered industrial sites runoff	Agriculture-related runoff
Effluent from waste water	Pollutant activities on land
Integrated storm and sanitary sewer spills	Runoff from mines that have been abandoned
Animal feedlot runoff and intrusion	Leachate from septic systems and discharge from damaged septic tanks
Runoff from construction sites covering more than 2 hectares	Grassland and rangeland runoff
Outfalls from storm sewers in cities with populations more than 100,000	Over a water surface, atmospheric deposition
Waste disposal site runoff and leaching	Construction-related runoff
	Unsewered and sewered urban runoff areas with a population of 100,000 or more

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In Malaysia, 1,488,848 sources of water contamination were recorded in 2014, opposed to 1662329 sources in 2013. In 2014, there was a drop in the total number of sources of pollution when relative to 2013. Research done by manufacturing industries in 2000 revealed that the food and beverage industry accounted for 23.7 % of total pollutants in water, whereas energy and electronics showed 11.4 %. The chemical industry accounts for 11.2 % of contamination, while the paper industry accounts for 8.8 %. The finishing industry/textile sector accounts for 7.4% and 5.3 %, respectively, of the sources of water pollutants. Factory effluents, oil palm effluents, and rubber effluents created in water resources accounted for 5.3, 2%, and 2%, respectively. Overall, these types of factors affected Selangor, Johor, and Perak significantly. Selangor (414), Johor (384), Pulau Penang (328), and Perak had the highest concentration of water pollution sources in Peninsular Malaysia. In Peninsular Malaysia, these are also the most industrialized states (Afroz and Rahman, 2017; Muyibi et al., 2008).

1.2. Forms of Water Pollution

Pollution can be classified into several categories.
Organic Contaminants, Inorganic Contaminants, Radioactive Pollutants, Floating Solids, Pathogens, Nutritional and Agricultural Pollutants, and Thermal Contamination are all examples of pollutant types.

1.2.1. Organic contaminants

Carbon, hydrogen, oxygen, nitrogen, and sulphur are all found in organic compounds. Sewage, municipal wastewater, industrial wastewater, and agricultural waste all produce organic compounds. Oleic acid, palmitic acid, dodecanoyl chloride, and docosanoic anhydride are some examples of these acids. Organic pollution is known as when substantial volumes of organic substances got discharged into sewers from sources such as domestic activities, sewage, urban runoff, industrial wastewater, and agricultural waste (Ekevwe et al., 2018; Singh et al., 2020).

1.2.2. Inorganic contaminants

Drinking water pollution by hazardous compounds such as nitrate, ammonium nitrate, and heavy metals is a worry in developing nations. High amounts of inorganic nitrogen pollutants (nitrate, nitrite, ammonium) and inorganic phosphates in river water are caused by draining water from agricultural fields, releasing municipal/industrial sewage, and other factors that cause several health issues. Nitrite is a carcinogen by design, increasing the risk of stomach, liver, and esophageal cancer as well as raising ammonium levels in the body (Singh et al., 2020).

1.2.3. Radioactive Pollutants

Radioactive and nuclear pollution occurs when radioactive and nuclear pollutants get released into the water, air, or land due to nuclear explosions and accidents, nuclear weapons, or the handling or disposal of radioactive sewage. Because radioactive elements are harmful to the environment, plants, animals, and humans, they can pollute surface water bodies. Radioactive chemicals, such as radium and uranium, accumulate in the bones that can cause cancer (Manisalidis et al., 2020).

1.2.4. Thermal pollution

The decline of water quality caused by any catalyst to increase the rate the atmospheric water temperature is known as thermal pollution, or "thermal enrichment." The water utilized as cooling by industrial plant companies is one of the most common sources of thermal pollution. When cooling water gets released to the natural surroundings at a higher temperature, the abrupt shift in temperature reduces oxygen delivery and a consequence on ecosystem composition. A rapid transition in water temperature can harm fish and other species that acclimated to a specific temperature range. Hot cooler water has a long-term

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influence on water temperature, raising the total temperature of bodies of water, includes deep water. The distribution of these temperatures rises throughout the seawater, influenced by the season.

1.2.5. Agricultural Pollutants and Nutrients

In a nutshell, the widespread use of chemical fertilizers in agriculture has resulted in a wide range of environmental issues, as certain fertilizers include heavy metals (such as cadmium and chromium) and high radioactive concentrations. Phosphate, nitrate, ammonium, and potassium salts are all found in non-organic fertilizers. Toxic elements including mercury, cadmium, iron, arsenic, copper, and nitrate become placed in the soil and plant system. Fertilizers get absorbed by plants into the soil, and they can enter the food chain, contaminating the water (Savci, 2012; Singh *et al.*, 2020).

1.2.6. Pathogens

Bacteria, viruses, pillows, and certain parasites are pathogens that are tiny microbes that cause disease. Hepatitis and Norwalk viruses are frequent viruses found in wastewater, while Candida is a prevalent fungus. Food poisoning is often caused by the salmonella bacteria, while cholera gets generated by the pathogen Vibrio cholerae. Cryptosporidium and Schistosoma are two parasites that can cause diarrhoea, and all wastewater pathogens can cause significant gastrointestinal sickness (Singh *et al.*, 2020).

1.3. Pollutant Control and Management

With water pollution control and management, there are a plethora of techniques. It can be through prevention training activities or participation in a plan, legislation, and supervision or control methods such as waste reduction and minimization. Management of pollution can be done effectively by regulatory oversight. Most countries have passed a law to restrict forms of pollutants and to minimize pollution's negative impacts. Controlling pollutants and toxic substances into the air, water, and land or soil is known as pollution control. Waste materials from consumption, heat, farming, mines, production, transport, and other human activities, either they collect or spread, will deteriorate the environment if no proper pollution control is in place (Owa, 2013).

Water contamination, on the other hand, can be reduced by using the measures listed below.

- Water reuse and recycling.
- Using kitty litter, mop up oil and other liquid spills and sweep them up.
- Every 3-5 years, examines your septic tank.
- Plastic should be avoided at all costs.
- Pesticides and fertilizers that can run off into water systems should be avoided.
- Garbage, chemicals, and solvents should not be poured into sewer drains.
- Avoid flushing medications.
- Stop soil erosion by cleaning up the stream.
- Participate in school and at work.
- Lastly, enacting legislation to prohibit pollution of water (Khatun, 2017; Owa, 2013).

1.4. Involvement of the Public in Water Resource Management

Public participation freedoms can be incorporated into statutory provisions also specific environmental or other laws at the state level. For legal recourse, legal rights may establish official, informal, or quasi-judicial channels. They also go through procedure problems include rights in the interest of the public litigation or collective claims and legal representation. Alternative means for individuals to engage in impact assessment processes may provide by sector law. The efficiency of public engagement is directly proportional to the amount of data available, necessitating the country's access to information legislation (Razzaque, 2009). Community involvement is a common subject in water resource management policy in several nations. For instance, Bangladesh's National Water Policy (1999) involves local community

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engagement in water sector development projects and the policy and managing process. Pakistan's Water Policy (2004) asks for a conducive climate for active stakeholder dialogue and involvement at all levels and in all elements of the water sector, encompassing agriculture, drainage, rural water distribution, flood control, and drought relief (Razzaque, 2009).

Public involvement provides a social dimension to the management of water resources, assists the public in comprehending technical issues, and clarifies the contradiction among its actions and the ecosystem. It manages issues between interested parties to help the public make the best environmental decisions and assure a sustainable ecosystem in policy-making (Jingling et al., 2010). After the end of the outbreak of the Itai Itai infection in Japan, a perfect example of public involvement in water pollution control became demonstrated. As a result of the incident, victims, locals, and the polluting firm agreed to let people involved in decision-making and pollution preventative measures, resulting in a unique example of successful pollution control in Japan (Kaji, 2012). Several studies showed that, as pollution issues become more serious, the traditional paradigm of government-led autonomous environmental governance is woefully inadequate to meet humanity's sustainability difficulties. The other sustainable development has arrived with the advancement of mobile information technology and the dawn of the era of big data. The final form of environment policy, known as "political involvement," has increasingly become a vital factor in achieving environmental sustainability (Ross et al., 2016). Jaleel et al. (2020) mentioned in their study a participation citizen science approach to assess the groundwater quality of 45 Maldivian islands, which is a cost-effective and large-scale way to increase citizen involvement in water pollution management. According to Li et al. (2018), successful air pollution control may be achieved by collaboration between government, industry, and the general populace.

1.5. Fundamental Components of Public Involvement

The rationales for the ongoing interest in public and stakeholder participation in water management, policy, and control are numerous and complicated. In broad terms, public involvement tries to improve decision-making by maximizing the efficiency of outcomes, or their legality, or either. The following aims became often used to justify and promote public involvement.

- Acceptance, dedication, and commitment of actions and plans by the general public
- To raise environmental problem awareness among the general populace.
- There will be fewer lawsuits, misconceptions, delays, and ineffective applications.
- Leveraging basic knowledge of the area improved the quality of judgments.
- Establishing a common understanding of the problem dynamics through social learning.
- Enhance legislative power of judgments by enabling the general public to get a say in and effect over the issues at hand (Özerol and Newig, 2008).

2. Methodology

This section identifies and discusses the procedures and methods used to collect data required to address the research's goal.

2.1. Sampling Method and size

The sampling method used for this study was random sampling which consists of members of the general public of all ages, irrespective of gender or region. The survey included working people and students using drinking water and wastewater facilities in their homes. The sample size for this study was 63.

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2.2. Method of Data Collection

The design of sample questionnaires and a thorough evaluation of the literature are the first steps in the data collecting and survey questionnaire design process. One of the most relevant sources of information on the subject is the survey questionnaire. However, the survey questionnaire to collect data for this study will be used. This study's data collection methodology got segmented into two parts:

2.2.1. Primary Data

This study took the form of a questionnaire survey. A structured questionnaire was created using Google Forms and administered to collect data depending on the objectives. The first section of the questionnaire focuses on the background of the respondents. The public's general understanding of water pollution issues gets covered in part two, and the public's readiness to help in water pollution reduction also gets covered in part three. The questionnaires were disseminated to the general public in Malaysia, due to pandemic restrictions. The forms were sent to them via email over the internet to get feedback from the respondents.

2.2.2. Secondary Data

Articles, journals, research papers, current studies, published books, survey reports, conference papers, journals, and other relevant sources provided secondary data. The data gathered was utilized to help plan the primary data collection, following the study's objectives.

2.3. Data Analysis

The data was analysed and discussed using Microsoft Excel (2019) after data collected for this purpose. The findings were analysed using descriptive statistics in percentages and figures and as bar charts and tables.

3. Results and Discussion

A total of sixty-three (63) responses got reordered from the dissemination of the questionnaires. It also discusses the general information of the respondents, general knowledge of the public on water pollution issues, the current level of public involvement in water pollution management, and the readiness of people to take part in activities to minimize water pollution.

3.1. General Background of Respondents

3.1.1. Age of respondents

Figure 2 reveals the age group of respondents. 14.3 percent of respondents are under the age of 20, 12.7 percent are between 20 and 24. 36.5 percent are between the ages of 25 and 34, while 19 percent are between 35 and 40, 7.9 percent, 9.5 percent are between 40 to 50 and more than 50 years, respectively.

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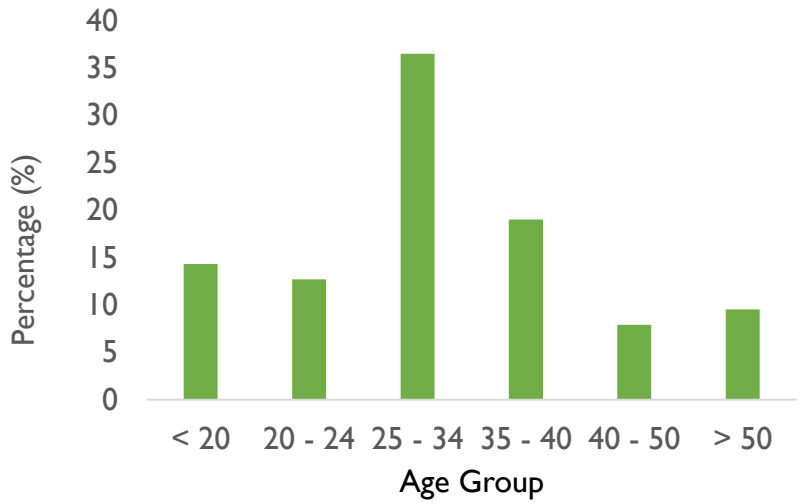

Figure 2: Age group of respondents

3.1.2. Educational level of respondents

Eight (8) of the 63 responses had a Ph.D. qualification, accounting for 12.7 percent of the total. Master's certificate holders make up 28.6%, followed by bachelor's certificate holders at 44.4 percent, diploma holders at 9.5 percent, and high school certificate holders at 4.8 percent. The majority of responders have bachelor's degrees, whereas diplomas and high school diplomas are held by the fewest. Figure 3 depicts the respondents' educational backgrounds.

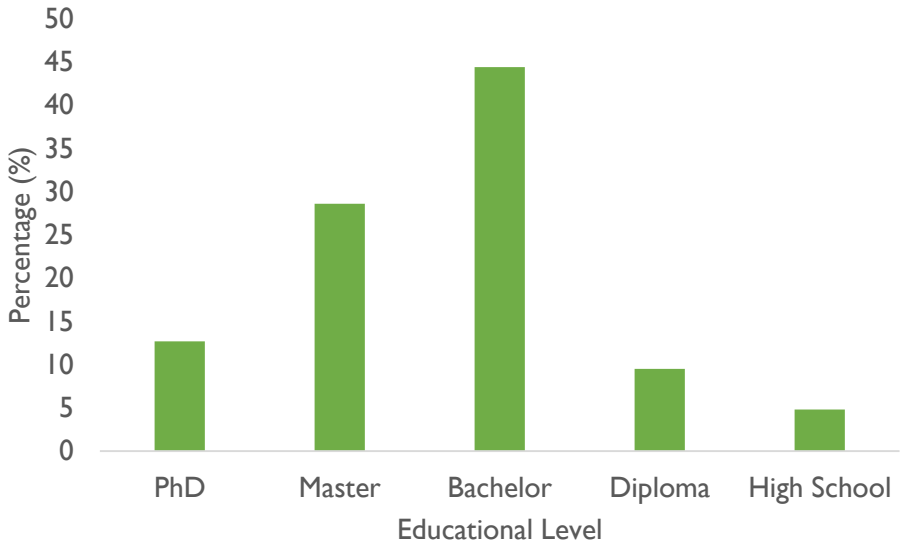

Figure 3: Educational level of respondents

3.1.3. Monthly income of respondents

The findings revealed that 14.3% of respondents' monthly income is between RM 2500 and RM 4500, followed by 19%, 12.7%, and 9.5 percent of respondents' monthly earning is between RM 4500 and RM 6500, RM 6500 to RM 8500, and RM 8500 to RM 10500, respectively. While the majority of monthly income is less than RM 2500 (34.9%), and the least earns more than RM 10500 (9.5 percent). The outcomes are as illustrated in Figure 4.

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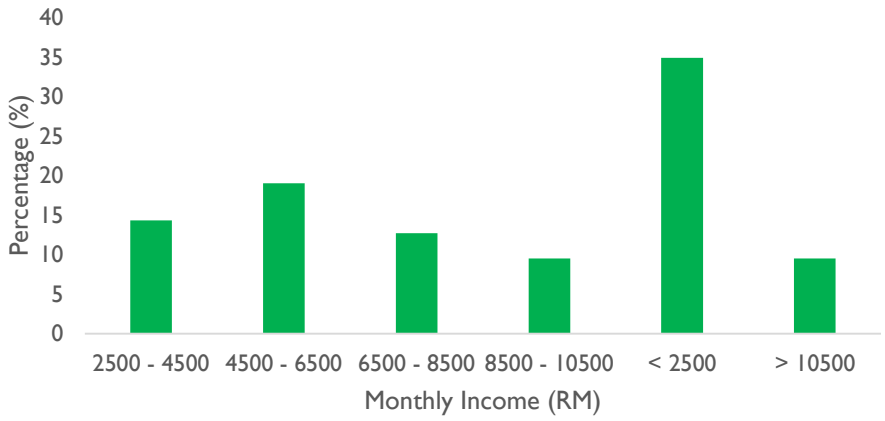

Figure 4: Monthly income of respondents

3.1.4. Respondent's location

The majority of the respondents (63.5%) reside in the capital, while 8% and 29% dwell in the rural and urban areas, respectively (Figure 5).

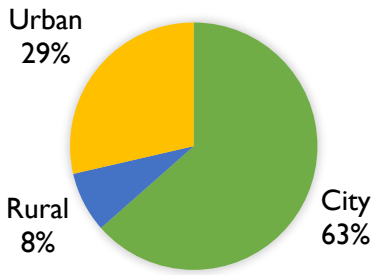

Figure 5: Respondent's location

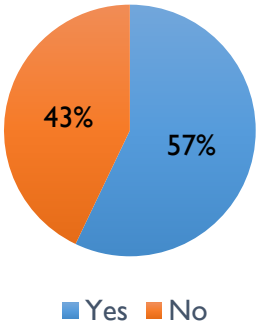

Figure 6: Source of drinking water

3.2. General Knowledge of the Public on Water Pollution Issues

As shown in Figure 6, 36 of the respondents, or 57.1 percent of the total, are aware of their drinking water source, whereas 42.9 percent are unaware of their drinking water source.

The findings revealed that 74.6 percent of participants have sewerage connections, while 25.4 percent do not. Additionally, 52.4 percent know whether the wastewater from their home is treated before discharge, while 47.6 percent do not know whether the liquid waste from their residence is not before disposal (Figures 7 and 8)

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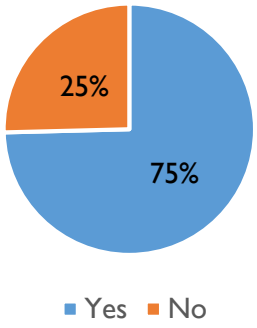

Figure 7: Sewerage connection

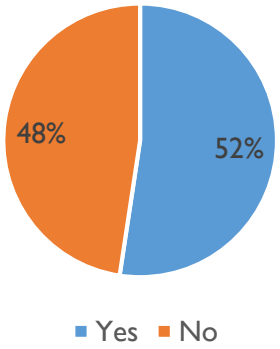

Figure 8: Waste water from home treated before discharged

Furthermore, 12.6 percent of respondents asserted that the water quality of rivers in their state is very poor, followed by 28.6 percent, 36.5 percent, 15.9 percent, and 3.2 percent stated that their water quality in their state is poor, acceptable, good, very good, and no opinion. According to findings majority of the participants (36.5 percent) agreed that the water quality of the rivers is satisfactory. However, 11.1 percent of the participants indicated that the quality of the groundwater in their state is very poor, followed by 19%, 28.5 percent, 20.6 percent, 4.7percent, and 15.8 percent alluded that the water quality of their state's groundwater is poor, acceptable, good, very good, and no opinion respectively. Figures 9 and 10 demonstrate how this works.

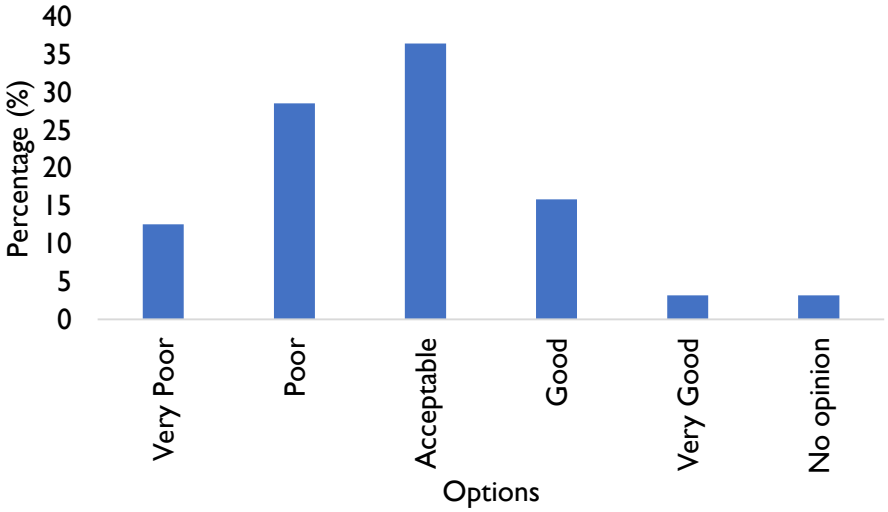

Figure 9: Water quality of rivers

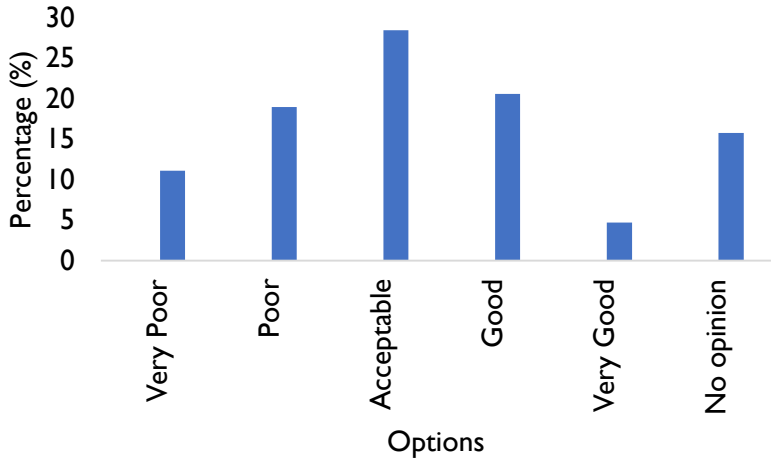

Figure 10: Water quality of ground water

Additionally, the findings revealed that 12.6 percent of respondents had never attempted to mitigate water contamination. The majority of respondents (39.7%) mentioned they tried to reduce water pollution sometimes, while 19.0 percent indicated they tried rarely, and 14.3 percent stated they tried very often and always, respectively. Figure 11 illustrates this.

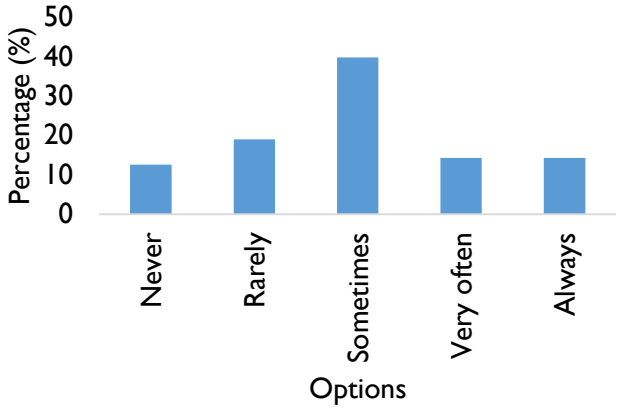

Figure 11: Effort to reduce water pollution

Ultimately, 14.2 percent of those surveyed agreed that water pollution is a crucial issue for environmental and social health, followed by 73 percent who agreed that water pollution is a critical issue for the environment and social health, and 6.3 percent who partially disagree and partially agree (Figure 12).

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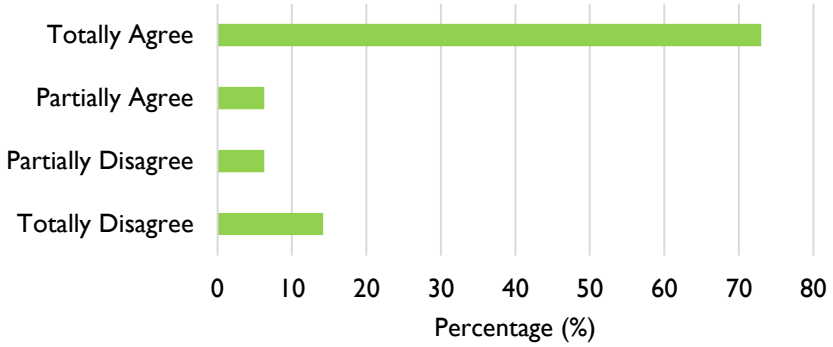

Figure 12: Environmental and social health issue

3.3. Level of Public Involvement in Water Pollution Management

Table 2 recapitulates the findings of the current level of public involvement in water pollution management. According to the survey, 38 out of 63 participants, or 60.3 percent, believed that they are well aware of their state's water management pollution regulations. Meanwhile, 25 responses indicated that 39.7percent of the total disagreed with the above statement about water pollution management regulations. The study also revealed that 11.1 percent of individuals are unaware of water pollution issues in their state, while 17.4 percent, 41.3 percent, 23.8 percent, and 6.3 percent are rarely, sometimes, very often, and always informed of water pollution issues in their state, respectively. Moreover, in terms of community involvement in decision-making processes on water pollution matters in their respective state, 22.2 percent of respondents stated that they never been involved in any decision-making process pertinent to water pollution issues. 26.9%, 34.9 percent, 9.5 percent, and 6.3 percent asserted that they rarely, sometimes, very often, and always been participated. This implies that officials still have the potential to enhance in terms of water pollutant information distribution. Respondents were further requested to suggest the measures that will have the best impact on water quality improvement. Some participants stated that one way to improve water quality is for individuals to help to prevent pollution (12.7 percent), enforcing stern punishment on polluters (19 percent). The majority of the respondents corroborated that spending more money on water and waste management and spending more money to raise awareness are two ways to improve water quality. (31.7 percent and 36.5 percent, respectively).

Finally, most participants stated that they were unaware that their homes and businesses must pay utility bills to manage discharged wastewater (66.7 percent), but 33.3 percent noted that they were aware of the need to pay utility bills to control discharged wastewater. It signifies that the authority requires financial support to raise public awareness about water pollution management.

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Table 2. Current level of public involvement in water pollution management

S/N	Items	Frequency	Percentage
1	Are you aware of legislation regarding water management and pollution in your state?		
	▪ Yes	38	60.3
	▪ No	25	39.7
2	Are you well-informed of water pollution issues in your state?		
	▪ Never	7	11.1
	▪ Rarely	11	17.4
	▪ Sometimes	26	41.3
	▪ Very often	15	23.8
	▪ Always	4	6.3
3	Are you or the community involved in any decision-making process on water pollution issues in your state?		
	▪ Never	14	22.2
	▪ Rarely	17	26.9
	▪ Sometimes	22	34.9
	▪ Very often	6	9.5
	▪ Always	4	6.3
4	Which one of the following actions will have the biggest impact on improving water quality (Select One)?		
	▪ Individuals trying to stop pollution	8	12.7
	▪ Enforcing stern punishment on polluters	12	19.0
	▪ Spending more money on water and waste treatment	20	31.7
	▪ Spending more money to increase awareness	23	36.5
5	Are you aware that household and premises need to pay utility bills to manage discharged wastewater?		
	Yes	21	33.3
	No	42	66.7

3.4. Readiness to Participate in Water Pollution Reduction Activities

This segment elucidates the findings on public involvement in water pollution-reduction efforts. The findings revealed that 6.3 percent of respondents are vehemently opposed to collaborating in the campaign to curb water pollution, the lowest figure recorded. However, the highest percentage of respondents, 41.3 percent, are highly willing to participate in the fight to reduce water pollution, followed by 25.4 percent and 11.1 percent who are both willing and unwilling to participate. For the campaign against water pollution, 15.9 percent of the responses are neutral. 14.3%, 22.2 percent, and 41.3 percent, respectively, are unwilling, neutral, willing, and strongly willing to enroll in water pollution management courses in their community. The results further showed that 6.3 percent of the participants were strongly unwilling to provide financial support in environmental activities to reduce water pollution, followed by 12.7percent of respondents who are not willing the fight to reduce water pollution, 36.5 percent of the respondents are in the neutral position. However, 17.5 percent and 26.9 percent are willing and highly willing to support a campaign to reduce water pollution, respectively. Furthermore, 3.2 percent, 4.8 percent, and 11.1 percent of respondents are strongly unwilling, unwilling, and neutral to modify their attitudes about water pollution reduction. Meanwhile, the vast majority of participants are willing and eager to alter their

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attitudes about water pollution reduction. (57.1%) and 23.8%), respectively. In terms of paying a higher billing rate to enhance the discharge of wastewater quality and minimize water contamination, most participants stated that they are vehemently not willing, not willing, and neutral to pay a higher billing rate (15.9%, 11.15% and 20.6 %) respectively. 25.4 percent and 26.9 percent are willing and strongly willing to pay a higher billing rate to improve wastewater quality.

Eventually, the participants were required to come up with strategies to prevent water pollution. Six (6) of the participants stated that they do not flush paints, fats, or grease down the sink or sewer. Eight (8) people suggested it to avoid dumping medical waste down the drains, followed by ten (10) individuals, twelve (12), three (3) people, and thirteen (13). (13). Elven (11) also mentioned using ecologically friendly cleaning and washing products, checking cars for oil leaks regularly, avoiding pesticides and herbicides in the backyard, and utilizing alternatives to plastic products. Table 3 gives a synopsis of the analyses of the survey.

Table 3. Readiness to Participate in Water Pollution Reduction Activities

S/N	Items	Frequency	Percentage
1	Are you willing to take part in a campaign to reduce water pollution?		
	▪ Strongly not willing	4	6.3
	▪ Not willing	7	11.1
	▪ Neutral	10	15.9
	▪ Willing	16	25.4
	▪ Strongly willing	26	41.3
2	Are you willing to enroll in the courses in managing water pollution at your area?		
	▪ Strongly not willing	-	-
	▪ Not willing	9	14.3
	▪ Neutral	14	22.2
	▪ Willing	14	22.2
	▪ Strongly willing	26	41.3
3	Are you willing to donate money or support in environmental organizations campaign to reduce water pollution?		
	▪ Strongly not willing	4	6.3
	▪ Not willing	8	12.7
	▪ Neutral	23	36.5
	▪ Willing	11	17.5
	▪ Strongly willing	17	26.9
4	Are you willing to change your attitude towards the reduction of water pollution?		
	▪ Strongly not willing	2	3.2
	▪ Not willing	3	4.8
	▪ Neutral	7	11.1
	▪ Willing	15	23.8
	▪ Strongly willing	36	57.1
5	Are you willing to pay a higher billing rate for your utility to improve the discharged wastewater quality and reduce water pollution?		
	▪ Strongly not willing	10	15.9
	▪ Not willing	7	11.1
	▪ Neutral	13	20.6
	▪ Willing	16	25.4
	▪ Strongly willing	17	26.9

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6	Which of the following actions do you do to reduce pollution?		
	Avoid disposal of paints, fats and grease down the drains / sewer	6	9.5
	Avoid disposal of toxic chemicals (solvents, pesticides and cleaners) down the drains / sewer	8	12.7
	Avoid disposal of medical wastes down the drains / sewer	10	15.9
	Use environmentally friendly products for cleaning and washing	12	19.0
	Check your car regularly for oil leaks	3	4.8
	Avoid using pesticides and herbicides on your backyard	13	20.6
	Use alternative to plastic products	11	17.5

4. Conclusion

This study focused on how public participation currently in the area of water pollution management in Malaysia and the willingness of people's involvement in reducing water pollution. The findings revealed that most of the participants have sewerage connections in their residences and that the water quality of their rivers is acceptable for the majority of the participants. The study also indicated that water pollution is a grave concern for environmental and social health. While some respondents claimed they are well aware of their state's water management pollution regulations, the results revealed that there is still a need for more education on these regulations. According to the findings, community involvement in water pollution decision-making processes is currently low on average, implying that authorities still have room to improve concerning water pollutant information delivery. The majority of respondents agreed that investing more money in water and waste management, and educating the public are strategies to enhance water quality, according to the research.

Finally, the findings revealed that the general public is enthusiastic about taking part in the fight against water pollution and is ready to participate in water pollution management activities in their community. Nevertheless, the substantial majority of respondents are eager to change their thoughts regarding reducing water pollution.

5. Recommendations

The following are recommendations about how the public can help to address the problem of water pollution.

I. Build a solid foundation that allows for greater public involvement in decision-making.
II. To enact strict pollution control policy.
III. To provide adequate financial support in the investment of technologies, specifically to curb sewage facilities of the human source of water pollution, and to empower the people to apply citizen science techniques in addressing water pollution and water quality problems.
IV. To organize seminars and training courses easily accessible to communities to help them optimize their water pollution-reduction efforts.
V. Improved and supplementary waste treatment activities are required to prevent pollution of water.
VI. Efficient waste disposal systems should be in place, and wastewater needs treatment before infiltrating rivers.

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