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The Sustainable Development Goals 6: A Pilot Study on The Readiness of Bukit Perdana Residents Utilizing Recycled Wastewater as Potable and Non-Potable Water

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Abstract

Sustainable water resources management and social rights for equitable safe water and sanitation are the focal point for long-term economic growth and productivity, health and education. By 2030, the Sustainable Development Goal (SDG) 6 that underlines the imperativeness of Clean Water and Sanitation aims at improving water quality by curtailing the rate and threat of pollution. This idea also aims at convincing the public on recycling water and safe water reuse. Indeed, global warming, water shortages, exponential growth of world's population and water pollution have caused significant impact on availability of the water resource throughout the globe. The trend of recycling wastewater has become one of the alternatives to reduce the pressure on the consumption of water resources. The key implementation for recycled wastewater derives from the intensive work in ensuring recycled wastewater is accepted by the public. Ergo, the challenge of the implementation is to remove the stereotype perception on the quality of recycled wastewater. The objectives of this study are to determine the acceptance of adults and senior adults to utilize recycled wastewater in the form of potable and non-potable water and to determine the correlation between the respondents' willingness in correspond to their age and education background. The survey was participated by the adults and senior adults' residents of Taman Bukit Perdana, Johor Darul Tazim and the data collected was analyzed using IBM SPSS version 27. Observations

have found 77% of the respondents are willing to utilize the recycled wastewater. Adults range age between 18 – 59 years old are more likely to support the utilization of recycled wastewater for both potable and non-potable water while senior adults' of 60+ years old are obtuse and quite uninclined to accept the usage of reuse water. Meanwhile, respondents who possess basic or intermediate knowledge on environmental concerns, and those with tertiary education have the propensity to accept in utilizing recycled water in comparison with respondents who have little insight on environment issues and/or those of lower educational background. Addressing these challenges, it requires tremendous efforts to raise the awareness through education and integration for public participation and to work out a sustainable water resources management.
Keywords: Recycled Wastewater, Public Acceptance, Age and Education Background

Introduction

According to the National Aeronautics and Space Administration (NASA) (2020), the earth is made of 71% water where it can be found under the ground, in the atmosphere and the most obvious is the vast seas on earth. However, 96.5% of this water is salt water, which unfortunately is not suitable to satisfy human water needs. This leaves the earth with only 3.5% of freshwater to accommodate human water needs. However, due to climate change, severe droughts are bound to happen if no actions are taken to slow down the rising temperature. The increase in the earth's population too will result in an increasing water demand to be used daily such as for showering and drinking (Black, 2016). According to Chaudhry & Malik (2017), there has been more news of water pollution in recent years due to a human's selfishness and negligence. Hence, to reduce the pressure on the consumption of water resources, recycling wastewater is introduced as an alternative to water supply. Wastewater can be recycled into potable and non-potable water. According to Lazarova et al. (2003), the non-potable reuse of reclaimed water is not drinking water quality but it is accepted to be used for other purposes, somehow there is a challenge of the public image to consume these reuse non-potable water. The standards of potable water consumption and treatment, make it safe for human to consume (Patterson & Haught, 2021).

Water scarcity is the shortage of fresh water resources that is used to fulfil water demand for the consumption of human beings in an area (Vliet et al., 2017). Around 64 billion m^3/year of freshwater has been used as world's water supply since 1990 aligned to the global population grew by an average of 80 million people each year (Altieri, 2013). Due to an increasing population, current water sources are under increasing pressure, which is only one of the numerous consequences of overpopulation (Postel, 2000). Water shortage can occur not just from a drop in its quantity but also from a decline in its quality. Generally, most countries rely on rivers flowing into their borders through neighboring country such as the Aral Sea region, the Ganges, the Jordan, the Nile, and the Tigris–Euphrates (Postel, 2000). By exporting polluted water to other countries, it poses a great danger and threat towards those countries. Global warming is also an important factor that contributes greatly towards water scarcity. Water scarcity is exacerbated when hydroclimatic extremes, including droughts, occur in a region with high consumptive water use, since both water usage and low water supply are impacted (Strosser et al., 2012).

An excellent sustainable water resource management plan should ensure that there is enough clean water for everyone to use and is easily accessible, be it for potable or non-potable uses. The Sustainable Development Goal (SDG) 6 has underlined the imperativeness of Clean Water and Sanitation that aims at improving water quality by curtailing the rate and

threat of pollution Water scarcity has already affected every continent in the world and it is estimated that more than 1.2 billion people does not have access to clean drinking water.

Sungai Batu Pahat being is the source for water supply for Batu Pahat district has significantly degrade throughout the year due to water pollution that was caused by industrial, commercial and agricultural activities. Taman Bukit Perdana in Batu Pahat has become saturated area as more houses are being developed in this area which may lead to overpopulation in the future. This study area has been selected due to the fact of the significance changes of the land use that may lead to increasing of water demand. Before the wastewater recycling project is considered to be implemented in this area, it is important to know the level of residents acceptance to utilize recycled wastewater for both potable and non-potable uses.

The objectives of this study are to determine the acceptance of adults and senior adults to utilize recycled wastewater as potable and non-potable purposes; to determine the correlation between adult and senior adult and the willingness to utilize recycled wastewater .The third objective is to determine the correlation between the willingness to utilize recycled wastewater based on educational background. According to Nithyashri & Kulanthaivel (2012), people whose age are between 18 – 59 years old are categorized as adults while people who are 60 years old and older are considered as senior adults.. An online version of the questionnaire was provided via Google Form and the data collected based on respondents' answers were analyzed using IBM SPSS version 27 software.

Research Methodology

This study was conducted by having a set of questionnaires as its primary method to collect and acquire data. The questionnaires provided are aligned with the objectives of the study and constructed so that the target respondents are able to easily understand the questions asked. Since the study area is in Bukit Perdana, the target respondents of this study will be focused on the adults and senior adults of Bukit Perdana residents. The survey was comprised of 4 parts; Part A – Part D where general information, knowledge on water scarcity, knowledge in wastewater recycling and the willingness of the respondents to utilize recycled wastewater as potable and non-potable water were assessed accordingly. The survey questions are made of closed and open-ended questions. The collected data were analyzed using the Chi-Square test and Frequency Analysis in IBM SPSS version 27 with descriptive analysis to achieve the study's objectives. 370 respondents were collected as per Table for Determining Sample Size by (Krejcie & Morganm, 1970).

Results and Discussion

The data obtained from the survey were analyzed based on the study's objectives. The acceptance of adults and senior adults to utilize recycled wastewater as potable and non-potable purposes, the correlation between adult and senior adult and the willingness to utilize recycled wastewater and the correlation between the willingness to utilize recycled wastewater based on educational background is analyzed and discussed.

Based on **Table 1**, it is observed that 285 out of 370 respondents (77.0%) were willing to accept the change and utilize recycled wastewater be it for potable uses, non-potable uses or both. From these 285 respondents, 178 respondents (62.5%) are willing to utilize the recycled wastewater for non-potable water only with 94 of the respondents (52.8%) is adults and the other 84 respondents (47.2%) is from senior adults. Based on the data obtained, the public have no problem with utilizing non-potable recycled wastewater as the respondents

do not have to consume as a drinking water (potable) directly. However, the results differ when the utilization of recycled wastewater as potable water is taken into account. According to the results analyzed, the total number of respondents who are willing to utilized recycled wastewater for both potable and non-potable has recorded willingness from 71 respondents less than the total number of respondents who are willing to utilize recycled wastewater as non-potable water.

One of the main factors that contributed to this finding is that the majority of the respondents doubt the cleanliness of the recycled wastewater and are being super cautious if the recycled wastewater is safe to be consumed. It is also not possible to rule out the possibilities of the respondents' imagining drinking the recycled wastewater as toilet water. According to Semerjian et al (2018), to estimate human health hazards in treated wastewater, the risk quotient is calculated (RQs) where possible adverse health effects may occur if RQ ≥ 1 even the study had proven that recycled wastewater is completely safe as the obtained RQ < 1.

Table 1
Willingness to Utilize Recycled Wastewater as Potable and Non-Potable Water

	N	%
Not willing for both potable and non-potable water	85	23.0%
Only for non-potable water	178	48.1%
Willing for both potable and non-potable water	107	28.9%

Note: Frequency Analysis in IBM SPSS Statistics 27

Table 2 represents the data analyzed between age and one's willingness to utilize recycled wastewater using the Chi-Square Test while in **Table 3** and **Table 4** shows that there is a strong relationship (p-value = $1.2371E^{-39}$) and strong correlation (Cramer's V = 0.696) between respondents' age and respondents' willingness to utilize recycled wastewater for potable and non-potable purposes. It is observed that adults (99.1%) have a higher tendency to support the utilization of recycled wastewater for both potable and non-potable water compared to senior adults (97.6%) who are reluctant to utilize recycled wastewater as potable nor non-potable water. According to Daghighi et al (2020), one's willingness to utilize recycled wastewater be it for potable or non-potable uses typically decrease. This trend probably can be explained by how younger people have different views towards new technologies and are highly interested and supportive of living a sustainable life compared to the older generations as the younger have a whole life ahead of them. Meanwhile, the older generations have different views regarding sustainability and are rather cautious in trying new things due to the lack of experience awareness.

Table 2
Crosstabulation for The Correlation Between Adult and Senior Adult and the Willingness to Utilize Recycled Wastewater

		Not willing for both potable and non-potable water		Only for non-potable water		Willing for both potable and non-potable water		Total	
		N	%	N	%	N	%	N	%
Age	Adults (18 - 59)	2	2.4%	94	52.8%	106	99.1%	202	54.6%
	Senior Adults (60+)	83	97.6%	84	47.2%	1	0.9%	168	45.4%
Total		85	100.0%	178	100.0%	107	100.0%	370	100.0%

Note: Crosstab Analysis for Chi-Square Test in IBM SPSS Statistics 27

Table 3
Chi-Square Test for The Correlation Between Age for Adult and Senior Adult and the Willingness to Utilize Recycled Wastewater

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	179.176[a]	2	.000
Likelihood Ratio	233.315	2	.000
N of Valid Cases	370		

Note. 0 cells (.0%) have expected count value less than 5. (significance value). P-value is $1.2371E^{-39}$ for Pearson Chi Square is small and the asymptotic significance is shown as 0.000. The p-value for the correlation between adult and senior adult and the willingness to utilize recycled wastewater is $1.2371E^{-39}$. According to McHugh (2013), when testing using the 5% significance level, the p-value obtained must be less than 0.005 to prove that there is a significant association between the variables. Therefore, the result has shown, it is sufficient evidence at 5% significance level to support the claim that there is an association between age and the willingness to utilize recycled wastewater.

Referring to **Table 4**, the Cramer's V value is 0.696 which indicates that there is a strong association between age and the willingness to utilize recycled wastewater.

Table 4
Symmetric Measures for The Correlation Between Adult and Senior Adult and the Willingness to Utilize Recycled Wastewater

		Value	Approximate Significance
Nominal by Nominal	Phi	.696	.000
	Cramer's V	.696	.000
N of Valid Cases		370	

Note: For df = 2 correlation between variables can be interpreted as small (0.07), medium (0.21) or large (0.35) (Zach, 2021).

Table 6 and Table 7 shows that there is a strong relationship (p-value = $1.1441E^{-51}$) and a strong correlation (Cramer's V = 0.584) between education level and the willingness to

utilize recycled wastewater as potable and non-potable water. Based on Table 5, 55.1% of the respondents who with tertiary education are willing to utilize recycled wastewater for both potable and non-potable water but majority of the respondents who possess basic or intermediate level of education (94.1%) are not willing to utilize recycled wastewater for any purposes. Meanwhile, a large percentage of respondents who holds a bachelor degree (38.8%) are willing to utilize recycled wastewater but only for non-potable purposes.

The higher the level of education of a person, the higher the acceptance level to utilize recycled wastewater. According to Lahlou et al (2021), respondents from tertiary education holder is more likely to accept the utilization of recycled wastewater compared to a respondent who is in their early 20s with a basic educational level. Previous studies have shown that there will always be a correlation between one's educational background with the willingness to utilize recycled wastewater (Garcia-Cuerva et al., 2016). Having an impressive education background is one thing, but having a vast knowledge regarding recycled wastewater and the environment are also one of the factors that may influence one's willingness.

Table 5
Crosstabulation for The Correlation Between the Willingness to Utilize Recycled Wastewater Based on Educational Background

		Not willing for both potable and non-potable water		Only for non-potable water		Willing for both potable and non-potable water		Total	
		N	%	N	%	N	%	N	%
Highest Education Level	Bachelor Degree	2	2.4%	69	38.8%	42	39.3%	113	30.5%
	Foundation/ Matriculation + Diploma	3	3.5%	28	15.7%	1	0.9%	32	8.6%
	Master + Doctorate	0	0.0%	8	4.5%	59	55.1%	67	18.1%
	None of the above	80	94.1%	73	41.0%	5	4.7%	158	42.7%
Total		85	100%	178	100%	107	100%	370	100%

Note: Crosstab Analysis for Chi-Square Test in IBM SPSS Statistics 27

Table 6
Chi-Square Test for The Correlation Between the Willingness to Utilize Recycled Wastewater Based on Educational Background

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	252.594[a]	6	.000
Likelihood Ratio	274.920	6	.000
N of Valid Cases	370		

Note. 0 cells (.0%) have expected count less than 5. P-value for Pearson Chi Square is too small hence to why it is reported as 0.000. The actual p-value is $1.1441E^{-51}$.

Table 7
Symmetric Measures for The Correlation Between The Willingness to Utilize Recycled Wastewater Based On Educational Background

		Value	Approximate Significance
Nominal by Nominal	Phi	.826	.000
	Cramer's V	.584	.000
N of Valid Cases		370	

Note: According to Zach (2021), the interpretation for Cramer's V values of correlation is only up to df =5. Hence, extrapolating from the table, when df = 6, small (0.03), medium (0.11) and large (0.20).

Conclusion

Based on the result obtained, it is shown that the objectives of this study are achieved. Majority of the residents in Bukit Perdana are willing to utilize recycled wastewater as there is a 77.0% of acceptance rate between adult and senior adult of the area considering the category of acceptance according to preference either the as potable and non-potable water. About 107 respondents willing readily to use recycled wastewater for both potable and non-potable purposes compared to 178 respondents that willing to use recycled wastewater for non-potable purposes exclusively. Majority of respondents opted for non-potable water due to the distrust on the purity of the recycled wastewater and level of safety for consumption. In spite of this, the respondents have agreed towards considering to adopt recycled wastewater in order to secure long-term sustainability of water supply.

There is a strong correlation between age and the willingness to utilize recycled wastewater for potable and non-potable water (Cramer's V = 0.696). Adults (18 – 59 years old) are more likely to support the utilization of recycled wastewater as both potable and non-potable water while senior adults (60+ years old) are rather reluctant to accept the recycled wastewater. This tendency may likely be explained by the fact that younger generations have different overview about the technology in water treatment and sustainability development goals as in context.

The Cramer's V analysis has shown the value as 0.584, it is indicated a strong correlation between education background and the willingness to utilize recycled wastewater for potable and non-potable water. Respondents who have a tertiary level of education willing to accept the recycled wastewater as potable and non-potable water compared to respondents who

have a basis educational background. The successful implementation for recycled wastewater project has to start with the intensive work in ensuring recycled wastewater is accepted by the public. The challenge of the implementation is to remove the stereotype perception on the quality of recycled wastewater. When a person comprehends the significance of reusing wastewater, the acceptability of doing so will improve, whether for potable or non-potable uses. According to the surveys, the main reason to the refusal is due to believe in the uncertainty percentage of purity in recycled wastewater and water treatment processes.

It is rather impossible to have unanimous agreement before implementing wastewater recycling project. Hence, it is more ideal to implement the project by first raising the public awareness on the Sustainable Development Goal (SDG) 6 that underlines the imperativeness of Clean Water and Sanitation that aims at improving water quality. It is utterly important to support this move to ensure that water scarcity can be prevented and everyone will always have access towards clean water.

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