Environmental Engineering and Management Journal *January 2021, Vol.20, No. 1, 97-108*
http://www.eemj.icpm.tuiasi.ro/; http://www.eemj.eu

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PERCEPTION OF THE PUBLIC TOWARDS SUSTAINABLE TECHNOLOGY FACILITIES IN REST AND SERVICE AREAS IN MALAYSIA

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Abstract

In this modern era, sustainable development has become more important as the world resources are diminishing. The emergence of issues such as insufficient landfills, diminishing usable clean water, pollutions, and greenhouse effect has made the development of sustainable elements more vital. A rest and service area (RSA) particularly can be upgraded to a sustainable area by installing sustainable technologies. Therefore, the current study aims to apply sustainable technology facilities in RSAs. This paper used a holistic sustainable facilities approach on six main components: waste management, compost, biogas, rainwater harvesting systems, green roofs, and green materials. A survey was conducted using impromptu random sampling to obtain public perception on sustainable technologies to be implemented in RSAs via Google Form. This research measured public preference for each technology and the effect of the implementation of these sustainable elements towards economic, social, and environmental factors. From the six elements, 81.52% of the respondents choose recycle or waste management as the most suitable sustainable element to be implemented in RSAs. Furthermore, 90.89% of the respondents admitted that the most affected factor among sustainable elements if sustainable facilities are implemented in RSAs is the environment factor. This shows that most of respondents aware that the sustainable facilities implemented to prevent the environmental issues. The collected results in this paper can serve as a preliminary result for further research and can be used as a recommendation for developers.

Keywords: public perception, sustainable development, sustainable facilities, sustainable technologies

Received: November, 2019; Revised final: July, 2020; Accepted: July, 2020; Published in final edited form: January, 2021

1. Introduction

In 1987, Dr. Gro Harlem Brundtland introduced the concept of sustainable development in the Brundtland Report for the World Commission on Environment and Development. Since then, sustainable development has become an important criterion to be considered during construction (Sneddon et al., 2006). The United Nations had introduced an ideology known as Sustainable Development Goals (SDG), in which all 17 goals are targeted to be achieved by 2030. This ideology is meant to be the transformation agenda that will benefit future generations (Sutopo et al., 2014). However, there are still many bad things happening around the world. According to Barlow and Fiala, although sustainable development has been emphasized in Europe, the percentage of replacing residential houses built in the 1940s to 1950s with poor energy consumption is still low, with a percentage of 1%–3% per year (Pombo et al., 2016). Lack of knowledge about ecologies is also one of the reasons that sustainable development is hard to achieve. According to Bennett et al. (2015), humans nowadays are still lacking knowledge about basics in ecology, the impact of ecology towards human, and the proper way to handle sustainable technology. Even so, researchers nowadays only explore sustainable technologies that

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are not familiar to everyone else instead of technologies that most people are familiar with (Clark et al., 2016).

The rapid increment in world population also causes many problems. For example, the production of solid waste is escalating. In Malaysia, solid waste is the main contributor to landfills. Most of them are from cities and research found that approximately 70% to 80% of these disposed solid waste are recyclable (Moh and Manaf, 2014). Water crisis can be troublesome as well, especially when the demand increases proportionally to the population. According to Shahabudin (2013), insufficient water treatment plants, irresponsible activities such as illegal dumping by the public, illegal disposing of untreated wastewater by factories, and non-operational water treatment plants will cause water crisis. Apart from this, current rapid urbanisation also brings in many issues as the problem damages the landscape of the surrounding places (Shafique et al., 2018) and will lead to heat island effect (Akbari et al., 2016). Furthermore, rapid urbanisation increases the emission of carbon dioxide, which will cause greenhouse effect that will raise an average of 2°C of the earth temperature (Aditya et al., 2017).

In order to overcome these problems, SDG have been proposed as the assessment system to guide the sustainability practices in the RSAs in Malaysia. According to Wang et al. (2010), the United Nations defined the sustainable concept as the act of preserving natural resources for future generations while preventing the depletion of the resources at present. In terms of civil engineering, sustainable can be defined as the effort to reduce the negative impact of construction towards the environment and simultaneously create a better-quality life for mankind (Bahaudin et al., 2017). Sustainable is mainly relevant to three pillars, which are economic, social, and environment. The establishment of SDG in 2015 contains 17 goals, which are no poverty; zero hunger; good health and well-being; quality education; gender equality; clean water and sanitation; affordable and clean energy; decent work and economic growth; industry, innovation, and infrastructure; reduced inequalities; sustainable cities and communities; responsible consumption and production; climate action; life below water; life on land; peace, justice, and strong institutions; and partnerships for the goals. In this framework, the present study focuses on sustainable rest and service areas.

As stated by the World Business Council for Sustainable Development, almost all buildings consume approximately 40% of energy. Cao et al. (2016) added that the energy consumed by a building is the energy for heating up and cooling down the building, cooking, and providing electricity. Besides, according to United States Energy Information Administration, a building can produce greenhouse gases that lead to global warming. The emission of greenhouse gases from buildings is predicted to reach a critical amount of 42.4 billion tons by 2035. Buildings may also cause other problems, such as sound and water pollution, traffic jams, and illegal disposal of unwanted construction materials during the construction phase (Zuo and Zhao, 2014). Thus, it is important to implement sustainable development practices. Sustainable development is a development or design of a building that prevent negative impact towards the communities before and after construction (Ahzahar et al., 2018). According to Alexander et al. (2019), a sustainable building has the following characteristics: constructed with green materials; uses renewable energy; uses high efficient water and electric system; and has low sound, water, and air pollution.

To ensure that each building meets the development eligibility requirements, most countries have introduced a sustainable rating system. Among them are EcoProfile, Leadership in Energy and Environmental Design (LEED), Green Star and more. In Malaysia, as an awareness and concern on the issues of nature and sustainability, the Malaysia Institute of Architect (PAM) and the Association of Consulting Engineers Malaysia (ACEM) introduced a rating system called as the Green Building Index (GBI) to promote the elements of sustainability in the design of buildings (Ahzahar et al. 2018). In addition, other ratings such as Malaysian Carbon Reduction and Environmental Sustainability Tool (MyCREST) was also introduced by CIDB. Mostly in Malaysia, the green practices is only focusing on the construction industry. There is no guidelines that specifically explain about the green highway.

According to Ahzahar et al. (2018), there are six classifications of framework to survey the proficiency for the sustainable highway. These incorporate strategy applied in the green highway, infrastructure in highway, RSA, toll plaza and interchange. Rest and service areas (RSAs) is the main concern in this research because RSAs are one of the common public areas built along the expressway to provide stops for long distance travellers. An expressway is a highway that connects a major city and another city without many intersections. According to Hirsch (2014), although lorry drivers must take a break after travelling for eight hours in accordance to the United States Federal Law, however in Malaysia, there is still no law-establishment regarding this issue, and it is possible that the law will be established soon. In Malaysia, RSAs are built along the North-South Expressway (Ramli et al., 2017). The scope of this research is to study current technologies which can be developed in RSAs in Malaysia. This research focusing more on sustainable technologies introduced from all over the world. All of the technologies listed will discussed and compared in detail to determine if this technology suitable for application in RSAs based on several factors such as model size, the advantages of the model and the costs involved in acquiring this model. RSAs are potentially suitable for the implementation of sustainable facilities because the areas have large durable surface areas to cater a huge number of vehicles. Moreover, RSAs require a huge amount of water for watering plants and for toilet flushing systems. Lastly, the 24-hour functioning lighting systems and air conditioning systems can be a wastage. Thus, proper strategies should be implemented to overcome these issues. The objectives of this research are to identify the public perspective towards sustainable development in RSAs and to identify the suitability of technologies to be implemented in RSAs.

1.1. Sustainable elements

Six sustainable elements suitable to be implemented in RSAs from this study's point of view were identified: waste management, compost, biogas, rainwater harvesting systems, green roofs, and green materials, and the elements are shown in Fig. 1.

Waste management is a practice including collecting, transporting, disposing, and sorting waste according to their types. According to the Malaysian Solid Waste and Public Cleansing Management Act 2007 (Act 672), solid waste can be destroyed either by incineration or decomposition (Nagapan et al., 2014). Good waste management includes recycling. Recycling is a process to return an item's originality so that it can be reused (Schill and Shaw, 2016). Recycling also reduces the transportation fee to landfills and helps in lengthening the life expectancy of landfills (Moh and Manaf, 2014). To encourage this habit among the societies, the 3R concept (reduce, reuse, and recycle) has been introduced. Reduce means the use of original materials and avoiding wastage, reuse means using back the same materials again, and recycle means converting waste materials into new materials or objects (Gomathi and Pradeep, 2017). In waste management, the most important action is to make waste separation. Source separation refers to the practice for isolate consumer materials and household waste so that they do not mix for a better waste management or recycling systems. According to previous research, the main purpose of source separation is to recycle, reuse and improvement of waste management services. This action has been successful in reducing amount of recycling and reducing solid waste to the landfill. In addition, large amounts of solid waste of households can be reduced by recovering solid waste in a variety forms such as energy recovery or compost (Sukholthaman and Sharp, 2016). Waste collection costs represent 80% to 90% waste management budget in low-income countries and 50% to 80% for those with a modest income. According to Das and Bhattacharyya (2015), in order to reduce the cost of solid waste collection, municipal authorities have been working hard to develop new strategies to address this problem, particularly in urban areas producing more solid waste.

Compost is decayed materials used as a fertiliser. Food waste is a component of compost. It is a waste product from food manufacturers, domestic and commercial kitchens, cafeterias, and restaurants. Traditionally, food wastes are incinerated with other combustible municipal wastes for the generation of heat or energy. Food waste contains high moisture content. It will produce dioxins when burned together with other waste with low humidity and high calorific value. Besides, the incineration of food waste will potentially cause the loss of chemical values in food waste and air pollution (Uçkun Kiran et al., 2014). Another way to solve these problems is by transforming food waste into organic compost. Unlike inorganic compost, organic compost can gain high-quality energy during the production and is able to preserve more nutrients within effluent (Chiew et al., 2015), which can help to fertilise the soil.

Regarding biogas, in year 2000, the Fifth Fuel Diversification Policy was launched under the Eight Malaysia Plan to promote renewable energy. The promoted renewable resources include biomass, solar, mini-hydropower, municipal waste, and biogas. Among these resources, biogas can offer a win-win situation towards the national effort to achieve energy security while combating waste accumulation. Biogas can be generated using anaerobic digestion. Biogas can be used to generate electricity or heat, which offers the reduction of using non-renewable resources in generating energy besides helping in reducing the amount of solid waste (Chien Bong et al., 2017). Generally, biogas is a mixture of methane gas (CH_4) and carbon dioxide (CO_2) and can be produced by anaerobic digestion (AD) (Lackey et al., 2015). Biogas systems can produce clean cooking gas with retains methane and other flammable gases during the process of fermentation (Meeks et al., 2016). According to Ge et al. (2014), AD is a biological process that will break down the internal structure of the material or organic waste with the help microorganisms without the use of oxygen.

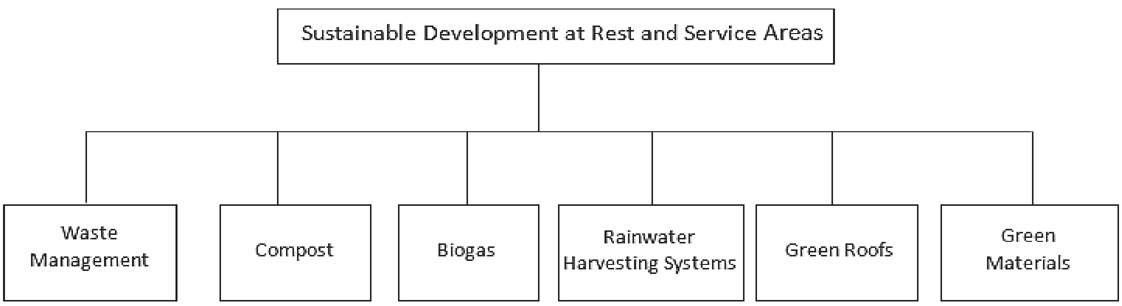

Fig. 1. Structure model of elements

The AD process will produce biogas products at the end of the process. AD starts with process of hydrolysis of bacteria with organic substances such as food waste, waste water from industry, oil and other organic materials to refine the structure inner core is an insoluble organic polymer such as carbohydrate. These polymers can be processed by other bacteria through the fermentation process. Acidogenic bacteria will then break down the excess fatty acids to carbon dioxide (CO_2), hydrogen (H_2), and organic acids known as acetic acid. Finally, methanogens will convert the product to methane and carbon dioxide which is a component of biogas.

Water demand grows fast as the population is growing rapidly. To cope with this situation, Rahman et al. (2014) suggested using water in a sustainable way that could help to balance out both matters. A system known as a rainwater harvesting system is introduced to reduce the use of direct water or well water. Two types of rainwater harvesting systems are collecting water from the roof and through surface runoff (Morey et al., 2017). This paper focuses on harvesting rainwater through the roof. The collected rainwater is then stored in a tank. This system does not only collect rainwater for irrigation purposes and toilet flushing systems (Liang, 2013) but also helps to reduce flood issues as the rainwater will flow into the tank instead of discharging directly to the drainage system (Ajim et al., 2017).

Water harvesting systems also bring many benefits to nature. For example we can reduce dependence on storage dams (Ajim et al., 2017). This can save you the cost of building a dam as well as can maintain the ecosystem around the construction site because of the construction dams require a large area. Usually, the location of the river is located in the forests and when the area is needed, the surrounding forest area must be cut down and disrupt the ecosystem in one area. In addition, the water harvesting system can reduce bill payments for water usage. The rainwater can be said to be crystal clear even though there are pollutants on it roof. So, we can use water from the water harvesting system to wash clothes, do the dishes, wash the car and wash the floor (Ajim et al., 2017). In addition, water collected during the rainy season can be used for plants irrigation especially in summer (Jim et al., 2017). Water harvesting systems can also reduce the occurrence of natural disasters such as soil erosion due to the reduction of the surface runoff velocity through a water pipe system that connects to the water harvesting system. This system can also help to prevent flooding as the water will go down and flow into the water system's tank instead of directly into the drainage system (Ajim et al., 2017). Collected water can also be used during emergencies if fires occur (Rahman et al., 2014).

Besides waste management, compost, biogas, and rainwater harvesting systems, green roofs are also discussed in this study. Many studies have emphasised that a green roof can reduce the temperature of a building. The roof can also reduce energy costs for heating and cooling of a building, especially for poorly insulated buildings (Eksi et al., 2017). A green roof is also able to simultaneously reduce urban heat island effect, water and sound pollution, emission of carbon dioxide, and improve human health quality. According to the General Service Administration of America, four types of green roofs are available: intensive, semi-intensive, single course extensive, and multi-layer extensive (Shafique et al., 2018). Besides mitigating environmental problems, a green roof also offers benefits, such as beautifying a building and helping people who work in a busy city to relief their stress (Lee et al., 2015). The green roof concept also offers other benefits such as resolving the issue of urban heat island (UHI), reduce water and noise pollution, reduce carbon dioxide emissions and improve the health and well-being of human life. In theory, most of the sun's rays on the surface will be absorbed by the earth itself and only a handful of light will be reflected outside space but clouds set on the earth will reflect the light back to terrain (Benestad, 2017). So when greenhouse gases increase, these gases will accumulate in the atmosphere and cause sunlight to be trapped within and cause an increase in temperature. Green roofs not only provide a cooler interior it also reduces sensible heat flux to the atmosphere (Santamouris, 2014).

Regarding green materials, according to Khoshnava et al. (2018), green materials give a lower impact on the environment and help in reducing the use of energy, emission of carbon dioxide, and internal air pollution. In addition, green materials are also recyclable. According to the Environmental Assessment and Specification of Green Building Materials, buildings constructed with green materials are sustainable and ecological (Froeschle, 1999). According to the sustainability criteria, the use of sustainable building materials is not limited as it can reduce the burden that nature has to deal with the economy and the social. Economically, building materials may contribute to the sustainability criteria. On the social side, sustainable building materials can help to improve human health. According to Khoshnava et al. (2018), 80% of human time it is spent in buildings, and hazardous materials can affect indoor air quality which can finally affect users health. Green materials are also interrelated to sustainable building design. Choosing the right green materials plays an important role in determining whether the building qualifies as a sustainable building or not (Farouh and Nessim, 2018). Besides buildings, green materials can be used in constructing green facilities, which are suitable to be placed in recreational areas and parks (Coutts and Hahn, 2015).

2. Methodology

Before constructing questionnaires, literature review was carried out to identify the definition of sustainability, to identify issues happening around the world, and to identify sustainable technologies suitable to be implemented in RSAs so that all the technologies can be included in the questionnaires. The selected respondents in this study were all Malaysians.

The survey questions are divided into three parts. Part A collects demographic data from the respondents. For Part B, all six elements which are waste management, compost, biogas, rain water harvesting, green roof and green material with their technologies are listed and the respondents are required to answer according to 5-point Likert scales. The technologies are listed for waste management are conventional recycle bin, RFID, reverse vending machine, garbage collector car, trash compactor and grease trap. For compost element, the type of technologies are Bokashi method, compost tumbler, vertical silo, high fibre composting, rotary vacuum drum filter and black soldier fly. The technologies listed for biogas are fixed dome digester, homebiogas 2.0 and balloon digester. Furthermore, the technologies for rainwater harvesting are gravity fed system, indirect pumping system, direct pumping system, water butt, aboveground cistern and underground cistern. The technologies that can be selected for green roof are biosolar roof, roof mount wind turbine and vegetation rood. In addition, the technologies for green material are sustainable insulation, sustainable wall, green environment and natural lighting. For Part C, the respondents are required to express their opinion on the suitability of the six elements to be implemented in RSAs and to identify the effects on economic, social, and environmental factors with these sustainable elements. Part C also contains 5-point Likert scales.

Before distributing the questionnaires, a pilot test was carried out to check the face validity and the results showed that the questionnaires passed the face validity test. After that, the questionnaires were distributed via Google Form to the public and the samples were chosen randomly without any restrictions. The survey lasted around one month to collect sufficient data for analysis.

After the period, the collected data were analysed using Statistical Package for the Social Sciences (SPSS). First, Cronbach's alpha was evaluated to check the reliability of the questions. Then, all the results were analysed using relative importance index (RII) method to determine the ranking of all the sustainable technologies within their categories.

2.1. Relative importance index

The aim of the RII method is to examine variables by generating indexes that are organised in ordinal c. The generated indexes represent the percentage of respondents who choose the technologies. All the technologies were ranked based on their generated indexes. There are 5 categories of relative index: high ($0.8 \leq RI \leq 1$), medium-high ($0.1 \leq RI \leq 0.8$), medium ($0.4 \leq RI \leq 0.6$), medium-low ($0.2 \leq RI \leq 0.4$), and low ($0 \leq RI \leq 0.2$) (Rafidah et al., 2018). The formula used to determine the RII can be expressed as (Eq. 1):

$$RI = \sum \frac{w}{A \times N} \tag{1}$$

where: w is the weight given by each respondent from scale one to five with one as the lowest and five as the highest, A is the highest weight, and N is the number of samples.

3. Results and discussion

3.1. Demographic data

A total of 246 respondents took part in the survey. The respondents can be divided into five educational groups. First, 6.5% of the respondents achieved their highest education level in SPM. Meanwhile, 24.8% of the respondents achieved their highest education level in STPM, foundation, A-level, matriculation, or diploma. In this survey, most of the respondents were from the public who achieved their highest educational level in degree with 57.7% of the respondents. Lastly, 6.5% and 4.5% of the respondents had masters and doctorate degrees, respectively.

80.9% of the respondents learned science during their highest education level. 12.6% of the respondents did not learn science during their highest education level whereas 6.5% of the respondents were irrelevant. Besides, 80.1% of the respondents admitted that they were exposed to sustainable technology previously whereas the remaining 19.9% of the respondents were not.

Furthermore, 6.9% of the respondents did not use the expressway at all in a month, and 56.9% of the respondents used the expressway 1 to 4 times in a month. Meanwhile, 15.9% of the respondents used the expressway 5 to 8 times in a month and 20.3% of the respondents used the expressway more than 8 times in a month. 32.1% of the respondents did not use RSAs in a month, 61.4% of the respondents used RSAs around 1 to 4 times in a month, and 5.7% of the respondents used RSAs 5 to 8 times in a month. Lastly, 0.8% of the respondents used RSAs more than 8 times in a month.

57.7% of the respondents admitted that they used RSAs when they wanted to eat or drink and 1.6% of the respondents used RSAs to have a shower. 51.6% of the respondents used RSAs for a short break whereas 87.8% of the respondents used RSAs to go to the toilet. 15.0% of the respondents used RSAs to pray whereas 6.9% of the respondents used RSAs for other purposes.

3.2. Sustainable elements

From Fig. 2, based on public perception and out of the six elements, 81.52% of the respondents chose recycle or waste management as the most suitable sustainable element to be implemented in RSAs. The 3R concept was introduced in Malaysia in year 1980, where the waste minimisation practices, promotion of reuse and recycling, 3R practices, and using environmentally friendly products are encouraged among Malaysians. The government also emphasised this matter in the Eighth (2001–2005) and Ninth (2006–2010) Malaysia Plan (Mallak and Ishak, 2018). Thus, this justifies the reason why recycle is the first choice among the respondents because the element keeps receiving promotion and urge from the Malaysian government from time to time.

The second element suitable to be implemented in RSAs is the green roof, with almost 80.65% of the respondents chose this element. In Malaysia, RSAs are built along the expressway and exposed directly to the sunlight as there are no high-rise buildings beside RSAs. Therefore, the implementation of green roof technology can help in cooling down buildings in RSAs. Furthermore, Malaysia targets include the decrease with 40% of released carbon dioxide until 2020 (Rafida et al., 2018). Thus, not only green roof technology helps to cool down buildings, but at the same time, the technology also helps in reducing the emission of carbon dioxide.

Two elements are ranked at number 3 where the same percentage of respondents (i.e., 80.41%) chose the elements suitable to be implemented in RSAs, which are rainwater harvesting systems and green materials. For rainwater harvesting systems, Malaysia is a tropical country with an average of 2,400 mm of annual precipitation, which can be considered as a country with relatively rich water resources (Lee et al., 2016). According to several researches, rainwater is suitable to be used for irrigation purposes and also as toilet flushing systems (Asmuni et al., 2016). Therefore, a rainwater harvesting system is very suitable to be implemented in RSAs as there are many toilets in RSAs, thus allowing long-distance travellers to use the facility. In addition, trees and flowers are planted in RSAs to provide shades and for decorations of the areas. These plants can be watered by using rainwater to reduce the dependency on direct water supply.

Regarding green materials, according to Shaikh et al. (2017), the weather in Malaysia is generally hot and humid throughout the years with an average temperature of 27°C. These typical subtropical climatic conditions of Malaysia closely affect the indoor environmental comfort conditions in buildings. Moreover, in RSAs, energy consumption has become the main source of carbon emission as RSAs are using heating, ventilating, and air-conditioning (HVAC) systems to heat, ventilate, and provide air conditioning to the buildings (Rozaid et al., 2019). Thus, it could be a good way to construct buildings in RSAs using green materials that can provide good heat resistance to the buildings. Besides, this technology is able to reduce the emission of carbon by reducing energy consumption in RSAs.

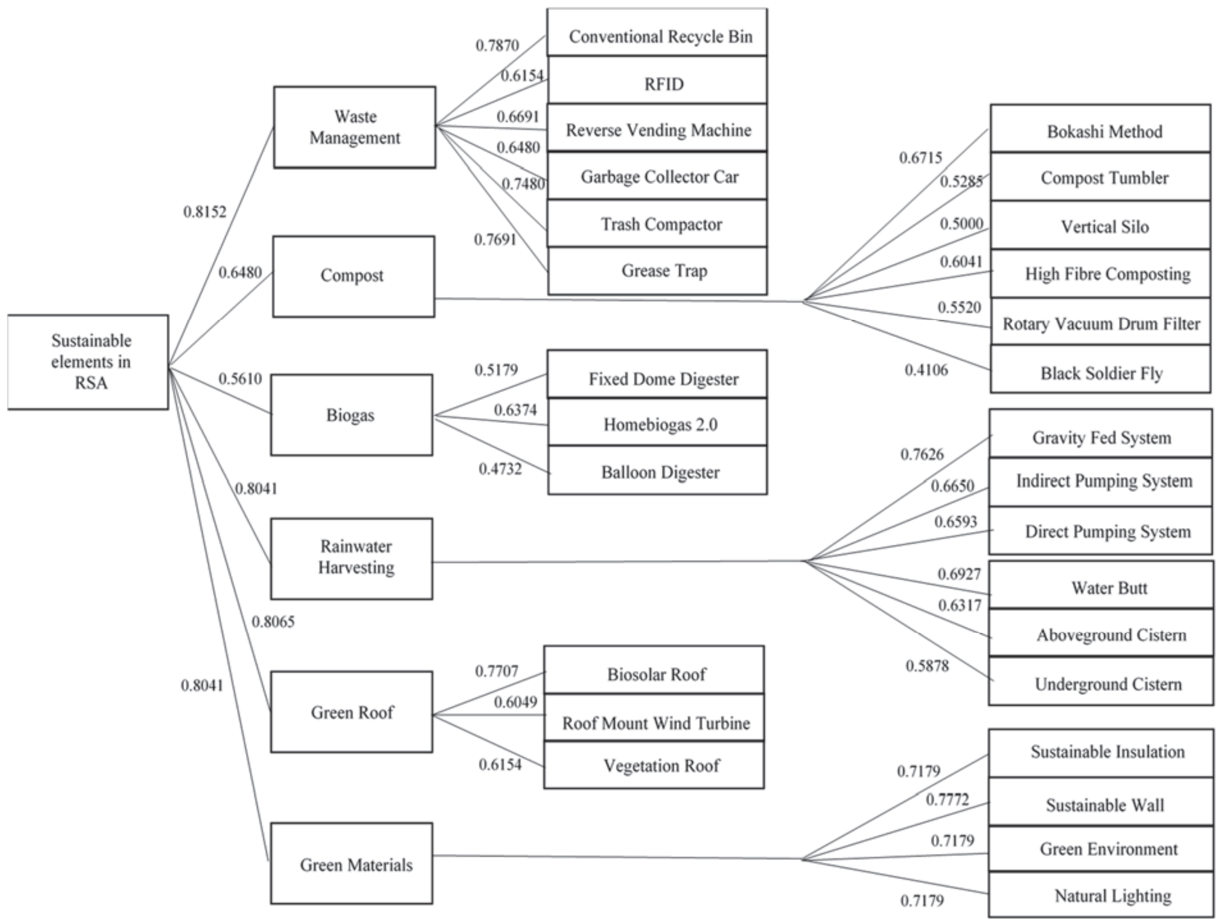

Fig. 2. Framework for sustainable elements and respective technologies

The two least chosen sustainable elements are compost and biogas. 64.80% of the respondents chose compost as the suitable element to be implemented in RSAs. According to Razali et al. (2019), despite Malaysia had launched the Separation at Source Initiative (SSI) under the Solid Waste and Public Cleansing Management Act 2007 (Act 672) in 2015, yet Malaysian households still resist in practicing waste separation. One of the reasons is due to the lack of awareness by households on the significance of waste separation and recycling activities. Even though many marketing media have been used to increase awareness among households, however, the impact of waste separation behaviour is still low. As waste separation awareness in Malaysia is still low, it might be the reason of the respondents to not have high hopes in this element. Without waste separation, all the wastes are combined and dumped to landfills. It would be hard for RSA developers to separate the wastes when they are mixed together.

For biogas, 56.10% of the total respondents admitted the element is suitable to be implemented in RSAs. According to Chien Bong et al. (2017), biogas production is hurdled by several challenges, such as high financial cost, insecure feedstock, infrastructure requirements, and technical maturity. Although the Malaysian government has pursued several national policies that can facilitate biogas development, however, there is still lack of supporting actions on several aspects, especially in terms of financial support, technical issues, and securing demands. The installation progress of biogas capacity is rather slow as major attention is given to solar photovoltaic (PV) and mini-hydro technologies. Moreover, food waste production in RSAs is lower based on the interview in the present study. According to the stall hawkers, the foods are prepared at other places and then transported to the RSAs. Moreover, the people who eat in RSAs can finish all the food without any residues left. Hence, this factor might be the reason the respondents have the perception that it is hard for biogas to succeed in Malaysia for the time being.

3.3. Waste management

From Fig. 2, it can be seen that conventional recycle bins are the most popular choice among all waste management technologies. 78.7% of the respondents believed that conventional recycle bins are more suitable to be implemented in RSAs. In terms of economy, a conventional recycle bin has lower maintenance cost. This is because most of the recycle bins are produced using plastic materials with lower cost (Keramitsoglou et al., 2018) and there will be no electric components in the recycle bin. Hence, as a conventional recycle bin is not digitalised, it is convenient especially for the elderly who are not exposed much to information technology.

Besides, conventional recycle bins are easier to use and the bins conserve natural resources. Conventional recycle bins have a long history in Malaysia. It is very common to see conventional bins placed everywhere in Malaysia. Furthermore, conventional recycle bins are always encouraged among young generations through Malaysian education systems, which makes the bins a popular choice among all waste management technologies.

The technology ranked in the second place is grease traps taking into account that 76.91% of the respondents agreed that the technology is suitable to be implemented in RSAs. First, grease traps can reduce the oil spill problem in RSAs, as the restaurants in RSAs serve oily food. According to Hussin et al. (2018), a grease trap is a device used for kitchen cleaning apparatuses such as sinks, woks, and other channels that gather grease. Thus, a grease trap can filter the discharged wastewater by trapping grease to prevent the grease from being released to the river nearby. Grease floats on top of the river as the density of grease is lower than water, thus blocking the penetration of sunlight and oxygen supply to the aquatic life, which will eventually die due to the inability of getting enough sunlight and oxygen to live. A grease trap can also be cost-effective for the users. The installation of grease traps can avoid the discharge of oily wastewater that can contaminate sewerage treatment plants and drains. Hence, the quality of life of the public can be improved by eliminating the grease in wastewater that can release uncomfortable odour and disturb the people nearby.

3.4. Biogas

Among all the composting technologies, it can observed that the Bokashi method is the most popular option with 67.15% of the respondents agreed the method is suitable to be implemented in RSAs. This method is very useful for conserving natural resources. According to Pérez-Godínez et al. (2017) and Meeks et al. (2016), the application of Bokashi compost to soil increases the number of microorganisms, improves the soil physical characteristics, and enhances the supply of nutrients to plants.

Besides, this method can also reduce the use of synthetic fertilisers. In comparison to traditional composting, the Bokashi method can compost all types of food wastes, such as meats, oily food, dairy, cheese, and breads. Thus, the developers of RSAs can produce their own organic fertilisers instead of purchasing synthetic fertilisers as there are many restaurants in RSAs that will contribute to a lot of food waste. Furthermore, the Bokashi method is a simple method to produce compost, which can be done just by anyone. The compost can be produced by only using a container and food waste. Hence, the developers can collect food waste from the store owners and produce their own organic fertilisers by following the given procedures.

According to Fig. 2, the composting technology ranked in the second place is high fibre composting, with 60.41% of the respondents chose the technology. This is because this method can reduce the use of synthetic fertilisers. Besides, the method for high fibre composting is simple as well, which can be done by anyone without requiring any guidance from the experts. The only step is to mix high carbon content waste, such as newspapers and magazines, together with high nitrogen content waste, such as food waste, and the process will occur on its own through aerobic digestion. Although this method can also conserve natural resources like the Bokashi method, however, the mixed waste can produce odour and might affect the people, especially for those dining in RSAs. In addition, high fibre composting is time-consuming compared to the Bokashi method because no enzymes are added to the waste.

3.5. Rainwater harvesting system

From Fig. 2, it can be observed that among the three systems, the gravity fed system received the highest acceptance with 76.26% of the respondents agreed that it is the most suitable rainwater harvesting system to be implemented in RSAs. The first reason is the gravity fed system can reduce the use of electricity. In a gravity fed system, the harvested rainwater will flow by gravity and is directed towards respective storage tanks where pumps are not needed.

Besides, this system is able to improve the quality of life of the public and simultaneously conserve natural resources. As the gravity fed system does not require the installation of a pump, hence noise pollution can be avoided. Thus, the users of RSAs will not be affected by the annoying sound produced by pumps. Unlike other systems, the developer has to find a large space to accommodate the pumps. Thus, some areas need to be cleared to place the pumps, which might affect the ecosystem of the area.

Regarding the storage system, water butts are the most preferred choice with 69.27% of the respondents stated that it is the most suitable rainwater harvesting storage system compared to other storage systems, as shown in Fig. 2. This is because a water butt has a lower start-up cost compared to other storage systems. First, the installation of a water butt does not require any excavation work, where the user only needs to buy the water butt and place it at the desired location. Moreover, no complicated installation is required, where only the installation of a connector between the rainwater downpipe and the water butt is required to channel the collected rainwater into the water butt.

Moreover, a water butt has a better look compared to other storage systems as a water butt comes in a wide variety of shapes, colours, and finishes, which can also serve as attractions for RSAs. In addition, a water butt can conserve natural resources. Most water butts are made from 100% hard wearing recycled plastics, which can reduce the use of ordinary plastics.

3.6. Green roof

By referring to Fig. 2, 77.07% of the respondents agreed that biosolar roofs are the most suitable green roof technology to be implemented in RSAs among other technologies. A biosolar roof is a green roof with PV panels installed together. PV panels are able to convert solar energy into electrical energy, which helps in reducing the use of electricity in RSAs.

Furthermore, biosolar roofs can improve the quality of life of the public. Plants that grow on the roof are able to cool down a building, as well as produce moderate heat flux into and out of a building. Thus, biosolar roofs can reduce the energy cost for heating and cooling, especially for buildings with poor insulation (Eksi et al., 2017). Moreover, biosolar roofs can mitigate the heat island effect. According to Rozaid et al. (2019), trees and plants will cool down buildings in two ways. First, the sunlight that would normally be absorbed or reflected by other urban surfaces is intercepted. Second, transpiration by plants creates a cooling effect around them. According to Whittinghill and Starry, (2016), a green roof could reduce urban temperatures by 1 to 2°C if planted in large numbers (Whittinghill and Starry, 2016).

The green roof technology ranked in the second place is the vegetation roof, with 61.54% of the respondents opted for this technology. According to Sanyé-Mengual et al. (2016), vegetation roofs are able to reduce food transportation distances, improve waste recycling, optimize food waste, and enhance urban biodiversity. In addition, it may improve the quality of life of the public and mitigate the urban heat island effect (Sanyé-Mengual et al., 2016). Moreover, vegetation roofs are able to increase food production as the stall hawkers in RSAs can grow their crops and use the crops in RSAs so that they do not have to spend their money on logistic activities. Furthermore, the vegetables produced are fresher for the public to eat (Whittinghill and Starry, 2016) compared to the vegetables delivered from other places. Additionally, this technology can overcome the insufficient food waste problem mentioned in the interview of this study. It is well known that some parts of the vegetables are inedible. These parts contribute to food waste, which can be used either in composting or to generate biogas.

3.7. Green materials

Approximately 77.72% of the respondents admitted that green walls are the most suitable green material technology to be implemented in RSAs, as seen in Fig. 2. This is because the technology has a lower start-up cost. The cost of installing green roofs is very dependent on the type and area installed. Since the area of RSAs is small, the cost is estimated to be cheaper compared to other bigger public areas.

Green walls are also able to provide a better look. According to Jain and Janakiram (2016), vegetation can provide visual contrast and relief from the highly built-up city environment. Plants also give the city dwellers a sense of closeness to the Mother Nature in the hard-concrete jungle in the city. Apart from that, the natural landscape provides elements of natural scale and visual beauty, as well as a seasonal indicator to buildings and streets.

Finally, green walls can help to reduce the carbon footprint of RSAs. Carbon dioxide, which is the greenhouse gas, is needed by plants to reproduce oxygen. Thus, carbon dioxide gas emission can be reduced, which directly reduce the greenhouse effect.

3.8. Sustainable pillars

The sustainable pillar consists of economy, environment and social as shown in Fig. 3. From Part C of the questionnaire, the respondents are required to express their opinion on the suitability of the six elements to be implemented in RSAs and to identify the effects on economic, social, and environmental factors with these sustainable elements.

According to Fig. 4, a total of 90.89% of the respondents agreed that the most affected factor among sustainable pillars if sustainable facilities are implemented in RSAs is the environment. The environment is the most important factor because sustainable facilities are meant to solve environmental issues. For example, the installation of conventional recycle bins can make RSAs cleaner and tidier. The impact given by sustainable facilities towards the environment can be clearly seen. Hence, it would be the reason why the environment is chosen as the most impact factor.

The second most affected sustainable pillar is the social factor, as chosen by 77.56% of the respondents. The awareness among the public will increase when sustainable facilities start to be implemented in RSAs. This is because these facilities are able to catch the attention of the public, especially as the technologies have not been implemented previously. The public will begin to search for the reason behind the implementation. At the same time, they will also start to become aware of these sustainable facilities. For example, when the developer of RSAs provides conventional recycle bins to manage waste more effectively, the public will begin to become aware with the results of providing these facilities. After that, the public will start to perform sustainable acts, which are good in terms of the social aspect.

Lastly, 73.41% of the respondents chose the economy as the sustainable pillar that will be influenced most once sustainable facilities are implemented in RSAs. These sustainable facilities are able to attract more people to rest at RSAs. For example, after a car driver travels for a long distance, the driver will surely find a place to rest. If green walls and green roofs are installed at the RSA, the driver will choose to rest at the RSA instead of resting in the car because the buildings in the RSA are cooler and more comfortable. Then, the driver might buy food or drinks, which will directly boost the economy of the RSA.

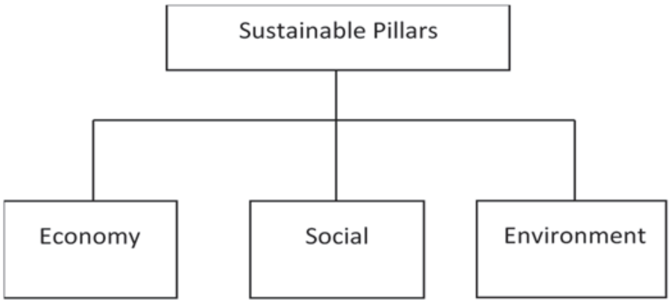

Fig. 3. The element in sustainable pillars

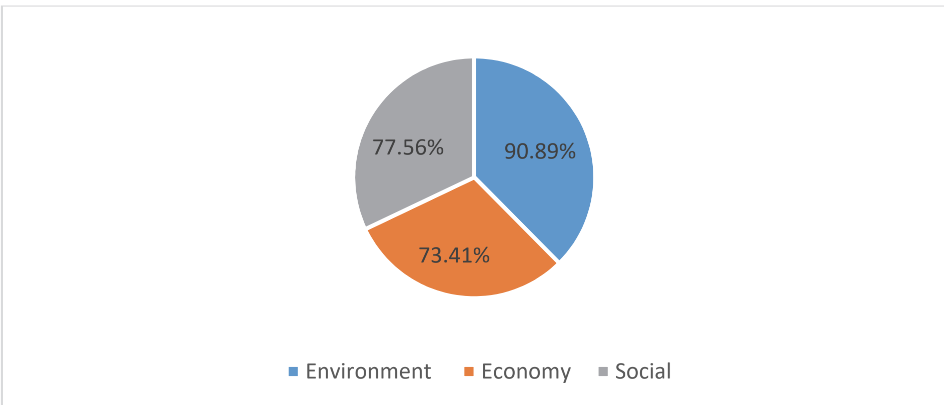

Fig. 4. Percentage of affected factor among sustainable pillars

4. Conclusions

Sustainable development has become very important with many issues faced recently. In order to achieve sustainability, people must begin to practice the principle every day. Although recycle or waste management has been identified as the most preferred element to be implemented in RSAs by the public, yet the developers must not neglect other elements. In this study, the public preference for all elements of their respective technologies was identified. The most suitable technologies to be implemented in RSAs according to their respective elements are conventional recycle bins for waste management, the Bokashi method for composting, Homebiogas 2.0 for biogas, gravity fed systems and water butts for rainwater harvesting systems, and biosolar roofs for green roofs and green walls for green materials. The results from the study can be used as a guideline, especially for developers. Therefore, the developers only need to identify the crucial issues regarding these elements in RSAs and implement the respective technologies accordingly.

Furthermore, the public perception on the most influenced factors (i.e., economic, social, and environmental factors) if sustainable technologies are implemented in RSAs was identified. From our results, the public agreed that the environment is the most influenced factor, followed by social and economy factors. In terms of the environment, sustainable facilities are able to reduce pollution and wastage, and consequently the surroundings will become cleaner. In terms of the social factor, these sustainable technologies are able to increase awareness on sustainable issues among the public, as well as to improve the quality of life of the public. In terms of the economy, besides boosting the tourism in Malaysia, the technologies can also create more job opportunities.

However, the awareness among the public towards sustainable acts is still low. In fact, people will only react to things they see and then they will react to the problem by finding solutions. Hence, sustainability problems can still be hardly seen in Malaysia, which made the public having less awareness on these issues. The educational system in Malaysia also still does not emphasise much on sustainability. Therefore, the Malaysian government should start now to encourage Malaysians to practice sustainable acts through the education system. The government should also try to explain the seriousness of these problems if sustainable acts are not practiced from now on.

Furthermore, the 'not my problem' attitude among Malaysians towards this situation may lead to many sustainable issues. From their perception, the Malaysian government should bear the responsibility to solve these issues. However, they do not understand that the issues can only be solved if the people and the government work together. Therefore, the Malaysian government should cultivate this mind-set to the public through social media or forums. The government should plan promising policies that can convince the public to carry out these sustainable acts. A rewarding system should be sufficient to encourage the public.

The implication of this study is this research only gathers the public perception of technology without the detail explanation about each of the technologies presented. Therefore, there are some improvement needed in order to improve the quality of this research such as examine in more detail each of the technology that is popular among the public perception.

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