



Perceived Sustainability Performance of Black Air Gun (BAG)

Zarinah Zaini¹, Tuty Kamis² and Faudzi Muhammad³

¹Department of Civil Engineering, ²Department of Commerce

Politeknik Sultan Salahuddin Abdul Aziz Shah, Shah Alam, Malaysia

³Department of Polytechnic and Community College Education, Ministry of Education, Malaysia

Abstract: Sustainability is a worldwide objective in balancing the gradual rise of human requirements and the decay of resources. In further aspect, the conceptual paper studies the sustainability performance of new techniques to control sewage contamination in order to prevent foul odors into the habitable space from drainage network, which is important for the healthiness and comfort of living environment. Waste drain pipe is a prominent facility in service engineering development and it is essential in regulating sewage contamination that is commonly obstructed by ungoverned disposal of debris by domestic and commercial buildings. This act is common and consistent in arising disturbance causing the failure of sewage management. This research emphasizes on the innovative establishment of a new controlling method upon sewage contamination known as Black Air Gun (BAG); this indicator is operated based on Perceived Sustainability Performance Indicators (PSPI). This indicator functions to evaluate the impact of BAG upon sewage contamination control. Furthermore, PSPI can acknowledge the sustainability issue of BAG usage in sewage management as a basis for evaluating the impact of BAG towards sewage contamination control. Adopting PSPI in this study will effectively provide a sustainable establishment attained for improvement of people's quality of life in long term aspects.

Key words: Sustainable development, sustainability performance indicators, black air gun

INTRODUCTION

Malaysia is thriving towards a high-income country supported by a healthy economic and social environment. The favourable economy foundation encourages new ideas and innovation resulted in the establishment of new cognitive skills as aspired by the 11th Malaysia Plan. The population is growing overtime within 330345 km² area of the country. According to Department of Statistics Malaysia [1], the Malaysia Population Data Sheet 2018 states the 2017 population in the country is approximately 32 million with 1.1% of average annual population growth rate in 2018. Due to the fact, Malaysia is facing challenges in harmonising human needs and the critical need to safeguard our mother nature. As the continuous effort to ensure sustainable development, Green Growth has become the central theme for the Plan in the context of The New Economic Model (NEM).

Sustainable development is a concept appointing to development in contrast to human and environmental issues [2]. In most of time, sustainable development is defined as the attainment of present needs without jeopardizing the ability of future generations to meet theirs [3]. Since the late 1980s, the concern of the countries around the world focusing on the issue of rapid deterioration of natural resources in fulfilling the rapid growth of physical development. In 2010, NEM was officially introduced in Malaysia acknowledging the sustainable development needs. The structure of the model is the acknowledgement of the importance of having quality of life through a balance and integrated objectives of high-income, sustainability and inclusiveness [4]. The high-income target is focusing on the economy performance of the country to achieve USD15,000 to USD20,000 income per capita. Sustainability emphasises on attaining present needs without compromising the ability of future generation meeting their needs. Lastly, inclusiveness focuses on

Corresponding Author: Tuty Kamis, Department of Commerce Politeknik Sultan Salahuddin Abdul Aziz Shah, Shah Alam, Malaysia, Email: tuty@psa.edu.my

the sharing of wealth of the country by all citizens despite their differences. Moving towards a high-income economy, innovation in producing wealth is more prominent compared to basic requirement enhancement. The utility of resources should reach its best potential in generating greatest benefit to the country [5].

Green growth is a fundamental shift in how Malaysians perceive the role of natural resources and the environment contributing to socio-economic development guarding both development advances and biodiversity [6]. Pursuing green growth requires the strengthening of environment enablement to facilitate a shift in the economy towards better sustainability. The transformation is for the determination of sustainability of nation's natural resources, reduction of pollution and elevation of energy, food and water protection. Therefore, the outlined strategy in attaining green growth for sustainability and pliability is through holistic management of resources including what we currently treat as wastes. All categories of wastes including sewage should be managed according to the life cycle approach. In Malaysia, the operation of sewage services is conducted by The Indah Water Consortium Sdn. Bhd. (IWK) and other concessions. The policies, including the goals and targets in sewage management are regulated and monitored by The Suruhanjaya Perkhidmatan Air Negara (SPAN); SPAN delegates economic regulation for customers' protection and sustainability of sewage management. Domestics, commercial, industrial and government premises are deemed as the sewage service customers [7].

Many programmes were planned and conducted to educate people regarding pollution, despite the impact remains minuscule. Sewage contamination due to the water waft in waste drain pipes blocked by accumulation of debris that is launched without proper regulation resulted in odour pollution. The wastes from households come in drastic variations in aspects of quantity and composition, their effects are no longer handiest by way of own family size, but also by using the varied living conduct of the occupants and other elements which include water consumption, for instance, varies broadly with own family conduct and climatic situations [8]. Researchers deliberated the composition of sewage from house is influence greatly by methods of practices involving the use of soaps, detergents, rubbish grinders, washing machines, and, in some areas, home water-softening unit [8].

Therefore, an innovation of new technique to resolve blockage of waste drain pipe is a critically needed contribution. From the problem solving activity, a group of diploma students in the Civil

Engineering from Politeknik Sultan Salahuddin Abdul Aziz Shah has introduced what they called as the Black Air Gun (BAG) in 2014 [9]. BAG is a tool that could help household solving their waste drain pipe blockage problem and thus preventing the sewage pollution. Despite its technical potential, the potential of BAG from the sustainability context remains unclear. Due to this scenario, this conceptual paper is produced to explore the potential evaluation assessment mechanism to evaluate the sustainability performance of BAG. The Perceived Sustainability Performance Indicators (PSPI) [2] is used as the principal evaluation guidance for BAG in serving its purpose of existence. The word perceived is used since the indicators evaluate preliminary potential of BAG and this is very important before further and detail laboratory tests to be conducted on the prototype. Conducting laboratory tests to a new product before a comprehensive evaluation to the potential by a set of experts might be time consuming and involve in unnecessary monetary spending.

Research objective

The main objective of this study is to introduce set of perceived sustainability performance that could evaluate the potential of a new innovation prior further laboratory testing to be conducted.

LITERATURE REVIEW

Sustainability themes in Malaysia

Malaysia plays a prominent role in executing and promoting sustainable development. Sustainable development is naturally a philosophical notion. Many studies in this area segment similar definition of sustainable development [10], [11], [12] with one provided by The Brundtland's Report [13]. Economic, environmental and social pillars are involved in sustainable development to attain to present needs without jeopardy of future requirements [14]. Sustainable development can be attained by considering the basic needs of all for a better quality of life. The physical ecosystem will strive to transformation through economic growth and development [13]. Despite the accumulation of vast amounts of data for sustainability performance, studies upon impact on sustainability are still in scarcity [15].

Sustainable development will be perceived as a process of continuous improvement of environmental, economic and social performance even though there were more than one aspect upon concerning sustainability due to the variation of the concept, a comparable pattern can be detected. Maximization of

the research commences their enquiries from exploration of the Triple Bottom Line (TBL) topics. TBL recognizes sustainability because the formation of the 3 interrelated pillars of economic, social and environmental sustainability [16]. Preceding studies discovered the most famous methods for sustainability performance evaluation is through the usage of performance indicators that permitting the provision of data for decision making purposes [17]. The Global Reporting Initiative outlines to record sustainability overall performance with huge variety of indicators [18]. Wherein, the World Business Council for Sustainable Development 2000, highlights eco-efficiency indicating environmental and economic indicators only [19]. In line, The Perceived Sustainability Performance Indicators (PSPI) introduced by [2] seems as a comprehensive themes that address the sustainability issues from the context of environment, economy and social.

The impacts of the product innovation upon the people and surroundings during its operations, hold the similar weightage as the impact during the usage process. Generally, sustainability state during the development of BAG could be attained through a cautious consideration ensuring the product cost can be augmented; negative effects to the surrounding community can be reduced inclusive of natural ecology preservation. Associated economic, social and environmental needs of the BAG can be balanced based on the considerations. Within the economic needs, the consideration of the ability of BAG contributing to a healthy economic growth of the nation is to be accounted during product planning and development. In addition, sustainable performance of BAG is evaluated by PSPI. This indicator serves as the basis for evaluation of the impact of BAG upon sewage contamination control. Besides that, PSPI can address sustainability issues of utilizing BAG in sewage management. A sustainable development improving quality of life in long term aspect can be attained through adopting PSPI in the study.

Perceived sustainability performance indicators (PSPI) for BAG

Sustainability is a global aim in achieving stability between the rapid growth of human needs and deterioration of resources. In the process of developing BAG, collective idea and knowledge of multidisciplinary experts in completion of the product development process. Sustainability is more than just the preach for greener or advocacy for nature friendly environment. Sustainability possesses three pillars: economics, social and environmental aspects [16]. PSPI is inclusive of sustainability themes [2] which can be

used for identification of user perceiving the sustainability performance of BAG. Table 1 presents the sustainability performance indicator.

INDICATORS	Sustainability Themes		
	ES	SS	ENS
1 The reduce in overall product cost	/		
2 The reduce in the overall operational cost (including maintenance cost) of the product	/		
3 The increase in workers' productivity	/	/	
4 The increase in the overall people that will benefit from this product	/		
5 The increase in the level of users', workers' and neighbours' health	/		
6 The increase in the level of users', workers' and neighbours' safety	/		
7 The increase in the ability of the product to facilitate the user to practice religious teachings harmoniously	/		
8 The increase in the ability of the product to help in maintaining the cultural heritage and leisure of the community	/		
9 The increase in the level of surrounding air quality upon the product operation in the long term	/	/	
10 The increase in the level of surrounding water quality upon the product operation in the long term	/	/	
11 The increase of potential life-long learning programmes for the user due to the existence of the product	/	/	
12 The increase of potential up-skilling/reskilling programmes for the user due to the existence of the product	/	/	
13 The potential of improving drainage network due to the existence of the product	/	/	
14 The increase for new products developments	/	/	

15	The increase of independent user to help reducing sewage contamination	/	/
16	The increase of awareness in to reduce sewage contamination activities	/	/
17	The increase of social participation and inter-racial cohesion due to the existence of the product	/	
18	The increase of potential that the product will not lead to massive changes in the natural ecology		/
19	The increase of potential that the product will not lead massive extinction of plants and animals in the surrounding areas		/
20	The increase of potential that the product to utilise local materials	/	/
21	The increase of potential that the product to adopt energy efficiency solutions	/	/
22	The increase of potential that the product to adopt renewable energy sources		/
23	The increase of potential that product will not use hazardous materials	/	/
24	The increase of potential that that the product to utilise rapid renewable materials		/
25	The increase of potential that the product will reduce material wastages	/	/

Table 1 Sustainability performance indicators
(Sources: Nawawi et al,2015)

Black Air Gun (BAG)

Waste drain pipe is one of the most essential facilities in building service engineering and it is prominent to regulate sewage contamination induced by debris released without control particularly through domestic and commercial buildings, they are common and a disturbance causing sewage management to fail. The blocked [20] waste drain pipe from the sink will be flushed to the floor trap before their entry to the inspection chamber and then they will flow to the sewerage manhole. Meanwhile, floor traps are constructed specifically to trap waste from entering the sewerage system. The waste will be stored gradually in floor traps and over the time, the accumulation becomes

compact. As a result, the drain line becomes narrow as the flow in waterway to the inspection chamber is affected. The rest of the waste occupies the entire floor trap (inspection chamber) contributing to sewage contamination.

This problem needs to be accounted immediately and one of the actions to be commenced is by using a hand pump available in hardware stores. This method is effective if the clogged sink is newly built in the initial stage but in a critical condition, the pump does not work on heavily saturated wastes. The next method to be directed is dispensing acid to relieve trapped wastes. However, the acid only penetrates the outer part of the waste instead of the bottomless part because of the heavy accumulation of saturated, thick and tough layers of wastes. Normally users will utilize a plumber service for better eradication. Plumber's job is very important in handling clogged sink issues with their full schedule. Commonly, plumber's service charges rely on the distance, location and the severity of the clogging. Clients' choices of plumber depend on their affordability of the service charge.

According to the blockage pipe report at the Penjara Sungai Buloh in 2012 (Table 2), it has been presented that 18 units of 651 units were involved. The repair cost per unit is RM80 and the amount purchased by the organization is RM1440. In addition, during the repair work, it foul odors were released when the waste is dissolved which disrupts the comfort of users. Users have other options by purchasing a tool of 2.7kg in market costing approximately RM1900. The tool is made of steel and it utilizes air pressure to dispose the clogged waste in the pipe. It requires meticulous care to prevent rusting and any damages, it can only be repaired by a specialist through a registered distributor. Due to high cost and its requirement of use when the pipe is blocked, the tool is deemed as unnecessary to users. Therefore, the innovation of new techniques to overcome blocked of waste drain pipe by using the Black Air Gun (BAG) was introduced in 2014. This tool is cost effective compared to other instruments in the market that can help users to alleviate the blocked of waste drain pipe and thus, control sewage contamination.

Class	Total/ Unit	(1) Living Unit	(2) Empty unit	(3) Case of blockage	(4) Other units
C	1	1	-	-	-
D	10	10	-	-	-
E	36	26	2	4	1-Development office 2-Store 3-Kinder-garden
F	44	34	2	3	4-Rest House 1-Store
G	560 (Married) 55 (Single)	454 55	20	11	3-Rest House 7- KAFA classroom 1- KAFA store 4- Kinder-garden 1-Store
TOTAL	651	580	24	18	29

Cost of repairing: RM80 X 18 units = RM1440.00
(Sources: Development Unit of Penjara Sungai Buloh, 2012)

Table 2 Report of waste drain pipe blockage at the Penjara Sungai Buloh in 2012

BAG is constructed using a 50mm diameter PVC pipe. This tool is designed with a foot pump. Air is blown in through foot pump that has a meter to measure air pressure within the BAG. Sluice valve ½ inch in size label with the number 4 is used to replace the picker assembly for air release. Sluice valve should be pulled immediately to ensure fast removal of air pressure. These tools are made of PVC; thus, it is light in weight and manageable to be handled. In addition, PVC is widely used in buildings and construction sectors such as for piping because it is relatively non-flammable, high durability, good insulation, and resistant to humidity [21]. The meter cover is also mounted to sustain damages against impact. Place holders are installed for simple handling during use. BAG also had a few achievements on innovation competition as shown in Table 2 and Figure 1.

Competition	Achievement
Civil Engineering Department, Final Year Project Competition	Top 5 and selected to the Final Competition of Polytechnic Projects
Politeknik Sultan Salahuddin Abdul Aziz	2 nd Place

Shah Final Year Project Competition 2014	
International Innovation Festival 2014	Outstanding Achievement Award Gold Medal
Conference, Competition and Exhibition 2014	Gold Medal
IPTS Design and Innovation Competition (PERINTIS 2014)	1. Gold Award 2. Appreciation Award “Malaysia Research & Innovation Society (MYRIS)

Table 2 Achievement of BAG



Figure 1 Certificate and Medal Achievement of BAG

The use of BAG proves that the problem of drainage can be reduced. As a result, it proved that BAG could reduce 92.10% at cost and 59.26% on weight compared to the product that available in the market. However, BAG's performance should be assessed from the point of sustainability as well. Hence, this study emphasizes the sustainability performance of BAG measures using the sustainability performance indicators.

METHODOLOGY

This is a quantitative study to determine the existence of sustainability performance of BAG upon sewage contamination control. The objectives can be attained through a descriptive survey where frequencies, mean scores, correlation and regression are produced. Cluster sampling is also utilized to identify the characteristics for inclusion of users of BAG in domestic and commercial building as subjects of this study. These identified users are considered important in the study because they have the experience in utilizing BAG. The

samples in this study were selected according to the table of sample size developed by T. Roscoe [22]. Using cluster sampling, the sample size of this study comprises of selected units. Questionnaires were used to ascertain the user perceived sustainability of performance of BAG. A set of questionnaires was distributed to the selected respondents. In this study, the questionnaire has also adopted the Perceived Sustainability Performance Indicators (PSPI) [2].

CONCLUSION

The ability of the BAG contributing to healthy economic growth of nation is to be considered within economic needs: product planning and development. Sustainable performance of BAG is measured by using PSPI. This indicator serves as the foundation for evaluation of the impact of BAG. Furthermore, PSPI can acknowledge sustainability issues of using BAG in sewage management. Adopting PSPI in this study will naturally encourage a sustainable development aiming for improvement of people's quality of life in a long term.

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