Sustainable Impact of Landfill Siting towards Urban Planning in Malaysia

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Abstract. Landfill is one of the most common, widely used waste management technique in Malaysia. The ever increasing of solid waste has made the role of landfill become prominent despite the negative impacts that caused by the landfill is unavoidable. The public and government regulations are getting more aware with the negative impacts that could be brought by the landfill towards the community. It led to the cultural shift to integrate the concept of sustainability into the planning of siting a landfill in an urban area. However, current urban planning tends to emphasize more on the environmental aspect instead of social and economic aspects. This is due to the existing planning guidelines and stakeholder’s understandings are more on the environmental aspect. This led to the needs of incorporating the concept of sustainability into the urban planning. Thus, this paper focuses on the industry stakeholders view on the negative impacts that will cause by the landfill towards the urban planning. The industry stakeholders are those who are related to the decision-making in the selection of a landfill site in the government department. The scope of the study is within the country of Malaysia. This study was conducted through the semi-structured interviews with a total of fifteen industry stakeholders to obtain their perspective on the issues of impacts of siting a landfill in the urban area. The data obtained was analysed using the software, QSR NVivo version 10. Results indicate that landfill bought significant sustainability-related impacts towards landfill siting in urban planning. The negative impacts stated by the respondents are categorized under all three sustainable aspects such as environmental, social and economic. Among the results are such as the pollution, such as the generation of leachate, the objection in siting a landfill site against by the public, and the negotiating and getting money contribution from local authorities. The results produced can be served as a guideline for the industry stakeholders to have a holistic overview of the impacts that could lead by the landfill in siting into the urban area in terms of sustainability aspects. Moreover, it serves as a platform for the developing a holistic guideline for urban planning in the consideration of sustainability aspect of the selection for a landfill site.

1. Introduction
The waste management industry is getting more important as the increase of solid wastes in Malaysia. According to [1], the management of the municipal solid wastes has become a major challenge in urban areas as the increase of the population which directly increase of the waste generation. It is further supported by [2] which stated that in urban centres worldwide, there is a common phenomena that there is a rise of the amount of the generation of the municipal wastes. The huge quantity of
municipal solid wastes generated requires more of the landfill sites to contain. In line of this, it means there is a need of the searching for more site in the urban area to place landfill.

Although landfill can contains most types of municipal solid wastes and it is one of the most widely used method in the managing of municipal solid wastes in Malaysia, nonetheless, the impacts that brought by landfill is undeniable [3]. In terms of environmental aspects, landfill can caused the pollution towards the soil, water and air [4]. According to [5], the biogas that release from the landfill site will caused global warming and it is dangerous to human health.

In terms of economic aspect, the land depreciation is getting higher as it is nearer to the landfill site [6]. The land value is being impacted by the noise and air pollution generated from the landfill site. Beside that, the landfill site has caused the surrounding area aesthetically unattractive. [7] also highlighted that, it is getting tougher in siting a landfill in an urban area as the land is scarce whilst it requires high cost in aquisitive a land for landfill.

On the other hand, due to the landfill site that is affecting the visual effect on a landscape and unpleasant smell released from the collected municipal solid wastes, it directly affects to the people who stayed near to the landfill site [8]. It makes the residents over there highly uncomfortable.

All these three aspects, namely, environmental, economic and social impacts generated from the landfill site has indeed caused the siting of landfill harder. These three aspects are known asa the principle of sustainable and it is important to be evaluated during the urban planning for the siting of a landfill site.

2. Principle of sustainability

As describe in the introduction the principle of sustainability is important in the evaluation of a landfill site, [9] again emphasized the areas involved are environmental responsibility, social awareness, and economic profitability. Sustainability also being defined as the ability in sustaianing the earth’s resources while being exploited. Refer to this case, it means the land that being used should be able to reduce the impacts to the surrounding while being used as a mean of managing of the municipal solid wastes. Authors [10] and [4] pointed out that sustainable waste management hierarchy prefers to reduce or to prevent the arising of waste, reuse, and recycle followed by energy recovery and lastly disposal. However, in most of the cases, Malaysia adopted landfill as the main waste management technique. For that reason, siting a landfill in an appropriate land in an urban area by reducing the potential sustainability related impacts are highly important.

3. Landfill site selection

According to [11], the landfill site selection procedure is a decision- making process supported by constraints and factors. These constraints are used to exclude unsuitable areas for the landfill sites. Maps containing several landfill selection criteria such as geology, soils, and water quality are used as a simple and common method to determine landfill suitability [8]. Those unsuitable areas from further consideration are eliminated.

It is then followed by preparation of data analysis. [11] stated in the second stage of landfill site selection process, factor maps which also known as non- exclusionary criteria were used to define the remaining area left for further consideration. In this phase, candidate sites are evaluated based on several criteria such as the landfill attributes, ranked, and its appropriate size. The initial data collected is used for Geographic Information System (GIS) analysis.

The third phase is undertaking specific detailed assessments on candidate sites. In this stage, the assessment will be done to weigh the landfill appropriateness based on the environmental impact assessment, economic viability, engineering design and cost comparison. This process helps to mapping the specific selected criteria to the potential site.
In the last step, the best site is selected according to the sites that fulfil most of the constraints (exclusionary criteria). Through the landfill site selection process, it can be seen that the criteria in the landfill site selection plays an important role in determining the best landfill site. In other word, the criteria are also one of the main factors to determine whether the landfill site is fulfilling the concept of sustainability. Hence, in this research, it is going to explore on the criteria that will affect the sustainability of a landfill site.

3.1 Industry stakeholders that involved
The waste management system needs the participation of many stakeholders with different roles. It can be briefly analysed into two major parts, which are public and government stakeholders. The participation and support from the public sector such as household has proved that it could reduce the cost in managing wastes. While on the other hand, the role of government sector is to ensuring the designated parties conduct the task for waste management is doing on their own part. This is where the important of each policy shown. The stakeholders shall execute the task as per require by the law.

In Malaysia, the stakeholders whom involved in the waste management are Department of Environment, Natural Resources and Environment Board (Sarawak), Project Proponent, Environmental Impact Assessor, Project Approving Authority, related government agencies, affected general public and local population, and non-governmental organizations [12].

In the planning stage, the Department of National Solid Waste start with finding a location for building a landfill site when the current landfill site has reached its limit. Thus, the person in charge will have a brief discussion with local authorities and state government to know the availability of the land.

Once the Department of National Solid Waste has come to an agreement with local authorities and state government, the Department of National Solid Waste hire an external expert to produce an Environmental Impact Assessment report and send it to land officers. The land officers in a state will then disseminate the report to different units for the evaluation. Among the units are State Economic Planning Unit, Public Work Department, Department of Environment, Town and Country Planning Department and Department of Irrigation and Drainage. If there is any opposition from either any one of the departments, then the application will be rejected.

Lastly, once the related departments have approved the land usage, the landfill can be constructed and Solid Waste and Public Cleansing Management will execute the operation after the landfill being constructed.

3.2 Assessment in the selection of a landfill site
In Malaysia, the criteria listed in the guideline to develop a landfill site are available areas, surrounding environment or conditions, topography and geological conditions and transport infrastructure and access, and post closure land use plan [12]. The main criteria listed in this assessment are all emphasize on the environmental aspect such as the available are, surrounding environment conditions, topography and geological conditions, transport infrastructure and access, post closure land use plan, and the availability of supplies. It is there lead to the needs to study the sustainability impacts in siting landfill in order to improve the assessment of the land to be placed as landfill purposes, refer to Figure 1. This is supported by , whom stated that there is a need in improving the system in the evaluation of environmental effects to landfill siting. Future development and changes has to be taking into consideration [13].
4. Research methodology
This research adopted the literature review and semi-structured interviews to collect the relevant data from the Malaysia waste management industry. The literature review showed that there is a need to have a holistic view in the consideration of selecting a landfill site, instead of assessing on the environmental impact, social and economic impacts are equally important. In order to identify the most important sustainable related impact of the landfill siting towards the urban planning, therefore the data gathered from the waste management industry stakeholders played an important role. This could be obtained by conducting the semi-structured interview.

A total of fifteen industry stakeholders from the government sectors related to the evaluation of landfill siting were involved. Among the fifteen industry stakeholders, all of them are from the top management level and it implies that all of the respondents were holding the authority in making the decision for the siting a landfill in an appropriate location.

The interviews were held through face to face discussion. A list of interview question was designed and distributed to the respondents via email prior to the interview session. This is to ensure the smooth interview session and allow the respondent to have early preparation before the interview session.

The interview sessions were recorded and transcribed into words through the software, QSR Nvivo version 10. Different perspectives of the respondents were being categorized into the main three sustainable aspects, namely, environmental, social and economic aspects by using the matrix table.

The views of the respondents revealed the negative impacts that could be brought by the landfill siting and affecting the urban planning. The findings also presented the importance of integrating the sustainable aspects in the process of landfill siting.

5. Results and discussion (Sustainable Impact of Landfill Siting towards Urban Planning)
The result for the sustainable impact of landfill siting towards urban planning is shown in Table 1.

\begin{table}[h]
\centering
\begin{tabular}{|l|l|l|}
\hline
\textbf{Traditional assessment of landfill siting} & \textbf{Research Gap} & \textbf{Current proposed assessment of landfill siting} \\
Emphasize on the environmental impact assessment & Lacking of the balance for the evaluation on social aspects and economy aspect in the landfill site selection & Emphasize on the sustainability impact, which are environmental, social and economy impact assessment \\
\hline
\end{tabular}
\caption{Transition of the Landfill Siting Assessment.}
\end{table}
**Table 1. Sustainable Impacts for the Landfill Siting.**

| Sustainable Aspect | Sustainable Impact | Annotation (Respondent, R) |
|--------------------|--------------------|----------------------------|
| **Environmental Aspect** | Pollution | The by-product, leachate will pollute the surrounding area of the landfill site. (R1, R2) |
| | - Leachate | |
| | - Solid wastes | The noise and smell generated by the landfill site will affect the surrounding area. (R7) |
| | - Noise | |
| | - Smell | The polluted water flow into the soil will caused the plantation dead. (R11) |
| | - Water | |
| | - Gases | |
| | Buffer zone | The landfill site need to set an large area to be placed as buffer zone (R2, R3). Contractors whom wants to build a landfill need to consider on the land. They need to provide enough area to set as buffer zone, that is about 10km from the landfill site. (R10) |
| | Environment Preservation | Siting for the development of a landfill need to ensure the environment in the near area will be protected. Safety measure need to be taken to reduce the impact towards the environment. (R4) |
| **Economic Aspect** | Distance | The long distance of the transfer station to the landfill site will eventually increase the transport cost. Thus, it is not preferable to site the landfill in that condition. (R1) Accessibility is affecting the cost for the urban planning as well. If the landfill sited at the inland area, then it is hard for the lorry to enter. However, if it is near to the town, people will normally complaint. (R7) |
| | Procuring the land | Federal government or the developer need to pay for the whole cost for the development of the landfill, thus, the price of the land will need to take into consideration for the planning for siting the land. (R2, R3, R4, R9) |
| | Quit Rent | Local authorities will need to consider the quid rent for the land that is used as landfill site. (R6) |
| | Land value | Siting a landfill will lower the value of the land. (R8) Siting a landfill at the commercial area will cause the dropping of the land value at the selected area. It is advisable to place it at outskirt. (R10) |
| **Social Aspect** | Public objection | It is normal that people do not like landfill site that is near to their living area. During zoning, we will not place the landfill site until it is confirm need to be built at the period of time. (R3, R11) Public protest as the Not In My Backyard mindset is still very apparent in the landfill site selection. (R6, R12) |
| | Political | State governments may have different standard with the Federal government and it makes it hard for the siting of the landfill site. (R6, R15) |
| | Health | Siting of landfill at the selected area need to take into consideration on the human health. (R4) |
| | Flora and fauna | The selection of a land become tougher when we need to protect the environment such as the protection of the flora and fauna, prevent water to be polluted. (R4, R14) |
From Table 1, it can be concluded that there are a total of eleven sustainability impacts being highlighted by the waste management related industry stakeholders. It is categorized into three main sustainable aspects, namely, environmental, economic and social aspects. The eleven sustainability impacts that are affecting the decision of siting a landfill in the urban planning are pollution, buffer zone, environmental preservation, distance, procuring the mand, quid rent, land value, public objection, political, health and lastly flora and fauna. It can be clearly seen that all three sustainable aspects carry important weight in deciding for siting a landfill.

Leachate, solid wastes, noise, smell, water and gases are the main pollutants listed under the sustainable impact, pollution. The high potential of landfill pollute the surrounding environment has makes the siting in the urban planning become tougher. Respondent 1, 2, and 6 has stated that the generation of leachate will cause the pollution at the surrounding area near the landfill site. It is also supported by the respondent 11 and 14, once the leachate flows into river, it will pollute the river. On top of that, if the river is the main water source for human as drinking water, it will lead to the serious health problem and the treatment of the water will incur high cost. It is thus important to take into account during the urban planning, a landfill site should not be placed near to the water source, also not near to the area that is having high density of population. This is being strengthened by the statement carried by the respondent 15 in which the gases the is produced from the landfill is 23 times dangerous than the normal carbon dioxide. Due to that reason, there is a need to set a buffer zone for the site that is going to develop as a landfill site.

Buffer zone is one of the sustainable impact towards urban planning in the landfill siting being mentioned by the respondent. It showed the importance in setting a buffer zone wherever a land is going to be used as a landfill site. This is because the potential pollution highlighted in the previous paragraph, a buffer zone can be functioned as the area that protect the near environment to be polluted and destroyed. Respondents 2 and 3 stated there is a need to reserve a large area on the dumping site to be set as buffer zone. On top of that, respondent 10 suggested the suitable area for the land to be planned as buffer zone is about 10km from the landfill site. Buffer zone is indeed play an important role in the preserving of the environment, thus, during the urban planning for siting a landfill, it should be taking into consideration.

Respondent 4 also emphasize the need of siting the landfill at the area that will reduce the possibility in affecting the human health and the surrounding environment. On the other hand, respondent 8 also agree that the planning for the siting of a landfill is essential to minimize the possibility that will affect the environment which will directly affect the human. Hence, the environmental impact assessment is imperatial to carry out during the urban planning for the siting of a landfill site.

Economic aspect is another sustainability aspect that will bring a substantial impact towards the landfill siting in an urban planning. The distance, procuring the land, quid rent and also the land value are among the economy impact that are concerned by the waste management stakeholders in the siting of a landfill. Respondent 1 and 7 remarked that the accessibility has become one of the consideration during the urban planning. The longer the distance of a landfill to the transfer station and the town area, the higher the transportation will be incurred. However, if siting the landfill at the town area, it will eventually create a lot of social issue and affecting the land value. It is therefore a dilemma for the urban planner to decide a suitable place to site a landfill.

Furthermore, the land value will significantly drop by the presence of a landfill site. Respondent 8 and 10 underline the land value of the commercial area will be affected if the are consists of a landfill site. Respondent 15 also added that the existing landfill site may need to take more than 30 years to be
reused again for other usage such as the building of solar panel on the landfill site. The dropping of the value of a land has to be take note during the urban planning.

Besides, procuring the land and quid rent are stress by the governments and the land holders. During the urban planning, the siting of a landfill site need to cost of the land or even getting the permission of the land by the public holders. Respondent 2, 3, 4, and 9 highlighted that the cost of a land matters much as the governments are having limited fund for waste management and either the federal government or the developer are required to pay for the whole cost of the development of a landfill site and procuring the land. It is supported by respondent 13 that sometimes due to the buffer zone requires a large area, the cost for siting a land has becoming higher. Apart from that, respondent 6 stated, quit rent has been an issue for the government thus far. Therefore, the cost of the land in an area also affecting the landfill siting in urban planning.

Last but not least, social impact towards the landfill siting in an urban planning cannot be neglected as well. There are four social impacts focused by the waste management industry stakeholders. Among them are the public objection, political, health and the flora and fauna. Respondent 1,3, 9 and 11 stating that siting of a land to be used as landfill becoming more difficult with the increasing of the public objection. People normally would not prefer the landfill to be sited near to their housing area. Moreover, respondent 5, 6, 8 and 12 supported that the public protest as the ‘Not in my backyard’ mindset is still very apparent in the landfill site selection.

Under the social impact, individual’s health and the flora and fauna also are one of the concerns by the waste management industry stakeholders. Due to the negative impacts produce by the landfill site, individual’s health and the lifespan of the flora and fauna are one of the priority to be taking note by the waste management stakeholders. According to the respondent 4 and 14, it is not advisable to site the landfill on top of the mountain as when rain comes, the landslide may cause dangers to the people living surrounding it. Also, the potential pollutants may destroy the living organism such as flora and fauna at the specific area. The aesthetic value of the landfill site location decreased.

Results of the semi-structured interview survey confirm the belief that sustainable impacts from the landfill siting do bring a substantial effect to the urban planning. However, the assessment on the economic and social impact is still lacking during the selection of the landfill site in the urban planning. It is believe that despite the sustainability impacts, there are still possible ways to tackle the issue and improve in the site selection during the urban planning. Through this platform, the sustainability related impacts from the landfill can be developed to the framework to serve as the decision making in the siting of landfill in urban planning.

6. Conclusion
Landfill is still one of the widely used waste management technique for the handling of most of the solid waste generated in Malaysia. It is therefore significant to make a good planning for siting the landfill in the urban planning. The consideration for the social and economic aspect for the landfill siting are still having the room for improvement. It is essential to review the potential impact of all the sustainable aspects in the siting of a landfill site while conducting the urban planning. Hence, this study carried a paramount importance in creating the awareness for the industry stakeholders in determining the future landfill site by taking the sustainability impacts as a concern.

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