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Including Public Realism in Determining New Pricing Scheme for Sanitary Landfill in Malaysia

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Abstract: Financial restriction and excessive demand for solid waste disposal is a pressing issue in developing countries. Neglecting this problem can worsen environmental damage and endanger public health. To address this challenge, this study investigated the influence of social factors on the willingness to pay for a sanitary landfill in Malaysia using choice modelling. Focusing on neighbouring districts, Kota Bharu and Bachok, where households share a crude-dumping landfill, the study collected data from 624 respondents. The findings revealed a common preference among respondents for a sanitary landfill attribute related to controlled disease vectors, with willingness to pay ranging from RM10.66 to RM13.33 per month. Interestingly, despite experiencing adverse effects from the crude-dumping landfill, respondents from Bachok still showed a preference for it. This preference could be influenced by lower mean incomes among Bachok residents who live closer to the landfill site compared to respondents in Kota Bharu. To address these dynamics, implementing cross-subsidies by charging higher prices to households in Kota Bharu and lower prices to households in Bachok could facilitate the successful implementation of the sanitary landfill. These results can inform

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other developing countries by highlighting the importance of considering the local social context when designing sustainable solid waste policies.

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JEL classification: H23, Q53, Q58

1. Introduction

The environmental problems associated with solid waste (SW) disposal practices constitute a pressing problem in most developing countries due to the imbalance between rapid urbanisation and deficiencies in SW disposal management (Kubanza & Simatele, 2020). Increased economic activity increases developing countries' gross domestic product (GDP), resulting in the largest growth trend in SW generation with an average of 0.56 kilogram per capita per day (Silver, 2010). This creates excessive demand for SW disposal services. Compared to developed nations which have taken significant steps to contain the demand for SW disposal, this issue is more critical in developing countries. It is aggravated by inadequate financial allocations for public sectors. Priority is usually given to sectors and utilities that fulfil basic livelihood needs like water distribution, drainage, health care and education. SW disposal, however, is a back-end public service that receives minimal attention from local governments. Hence, it often receives limited resources, which hinders its capacity for planning, operation and monitoring (Xiao et al., 2017).

The deficient infrastructure for SW disposal resulted in 90% of waste often being disposed of uncontrollably in open dumps or unregulated landfills (Fernando, 2019). Most landfills severely lack effective leachate and gas collection systems, causing environmental, health and safety disadvantages. The leaching from landfills causes pollution of the groundwater supply and jeopardises public health from water consumption, and contributes to rotten odours (Bundhoo, 2018). The emissions of greenhouse gases (GHG) from unregulated landfills and open dumps are significant. From one estimation, 5% of the total GHG emissions worldwide result from SW disposal (Devadoss et al., 2021). The piling of GHG concentration in the atmosphere gradually contributes to climate change in the form of the warming effect, higher temperatures, rising sea levels and changes in seasonal precipitation. Other implications of deficient infrastructure for SW disposal are flooding, waste landslides and transmission of diseases such as leptospirosis and dengue by breeding rats, houseflies and mosquitos (Kumara & Pallegedara, 2020).

From the mixed drawbacks, it is difficult to overemphasise that proper SW disposal is essential for building a sustainable environment. With increased populations generating increasing SW, properly disposing waste has become a challenge to sustain the quality of the environment. The roles of SW disposal for sustainability were enshrined in Goal 12 of the Sustainable Development Goals (SDGs) to call for adaptation to sustainable SW management practices from developed and developing nations. An instance of a favourable outcome of sustainable SW disposal is the potential to reduce global GHG emissions in the range of 10% to 15% (Vassanadumrongdee & Kittipongvises, 2018). However, cultivating sustainable SW disposal practices remains challenging for developing countries, where they are often confronted with financial limitations. There are many cases of failed SW disposal facility projects, public opposition and continuation of non-sustainable SW disposal practice (Chu et al., 2019). This leads to the unanswered question of the feasibility of introducing sustainable SW disposal practices in developing countries.

As of now, most developed countries manage to apply adequate technology and advances in environmental education and public participation. However, developing countries are still grappling with difficulties to apply basic procedures in SW disposal (Alzamora & Barros, 2020). Bluntly following sustainable SW disposal solutions practised in developed countries may not be relevant due to differences in local backgrounds (financial, socioeconomic background, experience and knowledge) and lack of sound SW management technology (Torrente-Velásquez et al., 2021). This highlights the importance of finding alternatives to make sustainable SW disposal practices in developing countries feasible.

Towards achieving sustainability, the development of SW disposal should be locally exclusive to cater to local demand. Therefore, it is realistic to assume that engagement of the local public in SW management may provide a solution since they offer a direct response to real situations. Public participation has been a recommended alternative to mitigate SW management conflict as early as 1993, with significant benefits of reducing opposition and results in long-lasting decisions which are satisfactory to all stakeholders (Wiedemann & Femers, 1993). The idea of engaging the public in SW management is supported by SW management stakeholders due to their role as the primary generators of municipal SW (Kala et al., 2020). Moreover, recent literature on SW management in developing countries showed encouraging outcomes on public participation. Xiao et al. (2017) aimed to improve understanding of the factors influencing household willingness to participate in SW management in China. The results indicated that an SW policy hierarchy in Chinese cities and future SW management should shift from the current legislative-centred strategy to a more locally effective one by including public participation. Based on Maiyaki et al. (2018), public participation is no longer a requirement, but it is the condition for successful SW management since many studies have recorded profound public engagement in SW management to accomplish more outcomes and develop more comprehensively.

Public roles should be broadened in the decision-making and planning processes where the needs and ideas of the public can be heard and integrated into more effective implementation of the sanitary landfill project (Fernando, 2019). This will improve on the norm of the top-down approach in project appraisal by bringing up the concept of the bottom-up approach. Lu and Sidortsov (2019) explored the potential of the involvement of the public in household waste sorting as an alternative to the conventional top-down approach. The outcomes showed that public participation would be most effective at the initial stage of policy implementation, along with policy consistency, strong volunteer effort and compatibility with local culture.

However, in the context of SW management, most works have focused on the role of the public in SW recycling and public interest in SW disposal is often disregarded (Keramitsoglou & Tsagarakis, 2018; Lu & Sidortsov, 2019; Ruliana et al., 2019; Xiao et al., 2017). For instance, Keramitsoglou and Tsagarakis (2018) examined public involvement in designing recycling bins to encourage recycling, and Xiao et al. (2017) analysed public satisfaction towards the SW separation pilot programme.

There is limited research focussing on the public's role in the context of SW disposal; the closest are studies estimating public willingness to pay (WTP) using economic valuation methods for SW disposal, as seen in Lim et al. (2014), Pek and Jamal (2011) and Sasao (2004). Pek and Jamal (2011) assessed the value of sanitary landfill and incineration, finding that households were willing to pay to reduce psychological fear. Sasao (2004) evaluated landfill sitings and observed that respondents living farther from landfill sites had a lower WTP, aligning with the "not in my backyard" (NIMBY) syndrome. In a study by Lim et al. (2014) on waste-to-energy incineration in Korea, economic impact attributes such as job creation and energy security resulted in a positive WTP.

However, previous studies lacked discussion on two aspects. First, incorporating public WTP and second, incorporating local social factors of WTP into policy decision recommendations. Indeed, more recent economic valuation studies on SW management such as those by Gebreeyosus and Berhanu (2019), Ko et al. (2020) and Woretaw et al. (2017) have suggested considering WTP values in policy decision-making. This approach allows policymakers to make informed and equitable social choices, leading to improved strategies for policy success. Furthermore, it would be valuable to specifically identify local social factors that represent the population, enabling comparisons across related studies and encouraging researchers to explore the influence of these factors on WTP determination across different regions (e.g., Asia, America, Africa and Europe) or countries with varying income levels (e.g., high-income, middle-income and low-income countries).

This highlights a recent study by Nik Ab Rahim et al. (2021), which focused on the SW disposal scheme in the context of developing countries. The study provided an empirical example of a feasible sanitary landfill project in Malaysia, including public demand information in project appraisal. The study improvised cost and benefit comparisons for the sanitary landfill project by applying three policy-relevant methods – choice modelling, benefit transfer and cost-benefit analysis as a new approach to measure project feasibility. Nik Ab Rahim et al. (2021) showed evidence of public mutual agreement towards the sanitary landfill, indicated by their WTP of Malaysian currency, RM5.88 per month. The accumulation of the WTP amount showed that households need to pay RM70.56 per year on top of current SW management fees for sanitary landfill implementation. This information is useful to bridge the communication gap between stakeholders, mainly to propose additional payment for implementing the sanitary landfill.

However, the question is, how can public information on WTP be successfully interpreted in the decision-making process? The need to answer this question arises because communities in developing countries come from diverse social backgrounds due to high income inequality between the rich and poor (Ravaillon, 2014). The social differences should not be disregarded since they reflect a response to real situations and can be the determinant of the WTP patterns, whether it is following economic theory or not, making the decision locally exclusive. This highlights the importance of considering social factors in shaping the sustainable SW disposal policy in developing countries. The definition of social factors captures all influences that affect individual or group behaviour, including demographic characteristics, psychological factors, economic factors and political background. Considering social factors when tailoring SW policy is a key point for successful implementation since the policy appraisal is close to the local context and background (Knickmeyer, 2020).

In scientific research, the social dimensions of SW management do not receive the necessary attention. Vieira and Matheus (2018) stated that most efforts in developing sustainable SW management had not recognised local cultural characteristics or social dynamics. Based on Ma and Hipel (2016), out of the total number of publications on SW management, only 0.69% relate to social aspects, and although recently more attention is being paid to social dimensions of SW management, most of these studies deal with social interest towards SW recycling. This study fills identified gaps in SW disposal policy practice and scientific research by highlighting the significance of social factors in the implementation of sanitary landfill. Currently, there is a lack of studies that thoroughly analyse the local social context when estimating WTP for SW disposal policies. Thus, the objective of this study is to build upon the choice modelling analysis conducted by Nik Ab Rahim et al. (2021) to investigate the influence of social factors on WTP for sanitary landfill and their implications for the establishment of sustainable SW disposal practices.

This study is of substantial importance for local governments and communities. It reveals influential local social factors that shape communities' willingness to pay for the implementation of sanitary landfill. The study's findings will guide recommendations to governments on formulating suitable solid waste disposal pricing policies that align with the local social context. This will help ensure the successful implementation of sanitary landfill practices, which has been challenging in many developing countries due to high operational costs. The transition from improper solid waste disposal to sanitary landfill is crucial for the safe and effective management of waste, while mitigating environmental and community-related risks.

2. Materials and Method

As this paper is an extension of the choice modelling analysis in Nik Ab Rahim et al. (2021), it is useful to provide an overview of the methodological flow of their paper. Figure 1 shows their simultaneous use of choice modelling, benefit transfer and cost-benefit analysis to estimate a sanitary landfill's monetary worth.

The performed choice modelling is grounded in its theoretical foundation, Lancaster's characteristics theory of value and random utility theory. According to Lancaster's theory, any good can be described as a combination of its characteristics and their respective levels (Lancaster, 1966). This characterisation encompasses both measurable attributes, such as the flow, size and length of a river, as well as non-measurable attributes, like landscape quality, which is based on subjective perceptions. The consideration of these subjective attributes introduces the potential for measurement errors. This connection to measurement errors links Lancaster's theory to the random utility theory, initially developed by Luce (1959) and McFadden (1973), which provides an alternative framework for understanding choice and deriving conventional demand curves. The random utility theory separates the utility function into two components: the observable component, denoted as V, and the error term, ε, representing

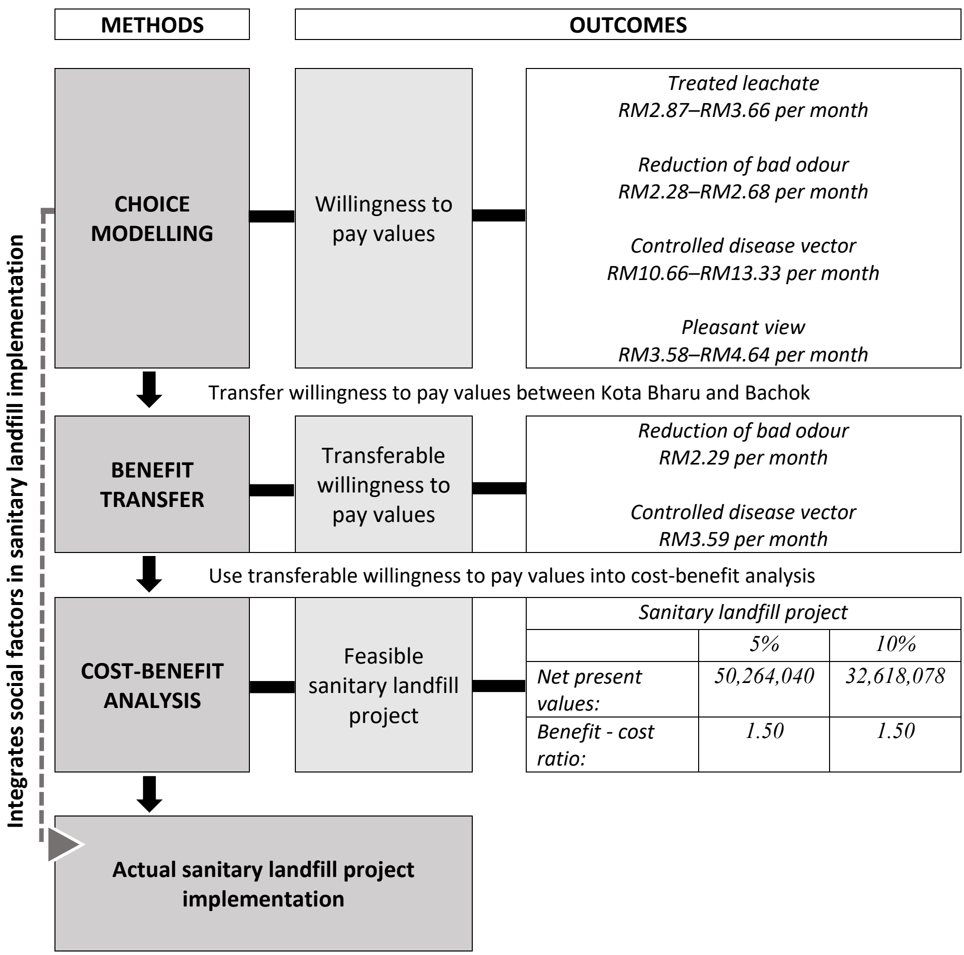

Figure 1. Methodological flow of the study

unobservable aspects of respondents' choice behaviour. Assuming the utility of an individual *i* for an alternative *n* depends on environmental attribute *X*:

$$U_{in} = V(X_{in}) + \varepsilon(X_{in}) = \beta X_{in} + \varepsilon_{in} \quad (1)$$

Equation 1 is the simplest presentation of the *i* utility of an individual on alternative *n* based on the random utility theory where assumptions have to be made about the unobservable parts of utility captured by the error term.

Following the theoretical basis of choice modelling, Nik Ab Rahim et al. (2021) performed a choice modelling study of the sanitary landfill by distributing questionnaires comprising socioeconomic, awareness and choice set questions. The formulation of the choice set questions is the central focus during the development of the choice modelling questionnaire, as it involves determining the attributes that best describe the sanitary landfill. It requires focus group sessions involving representatives from local households and solid waste management service providers. The primary goal of these sessions is to determine the attributes that effectively describe the sanitary landfill. After deliberation, four environmental attributes were agreed upon: leachate discharge, bad odour, disease vector and view. Each attribute was assigned a level one to represent the status quo of the “crude dumping” landfill, which includes untreated leachate discharge, strong bad odour, uncontrolled disease vectors, and an unpleasant view. Higher levels of each attribute indicate improvements, illustrating the environmental benefits of the sanitary landfill. In order to quantify the welfare associated with each environmental attribute, monetary attributes were introduced in the form of an additional solid waste disposal fee.

The choice set questions were constructed using fractional factorial design to assign attribute and level combinations. Each choice set presented a three-way choice between Option A and Option B for the sanitary landfill, incorporating levels from all attributes that maintained balance and orthogonality, as well as the status quo observed at the “crude dumping” landfill. A pre-test was conducted before the actual survey to assess the clarity of the choice set questions, the time required by respondents to complete the questionnaire, the effectiveness of using diagrams to assist respondents, and the appropriateness of the translated questionnaire. The pre-test involved interviewing 48 participants who answered four choice set questions from 12 different versions. Based on the feedback received during the pre-test, modifications were made to finalise the questionnaire.

Actual data collection involved stratified-random sampling, where house-to-house questionnaires were distributed among 624 household users of a crude-dumping landfill for SW disposal in the neighbouring districts of Kota Bharu and Bachok. The ratio of respondents from Kota Bharu to those from Bachok was 3:1, which corresponded to the ratio of the actual population in Kota Bharu to the population in Bachok.

In the set questions, the respondents were asked for their preferred SW disposal options with generic-format questions where:

- Option A: baseline SW disposal (crude-dumping landfill)
- Option B and Option C: improved SW disposal (sanitary landfill)

Figure 2 is an example of the set questions. Note that all the options were characterised by environmental attributes (leachate, bad dour, disease vector and view) and a monetary attribute (additional fee). Options B and C consist of attribute combinations generated from experimental design to elicit respondents’ preferences and WTP towards improvement in environmental attributes due to sanitary landfill implementation.

The respondents made their choices from the provided choice sets. Subsequently, multinomial logit (ML) and nested logit (NL) regressions were separately conducted on the collected responses from Kota Bharu and Bachok samples using NLogit 4.0 software. These regressions aimed to analyse the respondents’ preferences regarding treated leachate, reduction of bad odour, controlled disease vector and pleasant view, as well as to estimate their WTP for the improved environmental benefits.

The study used benefit transfer to only consider comparable values between the study areas for the sanitary landfill project appraisal, resulting in transferable WTP

Attributes	Baseline	Improvement	
	CRUDE-DUMPING LANDFILL	SANITARY LANDFILL	
	OPTION A	OPTION B	OPTION C
Leachate	Untreated discharge	Untreated discharge	Untreated discharge
Bad odour	Strong	Strong	Weak
Disease vector	Uncontrolled	Controlled	Uncontrolled
View	Unpleasant	Pleasant	Pleasant
Additional fee	No payment	RM5 per month	RM5 per month
CHOICE Please write (√)			

Figure 2. Question sets

values for the reduction of bad odour (RM2.29 per month) and controlled disease vector (RM3.59 per month). The cost-benefit analysis used these values as a proxy of additional solid waste disposal payment. The sanitary landfill yielded positive net present values and a benefit-cost ratio above one, offering empirical evidence of the feasibility of the sanitary landfill project in comparison to the baseline (crude-dumping landfill).

The results from Nik Ab Rahim et al. (2021) require extended analysis for a reasoned sanitary landfill implementation. Hence, this present study extends the choice modelling analysis to integrate social factors in the households' choices for SW disposal options. By following Figure 1, the integration of the social factors will be included in ML and NL model regressions. The social variables were estimated interactively with the alternative specific constant (ASC) along with environmental attributes with the following equation:

$$V_n = ASC + \beta_1 * LC + \beta_2 * OD + \beta_3 * DI + \beta_4 * VI + \beta_5 * FEE + \alpha_1 ASC * INC + \alpha_2 ASC * FAM + \alpha_3 ASC * ALAND \qquad (2)$$

For n = 1, 2 and 3, and ASC = 1 for n = 1, and applying the definitions according to Table 1.

For the NL model, the choices for SW disposal options were postulated as a sequence of two-level processes. In the first level, respondents were assumed to choose between two choices, either supporting or not supporting implementation of a sanitary landfill. The utility function for the first level was assumed to be influenced by social factors. $V_{\text{support sanitary landfill}}$ was the utility associated with supporting a sanitary

Table 1. Variables used in the choice modelling study

Variable	Definitions	
ASC	Alternative specific constant	1 = Status quo (*Current landfill*) 0 = Improved alternatives (*Sanitary landfill*)
LC	Leachate discharge	1 = Improved (*Half or fully treated*) 0 = Status quo (*Untreated*)
OD	Bad odour	1 = Improved (*No odour, weak or distinct*) 0 = Status quo (*Strong*)
DI	Disease vector	1 = Improved (*Controlled*) 0 = Status quo (*Uncontrolled*)
VI	View	1 = Improved (*Pleasant*) 0 = Status quo (*Unpleasant*)
FEE	Additional fee	Monthly fee
INC	Household income (ratio data)	
FAM	Number of household members (ratio data)	
ALAND	Acknowledgement of problems in landfill	1 = Acknowledged 0 = Unacknowledged
EMP	Employment	1 = Employed 0 = Unemployed
HOM	House ownership	1 = Self-owned 0 = Others

landfill implementation, and $V_{\text{do not support sanitary landfill}}$ was the utility derived from selecting not supporting sanitary landfill implementation.

$$\begin{aligned} V_{\text{support sanitary landfill}} &= \alpha_1 ASC*INC + \alpha_2 ASC*FAM + \alpha_3 ASC*ALAND + \\ &\quad \alpha_4 ASC*EMP + \alpha_5 ASC*HOM + \alpha_6 ASC*DIS + \\ &\quad \alpha_7 ASC*APAY + \gamma_1 IV_{\text{support sanitary landfill}} \\ V_{\text{do not support sanitary landfill}} &= \gamma_2 IV_{\text{do not support sanitary landfill}} \end{aligned} \tag{3}$$

In the second level, conditional on supporting the sanitary landfill, the respondents were assumed to choose within a nest between the two sanitary landfill options, "Option 2" or "Option 3" presented in each choice modelling question, as referred to in Figure 2. Note that another feature of the NL model was the addition of an inclusive value (IV), which represented a measure of the expected utility associated with the degree of substitutability between alternatives in a given nest. The utility function was assumed to be influenced by the ASC and the environmental attributes:

$$V_n = ASC + \beta_1*LC + \beta_2*OD + \beta_3*DI + \beta_4*VI + \beta_5*FEE \tag{4}$$

For n = 1, 2 and 3, and ASC = 1 for n = 1, and applying the definitions according to Table 1.

By referring to Table 1, the variables used for choice modelling analysis in the present study can be divided into two categories to describe the characteristics of the sanitary landfill and the respondents. The former variables consisted of the qualitative environmental attributes (LC, OD, DI, VI) characterising the sanitary landfill. They were dummy coded as (0, 1), with the improved levels of environmental attributes coded as (1), while the status quo levels were coded as (0). For instance, leachate discharge, denoted by (LC) has three levels. The improvement levels for LC are half-treated discharge (level 2) and fully-treated discharge (level 3). These levels are coded as (1) indicating the improvement levels while untreated discharge is the status quo coded by (0). Meanwhile, the description of the respondents was based on the information solicited from the survey to reveal their social backgrounds, such as household income, number of households, employment, house ownership and their locally based knowledge about the problems in the landfill. ASC was also included to reflect the respondents' choices for improved alternatives or the status quo and interact with other variables in the estimated models. ASC was dummy coded as (1) when the respondents opted for the baseline alternative (crude-dumping landfill) in the choice set and (0) when the respondents opted for options for the sanitary landfill.

3. Results and Discussion

The results of this extended study are shown in Table 2. Columns I and II are the outcomes for the MNL models, and Columns III and IV show the NL models for Kota Bharu and Bachok. All of the environmental attributes were highly significant and displayed positive signs. Across the models, the coefficient value for DI was the highest compared to the coefficients of the other environmental attributes (LC, OD, VI). This shows that respondents had the highest utility where propagation of the disease vector is controlled, *ceteris paribus*. This indicates that the marginal utility received by respondents when the disease vector is controlled is greater than the utility received for improvements in the other environmental attributes.

Social factors were incorporated in the MNL and NL models by arranging them to interact with ASC, the alternative specific constant for opting for the baseline alternative (crude-dumping landfill), as shown in Equation (2). The interaction variables allow investigation of the influence of the social factors with respect to the respondents' choices for opting for the crude-dumping landfill. Across the models, an interesting observation that involves the interactive variable ASC∗INC is shown. Both models' coefficients for ASC∗INC for Kota Bharu were negative and highly significant. This interprets that higher-income respondents in Kota Bharu played an important role towards their choices to support the sanitary landfill. Despite the small coefficient values, the standard deviation values are very small, reflecting the high precision of the results.

A counter-intuitive observation involving the positive signs for the coefficients of ASC∗INC in Bachok interprets higher income respondents to support the crude-dumping landfill. Although the coefficient value is very small in the MNL model, it is highly significant and has a low standard deviation, suggesting high precision of the result. This result is unique in two ways. First, it is an unusual finding that is different to the welfare theory. Higher-income respondents should respond positively to the

Table 2. Results of the study

Variable	I	II	III	IV
	Multinomial Logit Model		Nested Logit Model	
	Kota Bharu	Bachok	Kota Bharu	Bachok
ASC	-0.615 (0.382)	9.776 (0.128D+07)	-0.317 (0.128D+07)	-237.488 (0.403D+08)
LC	0.313*** (0.042)	0.675*** (0.091)	0.342*** (0.044)	0.675*** (0.092)
OD	0.267*** (0.036)	0.421*** (0.076)	0.320*** (0.040)	0.421*** (0.076)
DI	1.382*** (0.081)	1.963*** (0.204)	1.593*** (0.096)	1.972*** (0.205)
VI	0.464*** (0.073)	0.661*** (0.149)	0.555*** (0.080)	0.661*** (0.150)
FEE	-0.109*** (0.014)	-0.184*** (0.029)	-0.120*** (0.015)	-0.185*** (0.029)
ASC∗INC	-0.001*** (0.001)	0.337D+03*** (0.001)	-0.001*** (0.955D+04)	0.013 (1267.612)
ASC∗FAM	0.156*** (0.033)	0.957 (0.548)	0.149*** (0.032)	18.420 (0.212D+07)
ASC∗ALAND	0.649*** (0.176)	-21.672 (0.128D+07)	0.641*** (0.177)	80.411 (0.317D+08)
ASC∗EMP			-0.732*** (0.261)	-11.146 (0.874D+07)
ASC∗HOM			0.400 ** (0.180)	16.746 (0.102D+08)
Inclusive value parameters				
Improvement			0.368*** (0.110)	1.195 (1.942)
No improvement (fixed parameters)			1	1
Summary statistics				
Log likelihood L(β)	-1502.589	-268.232	-1403.218	-283.919
Log likelihood L(0)	-1736.502	-403.135	-2482.853	-792.267
Pseudo-R^2	0.13	0.33	0.43	0.64
Iterations completed	6	31	26	11
Observations	1872	572	1872	572

Note: Values in parentheses ( ) indicate the standard errors of the respective coefficients. *Significant at 10% level, **significant at 5 % level, *** significant at 1 % level.

improvement (sanitary landfill) rather than the status quo (crude-dumping landfill). Second, those who live closer to the crude-dumping landfill site are expected to have the "Not In My Backyard" (NIMBY) syndrome. This syndrome is a strong emotional collective opposition due to worries about the negative impacts on physical health, environmental quality and asset value (Xu & Lin, 2020). The NIMBY syndrome usually influences decisions among affected communities where they would support the improvement rather than the status quo. This result may suggest that other factors contribute to this unexpected result.

Differences in the mean income can explain the unexpected result among the respondents from Kota Bharu and Bachok. Compared to the respondents in Kota Bharu, those in Bachok have a lower mean income, averaged at RM1250. The mean income value is lower than the state's income poverty line at RM2139 (Department of Statistics Malaysia, 2019). This reveals that poverty is an embedded factor that causes them to favour the status quo. They would have to pay more for the sanitary landfill to choose the improvement. Poverty has existed alongside income inequality in developing countries and has stalled public projects from succeeding (Ravaillon, 2014).

Therefore, consideration of social factors in determining WTP for improved SW disposal is crucial in addressing poverty-related issues, as highlighted in this paper. It emphasises the importance of understanding the actual circumstances before deciding on SW pricing policies. This finding aligns with the recommendations of Gebreeyosus and Berhanu (2019), Ko et al. (2020) and Woretaw et al. (2017), who advocate for the inclusion of WTP values in policy decision-making. However, implementing WTP values without knowledge of the prevailing conditions can be risky, as there may be constraints that limit households' ability to pay. This underscores the need for a comprehensive discussion on incorporating local social factors into WTP considerations, a gap in previous studies. Simply recommending additional payments for SW disposal based on the current uniform SW disposal fee is no longer viable, particularly given the acknowledged poverty issues among households in Bachok.

Regarding poverty issues, providing improved SW disposal services to communities demands different pricing policies (Vieira & Matheus, 2018). Instead of applying uniform SW disposal fees across benefited communities, unequal measures suit more, for example, the adoption of a cross-subsidies scheme. Cross subsidisation sets variations in waste disposal pricing schemes for two communities, commonly divided by their social differences. It is an effective fiscal tool to support financing safe sanitation and expand public services access for low-income households. This includes necessary public services like waste management, water supply, irrigation and electricity. Cross-subsidies from higher-income to lower-income communities are not yet common, with little experience from least developed and developing countries, including Burkina Faso and Zambia, in financing waste management (Acey et al., 2019). However, the relevance of cross-subsidies is supported by a study of community compliance attitudes towards taxation for public services in four African countries (Ali et al., 2014). The finding revealed that tax compliance attitude is positively correlated with the community's perceived health and environmental benefits. The perceived benefits include improvements to their neighbours' sanitation. Acey, et al., (2019) also discussed opportunities for cross-subsidies in urban Kenya to support basic services for low-income communities. The evidence shows the relevance of introducing cross-subsidies as a new pricing policy for public services, in this case, to finance the sanitary landfill.

There are other pricing choices. For example, Welivita et al. (2015) reviewed waste charges for developing countries and recommended the adoption of “Pay as You Throw” through bag-based schemes. However, the current pricing scheme in Malaysia is not yet systematic in terms of technical, financial, and administration. The waste disposal fee is absorbed into a local tax imposed based on the value of land property. To fit with the current pricing scheme, cross-subsidies have the direct translation to put into action with less technical changes. However, the prompted changes should encompass transparency in the waste disposal pricing scheme to obtain community trust.

4. Policy Implications

Implementing an additional payment for the implementation of a sanitary landfill in Kota Bharu and Bachok for SW disposal services is a complex task. The existing payment system for SW management (including SW disposal) relies on annual assessments collected from households, known as “*Cukai Pintu*,” based on the value of residential properties. The assessment rate varies between four percent and twelve percent of the property value. While the annual assessment amount differs among households, the additional payment for the sanitary landfill must be a fixed flat rate (uniform fee). SW disposal is considered a public service with non-excludability and non-rivalry characteristics, meaning all households have equal access to the benefits of the sanitary landfill. Therefore, implementing a Pay as You Throw policy, commonly used in developed countries, may not be suitable in Kota Bharu, as it is difficult to accurately measure the actual volume of SW generated by households. Instead, the non-market value of the sanitary landfill can be used as a basis for determining the additional payment. For instance, based on the non-market values calculated in a previous study Nik Ab Rahim et al. (2021), an annual additional payment of RM70.56 per household was proposed. This payment can be divided into two instalments of RM35.28, paid every six months, which should not impose a significant burden on households.

However, the findings of this paper indicate that poverty is a significant factor influencing households in Bachok to prefer the status quo rather than paying more for the implementation of the sanitary landfill. To address this issue, cross subsidies can be implemented to distribute the financial burden more fairly and ensure affordability for households in both Kota Bharu and Bachok. Cross subsidies would involve redistributing costs of the sanitary landfill implementation among households in Kota Bharu and Bachok. This approach aims to balance the financial burden and promote affordability, with households in Kota Bharu contributing more to offset the costs for households in Bachok. By implementing cross subsidies, improved solid waste disposal services can be made accessible and affordable for all households in both areas.

5. Conclusion

Waste disposal is one of the public services requiring improvement. However, improvement attempts often find a dead end due to financial crises. It is not critical in developed countries where the finance and public participation rate are advantageous to good SW management. They have a high success rate for sustainable waste disposal services through incineration, sanitary landfill, or waste reduction initiatives. It differs for developing countries where allocating funds to finance the sustainable waste disposal service is still in haze due to high income gaps between high- and low-income earners. This jeopardises consistent payment for current waste disposal and has halted many initiatives to improve waste disposal service. In return, environmental issues are escalating from unsanitary waste disposal. Without intervention would mean putting a barrier towards achieving the Sustainable Development Goals 2030.

However, the financial capability to fund waste management differs between countries. Without classifying countries, the financing of waste management involves approximately 50% investments from local governments, the remainder provided through national government, and payments by households. They typically comprise nearly 20% of local governments' budgets in low-income countries, more than 10% in middle-income countries, and 4% in high-income countries. Including a more advance waste disposal approach would require increasing fees. However, political support will be limited especially in developing countries. Cross-subsidising is novel in waste management pricing policy. With limited funds, cross-subsidising from payments by higher-income waste generators can help reduce the financial strain. This will alleviate the burden of lower-income waste generators and local government budgets. Therefore, future questions need to be explored, "how should the payments be collected indefinitely?" and "should the payment be capped above a certain amount?"

This paper answers the future questions by elaborating the findings of an economic valuation, benefit transfer and cost-benefit analysis conducted by Nik Ab Rahim et al. (2021) on the sanitary landfill. This paper considers local social factors to provide recommendations for cross-subsidies for SW disposal pricing policy. The recommendation for cross-subsidies is crucial in narrowing the gap between higher-income and lower-income households' ability to pay for the sanitary landfill. This ensures consistent payment among households for the implementation of the sanitary landfill. The outcomes of this paper differ from previous studies, which typically estimate WTP without integrating the results and local social factors into specific policy decision recommendations. Instead, this paper contributes to the existing literature by examining the local social context to propose an appropriate pricing policy.

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