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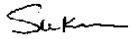

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The importance of environmental services inclusion in waste management: The Household responses in Palembang City

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ABSTRACT

The environmental sociology perspective highlighted how to overcome the ecological degradation based on social aspect inclusion in such solving action that seemed useful to solve household waste management problems in Palembang City. The study aims to assess household responses to the importance of water and air quality services inclusion in waste management. The research used a choice experiment by using a half-fraction factorial design. The number of attributes used was four; each of them had two levels. Attributes used were water and air quality, cost, and sorting of waste. The conditional logit regression approach interprets the marginal coefficient of willingness to pay for environmental services. The findings showed that water quality was more likely to be one of the considerations in choosing a waste management model rather than air quality. Households were more willing to pay in time-allocation-to-separate-waste form rather than paid additional fees. The spatially differentiated action should be taken to increase the effectiveness of waste collecting. The waste management policy should view as mandatory for every citizen. This perspective could give additional benefits to counter the hedonic factors.

Key words : *Social aspect inclusion, Water quality, Willingness-to-pay, Hedonic factors*

Introduction

It has been more than five years since the Mayor of Palembang City and the community carried out routine voluntary work every week to clean the river from rubbish. Still, there hasn't been much change in people's habits of throwing garbage into the river. The phenomenon had raised a question if the environment factor is playing roles in such a situation. It is known that Palembang City built and expanding on wetlands plain, starting from around the riverbanks and continues with the reclamation of the surrounding marshes (Bronson and Wisseman, 1976). The tidal phenomenon of river water levels causes the early residential building constructed to adapt in the form of stilts house connected by a minimalist sized bridge and tends to be winding. The path suspected gives difficulty to collect household waste, which one of several significant problems in providing proper waste handling services (Shekdar, 2009). On the other side, the absence of a temporary waste dump site thought to be one of the factors that made the residents in the stilts house relatively never manage their waste correctly

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and tend to dump their waste into a water body. From this point of view, one could say that the environment influences waste handling behavior, the statement that in lines with Vollmer and Grêt-Regamey (2013) conclusion.

The environment is not a passive object but also acts to influences human living (Stevens, 2012). Therefore, to reduce people's habits of throwing waste into a water body, one could use the environmental sociology perspective that reflects a series of reciprocal dynamic relations between humans and the Biophysical Environment, both in the form of actions and institutions (Woodgate, 2010). The environmental sociology highlighted how to overcome the ecosystem degradation based on social aspect inclusion to maintain adequate ecosystem service delivered properly. The environmental services needs for each population is unique, depending on socio-economic and community perceptions. The evaluation of ecosystem services necessity indeed is constructed based on the level of demand, namely the need for immediate use, and the need for 'wants' (intended use). The need for direct use is more oriented towards economic value, while the demand for 'wants' tends towards conservation (Wolff *et al.*, 2015).

On the other side, waste empirically has affected the capability of nature to provide ecosystem services. Improper waste management led to an increase in greenhouse gas (Themelis and Ulloa, 2007), spread odor and bio aerosol pollutants, and heavy metal deposits on soil (Wei *et al.*, 2017), and to contaminate water sources (Wang *et al.*, 2006). In an attempt to change the ill behavior of households regarding waste handling, it is necessary to understand how the community assesses waste as part of ecosystem services (Boonrod *et al.*, 2015). Differences in environmental services demand would give different community action on using currently available resources. Therefore, the study aims to assess household responses to the importance of water and air quality services inclusion in waste management.

Methods

The research conducted in two locations (Kemang Agung and Sukamaju) in Palembang City 2020. As much as 40 household are randomly sampled from two locations. The research used a choice experiment, one of the methods commonly used to assess environmental service needs (Hanley, Mourato and Wright, 2001), by using a half-fraction factorial design. The number of attributes used was four; each of them had two levels. The choice experiments carried out used eight variations that designed orthogonally by assuming the relation Intercept = ABCD. Attributes used were environmental services that have proven to be affected by waste management, i.e., water quality and air quality (Pek and Othman, 2009). Two other attributes related to cost included in choices, i.e., compulsory sorting of waste (Naz and Naz, 2006)- that could convert into money by using the equation of time allocated to sort waste times typical informal wage per hour- and waste handling services (WHS) fees (Pek and Othman, 2009; Jin, Wang, and Ran, 2006).

The respondents are offered two packages of waste management. The first was the status quo package that had attributes: households need not to sort their waste, waste management does not improve water and air qualities, it did not increase WHS fee. The second was an alternative package consisted attributes: households had to sort their waste, waste management does improve water and

Table 1. Description of the attributes and levels of environmental services

Code	Attribute	Definition	Existing waste management	Alternative
A	Time	willingness to allocate time for sorting waste	household did not sort their waste	low value: unwilling to sort high value: willing to sort
B	Water quality	water body quality around the residence	polluted surface water	low value: no changes high value: water quality is improved
C	Air quality	no odors	odor spread uncontrollably	low value: no changes high value: air quality is improved
D	Cost	monthly waste handling service fees	there is no additional fees	low value: no additional fees high value: had additional fees

air qualities, it need additional WHS fee. Description of the attribute and level summarized in Table 1. Pair of environmental services set selected using a random generator. Respondents asked to choose a set of environmental services included in the waste management had modeled. An example of the questions asked is displayed below.

Each of the environmental services set that chosen valued as one, while unchosen set valued as zero.

The probability of the environmental services set that chosen then interpreted by using a logit analysis approach. The model analysis often used include mixed logit (Ryffel *et al.,* 2014), conditional logit (Yacob *et al.,* 2009), and multinomial logit (Pek and Othman, 2009). For the current study, the conditional logit regression would be used, which expressed by the equation:

$$ln\left(\frac{P}{1-P}\right) = \beta_A.A + \beta_B.B + \beta_C.C + \beta_D.D$$

where

P : probability of model being chosen;
A : household do waste sorting;
B : increase in river water quality;
C : increase in air quality;
D : paying additional waste handling service fee; and
β : coefficient regression of corresponding attributes.

If the regression coefficient had a positive sign, the attribute is likely to be included in household waste management. If it had a negative sign, it means rejected. Willingness-to-pay then calculated by comparing the coefficient of environmental service attribute to the coefficient of cost variable. This ratio is also known as the implicit marginal price (Yacob, Radam and Rawi, 2009). In the conditional logit regression, the probability of the selected model is one so that $ln\left(\frac{P}{1-P}\right) = 0$. Therefore, the marginal coefficient of willingness to pay for environmental services on a money basis is calculated by the equation $WTP_D = -\left(\frac{\beta_{A,B,C}}{\beta_D}\right)$ (Karousakis and Birol, 2008) while in the basis of time it is calculated by the equation $WTP_A = -\left(\frac{\beta_{B,C}}{\beta_A}\right)$. In terms of money, if the marginal coefficient had a positive sign, it indicated that the respondents were unwilling to increase the WHS fee regarding obtaining better environmental services and vice versa if it had a negative sign. In terms of time, if the marginal coefficient had a positive sign, it stated that the respondents were unwilling to spend time to sort waste and mean the opposite if the marginal coefficient had a negative sign.

Results and Discussion

Respondents in the two research locations tend to increase river water quality as a factor that must be included in waste management while improving air quality is not a factor that needs attention. Respondents in Sukamaju have a more environmentally sound response than Kemang Agung showed by the willingness to sort waste (Table 2). As many as 5/8 of households in Kemang Agung, who previously did not pay waste handling service (WHS) fees, later were willing to pay WHS fees of the waste management package offered. On the other side, in the household group that spent WHS fees from the beginning, as many as 5/12 of households in Kemang Agung and 12/19 of households in Sukamaju were willing to increase their WHS fees.

At Kemang Agung, the average WHS fees paid by the group of households that willing to add costs was IDR. 19,600, which was lower than the mean of WHS fees spent by their counterpart (IDR. 27,857). Whereas in Sukamaju, it occurred opposite where the group of households that willing to add costs

Question: waste management that i preferred to run is:

Set 1	Set 2
households had to sort their waste	household had no to sort their waste
waste management might not improve water body quality	waste management might not improve water body quality
waste management might improve air quality	waste management might not improve air quality
waste management has additional waste handling service fees	waste management has additional waste handling service fees

the answer is: _____

had a more generous contribution as much as IDR. 4,869 then their counterpart (IDR. 40, 583 vs. IDR. 35,714). Based on these data, the study assumed the upper limit of the willingness to pay WHS fees in Kemang Agung was around IDR. 30,000, while in Sukamaju was around IDR. 40.000. In terms of food per capita expenditure, it knew that households were willing to increase their WHS fees had higher average spending than households were not ready to advance their WHS contribution (IDR. 666,040 vs. IDR. 399,230). The opposite condition existed in the group of households that were currently not paying dues, where those were willing to pay WHS fees had a lower food per capita expenditure than their counterpart (IDR. 341,670 vs. IDR. 346,880).

The results of the conditioned logit regression showed that environmental service variables were more likely to be one of the considerations in choosing a waste management model in Kemang Agung (ρ: .046). Still, it probably would not be considered in Sukamaju (ρ: .494). Environmental services were also more likely to be considered in waste management based on the overall sample (ρ: .048) (Table 3). In general, to create proper waste management, waste managers need to convince households that waste management carried out positively impacts river water quality. It would ease waste managers to encourage people to sort their waste. The significant value of the variables revealed that increasing the WHS fee was the last option that should be taken by waste managers in improving waste management.

Based on all samples, the marginal coefficient analysis showed that respondents were unwilling to pay a larger fee than currently applied to improve river water quality but were willing to spend time to sort waste in exchange for cash contributions. Similar results are found based on each settlement (Table 4). This finding reflected the empirical facts that the Palembang City government emphasizes improving river water quality through community's voluntary work by picking out waste directly from the river, which later created a perception that additional costs are not required.

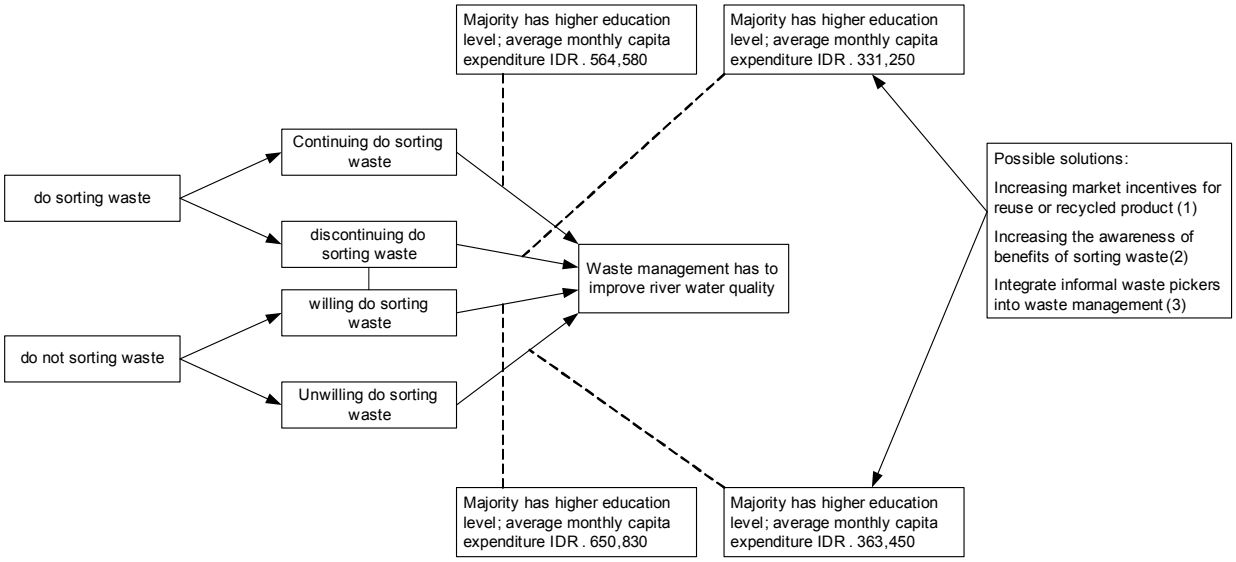
Of the household that demanded waste management had to improve environmental services, around 70.59% of households were unwilling or will discontinuing sorting activities. Unfortunately, these households had a high educational level that, theoretically, should have better responses on request to sort waste. Several reasons could use to ex-

Table 2. Propensity to include an environmental services needed by household in waste management

Indicators	Location		Propensity to include an attribute in waste management	
	Kemang Agung	Sukamaju	Kemang Agung	Sukamaju
Age (mean, years)	34.5	40.0		
Education level (%)			n.a.	n.a.
Secondary level or below	60.0	63.2		
Higher level	40.0	36.8		
Household had to sort waste before disposing of (%):			negative	positive
No	61,9	31,6		
Yes	38,1	68,4		
Waste management could improve river water quality (%):			positive	positive
No	23,8	36,8		
Yes	76,2	63,2		
Waste management could improve air quality (%):			negative	negative
No	52,4	63,2		
Yes	47,6	36,8		
Households were willing to provide additional fees (%):			negative	positive
No	52,4	36,8		
Yes	47,6	63,2		

Remarks: n.a.: not applicable

plain these phenomenon. First, the households were not aware of the benefits of sorting waste and, at a certain level, have perceived that sorting waste was difficult (Cudjoe *et al.*, 2020). Second, relatively low expenditure suggested played a role (Miliute-Plepiene and Plepys, 2015) that prevented the household member for allocating time to sort waste. Third, hedonic factors such as smell and inconvenience were also found as an obstacle to sort waste (Pickering *et al.*, 2020). For current study findings, integrating informal waste pickers into waste management would suit a settlement area with a winding and narrow road while optimizing the waste picking route might be useful for settlement with wide access. This spatially differentiated action is believed to increase the effectiveness of waste collecting. The waste management policy should view as mandatory for every citizen. This perspective



Sources: (1) Cudjoe, Yuan, and Han (2020); (2) Miliute-Plepiene and Plepys (2015); (3) Nogueira Zon *et al.* (2020)
Fig. 1. Current and possibility to continue to sort waste, demand to improve environmental services, and household characteristics

Table 3. The conditional logit regression coefficient of featured environmental services inclusion in waste management

Attribute	Both location				Kemang Agung			
	β	S.E.	Exp(β)	Sig.	β	S.E.	Exp(β)	Sig.
Sorting out the waste	.951	.632	2.588	.132	1.650	1.323	5.205	.212
River water quality improvement	1.431	.573	4.184	.012	2.420	1.150	11.246	.035
Air quality improvement#	-.175	.610	.840	.774	-	-	-	-
paying additional cost	-.397	.570	.673	.487	-.560	.832	.571	.501
Pseudo R-square	.173 – .284				.289 – .440			
Chi-square (sig.)	9,566 (.048)				8,005 (.046)			

Attribute	Sukamaju			
	β	S.E.	Exp(â)	Sig.
Sorting out the waste	.963	.856	2.619	.260
River water quality improvement	.694	.744	2.002	.351
Air quality improvement	.095	.886	1.099	.915
paying additional cost	-.320	.949	.726	.736
Pseudo R-square	.123 – .208			
Chi-square (sig.)	3.398 (.494)			

Remarks: # the air quality variable is excluded from the model analysis for Kemang Agung because it did not meet the regression requirements.

Table 4. The marginal coefficient of WTP

Attributes	Environmental services marginal coefficient		
	All samples	Kemang Agung	Sukamaju
In-cash			
Sorting out the waste	2.40	2.95	3.01
River water quality improvement	3.60	4.32	2.17
Air quality improvement	-.44		.30
In-kind			
River water quality improvement	-1.50	-1.47	-.72
Air quality improvement	.18		-.10

could give additional benefits to counter the hedonic factors (Li *et al.*, 2020).

Research Limitations

Unlike most previous willingness-to-pay research that explicitly stated various amounts of cash as a choice, the current study instead used willing to pay additional waste handling services fees as a choice. This approach believed more properly to implement in a settlement area that has various socioeconomic levels. Unfortunately, the approach's consequence was the amount of cash that households willing to pay for an environmental service could not be used to compare other study findings.

Conclusion

In general, the household demanded an improvement in water quality to include in waste management rather than air quality improvement. Households were more willing to pay in time-allocation-to-separate-waste form rather than paid additional fees. The spatially differentiated action should be taken to increase the effectiveness of waste collecting. The waste management policy should view as mandatory for every citizen. This perspective could give additional benefits to counter the hedonic factors.

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