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ENVIRONMENTAL CHEMISTRY, POLLUTION & WASTE MANAGEMENT | RESEARCH ARTICLE

Households' preferences for improved solid waste management options in Aksum city, North Ethiopia: An application of choice modelling

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Abstract: The non-market welfare gain from different improved solid waste management options for households in Aksum city, Ethiopia, was estimated using choice modelling. The proposed improvements in solid waste management were presented by three service attributes (i.e. frequency of waste collection, waste disposal mechanism, and mode of transport used to transport waste) along with a monetary attribute (monthly charges of households for the service rendered). For the purpose of the survey, 150 dwellers of the town were randomly selected. Two multinomial logit models were used for the estimations. In both models, the coefficients of the attributes are significant and with the priori expected signs. Except for the gender of the respondent, family size and monthly income of the households, all included variables significantly affect utilities of the respondents. Implicit prices were calculated and found 4.6, 1.7 and 2.5 Birr for the frequency of waste collection, waste disposal mechanism and mode of transportation, respectively, for the extended model. The trade-offs between the non-monetary attributes were also calculated. Analogous results were found for the two models, and frequency of waste collection ranked top in terms of relative importance to households. Finally, the various hypothetical scenarios support that the dwellers of the town are willing to pay for improvements in the existing solid waste management activities.

Subjects: Environment & the City; Environmental Policy; Environmental Change & Pollution; Urban Economics; Environmental Economics

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Metkel Aregay Gebreeyosus is an Assistant Professor in the Department of Agricultural and Resource Economics at Mekelle University, Ethiopia. He has researched on range of environmental issues including sustainable land management, community-developed exclosures and investment on land. Generally, his research interests include waste management, forestry and livelihood, issues related to rural land and poverty among others. The current work relates the non-market valuation of solid waste management scenario to the perceptions of urban dwellers. It helps solid waste management policies to look into the demand side of the story rather than focusing on the supply side only.

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PUBLIC INTEREST STATEMENT

Solid waste management is a widely researched area of study. There are ample studies on waste generation, waste recycling, waste disposal and waste content. However, the public preference and potential participation are less sought. Public policies based on researches that neglect this important part are obviously one sided. The large amount of solid waste generation is a real threat to the environment. In Ethiopia, solid waste management is at its lowest stage compared to others. The inclusion of the perceptions of urban dwellers can help better-informed policies and decisions.

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Keywords: Solid waste management; Aksum; Ethiopia; choice modelling; valuation

1. Introduction

Urbanization and increase in population come with an immense increase in the amount and composition of solid wastes around the world (Bartone & Bernstein, 1993; Beede & Bloom, 1995; Eugenia, Georgina, & Ramil, 2002; Mehra et al., 1996; Se-Ju Ku et al., 2009;). Being the mixture of many things including hazardous materials, an increase in quantity and content of solid waste poses serious environmental problems and hence needs to be managed properly so as to reduce its negative impacts. Proper management of solid waste involves many hierarchical steps which include reducing waste, reusing, recycling, energy recovery and finally landfilling (Gray, 1997; Hajkowicz, Tellames, & Aitaro, 2005). Each stage must be taken carefully, the major aim being minimizing the environmental impact of unmanaged solid wastes. Landfilling should also be the final step. Before simply being disposed of to landfills, it is wise to reuse reusable, recycle recyclables and recover possible energy.

If not managed properly, solid waste has social, economic and environmental implications. These implications make solid waste management one of the critical concerns facing the world, and the problem is more pronounced for less developed countries. The central aim of managing waste is to reduce its volume, composition and adverse effects. However, cities in developing countries have great challenges to deal with the solid waste management activities. Budget and infrastructural constraints, rudimentary organization and planning of solid waste collection and disposal, poor or no segregation at source and corrupt public sector (Buenrostro & Bocco, 2003; Das, Birol, & Bhattacharya, 2008), are among the main problems of developing countries in properly managing solid waste. Beeds and Bloom (1995) put a solid argument that developing countries have poor waste management, managing only 30–50% of the waste properly. The rest is either burned or left to decompose in open space or dumped in unregulated landfills, which is environmentally damaging. The spending in contrary to this is significant; it ranges 20–50% of municipal revenues serving only 50–70% of the residents inadequately. (Cointreau, 1987; Longe, Longe, & Ukpebor, 2009; Schubeler, 1996) This indicates that the management of solid waste in many developing countries absorbs a large share of their respective budgets but still is in its unsatisfactory stage.

To find solutions for the mismatch between demand and supply in the solid waste management services, many types of research had been undertaken in many parts of the world by employing different approaches, mostly contingent valuation method. In recent times, however, choice modelling is becoming more appealing due to the variety of options it offers. The Ethiopian case is not different. Almost all studies in this respect employed contingent valuation method (Metkel, 2018; Tesfahun, 2007; Seleshi, 2007; Tolina, 2006). Very few studies employed choice modelling (Yonas, 2010) concerning solid waste management. The main aim of the study, conducted in the historical city of Aksum, is to look for households' preferences for improved solid waste management options so that this mismatch is solved employing choice modelling. In researching solid waste management, a significant focus is traditionally placed on the supply-side information. This study is undertaken to show the possibility of including the demand-side perception of the public in solid waste management exercises by valuing the non-market welfare gain of households from different improved solid waste management options. The article is organized as follows: Section 2 discusses the materials and methods part and Section 3 presents the major findings of the study. The fourth section deals with the concluding remarks.

2. Materials and methods

2.1. Data source and survey sampling

The main source of information was face-to-face interview with the selected households. Multistage Area Sampling (MAS) technique was used to exploit the administrative division of the

city. MAS is a cluster sampling technique, hence a probability sampling technique, with several stages. Accordingly, first, all the "*Tabias*" (local administrative division smaller than sub-city) were taken for the sake of representativeness, and then respected "*Ketenas*" (the smallest local administrative division) were randomly selected from the selected "*Tabias*" (actually two "*Ketenas*" from each "*Tabia*"). Finally, 150 households were selected from the "*Ketenas*" using systematic radom sampling technique, the sampling frame being the total number of households in the city.

2.2. Questionnaire design

In order for the whole work in choice modelling to be successful, careful and detailed design and preparation of questionnaire is indispensable. By its nature choice modelling offers different options and let the respondents to choose their favoured one. The alternatives that were presented in the choice sets are integral parts of the questionnaire which demand a cautious identification and experimental design during the course of the questionnaire preparation. The questionnaires designed generally include questions that elicit households' perception of the current solid waste management status of their environment, their socio-economic and demographic characteristics and their choice of different solid waste management alternatives (which were reflected by the choice sets). In the first part, questions regarding the general perception of the current status of their environment and specifically in connection with solid waste management were presented to the respondents. Here, the intention is to know the perception of respondents with regard to the current solid waste management situation of their vicinity. The second and the main part of the questionnaire has to do with the presentation of the choice sets. A series of five choice sets with several solid waste management options were part of the questionnaire. Similar service attributes taking on different levels make up the choice sets in such a way that the attributes varied independently of one another. The choice sets were constructed using the optex procedure in SAS statistical software, and fractional factorial design was employed to reduce the number of alternatives to a manageable size.

Five choice sets were presented to each respondent together with other questions in the questionnaire. Each choice set has three options. The first option, the "status quo", which is similar across all the choice sets, advocates no changes in the current solid waste management situation. The status quo allows the current solid waste management situation to continue as it is. The two additional options (alternative 1 and alternative 2) vary across choice sets according to the experimental design and were presented to the respondents with proposed improved solid waste management options. The final part of the questionnaire has to do with different socio-economic and demographic characteristics of the respondent such as age, sex, marital status, employment, income and others.

2.3. Defining attributes and their levels

This study focuses on the improvement of solid waste management options. Since the methodology used is choice modelling, the overall improvement in solid waste management was attempted to be represented by some attributes with their respective levels. The preliminary attributes and their levels that were developed in consultation with members of a union who work on solid waste management in Aksum town and municipality officials of the town who specialize on solid waste management were refined after a Focus Group Discussion with dwellers.

The first attribute is the frequency of waste collection, and it is all about how many times in a week waste is collected. It takes four levels; currently, waste is collected once irregular (the collection day is not fixed and known), and it is proposed that waste is collected once regular, twice regular and three times irregular. The second attribute is waste disposal mechanism, and it is about how solid waste is finally disposed of. This attribute takes three levels; at present, waste is disposed of in open dumps and the proposed levels are sanitary landfill and incinerator. The next attribute is the mode of transportation used to transport waste. It takes three levels: carts and open truck (current situation), open trucks only and covered trucks. The final attribute is cost. It

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represents the monthly charges to be paid by households for the service rendered. This attribute has four levels: 2(current situation), 5, 10 and 15.

2.4. Econometric model specification

The theoretical foundation of choice modelling rests upon random utility theory. The central idea behind this theory is that consumers derive satisfaction not from goods themselves but from the attributes they provide. Let us illustrate this by considering the solid waste management options of an individual. Suppose the utility of an individual depends on the choices he/she made from a given choice set C, which includes all possible solid waste management options. The utility function takes the form (Adamowicz, Boxall, Louvier, & Swait, 1999):

$$U_{im} = V_{im} + \varepsilon_{im} \tag{1}$$

This utility function is composed of an objective component (V_{im}) and an error component (ε_{im}). Selection of one solid waste management option over another implies that the utility (U_{im}) of that option is greater than the utility of another, say U_{jm}. Since overall utility is random, one can only analyse the probability of choice of one package over another, or

$$Pr\{i \ \text{chosen}\} = Pr\{V_{im} + \varepsilon_{im} > V_{jm} + \varepsilon_{jm}, all \ \ j \, \varepsilon \, C, i \neq j\} \tag{2}$$

where C is the choice set. Specific choices of error distributions lead to methods for the estimation of the parameters of this utility function and to quantitative representations of trade-offs between attributes. Assuming that the error terms are identically and independently distributed, the probability that an individual *m* chooses alternative *i* over *j* is given by (Adamowicz et al., 1999; Timothy et al., 2002):

$$Pr_{im} = \ e^{Vim\lambda} / \sum e^{Vjm\lambda} \tag{3}$$

This represents the multinomial logit model. It gives the probability that individual *m* chooses alternative *i* over alternative *j* as a function of individual characteristics and unknown parameters. λ is a scale parameter which always is normalized to 1 (Othman, 2002). Coming to the empirical model, the most basic form of the utility function takes an additive structure, which includes the attributes from the choice sets only (Louviere, Hensher, & Swait, 2000):

$$V_{im} = \ ASC_i + \Sigma\beta_{iK}X_{iK} \tag{4}$$

where V_{im} is the utility function from choosing different management options, ASC_i stands for an alternative specific constant which captures any systematic variations in choice observations that are not explained by the attribute variations, β is a coefficient and X represents a vector of attributes from the sets.

The effect of attributes in the choice sets is captured by the *X* variables, while ASC represents the effect of systematic but unobserved factors that explain the respondents' choices. Technically, ASC reflects the differences in the error terms. In our case, the four attributes and their levels discussed above are included. These are frequency of waste collection (FREQ), waste disposal mechanism (DISPO), waste transportation mechanism (TRANS) and the monthly charges to be paid by households (COST).

It is possible to include socio-economic and environmental attitudinal variables into the utility functions by estimating the variables interactively, either with the ASC or with any of the attributes from a choice set (Morrison, Bennett, & Blamey, 1999; Pek & Jamal, 2009). An added advantage of CM is its flexibility to incorporate simultaneously the importance of economic, social and environmental factors in a valuation exercise. In this case, the model can be represented as:

$$V_{im} = \ ASC_i + \sum \gamma_{im}(ASC_i{}^*S_m) + \sum \beta_{iK}X_{iK} \tag{5}$$

where **Sm** indicates the socio-economic or environmental attitudinal variables for the nth indivi-dual and **γ$_{im}$** is a vector of coefficients associated to the individuals' socio-economic characteristics interacted with the **ASC**. The inclusion of socio-economic and demographic variables is an impor-tant part of a certain model as it may help to overcome problems associated with violations of important assumptions in MNL models such as Independence of Irrelevant Alternatives.

The second model includes socio-economic and demographic variables. Since these characteristics do not vary across alternatives, they must be introduced as an interaction with either the attributes or the alternative specific constant (Bennett & Blamey, 2001). Age of the respondent (AGE), gender of the respondent (SEX), marital status (MARSTAT), education (EDU), family size (FAMSIZ), availability of children under 10 years (UND10), house ownership (HOWOW), length of living in the area where they are now (LENLIV), employment (EMPL) and level of monthly income of the household (INC) are included as interactions with the alternative specific constant.

2.5. Method of data analysis

Having all the necessary inputs, the models were estimated using the maximum likelihood method in the econometric software package LIMDEP NLOGIT 4.0. After getting the coefficients from the estimated models, one can calculate the marginal willingness to pay (MWTP) and compensating surplus (CS) of respondents. MWTP is the marginal value of a change within a single attribute, and it can be calculated as follows (Bennett & Blamey, 2001):

$$MWTP = -(1/\beta_{monetary\ attribute})(\beta_{non-monetary\ attribute}) \tag{6}$$

This calculation gives us the marginal rate of substitution between the attribute of interest and the monetary attribute. The other possible welfare measure of respondents is the compensating surplus. We can measure CS for different solid waste management scenarios relative to the status quo. CS can be obtained by the following formula:

$$CS = -(1/\beta)(V_0 - V_1) \tag{7}$$

where β is the coefficient of the monetary attribute and V_0 and V_1 represent the level of indirect utility before and after the change under consideration (Bennett & Blamey, 2001).

Equilibrium values for the non-monetary attributes were also estimated following Othman (2002). These equilibrium values are trade-offs between the non-monetary attributes that will leave the respondents in the same utility level. Calculation of these values involves the identifica-tion of the reference implicit price and the implicit price of interest. We follow the below formula for the calculations.

$$Equilibrium\ values = WTP_{Referred\ attribute} / WTP_{Searched\ attribute} \tag{8}$$

3. Results and discussion

3.1. Descriptive statistics

Out of the total 150 questionnaires used at the survey in Aksum city, 5 were found to be unusable. The rest 145 complete questionnaires are analysed and discussed here. Since the experimental design produces five choice sets, these 145 usable questionnaires give us 725 completed choice sets. Looking for the socio-economic composition of the respondents, 52.4% of the respondents were females, while the rest are males; coming to marital status, 76.6% of the respondents are married, 17.9% are singles and the rest are in the other group (like widows and widowers); in terms of their employment structure, civil servants and self-employed people comprise 29.3% and 65.4% of the surveyed households, respectively. Workers of non-governmental organizations consist 3.3% and the rest lie in the other group which includes segments of the society like pensioners. Out of the total surveyed households, 64.1% live in their own houses and the rest lives in rented houses.

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Table 1. Descriptive statistics of some selected variables				
Variables	**Mean**	**Std. Dev.**	**Minimum**	**Maximum**
AGE	37.409	14.314	18	84
EDU	6.584	4.994	0	19
FAMSIZ	4.295	1.982	1	9
LENLIV	11.829	8.528	0.5	40
INCOME	954.409	1,243.33	100	12,000

A larger percentage of the households (i.e. 57.2%) have members with the age of under than 10 years. (Table 1 presents descriptive statistics of some selected variables.)

Households included in the survey were also asked if they are concerned about solid waste management issues in their vicinity and 95.6% of the households said they are concerned. For the question to rate the current solid waste management in their area, 15.9% rated it as fair and 36.2% rated it poor which actually calls for immense work of improvement. Solid waste is collected door to door, and there is one union with 30 members in this regard engaged in this though far from covering the whole town. The municipality of the town monitors every movement of the union and offers help when needed. Households in some segments of the town dispose of solid waste on mobile waste collectors (carts and open truck) by themselves. Others are completely uncovered by like services and simply dispose of waste on open space. Plastic bags, by their nature, stay for so long in the environment and cannot simply decay. Therefore, special focus is needed for their treatment. Households were asked on how they dispose of plastic bags; only 8.2% of the respondents separate and burn plastic bags. The rest did not practice separate treatment for plastic bags, and they dispose of it together with other solid wastes. The solid waste disposal behaviour of very few households, especially households on the edge of intermittent rivers through the town, is found to be affected by the location of the households. This is because rather than waiting for the collectors, some households carelessly dispose of wastes on the rivers which of course poses negative externality for the nearby dwellers. Although it is not that much practical, there is a rule called "10 meter radius" to protect dumping in open areas. The rule holds every household responsible for wastes disposed of up to 10 meters in every direction of its house. The municipality works in cooperation with the respective "*Tabias*" in this regard but with much satisfactory results yet to come.

3.2. Empirical results
The empirical findings are estimated using two multinomial models: the basic model (the model which includes the attributes only) and the model which includes the socio-economic variables (hereafter called the extended model).

All the coefficients of the attributes for the basic model in Table 2 are significant and with the priori expected signs. A positive sign and significance for the coefficients of the three attributes frequency of waste collection (FREQ), waste disposal mechanism (DISPO) and mode of transportation used to transport waste (TRANS) indicates respondents are willing to pay for improvement of these attributes since the improvement in these attributes increases their utility. The coefficient for monthly charges to be paid by households for the service rendered (COST) is negative and significant, indicating the decrease in utility for respondents as the monthly charges increase. This indicates that people become less willing to pay for changes as the charges keep increasing.

The second multinomial model (the extended model) is a model estimated by including various socio-economic variables together with the attributes in the basic model. These variables are interacted with the alternative specific constant to account for heterogeneity of preferences. The inclusion of the socio-economic variables in the basic model, as can be seen in Table 3, has improved the overall fit of the model as can be seen by the decreased log-likelihood function and the increased *R*-squared. The coefficients of the 10 included socio-economic variables are with the priori expected

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Table 2. Results of the basic MNL model

Variable	Coefficient	Standard error	P[|Z|>z]
COST	−0.0741***	0.0164	0.0000
FREQ	0.3500**	0.1478	0.0179
DISPO	0.1228*	0.0709	0.0835
TRANS	0.2000**	0.0835	0.0165
ASC	1.0765***	0.2808	0.0001
Summary statistics			
Number of observations	725		
Log-likelihood function	−753.5105		
R-sqrd	.11649		

***Significant at 1%.
**Significant at 5%.
*Significant at 10%.

signs, but three of them are insignificant. The coefficient of age of the respondent (AGE) is negative and significant signifying elder people are reluctant to changes from the environment they are accustomed to and hence are likely to be less willing to pay for improvements in solid waste management services. This result is in line with a Kenyan study by Grace J. et al. (2012). Married people are more willing to pay for improvements in solid waste management services than singles as can be seen from the positive sign and significance of the coefficient of marital status (MARSTAT). The coefficient of the variable level of education of the respondent (EDU) is positive and significant at 1% and tells us that people with more years of education favour the improvements in solid waste

Table 3. Results of the extended MNL model

Variable	Coefficient	Standard error	P [|Z|>z]|
COST	−0.0775***	0.0169	0.0000
FREQ	0.3574**	0.1503	0.0174
DISPO	0.1320*	0.0737	0.0733
TRANS	0.1970**	0.0849	0.0203
ASC	−2.6375***	0.6852	0.0001
ASC*AGE	−0.0199*	0.0116	0.0856
ASC*SEX	0.1195	0.2555	0.6400
ASC*MAR	0.7083**	0.2726	0.0094
ASC*EDU	0.1470***	0.0286	0.0000
ASC*FAM	0.0934	0.0682	0.1708
ASC*UND	0.5052*	0.2652	0.0568
ASC*HOW	1.0755***	0.2888	0.0002
ASC*LEN	0.0334**	0.0169	0.0483
ASC*EMPL	0.4717**	0.2225	0.0340
ASC*INC	0.0006	0.992509D-04	0.1212
Summary statistics			
Number of observations	725		
Log-likelihood function	−688.8980		
R-sqrd	0.12083		

*** Significant at 1%.

** Significant at 5%.

* Significant at 10%.

management services. Since educated people have rich awareness as compared to people with less years of education, this result is intuitive. Adogu, Uwakwe, Egenti, Okwuoha, and Nkwocha (2015) and Grace J. etal. (2012) found comparable results where the level of education of a household significantly affects the willingness to contribute to more waste collection efforts.

As compared to households without little children, households with children under 10 years opt for improvement in solid waste management services as reflected by the positive and significant coefficient of the variable availability of children under 10 years old (UND10). House ownership (HOWOW) has positive and significant (at 1%) coefficient implying that households who live on their own houses favour improvements in solid waste management services than those households who live in rented houses. The coefficients for length of living in the area (LENLIV) and employment status (EMPL) of the respondent are also positive and significant which indicates that households who lived longer in that area and employed households opt for the improved plans.

3.3. Calculating implicit prices

Implicit price or part worth is the amounts of money respondents are willing to pay in order to receive more of a non-marketed environmental attribute. Implicit prices are the marginal rate of substitution between the monetary attribute and the non-monetary attribute under consideration. The results of the two estimated models depicted in Table 4 are comparable. These values measure an individual's willingness to pay for the introduction of improved non-market attribute, other things remain constant. Taking the extended model, for example, respondents are willing to pay 4.6 ETB (Ethiopian birr—Ethiopian monetary unit), 1.7 ETB and 2.5 ETB per month for additional improvements in frequency of solid waste collection, waste disposal mechanism and mode of transport, respectively.

3.4. Calculating equilibrium values of the non-monetary attributes

The values in Table 5 are calculated based on the marginal willingness to pay of DISPO.

All non-monetary attributes are not divisible; therefore, these values indicate the relative importance of the attributes to households. In terms of the relative importance to households, the frequency of waste collection takes the lead followed by the mode of transportation used to transport waste and waste disposal mechanisms ranked last.

Table 4. Implicit prices of the attributes		
Attributes	**MWTP in Birr**	
	Basic MNL	**Extended MNL**
FREQ	4.72	4.61
DISPO	1.657	1.70
TRANS	2.699	2.541

Table 5. Equilibrium values of the non-monetary attributes			
Attributes	**Equilibrium Values**		
	Basic MNL	**Extended MNL**	**Ranking**
FREQ	2.85	2.71	*1*
DISPO	1.000	1.000	*3*
TRANS	1.63	1.495	*2*

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Table 6. Compensating surplus of various scenarios	
Scenarios	Compensating surplus or WTP per month (Ethiopian Birr)
Status Quo	*0*
Scenario One	*17.194*
Scenario Two	*21.909*
Scenario Three	*23.563*
Scenario Four	*28.279*
Scenario Five	*26.625*
Scenario Six	*21.543*
Scenario Seven	*31.341*
Scenario Eight	*27.237*
Scenario Nine	*37.344*

3.5. Estimating compensating surplus of alternative programmes

What consumers are willing to pay for a change from the status quo to various scenarios per month is presented in Table 6. For instance, for a change from the status quo (frequency of waste collection is once per week and irregular, waste disposal mechanism is open dump and waste transportation mechanism is carts and open truck) to scenario 4 (frequency of waste collection is twice per week and regular, waste disposal mechanism is sanitary landfill and mode of transport is open trucks), consumers are willing to pay 28.3 ETB per month. Scenario 9 presents the combinations of the maximum included levels of the attributes, where the frequency of waste collection is three times per week but irregular, waste disposal mechanism is incinerator and mode of transportation is covered trucks and has the highest compensating surplus value of 37.3 ETB. One can see the strength of choice modelling here. Hypothetical scenarios are created and then their value can be inferred from the findings of the model where policymakers can come up with important deductions to match people's willingness and ability.

Generally, households in Aksum town favour improvements in frequency of waste collection, waste disposal mechanisms and mode of transport used to transport waste. Das et al. (2008) found that households are willing to pay for the provision of covered trucks for waste collection. Households in this study are also willing to pay for improvements in the mode of transportations used to transport waste which includes covered trucks. In this study, households are willing to pay more for additional frequency of waste collection than other attributes which is comparable to Yonas (2010) who found similar results. The study is significant that it shows how public engagement in solid waste management can improve policies by addressing demand side issues in addition to the usual supply-side considerations. The effectiveness of sharing the costs of solid waste management is well researched and supported. Several studies (Aregay, 2018; Eshun & Nyarko, 2011; Metkel, 2018; Wang, He, Kim, & Kamata, 2011) concluded a successful full or partial recovery of the costs of solid waste management by encouraging the public to participate. On the other hand, a study by Lohr et al. (2014) in Bahirdar asserts that the cleanness of the environment can be increased by engaging the public; however, the effect of this on financial sustainability is vague. Looking at the relative ranking of the attributes in terms of their equilibrium values, Othman (2002) found that separation of waste is more important to households. However, the equilibrium values of this study show that the frequency of waste collection is relatively more important than other included attributes.

4. Concluding remarks

The main aim of the study was to estimate the non-market welfare gain from different improved solid waste management options for households in Aksum town using choice modelling. Believing that proper solid waste management makes a huge contribution to a clean and healthy

environment, its improvement was represented by various service attributes and presented to households to account for their options. Two multinomial logit models were estimated at first: the basic model and the extended model. Coefficients of all included attributes were significant and with the expected sign in the basic model. As for the extended model, the case of the attributes is the same to that of the basic model, but out of the included 10 socio-economic variables, gender of the respondent, family size and household monthly income were insignificant though with the priory expected signs. Equilibrium values of the included attributes were also estimated, and the attributes were ranked in terms of their relative importance to households. The frequency of waste collection per week was relatively more important than the other attributes to the households. The final analysis dealt with the estimation of compensating surplus or values of different programmes. Hypothetical programmes were set up and their values estimated based on the model coefficients. Accordingly, nine different scenarios were created and considered along with the status quo. One can see how the compensating surplus as we switch hypothetical scenarios. The improvement in the service attributes enhances the utility of respondents. The findings indicate the possibility of including the perceptions of urban dwellers in policymaking. The calculated implicit prices and values of the hypothetical scenarios can give policymakers useful information. Policymakers can use different combinations of the attributes by understanding the willingness to pay of households. Other results that policymakers should be keen are the equilibrium results of the attributes. These equilibrium values indicate trade-offs between the non-monetary attributes and thereby relative importance of the attributes to the society. Therefore, policymakers can use these to set priorities.

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