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Assessing Household Solid Waste Management: Cause of Ansho Town, Duna Woreda, Southern Ethiopia

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Abstract
Solid waste management remains a serious problem in most developing nations, even although it consumes a larger portion of the municipal budget. Thisarticle examines factors that might influence solid waste generation and solidwaste management behavior of households in Ansho Town southern Ethiopia. Simple random sampling techniques were employed to select 343 households forprimary data collection. The data were subjected to both descriptive and econometric technique of analysis. Multiple linear regression analysis was used to identify households' solid waste generation dominant factors. The result shows that meanweight waste generation by sample households was 0.21 kg per capita per day in the Town. High proportion of the households' waste (85.17%) was of biodegradable types such as food left over, wood, paper, and so on. The remaining 14.72% were non-biodegradable wastes such as plastic, textiles, leathers and glass.Based on the findings of this research, the households' solid wastes generation rate for low, middle and high income families were measured to be 9.16 kg/day,10.88kg/day and 11.86 kg/day respectively. The multiple linear regression results showed that the quantity of solid waste generation of households Ansho Town was significantly affected by household size and household aggregate income.
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1. Introduction

1.1. Background of the Study

Economic growth in developing countries has led to the massive movements of peoples from rural to urban areas for searching better life (Lichter and Brown, 2011). As result, the number of persons added to the urban planner, non-governmental services providers and urban residents (Baqui, 2009). Due to this, there is increasing solid waste generation. However, because of rapid population growth followed by economic development and urbanization majority of developing countries are experiencing difficulties in the management of solid waste produced by the urban dwellers. In developed countries the daily life of people can generate greater quantity of solid waste than developing countries, but most parts of developed nations are efficient in handling waste when compared to developing countries because of they are technologically complex, institutionally efficient and have cost effective solid waste management systems. However, the practice of solid waste management in cities of developing countries has been largely unsatisfactory (Solomon, 2011). According to Collivignarelli *et al* (2004) in last decade reported that many developing countries have shown progress to improve their households' solid waste management practices. However, because of limited technical capacities and low financial resources, adequate management of households solid waste is not achieved (Kassim& Ali, 2006).Thus, Ethiopia was not exceptional to these problems, with the current rate of urbanization households' solid waste collection; transportation and disposal have been a major problem of municipalities in most of cities. And then in order to reduce this situation and achieve efficienthouseholds' solid waste management system of the town, it is critical to make detail study of the existing status of solid waste management service and identify possible gaps or constraints that should be tackled to bring long lasting solution in Ansho Town.

1.2. Statement of the Problems

Households'Solid waste management is becoming a big challenge to many towns and cities in Ethiopia. Ansho town is at characterized by rapid population growth of its dwellers and migration from rural area (Ansho town municipality Report, 2015).Such rapid increase in population together with rapid development of the town has produced increasing volumes of solid waste and in turn it induced greater infrastructural demand, institutional setup and community participation for its management. But, the Municipality of the town does not provide adequate sanitation services including proper solid waste management. The municipality of Ansho town is still using very few horse carts and has not yet introduced truck for solid waste collection, transportation and disposal at proper site. As a result, most solid wastes that are generated in the town remain uncollected and simply dumped in open areas. In addition to this, there are no public solid waste storage containers and road side dust bins. Furthermore, the municipality has different institutional constraints and other gaps to be identified and addressed if sustainable solid waste management to be in place. Therefore, this study is focused on evaluating the current status and identifies gaps or hindrance of household solid waste management in Ansho town

1.3. Objective of the Study

The general objective of this study was to assessing households' solid waste generation associated to its determinant in the case of Ansho Town, Hadiya Zone, SNNPRs, Ethiopia. Specifically; to assess households solid waste generation rate in study area and to identify the determinate factors of households' quantity of solid waste generation in the town

2. Research Methodology

2.1. Research Design

The research design of this study was descriptive survey method, which focuses on investigating the current status, practice, gaps or problems/constraints of households SWM practices of Ansho town.

2.2. Participant of the Study

The target population estimated in this stud was house-hold in Ansho town.

2.3. Sampling Techniques

A simple random sampling technique was usedinthisstudy to collect primary data. Considering the objective of the study and representativeness of the sample, from total Household 3430 household (10 % of targeted household) was randomly drawn.

2.4. Tools of Data Collection

Source of data to this study were both primary and secondary data. Primary data collected using a structured questionnaire with the help of trained enumerators. The questionnaire includes personal information, socio demographic profile of household head, and outcome variables income of households.

2.5. Data Analysis Methods

Data generated from different sources were analyzed using Stata. Solid waste generation rate (GR; weight of waste produced by person per unit time) was determined based on a weight–volume analysis, using the following formula cited in Asmelash, 2014.

$$GR= \frac{weight\ of\ solid\ waste(g)}{population \times duration(day)} \quad \ldots\ldots(1)$$

The reason for measuring GR is to obtain data that can be used to determine the total amount of waste materials to be managed;

Multiple linear regressions were used to analysis the households solid waste generating factors.

$$W = \beta C \quad \ldots\ldots (2)$$

Where; W = vector of components of solid waste β = Vector of technical waste transformation coefficients relating the types and quantities ofsolid waste to each consumption activity C = is a vector of consumption activities selected by the household.

Any particular waste may be generated by the consumption of more than one commodity. Here no attempt is made to identify the technical waste transformation coefficients associated with the individual products. It mainly tries to compare the relationship between different types of waste generation and socioeconomic variables affecting the quantity of waste generated.The major determinants of household consumption activities are assumed to be household monthly total income (TOTI), size of the household (TOTPOP), educational status of the household (GRAD); and extra land area in the house compound (EXTLA), solid waste management services availability in the area (SER).

The choice of econometric model depends on the nature of the dependent variable, i.e. nominal, ordinal, interval and/ratio scale. Since the dependent variable quantity of waste generated per household per day (TOTW) is continuous, the appropriate econometric model is multiple linear regression models. The model specified as follows:

$$TOTW = \beta 0 + \beta 1TOTI + \beta 2TOTPOP + \beta 3GRAD + \beta 4EXTLA + \beta 5SER + \beta 6AGEHH + e \quad \ldots\ldots (3)$$

Here household is assumed as a production unit producing solid wastes. The hypothesis is as follows:

(i) Increase in income (TOTI) is expected to increase the demand for convenience factors and services embodied in commodities. The sign of the coefficient is expected to bepositive for total quantity of waste generated. Consumption increases as income increaseand so does waste generated. ($C= \alpha + \phi Y_i$ Where C = household consumption,α = autonomous consumption, ϕ = slope of consumption function and Y = income).(ii) A larger household size (TOTPOP) is expected to generate higher quantity of waste sincemore households are included in the unit; thus, the sign is also expected to be positive.(iii) Educated household members (GRAD) work in the office and stay outside of the house fora long time. So the waste generation will be low. However, the generation of packingwaste may be higher in case of a fully employed family as they have less time to preparefood.

As such, they consume more packed food. So, number of educated households haspositive relationship with total quantity of waste generated. (iv) It is assumed that higher the extra land area within the compound (EXTLA) less the waste generated by the household. It is also assumed that the household with extra land area may dispose some of the waste in their land, which may not be counted in the total volume of waste generated. Thus extra land area and the total quantity of waste are inversely related and the sign of the coefficient of extra land area will be negative. (v) Solid waste management services availability (SER) in the area is expected to generate higher quantity of waste since the quantity of waste disposed properly by collectors in case they increase demand that results waste.(vi) Age of households (AGE) is expected to have a positive relation with quantity of wastegenerated because when age increase consumption becomes so does due to demandincreases.
Qualitative data were analyzed by describing, narrating and interpreting the collected data. Finally, both qualitative and quantitative data‟ were triangulated; synthesized, and elaborated to generate meaningful information.

3. Data Analysis and Interpretation

3.1. Monthly Income of Household

Table 1: Economic status of household (n = 343)

Parameter	Category	Frequency	Percent
monthly income (birr)	< 1000	59	17.2
	b/n 1000 and 2000	166	48.4
	>2000	118	34.4
	Total	343	100

Table 1 depicted that more than 80% of the HH respondents have monthly income greater than 1000 Birr , with 166 households (48.4%) with monthly income between 1000 and 2000 birr and 118 (34.4 %) earned a monthly income greater than 2000 Birr. HH respondents with lower monthly income of less than 1000 Birr were only 59 households (17.2 %).

3.2. Types and Composition of Residential Solid Waste

Information and data on the physical composition ofhouseholds' solid wastes are important in the selection and operation of equipment and facilities, in assessing the feasibility of resources and energy recovery and in the analysis and design of disposal to facilities. Accordingly thehouseholds' solid wastes of the town as in elsewhere could be categorized as biodegradable and non-biodegradable. The biodegradable solid wastes generated from households accounted for 85.3 % and it was dominantly composed of organic matter: ash (34.5%) and food waste (22.6%).

The major factor, which causes the proportion of ash to be high, is the life style of the population. From field observations almost all households included in this study use traditional kitchens whose energy sources are mainly, fire wood, charcoal, yard and paper wastes. This generates high amounts of ash. Food wastes (22.5%) also generate from house cooking, food slip and fruits. This condition dictates that the most appropriate and sustainable method for management of Angacha town solid waste is composting. Wood, Paper and Cardboard wastes constituting only 9.4 and 4.7% in weight respectively;these solid wastes have high demand for energy production (fuel) in households' traditional kitchens.

Table 2: Composition of residential solid waste in 2017

No	Type of solid waste	Kg/HH/day	Kg/day/person	Percentage share
1	Ash/Dust	11	0.04	34.5
2	Food waste	7.2	0.067	22.6
3	Wood scarp	3	0.02	9.4
4	Grass and Leaf	4.5	0.029	14.1
5	Paper and card board	1.5	0.0096	4.7
6	Plastic	1	0.0096	3.1
7	Glass	2.5	0.0225	7.8
8	Metals	1.2	0.00774	3.8
	Total	31.9	0.21	100%

3.3. Households Solid Waste Generation Rate

As represented by table 2 there is direct relationship between Per capita income level and solid waste generation rates. This is well illustrated in Table3 Accordingly, a households generated 11.86 kg/day for higher -income families, where as middle income and Lower-income households generate 10.88kg/day and 9.16 kg/day respectively. Similarly, per capita generation rate of a person is 0.15 kg/day, 0.21kg/day and 0.26 kg/day for low, middle and high in-come, respectively. Thus; the study revealed that per capita generation rate of low in-come families is less than that of middle and high-income families. This indicates that households that have better life

standard use more consumption materials than low-income households do, through which they generate higher wastes.

Table3: householdsSolid Waste Generation Rate of Ansho Town

Income groups	No of sample HH	Family size (Average)	Kg/HH/Week	Kg/HH/day	Kg/Cap/day
Lower	10	60	64.152	9.16	0.15
Middle	10	50	76.19	10.88	0.21
Higher	10	45	83.025	11.86	0.26
Total	30	155	223.367	31.91	0.21

Table 4depicts, daily total solid waste generation of residential areas of Anshotown, which was calculated as total population of the town (32000) times per capita households solid waste generation rate. Based on the per capita householdsgeneration rate of 0.21kg of the three income groups indicated in table5 daily total solid waste generation was 6,720kg). Thus, the annual (365.25 days) total generation of solid waste from residential areas of Angacha town would be 2, 454, 480 Kg,

Table4: summery of household solid waste generation of the Ansho town

Total population of the town	Kg/cap/day(per capita generation rate of a person)	Daily total solid waste generation	Annual total generation of solid waste
32000	**0.21kg**	**6720kg**	2,454,480kg

3.3.1. Association of Income with Households Solid Waste Generation Rate and Management

The relationship between waste management set of independent variables were analyzed by using bi variant and multivariate analysis to show whether there is an association between the dependent variable households SWM, households Solid Waste Generation Rate and Independent variables households income. The results are shown in table 5. Accordingly, there is a significant positive association ($P< 0.05$) between income of the households and SWM. The result further implies that the proportion of those respondents which used proper management of solid waste increases from 18.2 to 54.5 percent as we go from low income to high income category respectively, while the proportion of households that follows improper solid waste management practice declined from 47.4 to 21.4 percent for the low and high income family respectively. The study supported the idea that the amount of income of households increases the capacity of proper solid waste management and the vice versa.

Table5: Association of households SWM, Solid Waste Generation Rate and household's income

households income	No of HHs	Generation Rate Kg/HH/day	households Solid Waste Management				Significant at 95% of CI
			Properly managed		Improperly managed		
			Frequency	%	Frequency	%	
Higher	10	11.86	6	54.5	4	21.0	
Middle	10	10.88	3	27.3	6	31.6	
Lower	10	9.16	2	18.2	9	47.4	0.048
Total	30	31.91	11	100	19	100	

Waste quantities generated are directly proportional to household's income level which is consistent to finding of Medina (2004). Thus, as average waste generation rate is increasing as per capita income increase. But, higher Income Households they manage their generated waste properly than low income households.

3.3.2. Econometric Results

The estimation result of waste generation and socioeconomic model has been shown in Table 6. Itmainly tries to compare the relationship between households' quantity of solid waste generationand socioeconomic variables affecting the quantity of waste.

Table 6. Factors affecting households' solid waste generation

Waste components	Intercept	TOTI	AGEH	TOTO	EXTRA	GRAD	SER	R^{-2}	F
TOTW(High income)	2.25	0.19	0.54	0.55	0.84	-0.13	0.19	0.38	16
	(-3.8)	(2.79)*	(2.55)	(5.8)**	(-1.9)	(0.37)**	(0.37)		
TOTW(medium income)	-2.9	0.26	-0.08	0.59	0.04	-0.32	-0.26	0.27	11
	(-3.6)	(3.04)	(2.5)	(5.5)**	(0.47)	(-3.72)	(-3.04)		
TOTW(low income)	-3.26	0.45	0.75	0.38	0.09	0.15	3.04		14
	(-6.2)	(6.08)*	(2.12)	(2.79)	(1.04)	(0.58)	(6.08)		

Econometric analysis may providebetter information and clearer focus on the factors that affect households' quantity of solid waste generation responses such that policy recommendations can be made based on result conclusions. Before estimation was done, data exploration is an important step. To start with, to check whether Multicollinearity is present or not a simple correlation coefficient matrix was conveyed. Multicollinearity is a

serious problem when correlation coefficient is 0.8 and above (VIF exceeds 10) which is based on rule of thumb (Gujarati & Porter, 1999). There is no problem of Multicollinearity (VIF = 2.7). The goodness of fit for the model has been tested in this study with some diagnostic tests which fulfill the following criteria of good results.

First, the a R^2 value (which is a measure of goodness of fit of the estimated regression model) of 0.51 depicts a good fitting of the model, which defines that 51% of the variation in change of the waste generation of the households could be explained by the independent variables in the model. The F-test shows that the estimated regression is quite meaningful in the sense that the dependent variable is related to each of the specified explanatory variables. The linear relation of the model is highly significant (the p value for the F-test is less than 0.0001). Second, the signs for the estimated coefficients are consistent.

This study result shows that income and household size were positive and highly significant. The positive coefficient on income variable (TOTI) at 5 percent level of significance, indicates that holding all other variables constant, higher income people are generating more waste than the lower income people. This result seems reasonable since increase in income is expected to increase the demand for convenience factors and services embodied in commodities. The positive coefficient on households size, at 5 percent level of significance, indicates that holding all other variables constant, large family are generating more waste than the small family.

A larger household size is expected to generate higher quantity of waste since more households are included in the unit; thus, the sign is also expected to be positive. The coefficient of education variable is positive but it is not significant. This related with educated households have an opportunity to leave more time out of home for field work. Extra land area has positive but insignificant effect. In the study area, there are very few households with extra land area; because of urbanization growth, high population density and have high economic value of houses in the city. The regression coefficient of the household size is higher relative to the coefficient of the total income in all the level exceptmedium income household. However, the coefficient of income is higher than the coefficient of the household size in the middle zone. Extra land area has positive but insignificant effect in all the zones. A variable family size is significant in both high and medium income household but not in the lower income household. Level of education is significant and has a negative effect on quantity of waste generated only in the lower income household.

4. Conclusion and Recommendation

4.1. Conclusion

This study examined the Roles of income of Household in Solid Waste management in Ansho Town, southern Ethiopia. The study mainly based on primary data obtained from 343 randomly selected sample households in order to assess type and quantity of Primary Solid Waste Storage Facility of residentsin Ansho town using questionnaires. In order to estimate the role of the income in solid waste management descriptive methods of analysis were used and analyzed with help of Statasoftware.

Households in study areas do not receive adequate solid waste management service and they are adversely affected by improper solid waste collection. The per capita waste generation was 0.21 kg/person/day in three income level household. The per capita waste generation is found to be the lowest in the higherincome household and highest inlowerincome household. Thus, the low per capita waste generation in the low income family may be due to the household sorting of waste more intensively in the high income household than in other income level households. Most households feel that the lack of stiff penalty and non-execution of law is the basic problem for the effective management of waste.

Thus, provision of strong penalties and effective execution of the law will be the major tool to reduce the problem of solid waste management in Ansho town. It is found that environmental awareness is very low among the residents of the town. Thus, stringent regulations with environmental awareness programs for household sorting and composting can reduce the volume and quantity of waste for land filling. The waste component relationship shows that size of the household and income are the major factor determining the total quantity of the waste in all income level. It was also found that education has a negative effect on waste generation.

4.2. Recommendations

Based on our research findings, the following points are recommended

- ✓ The community has to provide awareness how to handle solid waste at home and how to generate income from waste product;
- ✓ Giving training and awareness on how to generate huge amount of compost, which enriches the soil for agriculture; further increment in farm output;
- ✓ Bio-gas formation is another way of energy recovery that the municipality might consider as an option of waste management thereby income generating.

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