

Household Solid Waste Management Practice Associated Factors and Service Delivery Performance of Private Solid Waste Collectors in Dire Dawa City, Eastern Ethiopia

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Abstract:

Introduction: Most developed countries recognized that solid waste management is very crucial for survival in addition to secure the safety of environment and human health. However, the developing countries like Ethiopia, let alone use its economic benefits, because of various reasons they are dumping of wastes in unauthorized sites, which easily expose to harsh hazards, like environmental pollution and health problem. This study was aimed to assess status of solid waste management, associated factors and service delivery performance of private solid waste collectors in Dire Dawa town from February 27-March 27, 2015.

Methods: Community based cross sectional was conducted. Data was collected from 511 households, which were selected through multi-stage sampling from three kebeles, and further information from responsible staff and private participants using interviews, focus group discussion, and field observation. The Obtained data was entered using Epidata and finally analyzed using SPSS Version 20. Bivariate and multivariate analyses were done to identify the independent predictors of improper solid waste management.

Result: The majority of the households, 352 (69%) disposed solid wastes in improper manner. Plastic, Ashe and “Chat geraba” constitute the major waste bulk generated by the households. Educational level of the household heads (AOR = 2.035, 95% CI = (1.255-3.301), Marital status of the respondent (AOR = 1.688, 95% CI = (1.081-2.634), Distance (AOR = 1.547, 95% CI = (1.060-2.257), awareness of Household head on Solid waste management (AOR = 3.863, 95% CI = (2.386-6.252), attitude of Household head on solid waste management (AOR = 1.759, 95% CI = (1.005-3.081), law enforcement(AOR = 2.872, 95% CI = (1.768-4.664)and Access to Micro and small scale enterprises (AOR = 5.029, 95% CI = (3.277-7.717) were associated with improper household solid waste management in the study area. Manpower, budget, and facilities such as inadequate vehicles were the reasons for low performance of Micro and Small Scale Enterprises.

Conclusion: The current study revealed that solid waste disposal system of most households was improper and unauthorized. Educational and marital status, family size, monthly income, Year of stay, location of household, access micro and small scale enterprises , awareness on solid waste management , attitude on Solid waste management and law enforcement were found to be associated with improper solid waste management. Manpower, budget, and facilities such as adequate vehicles were the reasons for low performance of solid waste management.

Keywords: Household solid waste management, Private solid waste collector, Micro and small scale enterprises

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I. INTRODUCTION

Solid waste is defined as material which no longer has any value to its original owner, and then discarded. The main constituents of solid waste in urban areas are organic waste (including kitchen waste and garden trimmings), paper, glass, metals and plastics. Ash, dust and street sweepings can also form a significant portion of the waste [1].

Solid waste management (SWM) involves the collection, storage, transportation, processing, treatment, recycling and final disposal of waste. Systems need to be simple, affordable, and sustainable (financially, environmentally and socially) and should be equitable, providing collection services to poor as well as wealthy households. SWM therefore, requires adequate infrastructure provision and maintenance for all activities [1].

The primary objective of solid waste management activity is to make the environment sound and safe in human health via disposed of wastes in a well-organized manner. However, through process the stakeholders of the management system, especially in the developed nations, did not stop on disposed of waste in open dump or landfill only; rather they tried to convert the trash/solid wastes/ to cash and make strong their economy in addition to environmental aspect [2].

Solid waste management (SWM) has been a big challenge to both the developed and developing countries over the world. It is estimated that more than 3.5 billion or more than 52% of the world population does not have access to the most elementary waste management services like sound waste collection and removal out of the residential areas and at least a controlled disposal. The problem is mainly urban and it is expected to be further increase due to the rapid urbanization process that will take place next 15 years [3].

According to UNESCO, the population growth and the rate of urbanization are alarmingly increasing throughout the African continent. But the technology, technical knowhow, financial capacity, culture, and understanding of the community required to properly manage solid wastes are not adequately available. Urbanization with inadequate waste management practices, specifically, widespread disposal of waste in water bodies, dumping inside the road and uncontrolled dump sites aggravates the problems of generally low sanitation levels across the African continent [4].

Waste management is a growing public concern in Ethiopia [5]. In many cities of the country, waste management is poor and solid wastes are dumped along roadsides and into open areas, endangering health and attracting vermin. Only 12 percent (8% in the rural and 29% in the urban) of the population use improved sanitation facilities [6].

Solid waste generation rate in Dire Dawa is increasing along with population growth rate over time. 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, community participation and also private organization for its management. But, the town's Sanitation, Beautification and Parks Development Agency (DDSBPDA) which runs the solid waste management activities of the town could not fulfill the requirements [7].

In Dire Dawa SWM practice is under the control of the town municipality since 2003. This municipality has a few trucks which are old and also formally organizing a great number of jobless females to participate in waste management system via door to door collection by their push cart. Through this system currently, the municipality is capable of collecting 48% of the waste generated in the town the remaining 52% is indiscriminately disposed of in drainage lines, open spaces, street sides and openly burned. It implies that, household solid wastes are not properly managed at source by its generator [8].

Similar studies conducted on the issue gave more emphasis to the issues like: waste composition [9], generation rate of the waste [10], and even special emphasis given to the "determinants of recycling of household solid wastes"; which is revolving on developed nations [11]. However, there is a lack of information about factors determining proper solid waste management at household level [12,13]. Therefore, this study was intended to fill the gap related to why the households dispose their wastes improperly and timely to find the real constraints of the household SWM practice of the town.

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II. MATERIALS AND METHODS

Study Area and Period

The study was conducted in Dire Dawa city from February 27- March 27/2015. Dire Dawa is located in Eastern part of Ethiopia at about 521 km far from the capital city of the country, Addis Ababa. The city is situated between 09°28.1' to 09°49.1' N Latitude and 41°38.1' to 42°19.1' E Longitude. The surface area of Dire Dawa city is about 133,262 hector out of which 2750.4 hector (2.1%) is urban and 130,463.5 (97.9%) is rural. The altitude ranges from 1000-2200 meters above sea level. Based on the 2007 central population projection, in 2015 the total number of household (HH) and population of the city are estimated to be 78,004 and 331,599 respectively [7].

Dire Dawa City administration includes 9 urban and 38 rural kebeles (districts). The city also has two service organs at city and Kebele levels. These are Executive Service Organs and Municipal Service Organs. Sanitation, Beautification and parking development Agency (SBPDA) responsible for solid waste management is one of the municipal service organs of the city. In the City there are 18 micro and small scale enterprises (MSSE) on solid waste management, one sanitary landfill site, two governmental Hospitals, 3 private hospitals, 16 Health centers and 31 Health posts. The potential health service coverage is 100%.

Study Design and Study Population

A community based cross sectional study was conducted. The source population was all households which registered by Kebele administrative units prior to 6 month and the study population was all households of the selected kebeles.

Sample Size Determination

Current status of household (HH) solid waste management practice in Dire Dawa city was calculated by using scientific statistical method from [14]. Assuming a non-response rate of 5% and design effect 1.5.

$$n = \frac{[z^2 \times (p \times (1 - p))]}{d^2} \text{ Thus } n = \frac{(1.96)^2 \times (0.32) \times (1 - 0.32)}{(0.05)^2} = 334$$

Where,

n = sample size of housing units

Z = Standardized normal variable and its value that corresponds to 95% confidence interval equals 1.96

d = Allowable error (0.05)

p = 0.32 (32%); proportion HHs expected to practice proper household solid waste management [15].

Proper solid waste management at household level: the household dispose their waste inside the road, on sewerage or burning on their back yard and also disposing waste through informal waste handler; it is improper management in the household side [16].

By adding 5% of non-response and multiplying the sample size by 1.5 for design effect of the sample size was increased to 526 respondents (households).

Sampling Technique and Procedure

Based on geographical location, population density and availability of different infrastructures Stratification technique was used to select the households.

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First, Nine kebelles (districts) of the city were divided in to three strata namely Central (kebelles close to the center), middle (kebelles located in the middle distance to the center), and Rural (rural areas of the city).

Second, three kebelles, one from each stratum, was selected using random sampling method. In the third stage, 526 households were selected proportionally from the three kebelles based on their population size. The study unit was the head of the house. For qualitative study, a total of 11 key informants were purposefully selected from the kebeles solid waste coordinator and staff from Dire Dawa Sanitation Beautification Park Development Agency. In addition, three small scale enterprises on solid waste management were purposefully selected for focus group discussion (Fig. 1).

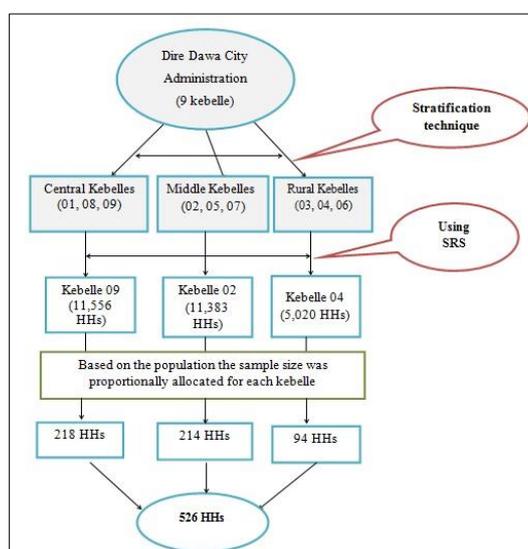


Fig. 1. Schematic representation of sampling procedure.

Data Collection Technique

Quantitative data was taken from the households through house to house visit and conducted face to face interview by using structured and standardized questionnaires adapted from Ethiopian Demographic and Health Survey (DHS), English version [17]. The questionnaire was further developed by reviewing different literatures and relevant factors were incorporated [10,15,18]. Then the questionnaire was translated into local language (Amharic, Afan Oromo and Somali) by language experts. The questions have both open and close ended questions. Questionnaire was included demographic and socio-economic characteristics, current situation of household solid waste management. The face to face interview was conducted by eight data collectors and the process was supervised by 2 field supervisors.

Study Variable

Dependent variable:

Household solid waste management practice.

Independent variable:

Demographic factors: Sex, Age, Income, Year of stay, Family size and Educational status.

Socio-economic factors: Distance from the main road; Willingness to pay for waste collection services; Knowledge about solid waste management, disease transmission; Attitude; Distance from waste containers and Availability of other disposal places. Institutional factor like access to collector.

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Operational definition:

Household: Persons who live together in one house or dwelling.

Solid waste: all type of solid waste generated from household such as Food related waste, Ashes, Plastic, Wooden and metallic wastes etc.

Proper solid waste management at household level: the households store their wastes on covered plastic bag or other material and then hand over to the door to door waste collectors within two to three day.

Knowledge: the respondent ability to answer the practice of household waste management. Hence, those respondents who score 50% and above were considered as having good knowledge toward household solid waste management practice. While less than 50% those considered as poor.

Attitude: refer to respondent opinion of agreement or disagreement to the statement concerning household waste management. Hence, those respondents who score 50% and above were considered as having good attitude toward household solid waste management practice. While those who scored less than 50% were considered as poor.

Data analysis method:

Data were first checked manually for completeness and then coded and entered in to Epidata version 3.1 and then analysed using SPSS version 20. Descriptive statistics such as frequency and percentage was done. Chi square and binary logistic regression was done to assess the potential predictors of the outcome variable. Finally, multivariate analysis was done to identify significant factor associated with Household solid waste management practice. P value<0.05 was taken as significant. Results were presented in statements, tables, and charts.

III. RESULTS

Socio-Demographic Characteristics

A total of 511 Households were participated in the study with a 97% response rate. Out of the total respondents 453(88.5%) were females. The mean age of the study units were 36.4 years and 245 (47.9%) of the participants were in the age group of 46-60 years. Also 371 (72.7%) were married and 74 (14.7%) were single. Furthermore, 128(25%) illiterates and 66(13.5%) completed College/University. Concerning occupation status, 189(36.9%) were merchants and 139(27.1%) was government employee.

Concerning the residence, 234 (45.7%) respondents live in private house. Two hundred seventy two (53.1%) of the study participant were lived in Dire Dawa for \geq 16 yrs and 209 (40.8%) lived in current house up to five yrs. Majority of the households 436(85.2%) have no adequate space for waste disposal in the back yard. Majority, 274 (53.5%), of the respondent reported 3-4 family members are found in the HH. On average, 182 (35.5%) of the family earns 1000-2000 Birr per month (Table 1).

Solid Waste Type, Storage and Disposal System of the Households

According to the survey most household solid wastes were plastic 102 (19.9%), Ashe 125(24.6%), food related waste 68(13.3%) and others like "Khat related waste" constitutes 216(42.2%). Majority of the respondents 477(93.3%) used sack as waste storage.

Most of the HHs, 494(96.7%), reported that no solid waste container available in almost all places of the town. But as an alternative, 411(79.6%) households dispose through private waste handlers (MSSEs) and 7(1.4%) disposed in open dump in the yard.

About half of the households, 265(51.8%), had enough access of private waste collectors services (MSSEs) and 318 (71%) of households were satisfied by service provided by private waste collectors.

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Variable	Category	Frequency (n)	Percentage (%)
Sex	Male	58	11.5
	Female	453	88.5
Age	17-30	13	2.7
	31-45	170	33.4
	46-60	245	47.9
	61-75	82	16
Educational status	Illiterate	128	25
	1-4	66	12.9
	5-8	101	19.7
	9-10	72	14.1
	11-12	76	14.8
	College or University	68	13.5
	Graduates		
Marital status	Married	371	72.7
	Single	74	14.5
	Divorce	38	7.4
	Widowed	28	5.4
Occupational status	Merchant	189	36.9
	Government employee	139	27.1
	Daily labor	94	18.4
	Farmer	62	12.1
	Other*	27	5.5
Housing condition	Kebelle rental	47	9.4
	Private rental	230	44.9
	Private house	234	45.7
Family size	1-2	99	19.5
	3-4	274	53.5
	5-9	117	22.9
	≥ 10	21	4.1
Monthly Income of HH (in Birr)**	<1000	114	22.3
	1000-2000	182	35.5
	2001-3000	122	23.8
	>3000	93	18.4
Year of stay in Dire Dawa	≤ 5	60	22.3
	1-10	112	35.7
	11-15	67	23.8
	≥ 16	272	18.2
Length of stay in the current HH (in Years)	<1	57	11.3
	1-5	209	40.8
	5-10	92	18
	≥10	153	29.9
Distance of HH from main road (in meter)	<50	71	13.9
	50-100	73	14.4
	101-150	115	22.5
	≥ 150	252	49.2
Availability of space in Back yard for waste disposal	Yes	75	14.8
	No	436	85.2

Note: (n=511). *Housewife, Student, Non-governmental employee, Jobless, **1 Birr = 0.043 USD

Table 1. Socio-demographic characteristics of study participants in Dire Dawa town, Eastern Ethiopia, February 27- March27, 2015.

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Household's Awareness and Attitude Towards Solid Wastes Management

Among the households, 228(44.6%) of them stated that solid waste means totally useless whereas, 198(38.7%) and 85(16.7%) were stated somewhat useful and useful respectively. Similarly, the vast majority 474(92.8%) of the respondents agree on the issue of proper management of household solid wastes.

According to the current finding, 286(56%) of the respondents collect and stored separately based on nature of solid waste. As mentioned by 145(64.2%), they didn't know the importance of separating waste based on its type whereas, 34(15%) believed that separating the home made waste was not their responsibility.

Out of the total respondents, 334(65.4%) of them reported that they were oriented about HH level waste handling and disposable. Among them 247(80%) respondents took the orientation from the health institutions and 66(12.9%) from the municipality.

Out of the total, 493(96%) households showed willingness to pay for private waste collection services, whereas, 18(4%) households were not. About 307(60%) of the respondents revealed that they did not know even whether the waste related laws and regulations are available in the town. Further, asked how they evaluate the practice / enforceability of laws and regulation in the town. Only 48(9.4%) of them stated that the enforceability of regulation is strong and 43(8.4%) responded it is weak. But majority of sample households 113(22.2%) responded no regulation at all (Table 2).

Variables	Categories	Frequency	Percentage (%)
Storage material	Basket	9	1.8
	Sack	477	93.3
	Plastic bag	25	4.9
Alternative waste disposal option	Open space	6	1.2
	Digging hole	82	16
	Backyard	10	2
	Private collector	413	80.8
Residential area & Access to MSSE	Yes	77	15.1
	No	434	84.9
Access to MSSE service	Enough access	265	51.8
	Inadequate	175	34.8
	None	70	13.4
Awareness of HH head on SWM	Useless	228	44.6
	Somewhat useful	198	38.7
	Useful	85	16.7
Attitude of HH head on SWM	Yes	474	92.8
	No	37	7.2
Reason for not separating solid waste	Lack of knowledge	34	15
	Not my responsibility	34	15
	Not important	145	64.2
	I don't know	13	5.8
Source of Information about SWM	Municipality	66	13.1
	Health institution	247	80
	Poster	9	2.7
	NGO	5	1.5
	TV and radio	7	2.7
Willingness to pay waste collection services	Yes	493	96
	No	18	4
Enforceability of laws and regulation on SWM	None at all	113	22.2
	Regulation weak	43	8.4
	Regulation strong	48	9.4

Table 2. Shows solid waste management of households in Dire Dawa town, Eastern Ethiopia, February 27- March27, 2015 (n=511).

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Bivariate Analysis on Socio- Demographic, Knowledge, Attitude and Institutional Factors of Household Solid Waste Management

The binary logistic regression analysis result showed that, educational status of the HH head (OR = 0.459, 95% CI = (0.247-0.853)), average monthly income of HH head (OR = 3.538, 95% CI = 1.867-6.704)), year of stay in current house (OR = 2.622, 95% CI = (1.425-4.823)), year of stay in DireDawa city (OR = 2.610, 95% CI = (1.079-6.312)), distance of household from main road (OR = 0.578, 95% CI = (0.345-0.971)) and awareness of the household head on SWM (OR = 0.147, 95% CI = (0.075-0.287)), HHs access to private waste collectors services (OR = 0.133, 95% CI = (0.074-0.237))and family size (OR = 4.579, 95% CI = (2.571-8.153)) were found to be significantly associated with improper waste management. Moreover, manpower, budget, and facilities such as adequate vehicles were the reasons for low performance of household waste management (Table 3).

Variables	HH solid waste management practice		COR (95% CI)	P value
	Improper	Proper		
Sex of HH head				
Female	315(89.7%)	138(86.2%)	1	0.516
Male	36(10.3%)	22(13.8%)	0.738(0.295-1.846)	
Marital status of HH head				
Married	244(69.5%)	127(79.4%)	1	0.065
Unmarried	107(30.5%)	33(20.6%)	0.657(0.354-1.220)	
Educational status of HH head				
Literate	204(66.9%)	111(80.4%)	1	0.037*
Illiterate	101(33.1%)	27(19.6%)	0.459(0.247-0.853)	
Family size				
≤ 4 people	277(78.9%)	96(60.0%)	1	0.000**
≥ 5 people	74(21.1%)	64(40.0%)	4.579(2.571-8.153)	
Year of stay in DD				
≤5 years	316(90%)	135(84.4%)	1	0.033*
> 5 years	35(10%)	25(15.6%)	2.610(1.079-6.312)	
Length of stay in current house				
≥1 year	120(34.2%)	33(20.6%)	1	0.003*
<1 year	231(65.8%)	127(79.4%)	2.622(1.425-4.823)	
Average monthly income of HH head				
>3,000 Birr				
≤3,000 Birr	286(81.5%)	111(69.1%)	1	0.001*
	65(18.5%)	49(30.6%)	3.538(1.867-6.704)	
Awareness of HH head on SWM				
Yes	36(10.3%)	49(30.6%)	1	0.000**
No	315(89.7%)	111(69.4%)	0.147(0.075-0.287)	
Distance of the house from the main road				
<150 meter				
≥150 meter	166(47.3%)	93(58.1%)	1	0.048*
	185(52.7%)	67(41.9%)	0.578(0.345-0.971)	
Access MSSE				
Yes	142(40.5%)	123(77.4%)	1	0.000**
No	209(59.5%)	36(22.6%)	0.133(0.074-0.237)	
Law Enforcement				
Strong regulation	39(11.1%)	42(26.4%)	1	0.127
Weak regulation	312(88.9%)	117(73.6%)	1.082(0.552-2.124)	

Note: (n=511). * Significant at P = <0.05, ** Significant at P ≤ 0.001, OR = Odd ratio, CI = Confidence interval

Table 3. Bivariate analysis on Socio- demographic, knowledge, attitude and institutional factors of household solid waste management in Dire Dawa city, Eastern Ethiopia from February 27- March27, 2015.

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Factors Associated with Solid Waste Management

Educational status, marital status, family size, average income, year of stay in current households, distance (location of household from main road), MSE access, law enforcement, attitude and awareness were found to be significantly associated with improper household waste management.

Variables	HH solid waste management practice		COR	AOR
			(95% CI)	(95% CI)
	Improper	Proper		
Marital status of HH head				
Married				
Unmarried	244 (69.5%)	127 (79.4%)	1	1
	107(30.5%)	33 (20.6%)	0.657(0.354-1.220)	1.688(1.081-2.634)*
Sex of HH head				
Female	315(89.7%)	138 (86.2%)	1	1
Male	36 (10.3%)	22 (13.8%)	0.738(0.295-1.846)	1.395(0.791-2.459)
Educational status of HH head				
Literate				
Illiterate	204 (66.9%)	111(80.4%)	1	1
	101 (33.1%)	27 (19.6%)	0.459(0.247-0.853)*	2.035(1.255-3.301)*
Family size				
≤ 4 People	277 (78.9%)	96 (60.0%)	1	1
>5 people	74 (21.1%)	64 (40.0%)	4.579(2.571-8.153)**	0.401(0.267-0.602)*
Length of stay in current HH				
≥ 1 year				
<1 year	120 (34.2%)	33 (20.6%)	1	1
	231(65.8%)	127 (79.4%)	2.622(1.425-4.823)**	0.500(0.322-0.778)*
Distance of the house from main road				
<150 m				
≥150 m	166 (47.3%)	93 (58.1%)	1	1
	185 (52.7%)	67 (41.9%)	0.578(0.345-0.971)*	1.547(1.060-2.257)*
Access MSSE				
Yes	142 (40.5%)	123 (77.4%)	1	1
No	209 (59.5%)	36 (22.6%)	0.133(0.074-0.237)**	5.029(3.277-7.717)*
Aware of HH head on SWM				
Yes				
No	36 (10.3%)	49 (30.6%)	1	1
	315 (89.7%)	111 (69.4%)	0.147(0.075-0.287)**	3.863(2.386-6.252)*
Average Monthly income of HH head				
>3,000 Birr				
≤ 3,000 Birr	286 (81.5%)	111 (69.1%)	1	1
	65 (18.5%)	49 (30.6%)	3.538(1.867-6.704)**	0.515(0.335-0.792)*
Law Enforcement				
Strong regulation	39 (11.1%)	42 (26.4%)	1	1
Weak regulation	312 (88.9%)	117 (73.6%)	1.082(0.552-2.124)	2.872(1.768-4.664)*
Year of stay in DD				
>5 yrs	316(90%)	135(84.4%)	1	1
≤ 5 yrs	35(10%)	25 (15.6%)	2.610(1.079-6.312)*	0.598(0.345-1.038)

Note: (n=511), * Significant at P = <0.05, ** Significant at P = < 0.001, OR=Odd ratio, AOR=Adjusted odd ratio, CI= Confidence interval

Table 4. Bivariate and multivariate analysis of associated factors with household solid waste management in Dire Dawa city, Eastern Ethiopia, February 27- March 27, 2015.

According to the current finding illiterates were 2 times more likely to manage solid waste improperly compared to those who are literate (AOR = 2.035, 95% CI = (1.255-3.301)) and households owned >5 family members were 0.4 times less likely to dispose solid waste improperly when compared HHs with ≤ 4 family members (AOR = 0.401, 95%

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CI = (0.267-0.602)). On the other hand, those respondents who live less than 1 year in current household were 0.5 times less likely to be improper when compared to those who live greater or equal to 1 years (AOR = 0.500, 95% CI = (0.322-0.778)).

In addition, Respondents who are not married were 1.6 times more likely to be improper when compared to those who are married (AOR = 1.688, 95% CI = (1.081-2.634)) and households with distance of greater than or equal to 150 meter from the main road were 1.5 times more likely to be improper when compared to those households less than 150 meter (AOR = 1.547, 95% CI = (1.060-2.257)). Households who have no access to MSE were 5 times more likely to be improper when compared to those access of MSE (AOR = 5.029, 95% CI = (3.277-7.717)).

Moreover, respondents who are not aware about solid waste management were 3.8 times more likely to be improper compared to those aware (AOR = 3.863, 95% CI = (2.386-6.252)). Furthermore, households their average monthly income less than or equal to 3,000 ETB were 0.5 times less likely to be improper compared to those greater than 3,000 ETB (AOR = 0.515, 95% CI = (0.335-0.792)).

With regard to law enforcement respondents when the regulation weak were 2.8 times more likely to be improperly waste manage than when the regulation becomes strong (AOR = 2.872, 95% CI = (1.768-4.664)) and also the respondent who are poor attitude toward solid waste management were 1.7 times more likely to be improper when compared to those who are good attitude (AOR = 1.759, 95% CI = (1.005-3.081)) (Table 4).

IV. DISCUSSION

The study was conducted to assess the status of household solid waste management practice and its associated factor in Dire Dawa city. The survey showed that which only 31% of them are dispose solid waste in a proper manner. Educational status, marital status, family size, average monthly income, year of stay in current households, location of household from main road, MSSE access, awareness on SWM, attitude on SWM and law enforcement were found to be associated with improper solid waste management. Manpower, budget, and facilities such as inadequate vehicles were the reasons for low performance of MSSE.

The magnitude of improper solid waste management in this study was 31% was almost similar to the study conducted in Ambo town of Ethiopia [15] which was only 31.56% of the household properly manage solid waste. However, study conducted in Bangladesh [19] revealed that 39% of the households dispose improperly. In addition, similar study conducted in Accra [20] revealed that 61.0% of the HHs disposed of their waste at community bins or had waste picked up at their homes by private contractors. The remaining 39.0% disposed of their waste in gutters, streets, holes and nearby bushes. This difference might be due to the criteria set by principal investigator to categorize proper and improper waste management, living style of the respondents in study area and also socio-economic difference increase the percentage of improper households.

In this study, respondents who are illiterate were 2 times more likely to be improper when compared to those who are literate. This finding is similar with study conducted in other part of Ethiopia [15] which found that the trends of HH head educational level and the properness of waste management at household level have a positive relationship. When the household educational level improves, the properness of household solid waste management level also improves. In contrary; a study showed that, educational levels are not serious causes for the action of households in the case of dispose wastes in illegal places or sites [12]. This could be due to sample size difference.

Household who family size greater than 5 people were 0.4 times less likely to be improper when compared to those who is less than or equal to 4 people. This indicates that households who manage solid wastes properly have, relatively, a large number of family members than households who manage its waste improperly. Similarly it was reported HH family size has a significant relation with the intensity of recycling of HH solid waste management [21]. This could be when the family members are increasing the intensity of waste management activity also increase.

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The recent study finding indicated that respondents who live < 1 year in current HH were 0.5 times less likely to be improper when compared to those who live greater or equal to 1 year. But another study revealed that existence of insignificant relationship between the two groups of households. From the total, 55% of the respondent live rental house either privately or kebele. So this kind of respondents takes more care for everything especially, on SWM [15].

In the current study, those households with distance from the main road greater than or equal to 150 meter were 1.5 times more likely to be improper when compared to those households less than 150 meter. But the finding from another part of Ethiopia showed that HHs which was nearer to the town main road (< 150 meters), where access is available have a chance to more properly manage solid waste [12]. This could be due to majority of respondent 436 (85.2%) have no backyard space.

In the current study households who have no access to MSSE were 5 times more likely to be improper when compared to those accesses of MSSE. Similar studies revealed that households who have no access to MSSE were 18 times more likely to be improper when compared to those access of MSSE service [15] and also accesses to private waste collectors showed significant relation with household waste management [20].

Moreover, respondents who are not aware about solid waste management were 3.8 times more likely to be improper compared to those who have knowledge. The finding of this study was found to be matching with what has been found by different literatures [15,22,23] which indicated that the level of households awareness on extensive implication of improper waste management increases, the probability of effective solid waste management at household level would be increased by 17%. In contrary, one finding specified that a majority of the respondents; 94.2% were aware of hazards brought about by incorrect solid waste management yet only 26.2% practiced correct management methods [24]. This could be sample size difference.

Households their average monthly income less than or equal to 3,000 ETB were 0.5 times less likely to be improper compared to those greater than 3,000 ETB. This finding supported by one of study done in Ethiopia [15] which showed that when the average monthly incomes of the household increase and the tendency to be improperly manage solid waste were also increase. On the other hand, some studies revealed that the higher income leads peoples to more participation domestic solid waste management [21,23,25]. Because, the higher income earner groups have a power to use the service of private waste collectors at any cost than the lower income group.

With regard to law enforcement respondents when the regulation weak were 2.8 times more likely to be improperly manage waste than when the regulation becomes strong. This is also related with what has been found by other studies [13,15] which indicated positive relationship between effective solid waste management and enforcement of regulation. Also respondent who showed poor attitude towards solid waste management were 1.7 times more likely to be improper when compared to those who are good attitude. This finding was supported by a study done in Ethiopia [15].

In addition, respondents who are not married were 1.6 times more likely to be improper when compared to those who are. This could be due to, the majority 371 (72.7%) of the respondents were married.

V. CONCLUSION

The current study revealed that solid waste disposal system of most households was improper and unauthorized. Educational status, Marital status, Family size, Average monthly income, Year of stay in current HHs, location of HH from main road, MSSE access, awareness on SWM, attitude on SWM and law enforcement were found to be associated with improper solid waste management. Manpower, budget, and facilities such as adequate vehicles were the reasons for low performance of MSE.

Ethics Approval and Consent to Participate

Ethical clearance was obtained from Institutional Health Research Ethical Review Committee (IHRERC) of Haramaya University, College of Health and Medical Science. Then letter of permission was obtained from Dire Dawa administrative health bureau and submitted to the respective kebelles (Sub-city) and DDSBPDA.

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The respondents were informed about the purpose of the study, and their oral consent was obtained. The respondents' right to refuse or withdraw from participating in the interview was fully maintained and the information provided by each respondent was kept strictly confidential by making each questionnaire coded and not sharing personal information of any patient to the third party.

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