

Assessment of Household Solid Waste Management Practice and Associated Factors in Debre Berhan Town, Amhara Regional State, Ethiopia

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ABSTRACT

Background: All over the world, countries are battling with waste management and governments are investing huge sums of money to tackle waste issues. Household solid wastes in Debre Berhan town are observed on the road, burning inside the village, and disposed of in sewerage.

Objective: This study was aimed to assess the status of household solid waste management practice and associated factors in Debre Berhan town from March 1- March 30, 2020.

Methods: Community-based cross-sectional study design was conducted in the household of Debre Berhan. Data was collected from 722 households, which were selected through multi-stage sampling from three kebeles. The Obtained data were entered using Epidata and finally analyzed using SPSS Version 21. Bivariate and multivariate analyses were done to identify the independent predictors of good solid waste management practice. Odds ratio with 95% confidence intervals and p-value <0.05 were used to assess the level of significance between determinant factors and the practice of solid waste management.

Result: The majority of the households, 473(67.4%) solid waste management practice were poor. Age of the respondent (AOR = 4.9, 95% CI = 2.6-9.3), Educational level of the household heads (AOR = 0.54, 95% CI = 0.32-0.92), Attitude of Household head on Solid waste management (AOR = 0.90, 95% CI = 0.06-0.15), cleanup campaign participation (AOR = 0.61, 95% CI = 0.39-0.95) and house ownership (AOR = 0.45, 95% CI = 0.29-0.70) were significantly associated with household solid waste management practice in the study area.

Conclusion and Recommendation: The current study revealed that solid waste management practice was poor. Educational level, homeownership, attitude, cleanup campaign participation, and attitude on solid waste management were found to be associated with solid waste management practice. The municipality should increase door-to-door solid waste collection service coverage, promote households on solid waste segregation, reuse, and proper disposal through continuous awareness creation campaigns and community-based programs.

Keywords: Household; Solid waste; Debre Berhan town; Solid waste management practice

Abbreviation

CBOs: Community Based Organizations; **CED:** Centre for Environment and Development; **ENPHO:** Environment and Public Health Organization; **FDRE:** Federal Democratic Republic of Ethiopia; **HH:** Household; **HHSWM:** Household Solid Waste

Management; **KI:** Key Informants; **MSWM:** Municipal Solid Waste Management; **NGOs:** Non-Governmental Organizations; **SWM:** Solid Waste Management; **UNEP:** United Nation Environment Programme; **USEP:** United state Environmental Programme; **SBPDD:** Sanitation, Beautification; and Park Development Department; **WHO:** World Health Organization; **WB:** World

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Bank; MSSE: Micro and Small scale enterprise

INTRODUCTION

All over the world, countries are battling with waste management and governments are investing huge sums of money to tackle waste issues and this is mainly due to the magnitude of rapid urbanization and increasing population growth; which in turn has greatly accelerated municipal solid waste generation rate in the urban environment [1].

Waste management in most cities in developing economies and countries with economies in transition involves overburdened waste collection services and inadequately managed or even uncontrolled dump sites where waste catches fire and burns [2]. The failure to provide adequate collection services poses a serious threat to human health and the physical environment [3]. Solid waste management practice can probably be improved significantly if the inhabitants of low-income communities start assuming the responsibility of handling their garbage and setting up a system appropriate to their economic situation.

Household solid wastes in Debre Berhan town are observed on the road, burning inside the village, and disposed of in sewerage [4]. This implies that like other developing country cities, Debre Berhan has also problems that prevent the municipality/responsible body from doing its task for environmental sound with economic efficiency. So that, this research is intended to identify and analyze the main factors associated with household solid waste management practice.

Urbanization with inadequate waste management practices, specifically, widespread disposal of waste in water bodies, dumping inside the road and uncontrolled dumpsites aggravates the problems of generally low sanitation levels across the African countries including Ethiopia [5]. The population growth and the rate of urbanization are alarmingly increasing throughout the African continent, but, the technology, technical know-how, financial capacity, culture, and understanding of the community required to properly manage solid wastes are not adequately available [6].

In Debre Berhan, The majority 75% population of the town disposed of waste illegally into public places, rivers, and ditches and burning inside the village. The reason for this illegal solid waste disposal is, inadequate solid waste collection coverage (only 25% of the generated waste is collected) and In addition to this, there are no public solid waste storage containers and roadside dust bins. Households also use to dump their wastes either solid or liquid in the open drainage and any open spaces [4]. It implies that household solid wastes are not properly managed at the source by its generator. Such practice poses a high risk to the local environment. So that, the preventive measure should be taken to have remedial action at least on biodegradable materials. Improper solid waste management causes all types of pollution: air, water, and soil. Most of the time, these waste disposal practices cause floods in the town, especially, during the rainy seasons [7]. Because of this, it is worthwhile to assess the practices and the factors affecting household solid waste management in the town. Uncollected waste can also block drainage channels and increases the health problems related to pool stagnant water.

On top of these, this type of research has not been ever conducted in the selected area and the municipality also has not filtered or proved information about the problem of household solid waste

management practice. Hence, this study would timely to find the real constraints of the household SWM practice of the town and would try to provide a feasible solution for the identified problems. So, this study is expected to improve existing solid waste management and to minimize related problems, and also to see the practices in the study area and to the next work as a springboard for researchers who would like to conduct detailed and comprehensive studies either in the Debre Berhan town or another study area.

MATERIALS AND METHODS

Study Area and Period: The study was conducted in the North Shoa zone, Amhara regional states of Ethiopia, Debre Berhan town. Debre Berhan town was established in 1454 by Emperor ZeraYaeqob. The town is located at 130 kilometers northeast direction along with Addis Ababa-Dessie-Mekele route. Astronomically, the town is positioned at 9°41' North latitude and 39°40' East longitude and characterized by a cool temperate climate. The annual average temperature of the town ranges between 40C in the coldest month (August) to 26°C in the hottest month (April). Average annual rainfall ranges between 814 to 1080 mm.

The total area of the town is 21169.95 hectares of land. The town Administration is further subdivided into nine kebele administrations. The projected population of the town based on the 2008 national census is 79,832 of which 37,500 are women and 42,332 men with 22207 Households [8].

Study Design: Cross-sectional study design was conducted to assess solid waste management practice and associated factors among households in Debre Berhan town. Both quantitative and qualitative approaches were used to collect data from the households and key informants.

Source Population: The source populations of the study include all households in Debre Berhan town.

Study Population: The study populations were all households from selected kebele of Debre Berhan town and the study unit was Household. For the qualitative study, a total of 11 key informants were purposefully selected from the solid waste collection service provider, street sweepers, and staff from Debre Berhan Sanitation Beautification Park Development Agency. A total of 722 samples were selected and sample size determination was calculated by using a scientific statistical method of single population proportion formula to assess the current status of household (HH) solid waste management practice and associated factors in Debre Berhan town.

Sampling Procedure: Multi-stage sampling technique was used to select sample households. The first stage was classifying 9 kebeles of the town into 3. This classification was just for stratification. Then, three kebeles were selected, (one kebele from each stratum) randomly. This is mainly because; the researcher believes that those kebeles located in the same stratum have homogeneous characteristics concerning proximity to the center of the town and availability of infrastructures. As a result, taking one kebele from each stratum can be representative. Then proportional HH was calculated from each selected kebele. Finally, the head of the households was selected by a systematic random sampling for every K^{th} interval to get a response about household solid waste management practice.

For the qualitative study, key informants were purposefully selected from SWM experts, employees who were mainly their specific work

related to solid waste management in the town's municipality, staff, and head of Debre Berhan sanitation beautification park development department (SBPDD).

Data Collection Methods and Tools: The study employed a questionnaire, interview, and field observation as an instrument to collect data. About questionnaires, there were two types of questionnaires (both open and close-ended) which were prepared to look at households' solid waste management practice and associated factors.

After preparation, (5%) questionnaires were randomly distributed as a pre-test to correct unclear and misleading questions. Then all questionnaires were brought to samples with the help of four data collectors employed by the researcher from Debre Berhan university undergraduate students with giving training and under the close supervision of the researcher. Moreover, data was also gathered with the help of semi-structured and unstructured interviews with the SBPDD head, other selected key informants, and workers about the overall activities of SWM practices and constraints of SBPDD.

Apart from these, field observation was employed for assessing the spatial distribution of SWM infrastructures, households' solid waste handling practices, illegal dumping, solid waste collection, and transportation systems of the town. Photographs were taken during field observation for partial exposure of disposal sites and illegal dumping of residents.

Data Quality Assurance Plan: The quality of the data was assured through careful design and pretesting of the tools, proper training of the data collectors and supervisors. Data quality was ensured through proper orientation of data collectors and continuous supervision during the process of data collection by the investigator. In addition, regular checkup for completeness and consistency of the data was made on daily basis. Questionnaires and interviews set in English were translated and administered in Amharic, the local language in the study area, to ensure clarity. The questionnaire was administered by trained data collectors.

Data Processing and Analysis Plan: The collected data were coded separately, edited, cleaned, and entered into the computer software Epi-data version 3.1 statistical packages, then transferred to SPSS version 21 used for data analysis. Descriptive statistics such as frequency distribution, percentage; mean, standard deviation were employed for the variables. The principal investigator performed a descriptive analysis that presents the results.

To reduce an extreme number of variables, P values less than 0.2 during the bivariate analysis were included in the multivariate logistic regression analysis to see the relative effect of confounding variables. Multicollinearity of significant independent variables was checked by tolerance and its reciprocal called variance inflation factor (VIF), if the value of VIF lies between 1-10, there is no multicollinearity, and if the value of VIF <1 or >10, multicollinearity is problematic. In this study VIF values of all independent variables included in multivariate logistic regression were lies between 1 and 10, so multicollinearity was not problematic.

All independent variables were separately put into the bivariate logistic regression model to evaluate the degree of association with practice and Crude Odds ratio with 95% confidence intervals and significance level at $P < 0.05$ were used to see the association between determinant factors and practice of solid waste management.

Multivariable Logistic Regression: Analysis, variables with 95% confidence interval and P-value <0.20 during the bivariate

analysis were included in the multivariable logistic regression were done by controlling confounders. Adjusted odds ratios with 95% confidence interval were calculated and finally, the data was presented by a statement, graphs, and tables.

Ethical Consideration: Ethical clearance for the study was obtained from the Debre Berhan University College of health science ethical review board and an official support letter from the administrative body of Debre Berhan town. Data collection was undertaken after permission was obtained from the Debre Berhan municipality. An objective of the study was explained for every study participant and they were asked for information only after they give their consent.

RESULTS

Socio-Economic and Demographic Characteristics of Respondents

A total of 702 Households participated in the study with a 97.2% response rate. As indicated in Table 1 out of the total respondents 468(66.7%) were females. The mean age of the study units was 36.4 with SD (+ 10.41) years and the majority of the respondents, 681 (97 %) belong to 15-64 age groups. Regarding the educational level, the majority 174 (24.8%) were secondary school graduates. In this study the majority, 560(79.8%) were married, 26(13.5%) were single by their marital status. The average family size of the survey households was 4.2 with a minimum of one and a maximum of

Table 1: Socio-Economic and demographic characteristics of respondents in Debre Berhan, town Ethiopia, 2020.

Variables	Alternatives	Frequency	percent
Sex	Male	234	33.3
	Female	468	66.7
Age (in a year)	15-24	22	3.1
	25-34	212	30.2
	35-44	264	37.6
	45-54	122	17.4
	55-64	64	9.1
	>64	18	2.6
Educational Level	Unable to read and write	100	14.2
	Able to read and write	84	12.0
	Primary (1-8)	120	17.1
	Secondary (9-12)	174	24.8
	Diploma	100	14.2
Residence duration in the town (in a year)	Degree and above	124	17.7
	<2	54	7.7
	2-5	64	9.1
	5-8	154	21.9
	8-10	144	20.5
Family size	>10	286	40.7
	<4	344	49.0
Average monthly income (in ETB)	>4	358	51.0
	< 1000	314	44.7
	1001-2000	88	12.5
	2001-3000	128	18.2
	3001-4000	100	14.2
	4001-5000	16	2.3
	>5000	56	8.0

nine. However, 358 (51.0%) of respondents have more than four family members.

The number of years of stay in Debre Berhan town 286 (40.7%) of sample respondents stayed in the town for more than 10 years. About 352(50.1 %) of the respondents are living in their own house and the remaining are rented either from the public (kebele) or private owners. Regarding the monthly income of the household, the majority of the respondents 314(44.7%) earned less than 1000 ETB per month.

Socio-Cultural Related Factors

The data illustrated in Table 2 below shows that, from the total sample households, 190(27.0%) of the respondents were living in less than 100 meters' distance from the main road, whereas, only 40(5.7%) were living in a distance of greater than 500m from the town's main road. Of the total 702 respondents, only 293(41.7%) the respondents have a good attitude and the remaining have a poor attitude toward solid waste management.

Regarding the responsible body of waste management, 332 (47.3%) of households included in the survey said that it is entirely the government/ municipality responsibility to deliver SWM whereas, 40 (5.7%) voted for the households and the majority 362(51.5%) of the respondent replied that the effort of a municipality in managing solid waste was poor. The survey data in the following table shows that 93.2% of households were willing to pay for private waste collection services.

Additionally, about 59% of the total respondents confirmed that they had information about solid waste and its management and from 414 respondents, who had information about solid waste management, 27% revealed that they got orientation from the

kebele meeting, while 20.3% of the households confirmed that they got solid waste-related information from health institution.

An Attitude of Respondents toward Solid Waste Management

As per the given data below, from 702 respondents 40.7% stated that solid waste means useless. However, the remaining respondent, of the selected households consider solid waste as a useful resource. According to the survey result (Table 3), the majority of respondents (91.2%) stated that they agree on the management of solid wastes. Regarding the factors that affect the SW generation, 56% of the respondents agree that it is related to their consumption pattern and about 82% of them were believe in environmental and health problems of poor solid waste management.

Institutional related factors

Regarding door-to-door solid waste collection services accessibility, 512 (72.9%) households have access to solid waste collection services and about 39.0% of the households got solid waste collection services within four days' intervals. From those who have access to the door-to-door solid waste collection, only 116(22.7%) of them responded that as they have adequate access and are satisfied with the service. About 280 (39.9%) the respondents knew that there was solid waste-related rule and regulation, about 61.1% of the respondents revealed that they did not know even whether the waste-related laws and regulations are available in the town, and from the total of 280 respondents who knew the existence of solid waste related rule and regulation only 22.1% of them stated that the enforceability of regulation is strong or municipal practically imposed a penalty to the person who violates the rules and regulation.

Table 2: Socio-cultural related factors of respondents in Debre Berhan, town Ethiopia, 2020.

Variables	Alternatives	Frequency	Percent
Distance of HHs from the main road	<100 meter	190	27.0
	100-200 meter	146	20.7
	200-300 meter	176	25.0
	300-400 meter	50	7.1
	400-500 meter	100	14.2
	>500 meter	40	5.7
HHs attitude status toward SWM practice	Good	293	41.7
	Poor	409	58.3
The responsible body for SWM	Municipality	332	47.3
	Household	40	5.7
	HH and municipality	230	32.8
	All are responsible	100	14.2
Evaluation on the effort of a municipality in SWM	Poor	362	51.5
	Fair	270	38.5
	Good	70	10
Information about SWM	Yes	414	59
	No	288	41
Willingness to pay for solid waste collectors	Yes	654	93.2
	No	48	6.8
HHs' information source about SW	kebele meeting	190	27
	social media	237	33.8
	health institution	143	20.4
	health extension workers	132	18.8

Table 3: SWM attitude assessment question and respond of households in Debre Berhan town, Ethiopia, 2020.

Solid waste attitude items	Yes	No
Do you think solid waste is useful?	66.4%	33.6%
Do you agree with the importance of SWM?	91.2%	8.8%
Do you think that your SW generation is affected by or related to your consumption pattern?	56%	44%
Are you concerned about the disposal of HH SW?	46%	54%
Are you willing to pay for the SW collection service?	85%	15%
Do you think that there is rule and regulation related to SW?	39.9%	60.1%
Do you think that poor SWM causes environmental and health problems?	62%	38%
Do you feel that the street should be clean and be free of solid waste?	87%	13%

This survey result was also supported by key informants. The staff members were asked about the availability of law and its enforcement. Their responses: "Solid waste laws and regulations at regional level were designed or developed. Concerning its enforceability, in principle, it has two steps: warning and then penalize the violator of laws. As per the response of the interviewees, this enforcement of regulations is not that much followed regularly."

The key informant interviewees from the DBBPD staff also said that "since the municipality (we) did not provide containers or adequate door to door waste collectors; it is difficult to seriously follow up and penalize when the households drop off their wastes in unauthorized site (illegally). They further stated that "That is why sometimes we advised the households to burn on their backyard".

We had also assessed the availability of waste storage containers in the town and all of the selected households stated as there is no container in all parts of the town and witnessed by our observation.

According to one of a 30 years old male DBBPD staff members, "there were around 11 containers bought by the municipality in 2016, but they didn't place in the town and serve the community because the municipality had no lift truck to transport those containers from transfer station to final disposal site" (Table 4).

Budget

According to information sourced from the head of the greenery and beautification sector, "the only source of income for solid waste management activity is the municipality income, which is collected from the people through tax." The other 30 years old DBBPD staff members stated that "Even the households did not pay specifically for solid waste related activities. Additionally, the head of greenery and beautification said that "of course at the time before one-year World Bank-supported us and facilitated training program with a full of budget for solid waste management related training at kebele level in Debre Berhan town."

Besides, the head of greenery and beautification sector said that "the budget assigned to solid waste management is inadequate to run the service properly and the municipality budget is assigned from internal income; from this budget, only some portion is given to solid waste-related purpose; rather the rest are assigned to other town's basic development. Concerning this, his expression (reply) goes as follows "that is why the sector did not provide containers in the town and permanently solve the vehicle-related problem and other necessary facilities".

Working Condition of waste collectors

Lack of appropriate personal protective equipment for waste

Table 4: Institutional related factors of solid waste management in Debre Berhan town, Ethiopia, 2020.

Variables	Categories	Frequency	Percent
Access to door to door SWC service	Yes	512	72.9
	No	190	27.1
Time interval of solid waste collection service	1-4 days	20	3.9
	4-7 days	96	18.8
	8-11 days	200	39.0
	12-15 days	108	21.1
	>15 days	88	17.2
SW collection service time and interval satisfaction	Satisfied	116	22.7
	Not satisfied	396	77.3
Existence of law	Yes	280	39.9
	No	422	61.1
Rule and regulation follow up	None at all	50	17.9
	Weak	168	60.0
	Strong	62	22.1

collecting such as gloves, eye and face protection, footwear, etc. are challenges that were raised by workers during an interview and also confirmed by observing their situation when they were doing their day-to-day waste-collecting activities.

They work in unhygienic working conditions some of them used mouth and hand cover they bought from their pocket whereas the protection is not adequate and standardized. This survey result was supported by the information collected from a key informant. One of the 27 years old male MSSE members stated that "The municipality did not provide any necessary facilities like transfer container, vehicle, job cloth (waste glove, eyeglass, and waste gown), shoe and others that are very important to deliver the service effectively".

According to the other 20 years old male MSSE members, "MSSE is not well organized, not well equipped with solid waste collection materials and technologies, they suffer from lack of financial credit, technical and moral support. As a result, this the participation of MSSE restricted to collect waste from roadsides residents and centrally located kebele".

According to the DBBPD staff head, "the municipality has only one old car used to collect waste throughout the town, since the car, which municipality used to transport solid waste, was very old, it spent most of the time in a garage to be fixed".

Lack of organizing and involving community participation

The survey result indicated that 232(33.0%) of the respondent

have participated in the cleanup campaign and 470 (77% %) of the respondents didn't participate in the cleanup campaign which organized by kebele on average 1-4 times a year. The reason for not participating in the campaign was lack of willingness and absence of such kind of campaign in their locality.

The current status of household solid waste management practice in Debre Berhan town

The overall good solid waste management practice among the household of Debre Berhan town was 32.6% with 95%CI, 29.1-36.1.

All of the respondents were store waste temporarily at their home and only 24.2% of them were store waste separately and about 42% of the respondents practice solid waste re-use at their home while only 36.2% of them were used MSSE to dispose-off wastes.

Besides, more than half of the respondents 51% participated in health education related to solid waste management and only 33% of the respondents participated in a cleanup campaign in their kebele (Table 5).

Regarding the kind of solid waste storage they used, the majority of the respondents (64.1%) used sack as waste storage, whereas, 6.6%, 11.1%, and 15.1%, 3.1% of the respondents used a locally made basket, plastic bags, jerry can, and other related storage materials respectively (Figure 1).

Table 5: Solid waste management practice related questionnaires and respondent in Debre Berhan town, Ethiopia, 2020.

Solid waste practice-related questions	Yes	No
Do you have temporary solid waste storage at your home?	100%	0%
Do you segregate waste at your home?	24.2%	75.8%
Do you practice solid waste re-use at your home?	42%	58%
Do you use MSSE to dispose-off your solid waste?	36.2%	63.8%
Do you have participated in a cleanup campaign in your kebele?	33%	77%
Do you have participated in health education-related solid waste management?	51%	49%
Do you separate solid waste which is sold or changed to materials?	26%	74%
Do you store solid waste generated from your house until solid waste collectors come to your home?	38%	62%

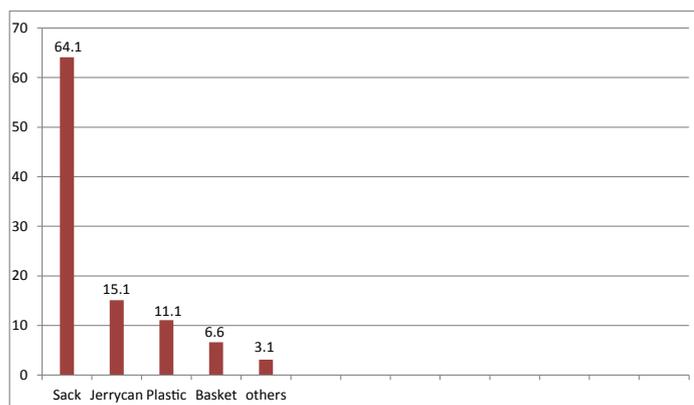


Figure 1: Household temporary solid waste storage materials in Debre Berhan Ethiopia, 2020.

Table 6: The reason why households in Debre Berhan town didn't practice waste segregation.

Reason	Frequency	Percent
I don't understand about waste separation	182	41.9
I don't think it's my responsibility	122	28.1
I don't visualize the waste separation	130	30

Lack of understanding about waste separation 182(41.9%) was the main reason given by respondents for not applying waste separation in their homes (Table 6).

Factors associated with solid waste management practice: bivariate analysis

Socio-Demographic Determinants of solid waste management practice

In socio-demographic determinants of solid waste management practice: age of household head (COR: 8.15, 95%CI: 4.81, 13.82), educational status (COR: 8.15, 95% CI: 4.81, 13.82, duration of stay (COR:2.77, 95%CI, 1.87, 4.14), family size (COR: 1.57, 95%CI: 1.11, 2.21) and house owner (COR: 0.24, 95%CI, 0.17, 0.34) were significantly associated with solid waste management practice (Table 7).

Socio-cultural factors of solid waste management practice

In socio-cultural determinants of solid waste management practice bivariate analysis: attitude (COR: 8.48, 95%CI, 4.8, 13.17) and cleanup campaign participation (COR: 0.46, 95%CI, 0.32, 0.66) was significantly associated with solid waste management practice (Table 8).

Institutional factors of solid waste management practice

Institutional determinants of solid waste management practice: access to the private waste collection (COR: 0.75, 95%CI, 0.52, 1.06) was significantly associated with solid waste management practice (Table 9).

Factors associated with solid waste management practice: Multivariate logistic regression

To reduce an extreme number of variables, P values less than 0.2 during the bivariate analysis were included in the multivariate logistic regression analysis to see the relative effect of confounding variables.

According to the current finding households, age >30 were 4.9 times more likely to practice good solid waste management when compared HHs with age <=30 (AOR = 4.94, 95% CI = 2.60-9.39) and illiterates were 45% less likely to practice good solid waste management compared to those who are literate (AOR = 0.55, 95% CI = 0.32-0.92).

In addition, respondents who are living in the private house were 55% less likely to practice good solid waste management when compared to those who are living in a rental house (AOR = 0.45, 95% CI = 0.29-0.70), households with poor attitude were 10% less likely to be practice good solid waste management when compared to those households with a good attitude (AOR = 0.90, 95% CI 0.07-0.15) and Respondents who didn't participate in the cleanup campaign were 39% less likely to practice good solid waste management when compared to those who participated on a cleanup campaign (AOR = 0.61, 95% CI = 0.39-0.96) (Table 10).

Table 7: Socio-demographic determinants of solid waste management practice in Debre Berhan town Ethiopia, 2020.

Variables	HH solid waste management practice		COR (95% CI)	P-value
	Good (%)	Poor (%)		
Sex of HH head				
Male	83(31.8)	150(36.2)	1	
Female	146(67.2)	322(63.8)	1.22(0.79-2.01)	0.24
Age of HH head				
<=30	212(60.4)	285(92.6)	1	
>30	17(39.6)	187(7.4)	8.15(4.81-13.82)	0.001
Educational level				
Literate	194(68.4)	323(85.4)	1	
Illiterate	35(31.6)	149(14.6)	2.56(1.61-4.17)	0.001
Year of stay in DB				
<=5 years	62(11.9)	56(27.0)	1	
>5 years	167(87.1)	416(63.0)	2.77(1.87-4.14)	0.001
Marital status				
Married	184(79.7)	376(80.3)	1	
Unmarried	45(20.3)	96(19.7)	1.06(0.71-1.57)	0.79
Monthly income				
<=3000 birr	170(76.0)	359(74.2)	1	
>3000 birr	59(24.0)	113(25.8)	0.90(0.63-1.30)	0.59
Family size				
<=4	165(62.3)	294(72.4)	1	
>4	63(27.7)	178(27.6)	1.57(1.11-2.21)	0.1
House owner				
Rental house	62(61.0)	288(27.0)	1	
private house	168(39.0)	184(73.0)	0.24(0.17-0.34)	0.001

Table 8: Bivariate analysis of socio-cultural factors with household solid waste management practice in Debre Berhan town Ethiopia, 2020.

Variables	HH solid waste management practice		COR (95% CI)	P-value
	Good (%)	Poor (%)		
Distance from the main road				
<=200 m	123(61.1)	289(53.7)	1	
>200 m	106(38.9)	184(46.3)	0.74(0.54-1.02)	0.63
Attitude				
Poor	171(25.8)	122(74.7)	1	
Good	58(74.2)	351(25.3)	8.48(4.8-13.17)	0.001
Cleanup campaign participation				
Yes	51(25.8)	181(7.3)	1	
No	178(41.6)	292(25.3)	0.46(0.32-0.66)	0.001
Information/lesson				
Yes	128(60.5)	286(55.9)	1	
No	101(39.5)	187(44.1)	0.83(0.60-1.14)	0.25
Willingness to pay				
Yes	200(83.9)	397(87.3)	1	
No	29(16.1)	76(12.7)	1.32(0.77-1.47)	0.70

COR= Crude Odd Ratio, CI= Confidence Interval

DISCUSSION

The study was conducted to assess the status of household solid waste management practice and its associated factor in Debre Berhan town. The magnitude of good solid waste management practice in this study was 32.6%. It is contrary to the studies conducted in Bangladesh [8] and Accra [9] that revealed 39% and

61.0% of the households practice good solid waste management. This difference might be due to the living style of the respondents in the study area and also the socio-economic difference that increases the percentage of good solid waste management practice. However, our result was in line with the study conducted in Ambo town and Dire Dawa city of Ethiopia [10,11] in which only 31.56% of the households practice good solid waste management.

Table 9: Bivariate analysis of institutional factors with household solid waste management practice in Debre Berhan town Ethiopia, 2020.

Variables	HH solid waste management practice		COR (95% CI)	P-value
	Good (%)	Poor (%)		
Access to private SW collection service				
Yes	158(74.8)	354(69.0)	1	
No	71(25.2)	119(31.0)	0.75 (0.52-1.06)	0.10
Existence of solid waste related rule and regulation				
Yes	94(39.4)	186(41.0)	1	
No	135(60.6)	286(59.0)	1.07(0.77-1.46)	0.70
Solid waste collection service day time and interval satisfaction				
Yes	80(53.0)	166(40.2)	1	
No	119(47.0)	147(59.8)	0.59(0.83-1.15)	0.26

COR= Crude Odd Ratio, CI= Confidence interval

Table 10: Bivariate and multivariate analysis of associated factors with household solid waste management practice in Debre Berhan town Ethiopia, 2020.

Variables	HH solid waste management practice		COR (95% CI)	AOR (95% CI)
	Good (%)	Poor (%)		
Age of HH head				
<=30	285(60.4)	212(92.6)	1	1
>30	187(39.6)	17(7.4)	8.15 (4.8-13.8)	4.94 (2.60-9.39)**
Educational level				
Literate	323(68.4)	194(85.4)	1	1
Illiterate	149(31.6)	35(14.6)	0.39 (0.26-0.59)	0.55 (0.32-0.92)*
Year of stay in DB				
<=5 years	56(11.9)	62(27.0)	1	1
>5 years	416(87.1)	167(63.0)	2.77(1.87-4.14)	1.68 (0.99-2.83)
Family size				
<=4	294(62.3)	165(72.4)	1	1
>4	178(27.7)	63(27.6)	1.57(1.11-2.21)	1.46 (0.95-2.24)
House ownership				
Rental house	288(61.0)	62(27.0)	1	1
private house	184(39.0)	168(73.0)	0.24(0.17-0.34)	0.45 (0.29-0.70)**
Access to private SW collection service				
Yes	354(74.8)	158(69.0)	1	1
No	119(25.2)	71(31.0)	0.75(0.53-1.06)	0.90 (0.58-1.40)
Attitude				
Good	122(25.8)	171(74.7)	1	1
Poor	351(74.2)	58(25.3)	0.12(0.08-0.17)	0.10 (0.07-0.15)**
Cleanup campaign participation				
Yes	181(25.8)	51(7.3)	1	1
No	292(41.6)	178(25.3)	0.46(0.32-.67)	0.61 (0.39-0.96)**

* Significant at P = <0.05, ** Significant at P = < 0.001, AOR=Adjusted Odd Ratio, COR = Crude Odd Ratio, CI= Confidence interval.

The major reasons behind the improper disposal of solid waste (67.4%) are the lack of door-to-door solid waste collection services and the absence of communal solid waste containers. This is in agreement with the study conducted in other parts of Ethiopia [12,13] and there were also poor awareness and attitude about solid waste management practice which forces the society to give low emphasis to solid waste management practice in the town. The interview from key informant support this idea, one of the 29 years' age female, street sweepers stated that "the community of Debre Berhan town has a negative attitude toward waste collectors and solid waste management. Thus, they simply throw household waste in drainage and roadside".

In this study, illiterate respondents were 45% less likely to practice good solid waste management when compared to those who are literate. This finding is similar to the study conducted in another part of Ethiopia [10,14] which found that the trends of HH head educational level and the practice of waste management at the household level have a positive relationship. When the household educational level improves, the practice of household solid waste management level also improves. On contrary; studies here in Ethiopia showed that educational levels are not as such related to the solid waste management practice of households [15,16]. This difference might be due to the community capacity-building programs and training given through time as scholars better understand the given message.

In the current study, finding households age >30 were 4.9 times more likely to practice good solid waste management when compared HHs with age <30, and households who have not participated in the cleanup campaign were 39% less likely to practice good solid waste management when compared to those participating in the cleanup campaign. This indicates involving the community in health promotion activities might have a positive benefit to increase the community's awareness and practices towards that specific activity. Similar studies support our findings [10]. Likewise, access to private waste collectors showed significant relation with household waste management practice.

A household who live in a private house was 55% and less likely to practice good solid waste management when compared to those who live in a rental house. This indicates that households who manage solid wastes properly were those who were living in a rental house (either kebele or private) than those who are living in a private house. This finding was similar to those from a Ghanaian [17] and might due to those who live in rental HHs have strongly monitored by the house owner [18-28].

Most households 64.1 % in our study used sacks to collect and store their solid waste. Sacks allow for the storage of more wastes for a relatively long period compared to another household solid waste collection receptacles such as plastic containers and polythene bags. In addition, sacks are also relatively cheap compared to plastic containers [29-35]. However, sacks are not suitable for solid waste receptacle storage as they are nonabsorbent, noncombustible, and not watertight. In line with this, properly segregating waste will create a suitable condition to recycle or reuse the waste. However, the survey result showed that households' reusing habit was not yet well improved and an activity to produce compost from organic waste was also absent. Furthermore, even those households who segregated some type of items were not aware of its positive contribution to the solid waste management system. This survey result was supported by information collected from a key informant, one of 22 years old MSSE member who gives solid waste collection service stated that "the household's attitude or view about solid waste collectors and segregation practice were important for their service delivery performance but the households waste segregation practice was poor" [36-45].

Finally, the unhygienic working condition of waste collectors prevents them from serving the whole community of the town, according to some members of MSSE "The municipality did not provide any necessary facilities like transfer container, vehicle, job cloth (waste glove, eyeglass, and waste gown), shoe and others that are very important to deliver the service effectively" [46-50].

CONCLUSION

The current study revealed that the solid waste management practice of households was poor. Age of the household head, Educational status, cleanup campaign participation, Attitude on SWM, and house ownership was found to be significantly associated with household solid waste management practice. Manpower, budget, and facilities such as adequate vehicles were the reasons for the low performance of MSSE.

RECOMMENDATION

The following strategic points should be taken into account to improve the SWM system of the town.

- ❖ The municipality should promote households on solid waste segregation, reuse, and proper disposal through continuous awareness creation campaigns and community-based programs. It has to be demonstrated through exemplary activities on the importance of good solid waste management like composting (using the waste as a resource).

- ❖ There is no sufficient door-to-door waste collection MSSE organized at Debre Berhan town. Therefore, the municipality should be given due attention to organizing jobless youths and women into MSSEs to operate in door-to-door solid waste collection services in the town. For this, a series of discussions should be held with residents to introduce and implement the service.

- ❖ There should be a rule and regulation follow up and the municipality should introduce the 'polluters pay' principle to overcome problems of illegal and deliberate waste dumpers in the town.

- ❖ The city municipality is not in a position to manage the waste completely and properly. The municipality should increase its infrastructure and capacity in terms of vehicles and workforce so that the present 36.2% of solid waste collection service coverage by the municipality can be increased accordingly.

- ❖ Finally, it is also recommended that further research work should be carried out in the study area to assess the performance of MSSE on door-to-door solid waste collection services.

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Authors' Contributions

Genesis Gentie: Conceived and developed the study. Designed the checklist, collected the data analysis, interpretation editing preparing, and writing the manuscript. Mahmud Ahmednur, Gertie Berihun, and Abraham Teym were involved in preparing the research proposal, data analysis and research report, and revision of the manuscript.

Ethical Consideration

Ethical clearance was obtained from the ethical review board institution of Health Science from Debre Berhan University. The authorization letter was written from Debre Berhan town municipality.

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