The Status of Household Solid Waste Management and its Associated Factors in Fiche Town, North Shewa Zone, Ethiopia

Environmental Health Insights
Volume 16: 1–7

DOI: 10.1177/11786302221117007

Samuel Chane Teferi

Department of Biology, Salale University, Fiche, Ethiopia.

ABSTRACT

BACKGROUND: Poor solid waste management is a major public health and environmental concern in developing countries like Ethiopia. This study aimed to assess the status of household solid waste management and associated factors in Fiche town.

METHODS: A community-based cross-sectional study was conducted among 236 residents of Fiche town from January to March 2022. Both questionnaire and field observation was used to collect data from households in the town. Data were first checked manually for completeness, then coded and entered into SPSS version 20, then descriptive statistics such as frequency and percentage were done. Multivariate logistic regression analysis was done to assess the potential predictors of the outcome variable ($P < .05$).

RESULT: In the present study, 185 (78.4%), of residents uses improper solid waste management practices. Multivariable logistic regression analysis revealed that knowledge of reduce, reuse and recycle (3R) (adjusted odds ratio [AOR] = 6.61; 95% confidence interval [CI] 2.94, 14.87), access to door to door waste collection (AOR = 3.91; 95% CI 2.03, 7.51), treating waste as a resource (AOR = 3.06; 95% CI 1.47, 6.36) and knowledge about the rule and regulations of solid waste management (AOR = 6.49; 95% CI 3.09, 13.61) were found to be significantly associated with waste management practices.

CONCLUSION: Therefore, there is a need to raise awareness about solid waste management at the community level using different pieces of training. In addition, the city municipality needs to strengthen door to door waste collection services.

KEYWORDS: Fiche, Ethiopia, solid waste management, public health, waste disposal

RECEIVED: May 19, 2022. **ACCEPTED:** July 13, 2022.

TYPE: Original Research

FUNDING: The author(s) received no financial support for the research, authorship, and/or publication of this article.

DECLARATION OF CONFLICTING INTERESTS: The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

CORRESPONDING AUTHOR: Samuel Chane Teferi, Department of Biology, Salale University, Ethiopia, P.O. Box. 245, Fiche, Ethiopia. Email: samuelchane19@gmail.com

Introduction

Solid waste is any type of waste, neither in water nor liquid form; for example, used plastic bags, broken bags, leftovers, or food scraps.[1] Municipal solid waste includes waste generated by households, commercial waste from shops, hotels, garages, and agriculture, and facilities such as schools, nursing homes, prisons, and public spaces such as streets, bus stops, parks, and gardens.[2] Designing a good solid waste management system requires better knowledge of municipal solid waste composition.[3] According to Damtew and Desta,[4] solid waste management (SWM) means the collection, transportation, recycling, or treatment of solid waste, or the subsequent use of a disposal site that is no longer operational.

Solid waste management system is a global concern which necessitates a sustainable SWM mainly in the developing countries.[5] Globally, the volume of waste is increasing rapidly, even faster than urbanization.[6] In 2012, the world's cities generated 1.3 billion tons of solid waste per year and this amount of waste is expected to reach 2.2 billion tons by 2025.[6] In Ethiopia, the per capita amount of waste generated ranges from 0.28 to 0.83 kg/person/day.[6] Poorly controlled waste has a significant impact on health, the local and global environment, and the economy.[7,8] On a local scale, solid waste attracts disease vectors, and those who live near or work with solid waste have increased disease burdens.[5] In addition, many types of waste such as old computers, tin cans, electronic waste, and old batteries contribute to the production of heavy metals in the soil.[9] Leachate discharged into the surrounding area poses a danger to human health when entering the food chain through plants and animals.[9] Contaminated soil, air, and water are breeding grounds for disease vectors such as flies, rodents, and insect pests.[5] Many diseases such as diarrhea, food poisoning, dengue fever, cholera, dysentery, gastrointestinal problems, worm infection and leptospirosis are caused by biological vectors.[5]

Waste control is a growing public challenge in Ethiopia. Studies such as in different areas of Ethiopia have shown poor waste control practices[10-13] and many factors are associated with residential waste control practices.[14] The main contributing factors are conventional modes of transport, dumping of waste in roadsides, waste disposal in water bodies, irregular waste picking programs, infrastructure constraints, financial constraints, a lack of skilled human resources, and unregulated landfills.[6,9,15] In Ethiopia, authorities found it difficult to deal with strict waste control without the involvement of local communities.[6] There are many initiatives taking place in Ethiopia to improve the environmental health especially in the capital

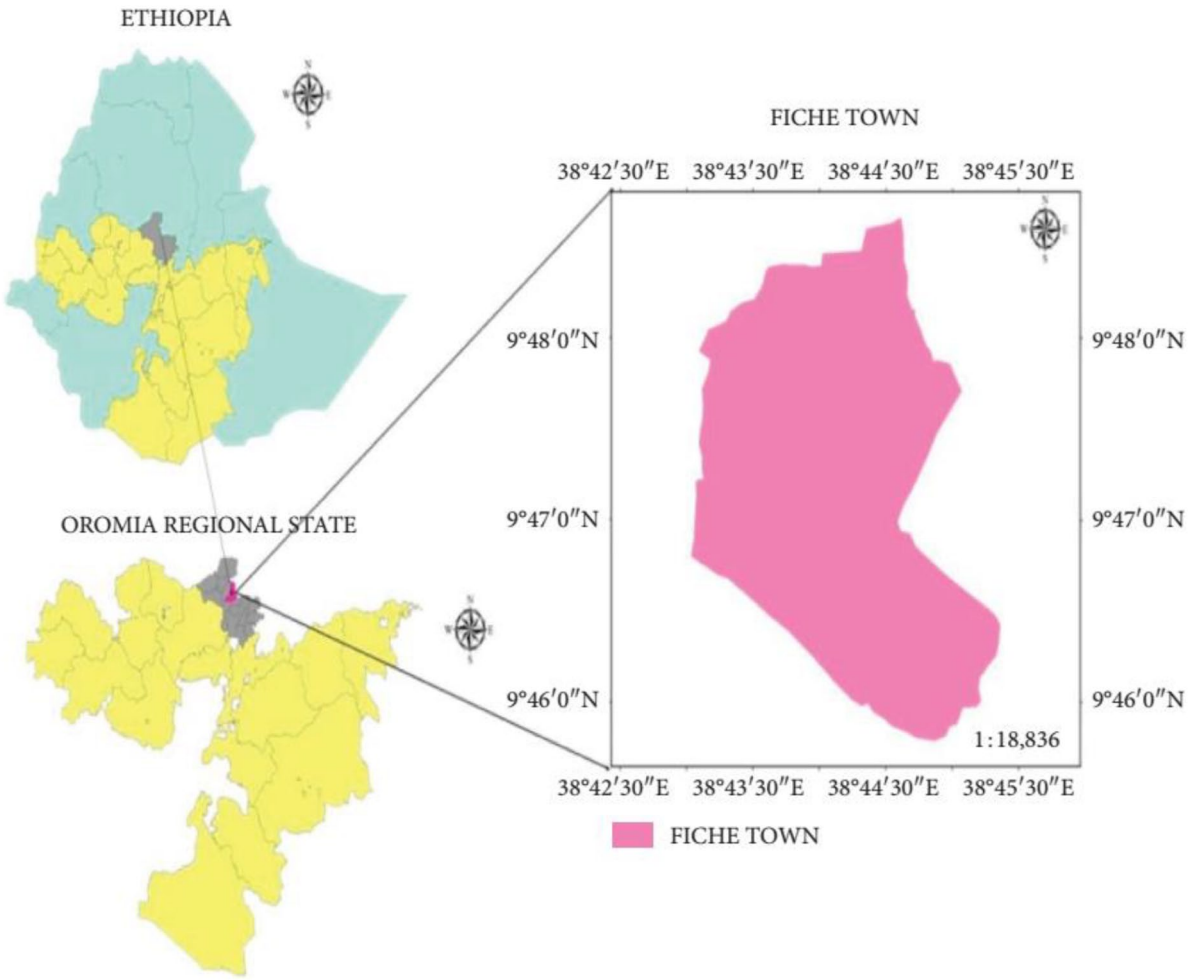

Figure 1. Map of the study area (source Teferi et al[19]).

city. As a result, in Addis Ababa, the capital city, a majority (70%) of residents are willing to pay for door-to-door solid waste collection services.[16]

Population growth, urbanization and expansions of industries in urban center have led to a rapid increase in the quantity and complexity of solid wastes in Ethiopia, particularly the study area.[6,10] Unluckily, this has not been accompanied by an equivalent increase in the capacity of municipality to deal with the problems. Fiche Town is a rapidly growing city in Ethiopia and 71.8% of food and drink establishments in the town involved undesirable practices of disposing of solid waste in open fields.[17] Solid waste management is a challenge to the municipality in terms of preventing the town from environmental pollution and health problems and there is also a limited study on solid waste management practices and its challenges in the town. Hence, this cross-sectional study was proposed to assess the status of household solid waste management and its associated factors in Fiche town. The results of this study can be used as a reference to conduct a similar study at regional level. Moreover, the finding of this study could help stakeholders and policy makers to devise solutions for solid waste management related problems.

Methods

Description of the study area

Fiche is a town in central Ethiopia. It is the administrative center of the North Shewa Zone of the Oromia Region and has 4 *kebeles* (the smallest administrative unit) (Figure 1). The zone is bordered on the south by Addis Ababa on the southwest by West Shewa, on the north by the Amhara Region, and on the southeast by East Shewa. It is located about 114 km north of Addis Ababa, the capital city of Ethiopia. Fiche has a latitude and longitude of 9°48′N and 38° 44′E respectively. Fiche town has an elevation between 2738 and 2782 m above the sea level. According to the 2007 census conducted by the Central Statistical Agency of Ethiopia, the town of Fiche has a population of 27 493.[18]

Study design and study population

From January to March 2022, a community-based cross-sectional study was utilized to investigate the status of solid waste management and associated factors in Fiche town. All households that lived for at least 6 months were used as the source population.

Sample size determination

Current status of household solid waste management practice in Fiche town was calculated by using Cochran.[20] The proportion of households expected to practice proper household solid waste management is $P = .11$ (11%) from previous finding,[21] significance level 5% (=.05), $Z/2 = 1.96$, the margin of error between the population and the sample 5% ($d = 0.05$), multiplying the sample size by 1.5 for design effect, and finally, a 5% non-response rate was considered. As a result, the total sample size was 236.

$$n = (Z\alpha/2)^2 P (1\text{-}P)/d^2$$

$$n = (1.96)^2 \times 0.11 (1\text{-}0.11)/ (0.05)^2 = 150$$

$$150 + 5\% (7.5) = 157.5 \times 1.5 \text{ (design effect)} = 236$$

Data collection techniques

For this investigation, both questionnaire and field observation were used. Quantitative information was gathered from the selected households through a face-to-face interview utilizing structured and standardized questionnaires that included both open-ended and closed-ended questions. The questionnaire was adapted from many sources and tweaked to fit the study area.[10-12,22] The questionnaire was then translated into local languages and then back to English to check for any language inconsistencies. Before the actual data collection, the questionnaire was tested and revised based on the gaps identified during the pretest. The pretest was performed on 5% of households outside the sampling town. The questionnaire's validity and reliability were also examined during pre-testing. The survey asked about socioeconomic and demographic factors, as well as the current state of home solid waste management. Field observation was used to gain a better understanding of the conditions of household solid waste management, disposal site facilities, and transportation systems. Respondents were assessed using 9 practice-related checklists to assess the level of SWM practice. Households scoring 6 points or less (⩽66.7%) were classified as having improper (poor) waste management practices and those scoring above 6 (>77.8%) were classified as having proper (good) waste management practices.[23]

Study variables

Household solid waste management practice was the dependent variable in this study. Gender, age, family size, education level, distance from the main road, willingness to pay for waste collection services, knowledge of solid waste management, availability of alternative disposal sites, and access to waste collectors were the independent variables.

Operational definitions

Poor solid waste management; poor solid waste management practices are considered a failure to properly segregate solid waste and/or dispose of it in an unauthorized location.[10]

Data analysis

First, data were manually checked for completeness, then coded and entered into SPSS version 20 for analysis. Descriptive statistics such as frequencies and percentages were performed. Binary logistic regression was performed to evaluate the potential predictors of the outcome variable. Then, *P*-values less than .25 in binary logistic regression were exported to multivariate analysis to assess the independent effect after controlling other variables.[24] A *P*-value less than .05 is considered to identify variables with statistical significance.

Ethical considerations

The respondents were informed about the purpose of the study, and their oral consent was obtained. The respondents' right to refuse or withdraw from the study is fully maintained and the information provided by each respondent is kept strictly confidential.

Result

All participants completed the questionnaire, giving a response rate of 100%. Of the total study subjects, 96 (40.7%) were male and 140 (59.3%) were female. 46.6% of respondents had completed high school studies. Regarding the age group, most of the respondents 80 (33.9%) were between 34 and 41 years old. In this study, about (62.3%) of the respondents were married, while 12.7% of them were single. In this study, about 44.5% (105/236) of the respondents were government employees and 40 (16.9%) of the respondents were daily laborers (Table 1).

Composition of municipal solid waste in Fiche town

Various types of solid waste are reported to be generated from households included in the study. Accordingly; 288, 196, and 185 households' heads have reported that they generated plastic, food residual and paper wastes, respectively (Figure 2). Only (25.4%) of households segregate solid waste at the source. In this study, 195 (82.6%) households did not implement the reduce and reuse strategy, and 84 (35.6%) households dispose of solid waste on the roads (Figure 3). Solid waste is collected by the municipality once a month from 12 (5.1%) households (Table 2).

Factors associated with solid waste management practices in fiche town

Fifty-one (21.6%) households have good solid waste management practices. All independent variables with *P* values less than .25 in the bivariate analysis were included in the multivariable logistic regression analysis. Multivariable logistic regression analysis revealed knowledge of 3R (adjusted odds ratio [AOR] = 6.61; 95% confidence interval [CI] 2.94, 14.87), access to door to door solid waste collection (AOR = 3.91; 95% CI 2.03, 7.51), knowledge of SWM rules and regulations (AOR = 6.49; 95% CI 3.09, 13.61) and treating waste as a

Table 1. Socio-demographic Characteristics of Respondents.

VARIABLE	FREQUENCY	PERCENT
Age group		
18-25	46	19.5
26-33	70	29.7
34-41	80	33.9
Above 42	40	16.9
Gender		
Female	140	59.3
Male	96	40.7
Educational status		
Unable to read and write	30	12.7
Able to read and write	52	22
Grade 9-12 complete	110	46.6
Diploma	20	8.5
First degree and above	24	10.2
Marital status		
Single	30	12.7
Married	147	62.3
Divorced	34	14.4
Widowed	25	10.6
Occupational status		
Government employee	105	44.5
Merchant	44	18.6
Daily labor	40	16.9
Housewife	33	14
Others	14	6

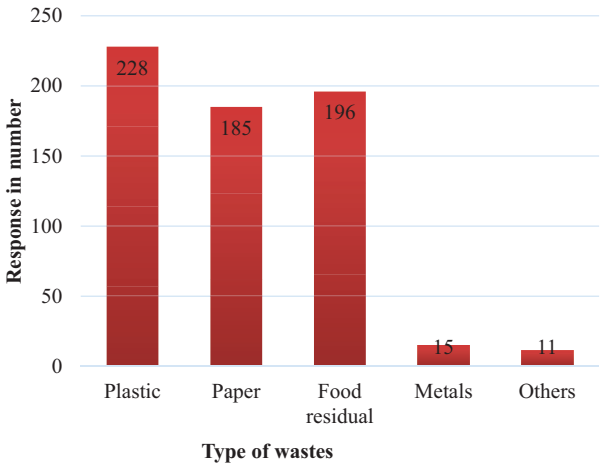

Figure 2. Types of solid waste generated and disposed of by households in Fiche town (Multiple responses).

resource (AOR = 3.06; 95% CI 1.47, 6.36) was found to be significantly associated with waste management practices with a *P*-value < .05 (Table 3).

Discussion

Municipal solid waste management has become a major concern for many developing countries such as Ethiopia. Solid waste management is mainly the responsibility of municipalities, which has resulted in inadequate service delivery in Ethiopia.[25] In many cities in Ethiopia, waste management is poor and only 2% of the population receives solid waste collection, transportation, and disposal services.[25] This study was aimed to assess the status of household solid waste management and its associated factors in Fiche town. In this study, education level, occupation, age, marital status, gender, and length of residence had no relationship with solid waste management practices. The present study is consistent with a study conducted in Ethiopia.[10] In contrast to the current findings, a study conducted in Dire Dawa found that respondents living less than 1 year were 0.5 times less likely to have improper waste management practices than those who have lived there for a year or more.[12]

Various types of solid waste were reported to have been generated by households in this study, such as plastic, food residue, and paper waste which causes a visual nuisance, soil deterioration, blockage of drainages, and contamination of surface water.[14] The present finding is supported by studies conducted in Ethiopia.[10,12] However, a study conducted on Malaysia by Fadhullah et al[5] revealed that 74.3% of households disposed of food debris as waste. In this study, only (25.4%) of households segregated their solid waste at the source. This finding is supported by studies conducted in Assela and Woldia town who reported (27.2%) and (35.2%) of household's separate waste at the source.[10,11] For recycling activity to take place, the waste has to be separated. The failure of sorting waste by type at the source is one of the problems in waste management.[26] This study shows that 78.4% of the city's residents practice poor solid waste management. The high level of inappropriate solid waste management practices is consistent with the results of studies conducted in Assela 82.8%,[10] Uganda 58.7%,[23] Ghana 82 .7%,[22] Gondar 69.7%,[13] and in Nigeria 83.3%.[27] This could be explained by differences in the research context, the development of the study site, and the sociodemographic characteristics of the respondents.

Respondents in this study improperly disposed of solid waste (dumped in the yard (23.7%), burned in their compound (81%), dumped in ditches (22%), and on the road (35.6%)) as most are unaware of proper solid waste management. This study is consistent with a study conducted in Tanzania and Ethiopia, where 62% and 75% of residents, disposed of their waste in an unauthorized location, respectively.[28,29] However, a study conducted in Kenya showed that the majority of respondents (94.2%) were aware of the dangers posed by improper solid waste management practices.[30] In addition, about 95.9%

Figure 3. Waste disposed of in ditches and roadside of Fiche town (Image taken by author).

of the respondents were aware that improper waste management leads to disease; such as diarrhea and malaria in Malaysia.[5] A possible explanation for this could be the lack of awareness on the danger posed by improper solid waste disposal in the Fiche town.

Lack of door to door solid waste collection service by town municipality was found to be the potential risk factor for improper solid waste management practice in Fiche town. The odds of performing solid waste management practice among households who had door to door solid waste collection services were about 4 times more likely to have proper solid waste management practice than their counterparts (AOR = 3.91; 95% CI 2.03, 7.51). In this study, only 5.1% of households have on-site solid waste collection service per month, which is why the city had poor solid waste disposal practices. This result is lower than a study conducted in Addis Ababa (84%) and Assela town (12.7%).[10,31] This difference can be explained by the weak infrastructure of the city, the willingness of households to pay, and the difference in solid waste management regulations. In Addis Ababa, the capital, there is a better transport infrastructure, which is accessible to most households and the service is available to those willing to pay.[16,31]

Households who knew the 3Rs and solid waste management rules and regulations were approximately 7 times more likely to implement appropriate solid waste management measures than their counterparts (AOR = 6.61; 95% CI 2.94, 14.87; AOR = 6.49, 95% CI 3.09, 13.61). In contrast to the present finding, a study conducted in Assela town showed no significant association.[10] In addition, the knowledge of households about solid waste management rules and regulations (16.5%) and 3R practices (17.4%) in the present study was low. The present finding is higher than studies conducted in Assela town (10.7% and 10.4%)[10] and Gondar town (2.43%).[13] In contrast to the present finding a study conducted in Bahir Dar town reported a higher finding (44.7%). This discrepancy in awareness could be due to the involvement of Nongovernmental Organizations such as the Dream Light private limited company in Bahridar town which is mainly involved in awareness

Table 2. Frequency distribution of household's solid waste management practices in Fiche town.

VARIABLE	FREQUENCY	PERCENT
Practicing Reduce, Reuse and Recycle strategy (3R)		
Yes	41	17.4
No	195	82.6
Collection interval of solid waste (SW)		
Once a 2 week	24	10.2
Once a month	12	5.1
For more than a month	150	63.6
No services	50	21.2
Solid waste segregation at your home		
Yes	60	25.4
No	176	74.6
Do you dump SW in the yard?		
Yes	56	23.7
No	180	76.3
Do you dispose of SW on the road?		
Yes	84	35.6
No	152	64.4
Do you burn SW in the compound?		
Yes	191	81
No	45	19
Do you dispose of SW in the ditch?		
Yes	52	22
No	184	78

creation and door to door waste collection services.[32] The absence of a legal framework and weak enforcement of rules and regulations hindered effective solid waste collection, storage, and treatment systems.[23,33] In contrast, according to Al-Khatib et al,[34] only good practice or knowledge of the law does not translate into proper solid waste management practice unless strictly enforced. Finally, households that treated waste as a resource were 3 times more likely to have good solid waste management practices than their counterparts (AOR = 3.06; 95% CI 1.47, 6.36). This finding is supported by a study conducted in Kampala who reported that (59.4%) of households engaged in some form of separation of solid waste.[26] The possible reason might be people in Kampala use their solid waste to produce manure. The composited manure would help in household gardens and reduce the amount of solid waste that goes to the landfill.[26]

Conclusion

The majority (78.4%) of the inhabitants of Fiche town have poor solid waste management practice. Key factors relevant to solid waste management practices are knowledge of the 3Rs, access to door to door solid waste collection, knowledge of SWM rules and regulations, and treating waste as a resource. Therefore, there is a need to raise awareness about solid waste management at the community level using different pieces of training. In addition, the city municipality needs to strengthen door to door waste collection services. The results of this study can be used as a reference to conduct a similar study at regional level. Moreover, the finding of this study could help stakeholders and policy makers to devise solutions for solid waste management related problems.

Table 3. Bivariate and multivariate analysis for factors associated with solid waste management in Fiche town.

VARIABLES	WASTE MANAGEMENT PRACTICE		WALD	SIG.	AOR (95% CI)
	GOOD	POOR			
Knowledge about 3R					
Yes	17	13	20.88	.000*	6.61 (2.94, 14.87)
No	34	172	1		
Access to door to door solid waste collection					
Yes	33	59	16.82	.000*	3.91 (2.03, 7.51)
No	18	126	1		
Knowledge about the rule and regulations of SWM					
Yes	21	18	24.56	.000*	6.49 (3.09, 13.61)
No	30	167	1		
Treating waste as a resource					
Yes	16	24	9.03	.003*	3.06 (1.47, 6.36)
No	35	161	1		

*Statistically significant at $P < .05$.

Recommendations

Based on the findings of the study, the following recommendations were forwarded.

- The municipality should encourage the private sectors to involve or participate in solid waste management of the town.
- There should be a rule and regulation follow up to overcome problems of illegal waste disposal in the town.
- The community should be involved in doing waste separation at source, waste reduction and recycling as a habit and way of life.
- Waste containers should be placed in some parts of the town.
- The municipality in collaboration with Community Based Organizations, Non-Government Organizations and private sector should educate people on simple household compositing systems.

Acknowledgements

The author is grateful to all study participants and data collectors.

Author Contributions

I developed the proposal, analyzed the data and wrote the report and the manuscript. I read and approved the final manuscript.

Availability of Data and Materials

The datasets analyzed during the current study are available from the author upon request.

REFERENCES

1. Wendimagegn A. Determinant of solid-waste management in Debre Birhan Town. *Am J Theor Appl Stat*. 2019;8:26-30.
2. Lohri CR, Rodić L, Zurbrügg C. Feasibility assessment tool for urban anaerobic digestion in developing countries. *J Environ Manag*. 2013;126:122-131.
3. Suresh S, Katiyar R, Sharma A. Characterization of municipal solid waste generated by the city of Bhopal, India. *Int J Chem Tech Res*. 2013;5:623-628.
4. Damtew YT, Desta BN. Micro and small enterprises in solid waste management: Experience of selected cities and towns in Ethiopia: A review. *Pollution*. 2015;1:461-427.
5. Fadhullah W, Imran NIN, Ismail SNS, Jaafar MH, Abdullah H. Household solid waste management practices and perceptions among residents in the east coast of Malaysia. *BMC Public Health*. 2022;22:1.
6. Mulat S, Worku W, Minyihun A. Willingness to pay for improved solid waste management and associated factors among households in Injibara town, Northwest Ethiopia. *BMC Res Notes*. 2019;12:401.
7. Hoornweg D, Freire M. *Building Sustainability in an Urbanizing World: A Partnership Report*. Urban Development & Resilience Unit, World Bank; 2013.
8. Adeleke O, Akinlabi S, Jen TC, Dunmade I. Towards sustainability in municipal solid waste management in South Africa: a survey of challenges and prospects. *Trans R Soc S Afr*. 2021;76:53-66.
9. Okeyode I, Rufai A. Determination of elemental composition of soil samples from some selected dumpsites in Abeokuta, Ogun State, Nigeria, using atomic absorption spectrophotometer. *Int J Basic Appl Sci*. 2011;11:55-70.
10. Lema G, Mesfun MG, Eshete A, Abdeta G. Assessment of status of solid waste management in Asella town, Ethiopia. *BMC Public Health*. 2019;19:1261.
11. Abegaz SB, Molla KA, Ali SE. Practices and challenges of household solid waste management in Woldia Town, northeastern Ethiopia. *J Health Pollut*. 2021;11:210605.
12. Alemayehu DS, Regasa MS, Mengestie B, Alemayehu T. Household solid waste management practice associated factors and service delivery performance of private solid waste collectors in Dire Dawa City, Eastern Ethiopia. *Int J Innov Res Sci Eng Technol*. 2017;10:1-12.
13. Gedefaw M. Assessing the current status of solid waste management of Gondar Town, Ethiopia. *Int J Sci Technol Res*. 2015;4:28-36.
14. Noufal M, Yuanyuan L, Maalla Z, Adipah S. Determinants of household solid waste generation and composition in Homs city, Syria. *J Environ Public Health*. 2020;2020:1-15.
15. UNESC. Africa review report on waste management. Committee on Food Security and Sustainable Development Regional Implementation Meeting for CSD 18, Sixth Session; October 27-30, 2009; Addis Ababa, Ethiopia.
16. Dika G, Nemie A, Birhane E. Household's willingness to pay for improved solid waste management in Gulelle sub City, Addis Ababa. *Energy Environ Eng*. 2019;6:1-7.
17. Chane S, Sebsibe I, Adibaru B. Determinants of sanitation and hygiene status among food and drink establishments in fiche town, Oromia, Ethiopia. *J Water Sanit Hyg Dev*. 2022;12:454-462.
18. CSA. *The 2007 Population and Housing Census of Ethiopia*. United Nations Population Fund (UNFPA); 2007.
19. Teferi SC, Sebsibe I, Adibaru B. Food safety practices and associated factors among food handlers of Fiche Town, North Shewa Zone, Ethiopia. *J Environ Public Health*. 2021;2021:1-7.
20. Cochran WG. *Sampling Techniques*. 3rd ed. Wiley; 1977.
21. Haile A. *Determinants of Effective Household Solid Waste Management Practices: The Case of Ambo Town – West Showa Zone*. Thesis submitted to Mekelle University; 2011.
22. Yoada RM, Chirawurah D, Adongo PB. Domestic waste disposal practice and perceptions of private sector waste management in urban Accra. *BMC Public Health*. 2014;14:697.
23. Ssemugabo C, Wafula ST, Lubega GB, et al. Status of household solid waste management and associated factors in a slum community in Kampala, Uganda. *J Environ Public Health*. 2020;2020:1-10.
24. Dun-Dery EJ, Laar AK. Exclusive breastfeeding among city-dwelling professional working mothers in Ghana. *Int Breastfeed J*. 2016;11:23.
25. Kassa Z. *The Challenges of Solid Waste Management in Urban Areas, the Case of Debre Markos Town, Ethiopia*. Addis Ababa University; 2010.
26. Banga M. Household knowledge, attitudes and practices in solid waste segregation and recycling: the case of urban Kampala. *Zambia Soc Sci*. 2011;2:27-39.
27. Adogu POU, Uwakwe KA, Egenti NB, Okwuoha AP, Nkwocha IB. Assessment of waste management practices among residents of Owerri municipal Imo state Nigeria. *J Environ Prot*. 2015;6:446-456.
28. Kasala SE. Critical analysis of the challenges of solid waste management initiatives in Keko Machungwa informal settlement, Dar Es Salaam. *J Environ Prot*. 2014;5:1064-1074.
29. Tyagi V, Fantaw S, Sharma HR. Municipal solid waste management in Debre Berhan City of Ethiopia. *J Environ Earth Sci*. 2014;4:98-103.
30. Mukui S. Factors influencing household solid waste management in urban Nyeri municipality. *Ethiop J Environ Stud Manage*. 2013;6.
31. Regassa N, Sundaraa RD, Seboka BB. Challenges and opportunities in municipal solid waste management: the case of Addis Ababa City, Central Ethiopia. *J Hum Ecol*. 2011;33:179-190.
32. Koyachew EK. The problem of solid waste management and people awareness on appropriate solid waste disposal in Bahir Dar City: Amhara region, Ethiopia. *ISABB J Health Environ Sci*. 2016;3:1-8.
33. Mamady K. Factors influencing attitude, safety behavior, and knowledge regarding household waste management in Guinea: a cross-sectional study. *J Environ Public Health*. 2016;2016:1-9.
34. Al-Khatib IA, Kontogianni S, Abu Nabaa H, Alshami N, Al-Sari MI. Public perception of hazardousness caused by current trends of municipal solid waste management. *Waste Manag*. 2015;36:323-330.