

Strategic Factor Analysis of Solid Waste Management in South Western Ethiopia: The Case of Jimma Metropolitan City

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Research Article

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ABSTRACT

Background: Solid waste management is a cosmopolitan environmental problem confronting humanities and metropolitan authorities by contributing 80% of all diseases and related mortality. With mean annual growth of 5.54%, Ethiopia is fostering a highest urban population growth rate in Africa. In contrast, there is low commitment in managing urban environmental issues. Consequently, Solid waste disposal is an important environmental and area of concern since information is barely available in the study area.

Objective: To measure solid waste management by using IFAS-EFAS-SFAS matrix, and explore how the system is organized

Method: descriptive cross-sectional surveys were conducted at household level where respondents were selected by using multistage-mixed sampling technique. Then IFAS-EFAS-SFAS analytical tool and interview schedule was employed to take data on advantage of existing opportunities and menaces towards minimizing weaknesses and threats.

Result: IFAS-EFAS-SFAS matrix showed strength and weaknesses of 1.16 and -1.42, respectively; with a difference of -0.26. Similarly, summary of opportunity and threats was 1.33 and 1.35 respectively; with a difference of -0.2. The overall result indicated; solid waste management was at inferior efficiency. Congruently, females were more committed to dispose of solid wastes than their counterparts at 10% significant level. Households with large number of female households were also better off in managing solid wastes. Regardless of economic status, better educational entitlement facilitated willingness to pay. Distance from main road brought significant effect on solid waste management. Private collectors didn't have adequate

facilities to serve each household; and therefore, households at distant location to waste collecting bins were disposing their wastes in illegal sites.

Conclusion and Recommendation: Participatory institutional support should be in place to ensure sustainable solid waste management. Similarly, further decentralization should be in place to empower local administrations since households were willing to pay if they got services, and community-based organizations should take part in service deliveries. Environmental NGOs should also play role in solving waste management issues by capping landfills and capacitating pre-collectors.

INTRODUCTION

Solid waste disposal is one of the major environmental problems confronting humanities and municipal authorities. It is an important challenge and area of concern in the era of increasing population and rapid urbanization. The problem is often magnified in cities where dense concentration of people is generating substantial amount of solid wastes; causing a heap of 1.3 billion tons of solid waste, and resulting in to annual cost of 205.4 billion USD. Inappropriate dumping in illegal sites has aggravated spread of anthropogenic diseases and in turn has accounted for 80% of all diseases and related mortality [1-3].

According to UNEP (2016), poor urban waste management accounted to five percent of total global greenhouse gas emissions and 12 percent of world's methane emissions (i.e. greenhouse gas that is affecting more than 20 times than that of carbon dioxide). Thus, solid waste management is a global problem demanding full and continuing coordination between different stakeholders of scientists, economists, technicians, politicians, private organizations and citizens. Events of 21st century indicated wastes have become a major consequence of modernization and economic development. However, in the quest for 'Western-styled' development, developing countries didn't budget enough for managing solid wastes. As a result, cities are suffering from solid wastes, inadequate water supply, sanitation and air pollution. The problems have disproportionately affected the urban poor than rural ones [4-8].

Rate of urbanization in Africa, which is estimated at 3.5% per annum, is highest compared to developed and developing nations who exhibited average urban population growth of 0.5 and 2.6 percent, respectively. In spite of this rapid urban growth, there seems to be a mismatch in managing urban environmental issues. This is also true in Ethiopia, where influx of people is moving to urban centres with a projected urban growth rate of 4.79%. This growth is the highest amongst most developing countries. Hence, solid waste management in Ethiopia is getting better attention in last few years. Nevertheless, the efforts, environmental and public health challenges are increasing [9,10].

Despite the challenges, there was limited information that describes the actual practice of solid wastes handling in the study areas. Similarly, technical knowhow, financial capacity, culture, and understanding of community are not well studied to forward preventive measure and remedial actions on solid wastes. Therefore, this research is conducted to fill the gap on households' solid waste disposal alternatives, and context specific factors of the study area.

Reliable waste management data provides an all-inclusive resource for comprehensive, critical and informative evaluation of waste management options in all waste management programs. Data on municipal solid waste generation and composition are available in few selected cities, most of which are over a decade old. Solid waste is not well managed since people dispose garbage wherever possible and this led to huge environmental pollution deteriorating the health of humankind and other living beings.

Due to lack of knowledge of disposing wastages, people trash the garbage in a way they want. The information on amount of waste collected and segregated by the informal waste workers has not been shared to the public, and nor the government has its record. As a result, they are mistreated and their role is undermined despite the fact that they are actually cleaning Jimma city. Despite increasing population and rate of urbanization, technology, technical knowhow, financial capacity, culture and understanding of the community are not well identified. With more and more people moving to Jimma city, the waste management sector is suffering from dearth of information. As Awetu River is running through Jimma and its skirts, there is temptation to use water bodies as quick and easy waste removal solution. However, their consequence is not well identified. Despite immensity of the problem, very little research has been carried out on subject in Jimma City.

MATERIALS AND METHODS

Jimma is one of the oldest modern cities in south-western Ethiopia, which is recently recovering from its deep sleep. As the city is experiencing rapid urbanization, waste generation is flustering to leave piles of solid wastes along roads, drainage channels and open spaces. Yet, the amount, type and composition of generated waste were unknown. Therefore, characterization of waste stream and its generation rate per capita is not well known.

Accordingly, this research is intended to fill current literature gap on solid waste management in Jimma city.

Jimma city is one of the special zones of Oromia Regional States, which is surrounded by Jimma Zone. The city has 17 Kebele Administrations with population size of 205,163. Among this total population, 49.72% are female and the rest are male. The average number of persons per household in Jimma city was 4.8 person/HH (JZHD, 2018). With an area of 50.52 square kilometers, Jimma city is geographically located with latitude and longitude of 7° 40'N and 36° 50'E. During 19th century, the city owed its importance in as a caravan route between Shewa and Kingdom of Kaffa, and Jimma.

Multistage-mixed sampling technique was employed to select sample respondents from the total population. But, at first stage, purposive sampling is employed to select Jimma City, since Jimma is one of the largest cities in south-western Ethiopia. Then by using simple random sampling, four Kebele Administrations: namely 'Bosa Kito' and 'Hirmata' are selected from Woreda 1; and Mentina', and 'Mendara Kochi' were selected from Woreda 2, respectively. Subsequently, by using Cochran sample size determination formula, the sample size is resolved with 90 percent confidence level.

A preliminary survey was first conducted before exploratory survey to develop a workable hypothesis. For this, three focus group discussions were held with 19 group members. Similarly, 18 key informants were interviewed by using open-ended checklists; and these were composed of two municipality officials; three Kebele administrations, five pre-collectors, three pre-collecting crewmembers, three korealwes and 2 Luwachs.

Then a semi-structured interview schedule is prepared to obtain information from selected households. But, before the formal survey, pre-testing was made to ascertain reaction of respondents and to revise lists of important issues that had not been left out. The pre-testing has also given opportunity for certain pertinent issues, which would have

been missed in draft interview schedule. Then, the interview schedule was modified accordingly to serve the purpose.

Data were collected from FGD participants by using questionnaires; and then analysis is done through qualitative approach to diagnose strengths, weaknesses, opportunities and threats on solid waste management. Subsequently six important items were abstracted for each section i.e. strength, weaknesses, opportunity and threats for IFAS-EFAS matrix through pairwise ranking.

Statistical Package for Social Sciences (SPSS) Version 20 was used to determine Chi-square, t-test and Pearson correlation to test respondents' level of awareness, knowledge and practices on solid waste management. Descriptive statistics of frequency, percentage, mean and standard deviation. The data were processed into statistical tables and charts for interpretation and discussion. Data analyse were disaggregated into various classes of residential areas in the Metropolis. Statistical analysis of relationship between waste generation rate, household income, waste generation and household size were performed using regression analysis.

IFAS-EFAS-SFAS analytical matrix is adopted to disclose preliminary decision of maximizing strengths and opportunities; to minimize threats and to turn weaknesses into strength towards taking advantage of existing opportunities and minimizing weaknesses and threats.

IFAS-EFAS-SFAS matrix represents table with appropriate factors (external or internal) which will be listed in first column; and other columns will contain weights assigned to factors (ranging from zero to 1; where sum of all weights should equal to one). Similarly, rating of each factor will be assigned basing on efficiency of solid waste management response. For each factor, weighted score is calculated by multiplying rate by weight. Sum of all weighted scores represented value showing how well solid management is operating in its internal or external environment. This value will range from one to three, with 3 being very important, and 1 and 2 were important and 2=important, respectively (Figure 1).

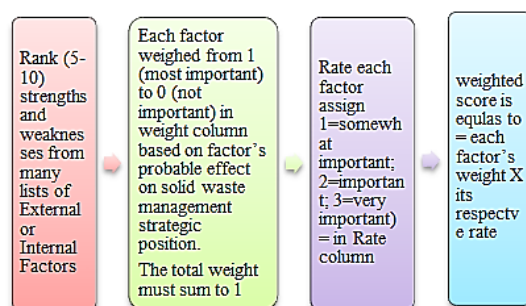


Figure 1: Summary of Steps in analysis of IFAS-EFAS evaluation.

RESULTS AND DISCUSSION

Demographic analysis which was concerned with family size, age, sex composition and education exhibited the following different responses accordingly.

Households age, which was a continuous variable measured in years, affected solid waste management significantly at 5 percent (Mean= 48.73 SD of 12.94). Similarly, the difference in household age was statistically significant at 5 percent (t=8.56, p=0.031). The larger households' standard deviation indicated that, the values in the data set were farther from the mean by +12.9 years of age; and the data set were not well concentrated around the mean i.e. 48.73 Years. As proxy measure of experience, older household heads (beyond 48 years of age) showed better awareness on waste management than older ones.

A dependency ratio of 129.9 is reported where 100 economically active household groups supported 129 dependent households. The result indicated that, large proportion households were dependent on family labour to dispose of wastes. This implied that, the reality can create a wide opportunity of creating revenue generation for jobless youths from the sector. The result was in line to Bartone (2000) and Kebede (2004) who reported most older households showed better attention for environment than the literate youngsters since they consider solid waste management is not the sole responsibility of municipalities, but it should be shared by the community and community based organizations at large.

Females were committed to clean their houses and dispose of solid wastes than their counterparts do (26.8%). This result was well supported by chi-square outcome, which showed female-headed households were more involved in solid waste management practices at 10% significant level. Similarly, households with large number of female households were better off in Managing Solid Wastes. The association between solid waste management practices and sex was positive and significant ($r = 0.149$, $p < 0.05$).

This result agrees with Cleaver (1993) and Pokhrel and Viraraghavan (2005) who lamented female residents showed positive concern for solid waste management practices than their counterparts. This was plausible because most female households in developing countries perform cleaning and sweeping by themselves. Correspondingly, females were customarily considered as part of the household for such household activities than their counterparts were.

About 7.56 percent of households were illiterate leaving the rest to literates, who were composed of 25.82%; 36.97 and 26.65 percent with elementary, high school and tertiary school education entitlements, respectively. Correspondingly, positive and strong relationship of educational privilege had supported solid wastes management at household level.

This result was in accordance with Solomon (2011) who stated education had significantly and positively affected quantity of milk marketed in Ethiopia. Cleaver (1993) also asserted educated households were more productive than uneducated ones, and educational status of farmers was positively related to their demand for new technologies. They also pointed-out literate households tends to pay better for waste disposal better than their counterparts do.

With an average family size of 5.5, majority of sample respondents (79.02%) had less than the average family size of the study area. However, this average family size was higher than the National average; which is five. The result implied, better availability of active labour force. However, this opportunity didn't help much since households were managing solid wastes in defectively manner when compared to households of smaller family size (4.38) who were dwelling best.

The result was in line to who reported households with large family size paid more than others for solid waste management, as the former generated more solid wastes. The study by Wolday (1994) also showed household size had significant positive effect on quantity of waste generated.

The study indicated 25.12% of respondents had better income (>1700 Eth. Birr/month i.e. 1.97 USD /day), while 42.12 of respondents reported as they often collect a monthly income between 851 to 1700 Eth. Birr r (i.e. 1 to 1.97 USD per day). However, 32.76% of respondents were collecting a monthly income of <850 Br, which was less than one USD per day. Hence, the meagre monthly income of households deterred their willingness to pay for SWM delivery services.

However, the amount of money that beneficiaries paid for the services differed at large. Similarly, all households were price takers who were getting a door-to-door waste collection service with a flat fee price of 10 to 20 birr/

polyethylene bag/service. However, 76.4% of households didn't have bargaining power and 12.2% of households of them were willing but unable to pay for the services due to their lowest monthly income. But 11.4% of households refrained to pay for any waste collection services since they assumed waste collection is the sole responsibility of local administration.

Despite increasing solid waste generation, Jimma municipality collected 19.19% of generated waste; which is below the national average (21.6%). Yet, the rest 17.23; 13.24 and 9.52% solid waste were casted off at open spaces, nearby collecting bins, and by roadsides, respectively. Similarly, open burning wastes was also one of the disposal systems for 5 percent of households. In addition, 6.27% of households dumped solid waste by riversides.

About 80.81% of respondents claimed that the city's solid waste was not properly managed by the municipality. Hence, they argue efficiency of solid waste management by is so weak compared to the National Average, which is 21.6 percent. As a result, it was common to see piles of wastes, smelly gutters, polluted streams, and choked gutters stink. This implied that there was a growing concern on impact of public health and the environment (Figure 2).

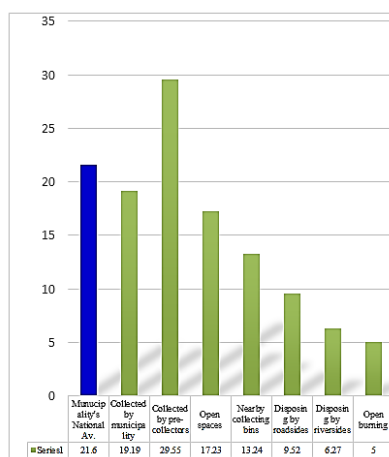


Figure 2: Waste collection by participants and disposal site

The analysis showed 92% of respondents have agreed that, clean and healthy environment is vital for life. This indicated they have better knowledge to safe and clean environment. However, 74.99 % of respondents of respondents were not interested to participate in SWM training. This was because, 35% of them thought their educational background that they already have is better to understand about the subject matter, and 15% of respondents reported, they don't have time to participate. Similarly, 12% of respondent were unwilling to participate in training due to language barrier and the rest reported; they are not totally interested to take part in such training 38%.

Exchanging and selling of old clothing, fabric scraps and electronics were familiar source reduction activities where 4.03% of used materials were donated for the neediest. Similarly, 28.29% of respondents had reused durable containers like bottles, boxes and bags. About 22.13% 'Luwachs' were important source reductionists since they bartered clothing and shoes with new household utensils. Similarly, using papers for soft tissue were popular reusing method for 20.12% of households. Similarly papers and plastics were used as igniting material to catch fire by 13.67% of respondents. Likewise, selling of casted-off materials for 'Koralews' was also accustomed by 10.76 % of households.

This result agrees with Gaurav (2014) and USEPA (2009) who reported segregation at source is completely missing. Similarly, and Sufian and Bala (2007) reported special care for site selection, refuse compaction, cover application, leachate collection and treatment, and site monitoring were prerequisites at ultimate waste disposal sites.

3.2.5. Valorization Chain of Households' solid waste management in Jimma

About 74.7% of households responded, they never tried to collect garbage scattered anywhere in the town, because 45.28% of them thought that was the responsibility of SWM service, while 29.92 and 34.10% of respondents said they were not aware of the problem and by the time they saw the garbage, they may not get sufficient material to collect the garbage.

CONCLUSION

Solid waste management is a serious agenda and a major cause for environmental. The result also supported that, inadequate collection, storage and uncontrolled disposal of solid wastes in open dumps and unauthorized sites have created serious problems. From demographic variables, educated household heads were better in solid waste management than illiterates, indicating that education supported to raise level of understanding. Likewise, female-headed households were better in solid waste management than their counterparts were, since they were customarily left for females. Among socio-cultural factors, distance of residential house from main road have brought significant effect since the municipality did not assign sufficient waste container in different parts of the city and private waste collectors didn't have adequate facilities to serve households equally. Hence, households who are living far from the centre were wrongly encouraged to dispose their wastes in unauthorized sites.

In relation increasing population size in the city, limited facilities of its municipality of container, vehicle service, waste gown, glove and carts, illegal dumping was highly practiced in the study area. Due to limited awareness, solid waste was simply disposed of giving lower chance for waste reduction.

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