Segregation of Solid Waste at Household Level in Addis Ababa City

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Abstract— *Source separation in addition to central sorting techniques has been the bedrock of successful materials recovery and recycling programmes in developed countries. The process goes along with an initial increase in the cost of solid waste storage, collection and subsequent transportation. The present status, the existing challenges and the opportunities of solid waste segregation at household level in Addis Ababa city was initial point of views of the study. The research design (mixed methods) that is qualitative and quantitative designs this is because of the need to obtain a variety of information on the same issue, to use the strength of each method to overcome the deficiencies that could come from using one design and to achieve a higher degree of validity and reliability Data were collected from two main sources, primary and secondary. The sample size estimation is calculated here is how the math works assuming a 95% confidence level, .5 standard deviation and a margin of error of +/-5% Therefore, $S= (1.96)^2 * 0.5(1-0.5)/ (0.05)^2 = 384$. Data analysis and processing were on-going and statistical analysis were done SPSS version 16, frequencies of the emerging issues are then established and this were presented in a tabular or graphic form like pie-chats, bar graph and frequencies and percentages were generated. That means segregation at house hold level don't depend on demographic characteristics of the house hold Rather it have significant relation with awareness, willingness, space and material availability. Most of sample respondents (71.1%) have no awareness about segregation of solid waste, 28.9% are aware about solid waste segregation almost this amount of respondents are willing to segregate, whereas solid waste segregation is now being 4.9%, which is very minimal, this is mainly as a result of lack of awareness, The other obstacle for the success of solid waste segregation are lack of space, lack of material and others (all of them). This result shows that lack of awareness is the major problem of segregation to the sampled households in the contrary the result showed that their opportunities to segregation like that of willingness of respondents to segregate, ability of material to recycle, presence of SME, presence of recycling factories, presence of organizational structure. Awareness creation to SME, public organizers (hizb aderegaget), religious organizations, educational organizations, stakeholders and waste pickers (quralews) and practice in householdsto improve solid waste segregation at the sources.*

Keywords— *Segregation, public, MSE, household, pickers, awareness.*

I. INTRODUCTION

In most developing countries urbanization is increasing in alarming rate. Especially in sub-Saharan Africa including Ethiopia there is high rate of urbanization. This high number of population due to urbanization leads to cities and towns in to different urban related problems. Environmental problems are one of the main problems that came due to urbanization and booming population number. Solid waste is the main environmental problem which needs greater effort to solve the associated problems. Management of solid waste is the main challenge for urban managers since the amount and type of solid waste is increasing continuously due to high population rate.

Municipal Solid Waste Management (MSWM) is considered to be one of the most immediate and serious problems confronting urban government in most developing and transitional economies [11]. Developing countries' main MSWM system has been collection, transportation and eventual disposal of co-mingled Municipal Solid Waste (MSW) unto uncontrolled and semi structured dumpsites. "The system has often been characterized by inadequate service coverage, operational inefficiencies of services,

limited utilization of recycling activities, inadequate management of non-industrial hazardous waste and inadequate landfill disposal" [17]. Such management practice has always come along with adverse public health effects and financial burdens. Environmental sanitation related diseases such as malaria, diarrhea, intestinal worms and acute upper respiratory tract infections are major health problems in the city [1]. The system is neither environmentally friendly nor economically viable. The system has become more challenging in recent times with rapid population growth, urbanization, competing needs and diminishing availability of disposal sites especially in urban centers of countries with developing economies.

The existing MSWM situation and associated adverse impacts can be solved by implementing and establishing a sustainable and integrated solid waste management option where all types of municipal solid waste and all facets of the waste management process are considered together [15] they tried to advice for acceptance and implementation in countries with developing economies, a sustainable and integrated solid waste management (SISWM) system that requires, the collection of solid waste composition data; progress from uncontrolled dumping to the use of sanitary landfill; separation of organic waste from MSW, which can then be

composted; and formal involvement of scavengers in the recycling of materials. A step toward the acceptance of such a sustainable and integrated system has already in construction in Ethiopia with the introduction of engineered landfills in Addis Ababa city.

A bigger technical picture of SISWM whereby waste minimization; source separation; hygienic storage, efficient collection and transportation, composting, recycling, incineration and sanitary landfill disposal would complement each other in an economically viable, socially acceptable, and environmentally friendly manner however still remains evasive[8].

The necessity of reducing the level of emission and the cost of managing open landfill in Addis Ababa and other countries with developing economies calls for a comprehensive review of the state and category of solid waste that ends up in them. Currently, mixed (co-mingled) MSW with approximately Organic 60%, Recyclables 15%, Others 25% specifically Vegetable 4.2%, Paper 2.5%, rubber/plastic 2.9%, Wood 2.3%, Bone 1.1%, Textiles 2.4%, Metals 0.9%,Glass 0.5%, combustible leaves 15.1%, Non-combustible stone 2.5%, All fine 65% [10]. In Ghana, the mixed nature of the waste, with plastics, metals, and raw faecal matter, especially in low income areas have been identified as a major problem of the plant [3].The fate will be the same if construct composting plant here in Addis Ababa.

Segregation of solid waste at house hold level into various components is an important in achieving a sustainable and integrated solid waste management system in Addis Ababa. Such a system associated with three pillars (economic, social and environmental) of sustainable development. It encompasses stakeholders, elements, and aspects and seeks to manage all three components in a sustainable manner [4]. To achieve system sustainability, all required aspects, such as financial, social, institutional, political, legal, and environmental that assesses the feasibility of the management needs to be addressed in a sustainable way.

In relation to, the study efforts to find the related literature were retrieved. However, as already mentioned, may not Addis Abba be unique from other urban areas because of this ; this study was carried out to explore the problems of source separation at house hold level and also to find alternative solutions.To assess the practice of solid waste segregation at the house hold level. The study were conducted to improve the status of waste segregation in Addis Ababa at the household level in waste minimizing and to change waste as a source of economy. It may give some guide line information to policy makers, to cleansing management agency and to other organizations works on integrated solid waste management in Addis Ababa. It may also important in setting base line information to the researcher who would like to conduct further research.

II. METHODOLOGY AND MATERIAL

2.1. Description of the Study Area

Geographically Located, Addis Ababa is located between 8055'and 90 0 5'N Latitude and 380 40' and 38050' E Longitude. The city is located at the center of Ethiopia with an area of 540 km2 of which 18.174 m2 is rural and its altitude ranges from AACA, 1998.

Fig. 1. City map of Addis Ababa (Source: ORAAMP).

Area:-Addis Ababa is a seat both for Federal Democratic Republic of Ethiopia (FDRE) and Oromiya National Regional State Government. It is bordered with Oromiya National Regional State in all directions. There are 10 sub-cities (Kifleketema) and about 113 Kebeles AACA, 1998.
Administratively, the city is a chartered city having three layers of government: city government, sub-city administrations, and district (*Woreda*) administrations. The total area of the city is about 527 km2 CSA, 2010.
*Major Economic Activities:-*The day to day life activities of the city's population is predominantly based on different kind of occupation. These include, 119,197 in trade and commerce; 113,977 in manufacturing and industry;80,391 home makers of different variety; 71,186 in civil administration; 50,538 in transport and communication; 42,514 in education, health and social services; 32,685 in hotel and catering services; and 16,602 in agriculture. Besides the residents of rural parts of Addis Ababa, the city dwellers also participate in animal husbandry and cultivation of gardens. Currently 677 hectares of land is irrigated annually, on which 129,880 quintals of vegetables are cultivated. About 65% of industries of the country are located in the city [13]. The city accounts for one-fifth of the urban GDP in the country [2].
*Topography and Climate:-*Addis Ababa lies between 2,200 and 2,500 meters above sea level. The city lies at the foot of the 3,000 meters high Entoto Mountains. The period of heavy rain (kiremt) is from June to September and accounts for 80% of the annual rainfall MAA, 2002, while the small rain (Belg) occurs between March and May. The dry period (Bega) is between October and January. The temperature is mild Afro

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alpine temperature and warm temperate climate with annual average temperature between 100c to 200c and average annual rainfall is 1200 mm.

2.2. Research Design

The study was conducted in Addis Ababa city a comprehensive survey of the segregation of solid waste at the household level. Descriptive study design was used in this study. The practice of solid waste segregation was interpreted at the present situation based on the response of the respondents. Both qualitative and quantitative data were used in this study.

2.3. Sample Size Estimation and Selection Criteria

The sample size estimation is calculated as:-According to Scot Smith, The sample size estimation is calculated as:- S= (Z- score)^2*St. Dev* (1- St.Dev)/ (Margin of error)^2, Here is how the math works assuming a 95% confidence level, .5 standard deviation and a margin of error of +/-5%. Therefore,

$$S= (1.96)^2 * 0.5(1-0.5)/ (0.05)^2 = 384$$

The total sample size is 384 households.

Selection criteria:-Initially, based on lottery method 10subcities of Addis Ababa are assigned as low, medium and high generations of solid waste then 4 sub cities are assigned as high, 3 sub cities are assigned as medium and the rest 3 subcities are assigned as low based on generation of solid waste. Secondly, based on cluster sampling method the woredas from each sub cities are classified as high, low and medium based on the generation of solid waste, from each high categorized sub cities 1 totally 4 high solid waste generated woredas were selected, from each medium categorized sub cities 1 totally 3 medium solid waste generated woredas were selected and from each low solid waste generated sub cities 1 totally 3 low solid waste generated woredas were selected. Thirdly, using Probability Proportional to Size (PPS) technique the sampled households were allocated to each woredasbased on their population size. Finally to select the households in this woreda simple random sampling method were applied. By using purposive selected sampling technique 30 stakeholders were interviewed and interviews were applied with 20 cleansing SME.

2.4. Methods of Data collection

Both qualitative and quantitative techniques were used for data analysis. Quantitative methods Include; percentages, means, graphical and tabular analysis, maps, ratios, rates, frequency Distribution and chi square. Qualitative techniques were involving descriptions of the study and this helps the study group to go beyond conceptions and generate and revise frameworks. This approach helps the study group to generate quality information that gives meaning to numbers.

2.5. Tools to be used in the Research

2.5.1 The interview guide

The study groups were conducted personal interviews and at same time using observation method where the occurrence of the social events or phenomenon were recorded. While interviewing, the researcher were guided by both structured and unstructured questionnaires which will work as interview guide.

2.5.2. Questionnaires

The questionnaire were comprise of sections like; the demography were the respondent's status, income level, type of house-rental or owned among others were asked, and also consist of questions both open and closed in which if answered well, were exhausted the research objectives and question However, the semi-literate respondents, the questions were translated in to Amharic languages.

2.5.3. Secondary data

The researcher got information from the study of documents about waste management; these documents includes the publications, annual reports of the city administration of Addis Ababa cleansing management agency, periodicals, journals, and other literature written by different knowledgeable scholar. This data helped the study group with the starting point for additional research.

2.6. Data Analysis and Interpretation

It was noted that, data obtained from the field in raw form is difficult to interpret. The initial data collected were subjected to quality checks, to ensure that the recordings were correctly done with minimal errors. This was entail editing, repeating interviews where necessary, coding, summarizing, categorizing and grouping similar information, analyzing according to the theme of the study. It is important to note quotations and observations made during the interviews and their sources or the name of the interviewee. All the questionnaires must be analyzed whether completed or not.

Data analysis and processing were on-going and statistical analysis were done SPSS version 16, frequencies of the emerging issues are then established and this were presented in a tabular or graphic form like pie-chats, bar graph and frequencies and percentages were generated.

Cares were taken to avoid discarding any data, as this could be reverted to in later analysis. Relevant quotations were ear-marked. Analysis were done by using SPSS software, identifying areas of emphasis according to themes and the responses summarized in a narrative form as a presentation of the major findings of the study.

At the end of it all, it is from the results of analysis that the study groupwere able to make sense of the data and gave interpretation and discussion of the data obtained in relation to phenomenon.

III. RESULT AND DISCUSSION

The study result presents the data found from 384 numbers of household respondents, 30 numbers of professionals from different disciplines and 20 SME. From these questionnaires the response rate was 100%. The finding of this study was discussed with the comparison of similar study conducted in different countries.

In the First Section, the data regarding the documentation of the socio-economic characteristics of household sampled at the household level to the Addis Ababa City were presented and discussed. In the subsequent Sections, The present status of segregation of solid waste presented in third part, the existing challenge of segregation. Fourthly, presenting the

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possible opportunity of segregation of solid wastes at the household level. Fifthly the relationship between segregation of solid waste and determinant factors are presented and then finally lesson learned from other countries were discussed.

3.1. Socio Economic and Demographic Characteristics of Sample Households

*Gender:-*According to this studies as listed in table I, about 33.6 % of the sampled households were males and 66.4 % females.

*Age:-*The majority of the sampled households are belonged the age group of 31-45 and also about 26.6 % are between the age group of 18-30 the rest 31.6% were above 45 years(Table I). So, the overwhelming majority, about 41.9 % can be considered as adult age group, this study shows that almost 91% of the sampled households are found in working age category.
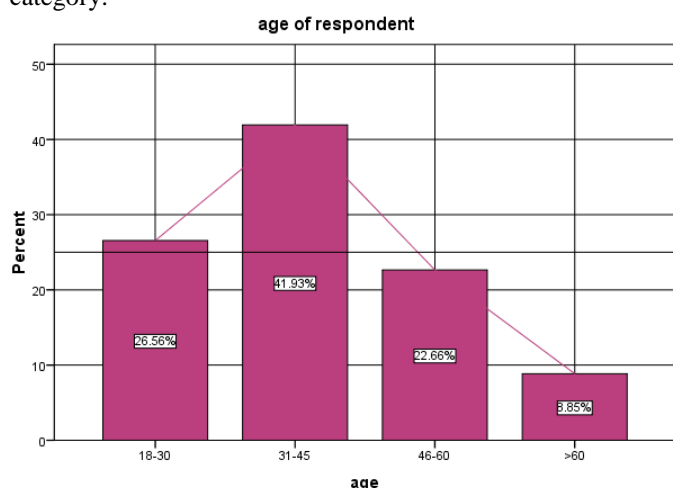

Fig. 2. Chart 1 Age of respondent.

Educational Status:-The majority of the sampled households (22.9%) are with secondary school next 19.3% with primary school, 17.4% able to read and write, 12% were illiterate 11.2% with diploma, 11.7% with degree and finally around 1.3% are master's level. The respondents who with secondary school level education were more predominant than the others. This result shows that the majority of the respondents have less educational status it also creates its own challenge in awareness creation and acceptance of new technologies.

Family size:-Around 28.4% of the sampled households were between 1-3 members of family size, 51% are amongst 4-6, and also 20.6% are above 6 members. The majority of the sampled households are between 4-6 members of family size. This study also shows that the dominant parts of the households have medium members of family size. And it is clear that as family size increases the amount of solid waste generation also increase.
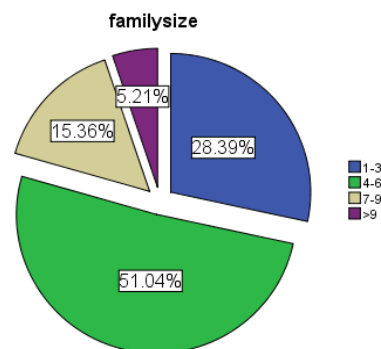

Fig. 3. Family size.

TABLE I. Socio-economic profile of the sampled households.

Items	Classes	Frequency	Percentage (%)
Gender	Male	129	33.6
	Female	255	66.4
Age	18-30	102	26.6
	31-45	161	41.9
	46-60	87	22.7
	>61	34	8.9
Educational Status	Don't read and write	46	12
	Able to read and write	67	17.4
	Primary	74	19.3
	Secondary school	88	22.9
	Certificate	16	4.2
	Diploma	43	11.2
	Degree	45	11.7
	Masters and above	5	1.3
Occupational status	governmental employed	52	13.5
	Non- governmental employed	35	9.1
	Self employed	219	57
	Others	78	20.3
Family size	<3	109	28.4
	4-6	196	51
	7-10	59	15.4
	>10	20	5.2
Amount of income	<600	94	24.5
	601-1650	120	31.2
	1651-2739	93	24.2
	2740-5000	50	13
	>5000	27	7
Home residence	Governmental house rent	118	30.7
	Private house rent	76	19.8
	Private owner	190	49.5

*Amount of income:-*Based on their monthly income the households classified into five groups. The majority of them (31.2%) earn between 601-1650 monthly income next 24.5% earn <600, 24.2% earn between 1651-2740, 13% earn between 2741-5000, finally the least number of sampled households earn >5000 (See chart, 3). As income increases the generation of solid waste also increases but as income decreases it will be the reverse, According to [6], the level of understanding of the differences in components of the waste stream was relatively weaker in low income but densely populated areas than the middle-to-high income areas. Most householders in low income areas considered silt as part of biodegradable solid waste.

According to our result the dominant parts of the households earn minimum amount of income it is clear that

monthly income has a potential to determine both the amount and type of solid waste generated even it has its own role in determining the practice of solid waste segregation, reusing and recycling.
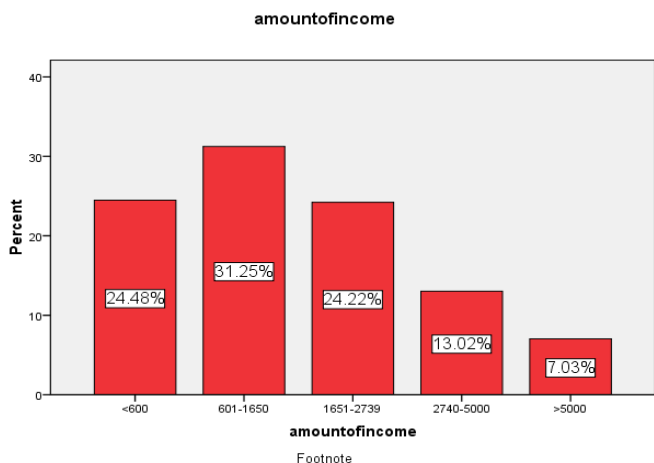

Fig. 4. Amount of income.

Occupational status:-In this study (Table, I) the dominant parts of the households (57%) were self-employed next 20.3 others (housewife and pensioner), 13.5% were governmental employed finally the least numbers of the households (9.1%) were worked at non- governmental organization (See figure 5). If there is the highest number of others (house wife and pensioner) it will be important for segregation of solid wastes because most of housewife and pensioner are stay and work at house rather than working outside.
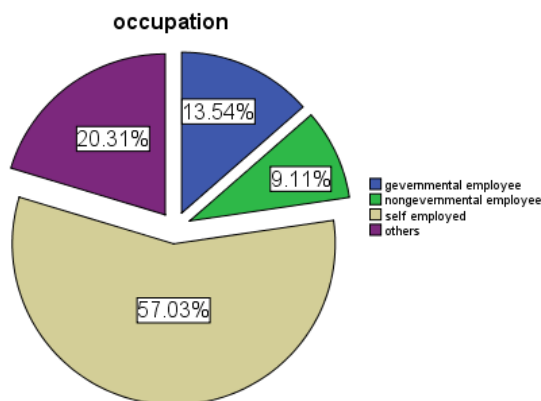

Fig. 5. Occupation of the respondents.

*Home residence:-*As shown in table I, around 30.7% of the sampled households were governmental house rent, 19.8% were private house rent and finally around 49.5% were private owner. The majority of them are private owner and it is important to take responsibility for segregation of solid waste. As the survey result shows that almost half of the respondents lives in their home residence, this is a better opportunity to segregate solid waste at the source, even 30% of household respondents lives in governmental house rent and mostly separation of solid waste will not be a challenge due to lack of space.

3.2. The Present Status of Segregation of Solid Waste

3.2.1. Type of solid wastes

The majorities of the sampled households described that food remnants, fallen leaves from trees, ashes, and dust from house, used tin, clothes and children game materials, softs, diaper, sanitary napkins, vegetable and fruit remnants are the common types of solid wastes that are generated from houses. The same ideas were reflected during interview with experts and SME.

3.2.2. Awareness of Segregation

Around 28.9% of the respondents have awareness about solid waste segregation nevertheless around 71.1% of respondents answered the reverse (See Figure 6). The dominant parts of respondents do not have awareness about segregation of solid wastes this shows that a little has been done about creation of awareness at the household level. The same ideas were reflected during interview with experts and corporates. As also in India source separation was limited due to infrastructure and lack of awareness [9].
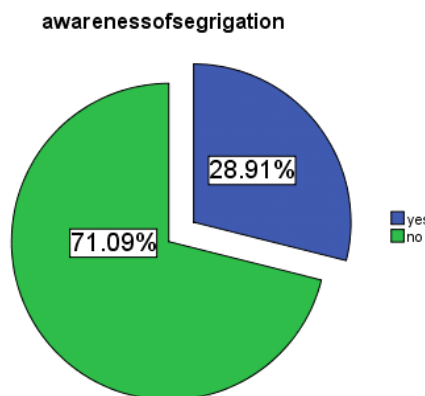

Fig. 6. Awareness of segregation.

3.2.3. Practice of solid waste segregation at the source

The foremost (95.1%) parts of respondents were not performing segregation of solid wastes at household level on the other hand only 4.9% of respondents were performing segregation (See, Figure 7). This result shows that the majority of them were not segregating the solid wastes this is due to mainly lack of awareness. The least part of households were segregating the solid wastes at the source but as they describe that the majority of them were segregate only ashes, plastics and metals. The other wastes are mix together in to one storage material, a few respondents describes that organic wastes like food, vegetable and fruit remnants are segregated for the purpose of reusing in their gardens and they sell the recyclable materials to quralews. The rest describes that after they segregated the solid wastes, they only gives to SME.

This is not fulfilling the segregation approaches and we are not meant that they are segregating the solid waste in proper way.
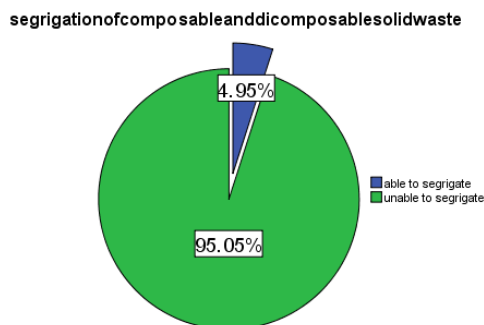
Fig. 7. Segregation of solid waste.

As also Regasa in his study describes that, a portion of respondents said that they don't separate waste at the household level. On the contrary, there are households who replied that waste is separated at the household level: into organic and inorganic only. He also states that Inorganic wastes like cans are usually sorted for sale. In few households, organic wastes like plant origin are sorted for the purpose of reusing in their gardens and as fuel after the waste gets dried; this is seen in low income households. Animal source (meat and bone) is used to feed domestic animals like dogs. Some households give the waste away to their neighbors who use it for different purpose like for animal feed. The purpose of separated waste is different for different surveyed areas and income group. More similarly his finding is related to our results.

3.3. The Existing Challenge of Solid Waste Segregation

As discussed the above result the foremost (95.1%) parts of respondents were not performing segregation of solid wastes on the other hand only 4.9% of respondents were performing. This result illustrates that segregation of solid wastes are very low. As discussed above the majority (77.1%) of them have lacks of awareness about segregation of solid wastes consequently the majority of respondents were not segregating solid wastes and the dominant parts of sample respondents have no awareness about recycling of solid wastes this shows that lack of awareness is one of the existing challenge for segregation of solid wastes. As also reported by [9], in India the status of waste segregation was very low. He also describes that Source separated solid waste collection is common in high income regions of the world like Europe, North America and Japan where the infrastructure to transport separate waste streams exist. On contrary, In Uganda, Kampala, The majority of the households separated waste because they earned an income from the separated waste. These are estimated at 70.1%. The other households separated the waste because they wanted it disposed of efficiently and in order to make manure from the separated waste. These represented 22.8% and 7.2% of the households. Households reported that what were mostly separated are banana and potato Household Knowledge, Attitudes and Practices in Solid Waste Segregation and Recycling.

The other observed challenges in the study area, the majority of sample respondents are not segregating solid waste at the source. They have forwarded several reasons for not segregating solid waste at household level. About 6.8% of

them are described that lack of space, 2.9% lack of material and 8.3% of them are others (all of them) (See chart 9). The same ideas also reflected during interview with SME. In other hand we observed that solid waste management system of the city is not practicing in consideration of source separation and resource recovery specially the collection and transportation system is following mixed way of disposal system (Figure 2, 3 and 3); even the separated solid wastes are collected and transported in a mixed way system. And this system is not motivating the households because Practicing of segregation solid waste does not generating income for them and they consider that segregation is a work load without generating income. As we observed that the majority of the households store the solid waste in to sacks in a mixed way and this creates other waste related problems like leachate formation and this leads to soil pollution.

Fig. 8. Mixed way of storage the solid waste at household level, source own.

Fig. 9. Collection of solid waste in a mixed way, source cleansing management agency communication.

Fig. 10. Mixed way of storage the solid wastes, source cleansing management agency communication.

Fig. 11. Transportation of solid waste in a mixed way, Source cleansing management agency communication.

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As also in China, in normal households of Chinese cities, there is no bin for separating the garbage. Due to the purchasing from door-to-door waste collectors of the materials such as plastic bottles, metal bins, used books or package papers etc., these wastes with direct recycling values are extracted from the mixed waste of normal households. However, the food residuals and other household wastes are mixed up and dumped into collective bins situated in neighborhoods, communities or streets [14].

There is policy about segregation of solid waste at the source however there is no specified rules and regulations that focused on segregation of solid waste at household level, the existing rules and regulations only states that "Be prohibited to store improperly or by littering waste generated from a house hold or an organization" Article 5/1. This article not specifically describes rules and regulation about segregation of solid waste at source. This is also one of the greater challenges for segregation. Article 5/1 is not strictly implemented and the amount of punishment described under Article 5/1 is only 10 birr which is not considering the offence.

An Interviewer with experts, he said that "proper solid waste collection and disposal system is one of the package from 16 packages of the existing health extension program but there is no segregation of solid waste at the source in the package and I suggest that if the issue of segregation of solid waste included in that package, it will facilitate segregation at source as well as cooperation between stakeholders on the issue."
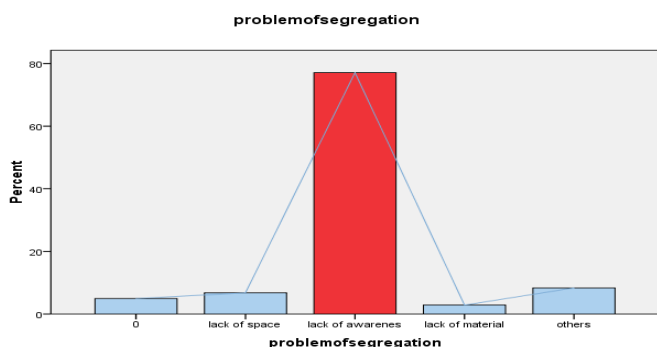

Fig. 12. Problem of segregation.

The majority of sampled household also suggested that to alleviate the problem of segregation:-

- If the experts work on awareness creation about solid waste management to them and SME, it will create a good awareness to alleviate the problem of segregation.
- The government should give attention on solid waste management.
- Emphasis should be given through Medias and discussion to create awareness to the households and SME on solid waste management.
- The government should assign a place for the purpose of solid waste separation

The same ideas reflected during interview with experts and SME.

3.4. Possible Opportunity of Solid Waste Segregation

3.4.1.. Willingness to segregation

As discussed above from 28.9% of respondents that have awareness about segregation, about 27.9% of them have willingness to segregate the solid waste but only 1% thought reverse (See Figure 13). This result shows that the majority of awared respondents have willingness to segregate the solid wastes. This is also one of the possible opportunities for segregation. Similarly, according to [8], In Ghana about 95.40% of the respondents were willing to source separate solid waste whilst 4.6% thought otherwise. The high percentage of people willing to partake was probable due to the explanation given to them on the benefits of source separation to the existing solid waste management system. As also According to [16], in china, they found that respondents have a very positive attitude about household source separation, 90% of them were willingness to segregate the solid waste.
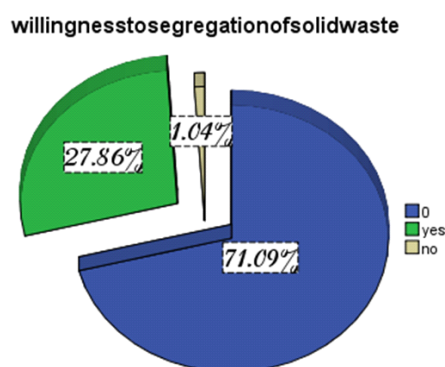

Fig. 13.Willings of segregation of solid waste.

The main parts of the households are willing to segregate the solid wastes, and when they describe about the importance of segregation of solid wastes:-
a) Easy for handling properly
b) Important for recycling the solid wastes
c) To dispose the solid wastes properly
d) To control diseases those are originated from solid wastes.
e) To create clean environment

An interview with Experts also said that "The segregated solid wastes have many opportunities to the households like, income generation, to proper handling, to control diseases and environmental sanitation, for composting, for clean environment or pollution control, It can facilitate for reusing and recycling, to create an Aesthetic environment for mind satisfaction, to minimize amount of solid wastes that are dumped in to land fill and to extend the life time of landfill and so on."

Similar to our result According to [7], Opportunities from Integrated Solid Waste Management
a) Leading to economic gains due to improved efficiency, overall cost reduction, minimal environmental impacts and social acceptance.
b) leading to more sustainable consumption patterns along with economic development
c) Facilitates recycling of valuable resources such as plastic, glass, paper and metals, recovery of alternate energy

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sources such as Refuse Derived Fuel (RDF) from high-calorific value fraction of waste, recovery of biogas or compost from biodegradable waste

d) Encourages innovative technology development in newer areas such as waste to energy and recycling and promotes green jobs that ensure safe working conditions

e) Addresses management of both MSW and other newer waste streams such as e-waste, construction.

The other opportunities observed in study site to improve the existing segregation of solid waste includes:-

a) Availability of recycling factories like COBA, OREX, OXFORD, PENDA, Ethio Plastic PLC. This factories can be a baseline for recycling and reusing because they have their own trend on segregation thus it can be used as an opportunity and their trend should be formulated in to a best practice as well as it can be scale up in to another type of recycling and improvement of segregation at household level. These factories also contributing to generate income for informal solid waste collector or locally known as quralews and households. This is also important to create motivation to them for working on segregation.

b) The presence of informal sold waste collector (quralew) also one of the opportunity for segregation because they buy the recyclable materials like plastics, metals and other used materials from each households and they transferred it to recycling factories. Besides segregation it is one way of to earn income for households and informal solid waste collector (quralews). If we organized and support informal solid waste collector (quralews) we can utilize their own trend on this job. According to [11] about 86% of informal solid waste collector (quralews) is willing to organize in to corporates (SME) so this is a good opportunity for segregation at the source.

c) The presence of strategies on green development strategy of Ethiopia is an important opportunity to facilitate segregation of solid waste at the source and to increase recycling and reusing because it follows zero waste strategy system(circular system of waste) to minimize the emition of pollutants like methane and other greenhouse gases from solid wastes.

d) The presence of SWRDPO is significant to support segregation at household level because mainly they monitor, support and evaluate the factories and other projects that are works on reusing and recycling of solid wastes. They are also conduct research on improvement mechanisms of segregation, reusing and recycling

e) The presence of NGO is one of the better opportunity for segregation because they give funds and support on integrated solid waste management furthermore they conduct pilot projects, model practices and research on the issue.

f) There is policy about segregation of solid waste at the source under the topic of Solid waste collection, transportation, disposal and reuse. It states that "the policy helps the households to minimize at source, segregation practice and proper disposal of the solid wastes."

3.5. The relationship between segregation and determinant factors

Segregation and age

H0= Age of the households is different from segregation of solid wastes.

H= Age of the households is associated with segregation of solid wastes.

Table II shows that the null hypothesis is accepted, that means the age of households is different from segregation of solid wastes this illustrates that age of households is not a determinant factor of segregation. There is no significant difference between age and segregation of solid wastes. (Contingency Chi square = 0.086, P = 0.993; Not significant).

TABLE II. Segregation of solid waste identified by age.

Segregation of solid waste	Age				Total	Chi square
	18-30	31-45	46-60	>60		
Practice of segregation	5	8	4	2	19	
Not practicing segregation	97	153	83	32	365	
Total	102	161	87	34	384	0.086

Df= 3,   P= 0.993, Not Significant

Segregation of solid waste and gender

H0= Gender of the households is different from segregation solid wastes.

H= Gender of the households is associated with segregation of solid wastes.

As Shown in table III gender is different from segregation of decomposable and non- decomposable of solid wastes. The null hypothesis is accepted furthermore there is no significant difference in this study. (Contingency Chi square = 1.700, P = 0.192; Not significant).

TABLE III. Segregation of solid wastes identified by Gender

Segregation of solid wastes	Gender		Total	Chai square Value
Practice on segregation	Male	Female		
	9	10	19	
Not practicing segregation	120	245	365	
Total	129	255	384	1.700

Df= 1,   P= 0.192, Not Significant

As we observed from our trend most of the time females are stay and work inside their house instead of working outside they are known as "housewife". As a result of this most of household activities including segregation and disposal of solid waste activities are done by women and they have a better knowledge, attitude and waste handling than men. Nevertheless the works on segregation of solid waste is not only for women but men also can perform this activity.

Segregation of solid waste and educational level

H0= Educational level of the households is different from segregation of solid wastes.

H= Educational level of the households is associated with segregation of solid wastes.

When cross tabulated with educational level of households with segregation of solid wastes, From this study as shown in table IV the null hypothesis is accepted. There is no significant

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difference was observed, the P value is greater than 0.05 this means the educational level of the households is different or

not dependent from segregation of solid wastes. (Contingency Chi square = 0.243, P = 0.545; Not significant).

TABLE IV. Segregation of solid waste identified by educational level.

	do not read	Able to read and write	Primary school	Secondary school	Certificate	Diploma	Degree	MA/MSC and above	
Practice of segregation	1	4	4	5	2	3	0	0	
Not practicing segregation	45	63	70	83	14	40	45	5	
	46	67	74	88	16	43	45	5	0.243

Df= 7,   P= 0.545, Not Significant

Segregation of solid waste and family size

H0= family size of the households is different from segregation of solid wastes.

H= family size of the households is associated with segregation of solid wastes.

when cross tabulated with family size of households with segregation of solid wastes , From this study as shown in table V the null hypothesis is accepted, there is no significant difference was observed, the P value is greater than 0.05 this means the family size of the households is different or not dependent from segregation of solid wastes

TABLE V. Segregation of solid waste identified by family size.

Segregation of solid waste	Family size				Total	Chi square
	1-3	4-6	7-9	>9		
Practice of segregation	6	19	6	0	19	
Not practicing segregation	103	365	53	20	365	
Total	109	196	384	20	384	5.323

Df= 3,   P= 0.150, Not Significant

Segregation of solid waste and awareness of dwellers

H0= awareness of segregation of solid wastes is different from segregation of solid wastes.

H= awareness of segregation of solid wastes is associated with segregation of solid wastes.

The null hypothesis is rejected because as shown in table, VI awareness about segregation of solid waste is less than 0.05 this means it is highly significant. Awareness of segregation is much more related with segregation solid wastes. (Contingency Chi square = 49.162, P = 0; very highly significant

Segregation of solid waste * awareness of segregation Cross tabulation

TABLE VI. Segregation of solid waste identified by awareness of segregation.

Segregation of solid waste	Awareness of segregation		Total	Chi square
	Yes	No		
Practice of segregation	19	0	19	
Not practicing segregation	92	273	365	
Total	111	273	384	49.162

Segregation of solid waste and willingness to participate

H0= willingness for segregation of solid wastes is different from segregation of decomposable and non- decomposable solid wastes.

H= willingness for segregation of solid wastes is associated with segregation of decomposable and non- decomposable solid wastes. The null hypothesis is rejected because Willingness to segregate is highly significant with segregation of solid wastes, the P value is less than 0.05 this means there is high association between willingness of segregation and segregation of solid waste at the household level (Table VII). (Contingency Chi square = 51.747, P = 0; very highly significant).

TABLE VII. Segregation of solid waste identified by Willingness to segregation of solid waste

Segregation of solid waste	Willingness to segregation of solid waste			Total	Chi square
	0	yes	No		
Practice of segregation	0	19	0	19	
Not segregating	273	88	4	365	
Total	273	107	4	384	51.747

Df= 2,   P= 0.000, Highly Significant

Segregation of solid waste and problem of segregation

H0= the problem of solid waste segregation is different from segregation of solid wastes.

H= the problem of solid waste segregation is associated with segregation of solid wastes.

As shown in table, VIII the null hypothesis is rejected because the problem of solid wastes are highly significant with segregation of solid wastes and there is much more association between problem of segregation of solid wastes because the P value is less than 0.05. Lack of awareness is one of the main reason for not segregating of solid wastes.(Contingency Chi square = 3.84, P = 0;. very highly significant).

TABLE VIII. Segregation of solid waste identified by problem of segregation.

Segregation of solid waste	Problem of segregation						
	0	lack of space	lack of awareness	lack of material	Others	Total	Chi square
Practice of segregation	19	0	0	0	0	19	
Not practicing segregation	0	26	296	11	32	365	
Total	19	26	296	11	32	384	3.84

Df= 4,   P= 0.000, Highly Significant

IV. CONCLUSION AND RECOMMENDATION

4.1. Conclusions

From our results we have conclude that the majorities of the sampled households in Addis Ababa city were the

relationship between age, gender, educational level and family size with performance of segregation of solid waste at the source have not significant difference. That means segregation at house hold level don't depend on demographic characteristics of the house hold Rather it have significant relation with awareness, willingness, space and material availability.

Most of sample respondents (71.1%) have no awareness about segregation of solid waste, 28.9% are aware about solid waste segregation almost this amount of respondents are willing to segregate, whereas solid waste segregation is now being 4.9%, which is very minimal, this is mainly as a result of lack of awareness, The other obstacle for the success of solid waste segregation are lack of space, lack of material and others (all of them).

This result shows that lack of awareness is the major problem of segregation to the sampled households in the contrary the result showed that their opportunities to segregation like that of willingness of respondents to segregate, ability of material to recycle, presence of SME, presence of recycling factories, presence of organizational structure. Generally due to the presence of many challenges these opportunities are not widely utilized and the status of solid waste segregation was very low.

4.2. Recommendation

Establishing training programs for cleansing management workers, ME, public organizers (hizb aderegaget), religious organizations, educational organizations, stakeholders and waste pickers (quralews) and practical work to improve the household level waste segregation system

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