

Practices of informal resource recovery from a solid waste stream; case study: Addis Ababa, Ethiopia

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Abstract— The status of amount, type and value chain process of materials recovered from a waste stream of Addis Ababa city was assessed by a cross-sectional study. Sampling of actors was done followed by appropriate counting of informal waste pickers called Koralews, dealers and landfill reclaimers. The hot working time of actors at the market centre were identified. Then, counting of Koralews (solid waste scavengers) and dealers was conducted for seven consecutive days. Landfill reclaimers were counted for three consecutive days. Accordingly 4864 Koralews, 1663 Shop dealers and 955 landfill reclaimers were found. About 958 respondents (i.e. 370 Koralews, 306 Shop dealers and 282 Landfill reclaimers) were taken as a sample for this study. Most of the Koralews, dealers and landfill reclaimers stay more than five years on the job and work on waste materials collection over 6 hours/day for consecutive 7 working days. Glass, plastic, textiles, paper and metals were the most demanded recyclable by Koralews and landfill reclaimers are collecting.

The average waste resource collection rate of one Koralew, woman landfill reclaimer and man landfill reclaimer found in this study was 42 Kg/day, 30 Kg/day and 7.5 Kg/day respectively. Woman and man landfill reclaimers were selling 0.86 cents per Kg and 7 ETB/Kg. One Koralew gets income of 140 ETB on lucky days and 31 ETB on bad days. The average monthly income of one Koralew, woman and man landfill reclaimers were 1445, 1060 and 1950 ETB/month. Several factors like daily weather conditions, amount of collected materials, selling price, amount of collected materials, poor public attitudes towards and treat become a bottle necks of their work. Additionally, female landfill reclaimers have complained about force monopoly of male reclaimers.

Key words: dealers, value chain, informal recycling, landfill reclaimers, solid waste

1 INTRODUCTION

Like many other developing country informal material recovery and recycling activities are taking place in Addis Ababa. But the work is not well recognized and being practiced by simple equipment. The actors in it are often recovering significant amount of the waste in a self-financing way. There is no formal integration of recycling to improve resource recovery and recycling efficiency in the city. However, the establishment of government offices initiates to institutionalize as part of the waste management [1].

The sorting of waste for recyclables takes place at various levels in the waste management process. The first level of source separation in the waste recovery system in Addis Ababa is the households. At this level, reusable materials are considered valuable and are therefore usually sorted out for reuse. Thus, the materials are used several times before they lose their utility value and are considered as waste.

cycle, given away to old or poor people, and either sold or given away to Koralews, depending on the income of the household.

At household level, especially in low-income groups, waste is widely used as an economic resource. If there is the least advantage to be gained, housewives, maids or children will sort the waste and make sure that they get the benefit, whether in terms of cash (Koralew), equipment (lewach), bio-fertiliser (vegetable gardens and vegetable growers), cattle feed or energy [2].

Almost the entire solid waste collection practice in the middle and high income groups is in mixed form, practice of separating solid waste at source is rather insignificant. As a result primary collectors who collect waste from those groups sort waste to find items for sale before they empty their bags onto the community solid waste storing containers or dump trucks. Other informal operators, locally known as “Genda Melach” also sort waste items for sale in those sites where community level garbage containers are located and where the primary collectors, Genda Melaches and “Koralews” trade waste items [2].

Several collectors represent the second stage in the material recovery system. The collectors can be divided into four groups: primary collectors, street boys, landfill reclaimers at the municipal landfill, and the Koralews who form the largest group of collectors in the city.

The aim of the study is to assess the existing informal waste material recovery system. In particular, the survey was conducted to identify the informal waste recycling actors and elucidate value chain process, to determine the type and

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At this level, recyclable materials are thrown into the waste

amount of recyclable solid waste that is being collected by Koralews and landfill reclaimers per day, to assess the current market prices of each recyclables and livelihood of informal recyclers and to assess the current working situation of informal solid waste recovering activities

2 METHODOLOGY

2.1 Sampling Method

The total number of sample respondents is determined from the whole population by using scientific sampling formula. The total number of target population to this survey were 4864 Koralews, 1663 shop dealers and 955 landfill reclaimers. Stratified and random sampling methods were employed to select the sample respondents. The informal recycling actors were stratified based on its type and then respondents were selected randomly. Data collection activity was undertaken at 95% confidence level and 5% error. A scientific sampling formula explained by [1] was used to determine the number of samples for the study. Accordingly a total number of 958 respondents (i.e. 370 Koralews, 306 Shop dealers and 282 Landfill reclaimers) were selected from 4864 Koralews, 1663 Shop dealers and 955 landfill reclaimers.

2.2 Data Collection

Various qualitative and quantitative data were collected from different sources. A primary data pertaining socio-economic profile of informal recyclers and data related to quantity and types of recyclables materials at the current market, the number of informal recycling actors and the cost of recyclables that are currently exchanged in the market were collected. The data was collected from sample respondents of Koralews, shop dealers and brokers, recyclers and landfill reclaimers by questionnaire and semi structured interview. Primary data that was gathered by questionnaire and interview was further proved through focused group discussion, informal discussion and observation of the physical working environment. Demographic relevant secondary data was collected from central statistics agency of Ethiopia however; the financial and economic related data were collected from the reports of city, sub-city and Woreda administration sector bureaus and offices in Addis Ababa. The data that showed effort of civil societies were also compiled from civil society organization.

2.3 Data Collection Approach and Strategies

The target areas of the study were determined through direct observation and consulting with relevant experts before data collection. Accordingly, Merkato-Min-alesh Terawas found to be the first ideal place for this study since it was found as a terminal point for koralews and household recyclable material buyers and sellers.

A counting strategy was designed to estimate the total population of sellers and buyers after determining the right hot spot area of selling Centre. All gates that Koralews entered to Min-alesh Tera and the active days and hot hours that Koralews could come to area were identified. Accordingly, it was found that Koralews enter to 'Min-alesh Tera' at a

number of ten gates. The pre-study assessment for counting the total Koralews was conducted for six days of the week with in hot hours from 9:00 am to 5:00 pm.. Counting all relevant workshops found at Min-alesh Tera were also undertaken to determine the total number of shop dealers. Informal recyclers at Repi landfill site were counted for two days to estimate the total number of landfill reclaimers. Finally, the shopless dealers called brokers that were found around Min-alesh Terahave also been counted.

After determining the total populations of those actors representative sample sizes were determined using a scientific formula and required data were gathered through interview, structured questionnaire, discussion and physical observation. A beam balance was utilized to determine the amount and composition of material recovered by the informal sector.

2.4 Data Analysis and Presentation

A simple arithmetic statistical analysis was done. Basic statistical analysis software like Microsoft XL and SPSS were used. Mean and percentage were used for interpretation. The findings were presented by tables, charts and graphs.

3 RESULTS AND DISCUSSION

According to the survey conducted a total number of 4864 Koralews, 1663 Shop dealers and 955 landfill reclaimers were found in the city. A similar figure data has been reported in other research [4]. The detail socioeconomic profiles are summarized below.

3.1 Socio economic profiles

3.1.1 Gender Profiles

All of the contacted samples Koralews were male. It also further proved through direct observation in Minalesh-Tera Merikato, market center of recyclable materials, and all Koralews that enter to the market every day were male. A report of [5] showed that about 95% of the work is dominated by male. This showed that this occupation is dominated by male. All the contacted shop dealers were male.

However, the gender composition of landfill reclaimers was dominated by females. The survey identified that 65 percent of the respondents were female and 34 percent of them were male. This showed that unlike Koralews landfill reclaimers were primarily dominated by female.

3.1.2 Age Groups

The survey revealed that most Koralews were young. Around 64 percent of the total sample respondents were found in the age group of 25-34 years. As shown in Figure 2, about 27% of Koralews were found in the middle age interval between 35-44 years. However, the number of Koralews in the age less than 25 and greater than 45 was also significant. As it was also seen in report in Zaria, Nigeria most of the solid waste scavengers what we call it in Ethiopia Koralews are found in in the age between 16 and 25 [5]. The very young groups of the society are engaged in the waste marketing systems.

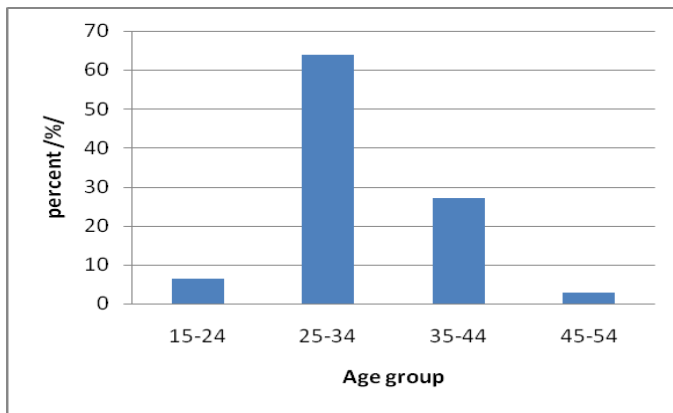


Figure 1 Distribution of koralews by age group

Unlike to koralews most of the landfill reclaimers were found in the middle aged group. As presented in Figure 3, out of the total interviewed respondents, 32 percent of them were found in the age gap of 25 to 34, 44 percent were found in age between 35 to 44 and 14 percent were above 45 years old however only 10 percent of respondents are below 24 years old. Most of the landfill reclaimers were found in the age between 35 and 44. A significant number of landfill reclaimers were also been observed in the age greater than 45 and less than 15.

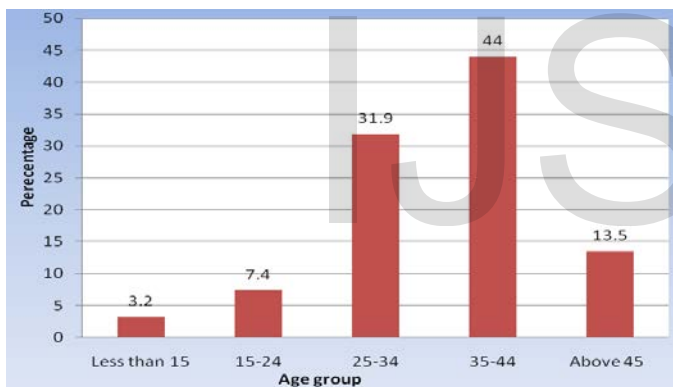


Figure 2 Distribution of landfill reclaimers by age group

3.1.3 Origins

Informal recyclers come from outside of the city in search of better quality of life. Out of the total surveyed respondents, 64 percent of them informed that they come from different part of the country while 36 percent come from Addis Ababa. The majority of reclaimers have been migrated to the city from rural areas. There was no dominant ethnic group in the system that has been observed as a finding of the study.

The result showed that out of the total sample Koralews respondents 32 percent were Gurage, 27 percent were Wolayta and 36 percent of them were mixed ethnics.

3.1.4 Education Level

As it is summarized in Table 1, most of the landfill reclaimers were found to have relatively lower level of formal education. Half of the sample respondents were illiterate while 44 percent had a primary level education.

Table 1

Education levels of landfill reclaimers

Level of education	Number of respondents	percent
Illiterate	141	50
Primary education	124	44
Secondary education	13	4.6
Above	4	1.4
Total	282	100

Unlike to landfill reclaimers, most Koralews were educated until primary level of education. As it was illustrated in Figure 3 about 82.7% of them were found in the primary educational level. It is possible to conclude that more than 93% of Koralews are educated.

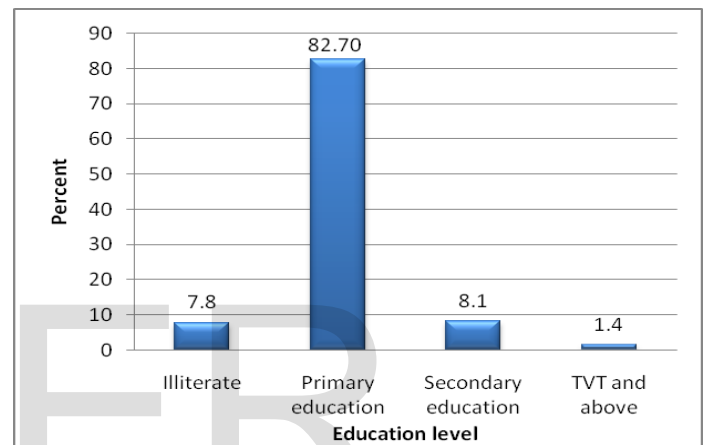


Figure 3 Education level of Koralews

3.2 Working Days, Hours and Length of Time

3.2.1 Working days

According to this study, Koralews working days per week were ranged from 4 to 7 days and the average working days per week were 5 days. This indicated that majority of Koralews worked at least five days per week for 6 hours.

In contrast to Koralews, the landfill reclaimers work greater than 6 days per week. As shown in Figure 4, 56 percent of the total respondents stated that they were working 7 days per week; unless they have experienced serious problems on their livelihood to feed themselves. About 24 percent of sample respondents reported that they were working 6 days per week while 19 percent work 3-5 days per week. This indicated that landfill reclaimers work longer hours a day and greater number of days for week than Koralews.

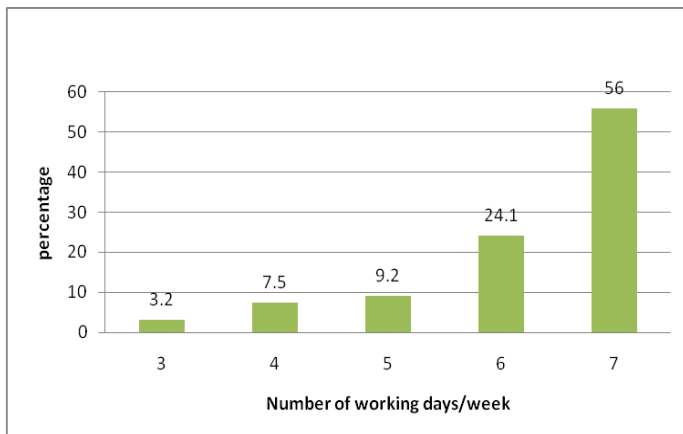


Figure 4 Percentage of number of weekly working days of landfill reclaimers

3.2.2 Working hours

As summarized in Table 2, Koralews working hours per day were varied from 3 to 10 hours and the average working hours per day was 6 hours. However, majority (65 percent) of the sample respondents from landfill reclaimers were working greater than 8 hours a day. The study found that women accounting for 58 percent constitute the majority of the sample respondent works more than 8 hours to feed their babies and themselves. This showed that women informal recyclers spent more time than men. It was also found that women with young babies work less than five hours.

Table 2

Percentage of working hours per day of landfill reclaimers

Hours	Number of respondents	Percent
4-5	34	12.1
6-7	64	22.7
8-9	141	50.0
10 and above	43	15.2
Total	282	100

3.2.3 Length of stay

The survey indicated that a large portion (71%) of the respondents have been working more than five years in the sector. As presented in Table3, 32 percent of Koralews have been working more than five years, 32 percent of them have been working more than seven years and 7 percent have been working above 10 years in the sector.

Table 3

Duration of koralews in the sector

Length of time/year	Number of respondents	Percent
1-2	30	8.1
3-4	79	21.3
5-6	118	31.9

Length of time/year	Number of respondents	Percent
7-10	118	31.9
Above 10	25	6.8
Total	370	100

Regarding the length of time that the landfill reclaimers have been worked in the sector, the survey data revealed that large portions (53 percent) of those interviewed reclaimers have been working for more than ten years. As shown in Figure 5, most of them joined the work in the last 10 years ago. However, significant number of reclaimers has been working since 30 years ago.

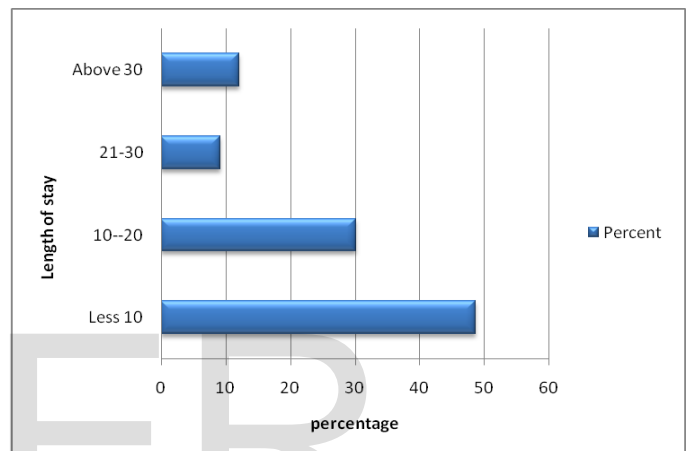


Figure 5 Length of stay in the sector of landfill reclaimers

3.3 Area and Sources of Collection

As it was mentioned in [6], solid waste management system in Addis Ababa is not integrated; it lacks collaboration of stakeholders and also concept of resource recovery system. Hence, Koralews (scavengers) are working life as usual without legal protection and government support. They have no definite resource collection point and places from the waste stream. The survey showed that Koralews collect recyclable materials from all over the city and nearby towns around Addis Ababa city. Moreover, the survey identified all of the Koralews collect recyclable materials from households, 69 percent collect materials from private and public institution, 5 percent collect recyclables from industries and 63 percent collect recyclable materials from street and public areas. In the other side, landfill reclaimers collects re-usable and recyclable material from the open dumpsite of Addis Ababa city.

3.4 Type and Amount of Recyclables Collected

3.4.1 Types of Recyclables to be collected

As depicted in Figure 6, out of the total sample respondents, more than 96 percent of sample respondents collected metals, plastics and glass while 27 percent of them collected paper and 17 percent collected other valuable materials in addition. 30 per cent of the solid waste generated in Netherlands is recovered through targeted recycling and organics management [7]. It therefore, the recovery of resources from

the waste stream in Addis Ababa is remarkable. The type of materials recovered from the waste stream like metals, plastics and glass have better demand in the recycling market in Ethiopia and also showed similar trends with that of developing countries. Plastic wastes are the highest demanded resources that are being recovered informally. As it was reported [1] and [8], the recovery of plastic waste materials in Addis Ababa is mainly driven by the need of local market. The demand is increasing from time to time due to increasing poverty that unable to afford plastic tools that made of virgin raw materials. Instead of this people select to use plastic materials made from recyclable plastic waste.

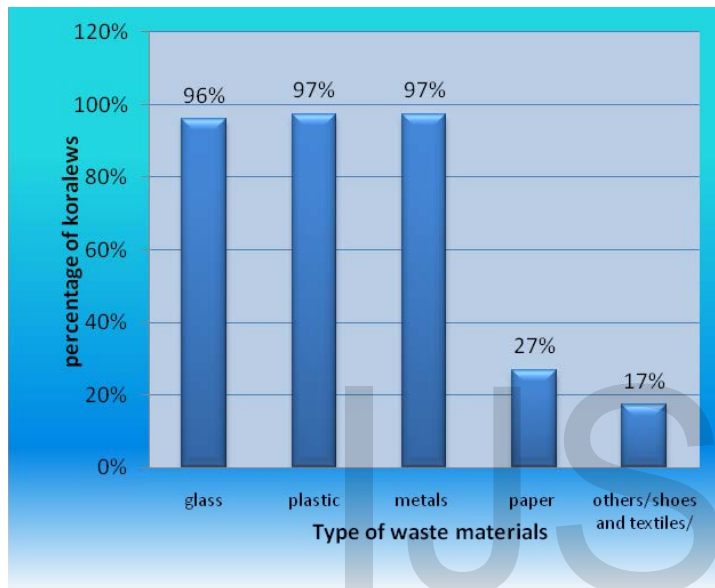


Figure 6 Types of recovered materials by Koralews

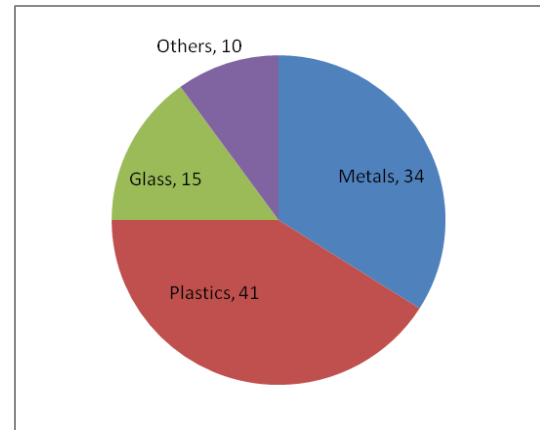


Figure 7 Percentage composition by mass of recovered materials by Koralews

Assuming that, there are 623 female and 332 male landfill reclaimers, 21 tons of plastic and around 5 tons metal were collected each day. This resulted in a collection rate of 26 tons of recyclables per day, 153 tons per week, 665 tons per month or 7987 tons per year for mixed recyclable materials from the landfill.

Table 4

Amount of plastics and metals recovered by landfill reclaimers

Amount of Plastic or Metals to be collected	Plastics			Metals		
	Male	Female	Total	Male	Female	Total
Kg/day	2490	18752.3	21242.3	2490	1869	4359
Kg/week	14940	112513.8	127453.8	14940	11214	26154
Kg/month	64740	487559.8	552299.8	64740	48594	113334
Kg/year	776880	5850717.6	6627597.5	776880	583128	1360008

4.4.2 Amount of Collected Recyclables

According to this study, percapita collection capacity of Koralew is 42 kg per day. Assuming the average numbers of 4864 Koralews are working every day; 204 tons of mixed recyclable materials were collected from the city within a day. With an average number of five working days in a week, 1020 tons recyclable will be recovered per week, 20400 tons per month and 244800 tons per year mixed materials are collected by Koralews. According to the Figure 7, out of total recyclable waste collected by Koralews, 46 percent were plastics, 34 percent were metals, 16 percent were glass and 4 percent were others by mass.

Unlike to Koralews, the type of recyclable recovered by landfill reclaimers was depended on gender of reclaimer. Metal and higher value plastic collection was dominated by men while women concentrated on plastics relatively lower price. As sumerised in Table 4, male reclaimer collected an average of 7.5kg/day of metal while women collected 30kg/day. Even though women reclaimers collected an average day 30kg/day of plastics and male collected 7.5kg/day of metals, the selling price of women collected plastic was 0.86 cents per kg and male collected recyclables was seven ETB per kg. This showed that men focus on collecting higher revenue generating metal and plastics.

3.5 Sale of Recyclable Materials and earnings

3.5.1 Sale of Recyclables

All Koralew sell collected material at Minalesh Tera, Merkato to shop dealers and local recyclers. A significant portion (90%) of the respondents stated that they sold recovered material to shop dealers and local recyclers that gave better price while 10 percent of them informed that they sold to shop dealers and local recyclers who gave them working capital.

All of sample respondents of landfill reclaimers sale recovered plastics to middlemen that found at Repi open dump. The middlemen collected and stored plastic materials at the dump site till the amount equals to hired transporting truck carrying capacity. Finally, they transported the plastic materials to the buyer. They pay to collectors every 15th days of collection. They also had the absolute power of determining selling price at landfill reclaiming site. A similar trend that collection by waste pickers followed by middle man and ended with factors or recycling centers has been followed in bandung city of Indonesia [9].

3.5.2 Earnings

According to the study, the daily income of Koralews was

not constant. As illustrated in Figure 8, Koralew get a higher income up to 140 Eth ETB on lucky days; however the average daily income amount to 31 ETB on bad days. Based on the interview and informal discussion, one thirds of total days are lucky for them and two thirds are bad days. Assuming Koralews work on an average five days per week, they are working for 22 days per month, resulting in the average monthly income amounts to 1445 ETB. Comparing the average monthly incomes of Koralew with country's average wages, Koralew are earning far greater than middle wage 1200. Amongst the landfill reclaimers surveyed, men have higher incomes than women since they collected metal and higher value plastics. The survey revealed that men average monthly income amounts to 1950 ETB while women monthly income amounts to 1060 ETB.

Moreover the survey identified factors that affect the daily earnings of Koralews. Accordingly, the amounts of collected materials, selling price and finding of higher value materials in a given day determine the daily incomes of Koralews. The later one depends on more by chance but the amount that can be collected and selling price of each day affected the Koralew's daily income. The availability of materials and whether conditions of a given day were the major determinant factor that affects the amount of recyclables collected in a given day. Selling price of recyclables was fluctuated from time to time. When recycling factories have got technical problem or made maintenance the demand for recyclables decreased. As the majority of shop dealers sold better quality reusable materials for rural merchants, during summer seasons similarly the demand for reusable materials significantly reduced. These result in a decrease in selling price of recyclables. Since all of the Koralews have no storage place, they have no alternative rather than selling the materials with a given price even those that have better working capital. In general the amount of material collected and selling price of a given day further affect the size of income earned in the day.

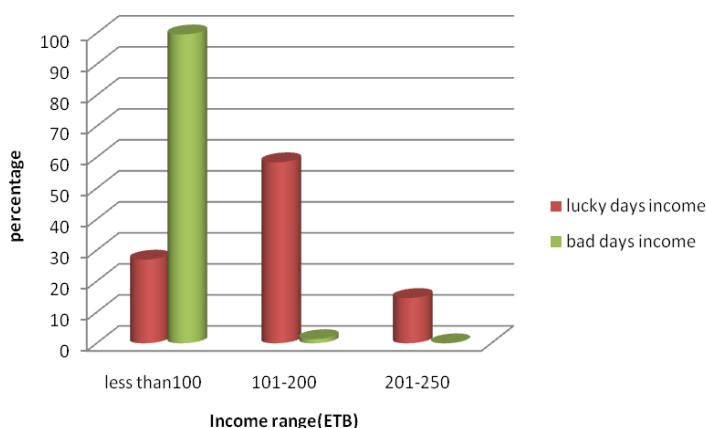


Figure 8 Daily income of Koralews/informal waste pickers

3.6 Working Conditions and the Environment

All of Koralews (informal waste pickers) collect valuable materials by traveling on foot and carrying their bag on their back or shoulder until it got full. If their day was lucky they

moved short distance otherwise they always move long distance to get full their bag. As soon as their bag got full they go to Min-alesh TeraMerchato, market center for recyclables, on foot or by taxi for sell since they have no storage place in general and limited capital. Given lack of storage place and limited capital they have no chance without selling the collected material determined by shop dealers selling price.

Regarding the use of personal protective equipment, out of the total interviewed Koralews, 76 percent informed that they wear personal protective cloths-hat, shoes and uniforms/overcoats- during their work and 24 percent stated that they collected materials without wearing any protective clothes. The use of mouth and nose caps and gloves was totally absent. Although majority of respondents reported the use personal protective clothes, as observed during the field survey most of the uniforms, hats and shoes might not be still appropriate for the type of work. Moreover all of Koralews stated that they haven't got any OSH related training.

However all of Koralews were working without wearing gloves and standard protective clothes the majority (53 percent) of sample respondents expressed that they haven't ever experienced work related injuries and illness while 47 percent experienced work related injuries. More than 94 percent of sample respondents of Koralews stated that they haven't got free health care services while 5 percent informed that they have got free health care services. This may be the majority of Koralews come from rural areas and have no Addis Ababa residents ID cards and other legal procedures to get free health services.

The hazardous waste items mixed with municipal waste and dead animal bodies hauled by track and disposed in the site. When the track starts to unload the waste on the site immediately landfill reclaimers start to search and pick valuable material using simple digging tools with bare hands and without wearing personal protective equipments.

In addition, as there was no specified area where they can pick valuable materials from disposed waste they work in areas where fresh waste spread leveled and compacted by excavators and bulldozers. As a result, they have experienced machine accidents. Most of the time wastes are burnt by men to get easy detection of metals and polluting the environment. These all show that considerable health risks and physical dangers are associated with landfill reclaiming work.

Despite they are working in the most hazardous place no landfill reclaimer reported using personal protective closes. Out of the total sample respondents, 56 percent stated that they have experienced work related illness and injuries. Around 73 percent of the respondents never get OSH related training and all landfill reclaimer had no formal credit access and not got training related with the work.

All Koralews and landfill reclaimers informed that they have no formal credit access and they have never get training that help to improve their livelihood. Despite the benefits they generate to the society, lack of OSH and capacity building training, and denied assistance in financing indicate that very little effort was done to assist Koralews and reclaimers. But, other report showed that several occupational health and accidents could be faced while working on solid waste recovery system in developing countries. Appropriate traing

and protective systems and PPE materials should be provided to enhance the system safely [10].

4.7 Problems Facing Koralews

Among the stated challenges by koralews, financial constraints, lack of storage place, price fluctuation, broker, traveling long distance on foot in search of recyclables, uncertainty of the amount and types of material collected are the main problems that Koralews mentioned in relation to their activities. Significant portion of sample respondents also mentioned that poor perception of the society another challenge of the work.

In the otherside, landfill reclaimers were challenged by dust and sun heat in the dry seasons, rain and leachate in the wet seasons, hazardous medical and household wastes and dead animal body. More over female reclaimers informed that young men using their physical strength monopolize valuable materials and forbid them to collect such materials. In addition the ongoing increasing numbers of people joined in the work have increased the competition.

4 CONCLUSIONS AND RECOMMENDATIONS

4.1 Conclusion

The survey has revealed that the informal recycling chain comprised of various actors. Koralews, primary collectors, landfill reclaimers and street boys were groups of collectors operating in the lower level of informal material recovery chain of Addis Ababa. Koralews purchased recycling materials directly at a source; micro and small scale collection workers separate the waste during their collection activities and street boys and landfill reclaimers sort out recyclables at skip points and city's open dump site respectively. Koralews sell recovered material to shop dealers and middlemen at Minalesh Tera. Again shop dealers and middlemen sort the materials and sell the materials via wholesalers to recycling factories. Whereas landfill reclaimers sell sorted recovered materials to middlemen and the middlemen sell to local plastics factories.

Of course the content and quality of recyclable materials decreased towards the end of the chain. Thus Koralews who buy recyclables directly from the sources can obtain the highest quality materials. However, collection workers still can extract highly valuable items from the households which don't separate waste for selling it. The poorest quality was collected by landfill reclaimers. However the materials recovered from the dump site by landfill reclaimers have a poor quality, local plastic factories buy the materials without any complain.

Though the length of the value chain significantly reduced the real income for those actors in the lower level of the value chain-Koralews and landfill reclaimers, the majority of koralews and landfill reclaimers earn above the national minimum wage level.

The survey concluded that the formal recycling industries have increasingly become dependent on the supplies of the Koralews and landfill reclaimers. But these actors in the informal recycling sectors haven't got competitive benefit as their contribution.

The activity carried out by the informal recycling sector generated a positive social externality such as reduction of production costs, minimizing city's collection and disposal cost and increasing of landfills' lifetime. In addition, virgin materials are used less intensively, conservation of natural resources, saving of energy and mitigating environmental pollution. Despite their contribution to the waste management system of the city in particular and to the society in general, the informal recycling sector actors operate under difficult working conditions.

The survey also showed, due to lack of capital, knowledge, skill and information they were not involved in processing reclaimed materials to create new products. Production of new material from waste not only maximize their incomes but also able to move up the value chain.

Furthermore the majority of Koralews and landfill reclaimers come from outside of Addis Ababa so that they have no accesses for free health care services and formal credit systems. The survey concluded that actors involved in the sector play significant role in the recycling activity at high health costs.

4.2 Recommendations

Informal recycling sector and its activities lead to a large number of direct and indirect positive impacts; however it was facing negative impacts such as health risks, hazards and social stigmatization on the actors particularly operating in the lower level of informal recycling chain. Hence, appropriate measures should be taken according to the following recommendations.

- Taking the positive contributions of informal recycling system for MSW into account formalization and integration/inclusion of the informal recycling sector into the formal waste management system
- Recognize the economic, social and environmental benefits of the informal recycling for policy review to integrate into formal solid waste management.
- To develop more supportive policies to stimulate and improve working conditions of the informal sector rather than neglecting.
- To help them to organize themselves into unions or cooperatives and to add value to the recycled materials before selling.
- Measures need to be taken to reduce the children involvement through legislation and enforcement.
- Improve the living and working conditions of the actors involved in the informal recycling sector actors through wearing protective clothing, shoes, boots and glasses, and the provision of infrastructure for sorting, store, etc. Hence, recycling sector working standard and guidelines need be prepared.
- Source separated materials have good value as well as avoid physical contacts with other waste during collection of recyclable materials.
- Appropriate system for the provision of social protection and inclusion should be done.

- Adequate public awareness program should be launched to alleviate social stigmatization.

5 REFERENCES

- [1] Bjerkli, C. L. (2013). Governance on the Ground: A Study of Solid Waste Management in Addis Ababa, Ethiopia; International Journal of Urban and Regional Research, DOI:10.1111/j.1468-2427.2013.01214.x
- [2] ENDA Ethiopia (2003); Proceeding of the experience sharing workshop on solid waste management in Addis Ababa, Ethiopia.
- [3] Yamane, Taro (1967). Statistics, An introductory Analysis, 2nd Ed., New York: Harper and Row.
- [4] Nicolas Escalante, Agata Rymkiewicz, Martin Kranert (2010). Understanding Waste Management in a Megacity - Experiences in Addis Ababa, Ethiopia.
- [5] Joy Ede Ukoje (2012). Informal Sector Solid Waste Collection and Recycling in Zaria, Nigeria.
- [6] Nigatu Regassa, Rajan D. Sundaraa and Bizunesh Bogale Seboka (2011). Challenges and Opportunities in Municipal Solid Waste Management: The Case of Addis Ababa City, Central Ethiopia.
- [7] Anne Scheinberg (2012). Informal Sector Integration and High Performance Recycling: Evidence from 20 Cities, The Netherlands.
- [8] Bjerkli, C. L. (2005): The cycle of plastic waste: An analysis on the informal plastic recovery system in Addis Ababa, Ethiopia. Trondheim: Norwegian University of Science and Technology.
- [9] Michael A. Tuori (2009), Strengthening Informal Supply Chains: The Case of Recycling in Bandung, Indonesia; University of Michigan, USA.
- [10] Cointreau, S.; (2006): Occupational and Environmental Health Issues of Solid Waste Management, Special Emphasis on Middle- and Lower-Income Countries. The World Bank, Washington D.C.