

# Circular Economy in Waste Reduction, Income and Employment Creation Potentials: The Case of Assosa Town Municipal Solid Waste Management, Western Ethiopia

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## Abstract:

The circular economy principle is applied in manufacturing, industries and services provision to minimize waste, through waste recycling and reusing, and recovering, making wise of resources, and changing waste –to- income. However, the application a circular economy to municipal solid waste (MSW) management services has been scarcely reported. The objectives of the study were to determine the potential of recoverable, recyclable, and reusable municipal solid waste, and evaluate how much income and employment can be created if the circular economy is applied. The study was conducted in Assosa Town using survey questionnaires that involved 385 randomly selected households. Samples from public institutions, commercial centers, and small- scale enterprises were systematically selected. The SW generated from these four major sources were monitored and recorded for three consecutive months. The study results showed that 73% of the average annual SW generated from HHHs, 67.7% of institutions, 69.6% of commercial centers, and 77.1% of small enterprises were recyclable and reusable, as well as, recoverable. Based on the current local market value, the recyclable, reusable, and recoverable SW can generate an average annual income of 49,972,996.31 ETB / y, which is possible to create employment opportunities for 375,585 persons /year. Hence, it is concluded that applying a circular economy principle helps reducing wastes moving to landfill site, enabling them to convert waste-to-money and create employment. Thus, it is suggested that municipalities should shift from linear approach to SW management and deploy existing waste resources through implementing a circular economy principle in provision of MSW management service.

**Keywords:** Circular Economy; Municipal Solid Waste; Recycle; Re-Use; Recovery; Waste-To- Income.

## 1. Introduction

Globally, urban solid waste management (SWM) has been attracting a lot of concern mainly because of the rapid growth of urban population, industrialization, rural-to-urban migration, and urbanization all contributing to increased solid waste generation in urban areas (Aikaeli et al., 2021). A study report showed that up to 50% of global waste has already been produced in cities and it has been projected that the level of municipal solid waste (MSW) will double in 2050 (OECD,2020). These conditions imply the need for

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rethinking new ways of managing MSW and designing more efficient use of waste resources, repurposing, and following a circular economy principle (Reddy et al., 2023).

Urban municipalities are usually responsible for the provision of municipal solid waste management services to create a clean and ideal environment for urban dwellers, and to maintain the aesthetic value of a town (Serge et al., 2020). In Ethiopia, in most towns and cities, MSW management is reported to be poor owing to many constraints such as a lack of expertise, equipment, logistics, and finance (Regassa et al., 2011). Gebrekidan et al, (2024) have reported that in Addis Ababa City, Ethiopia, on average, the percentage of solid waste collected between 2016 - 2020 was 70%, while 30% was uncollected. The authors have also described that in Bangladesh, (50%) of MSW, India (82%) of MSW, and Kenya (65%) of MSW are properly collected.

Like many towns in Ethiopia, in Assosa Town, which is the capital city of Benshangul Gumuz Regional State, MSW management is not well managed due to financial and logistic constraints, and accessibility. In this regard, Bekele (2023) has reported that solid waste originating from a residence is gathered by the side of the road as there is no public solid waste container for temporary storage of SW in the Assosa Town. As a result of these constraints, a good portion of MSW generated from households and other sources is disposed of in open places like roadsides and river-banks (Kebede, 2020), blocking drainage systems and causing flood risk during rainy seasons (Bekele,2023).

Dumping municipal solid wastes outside landfill sites can generate leachate that contains toxic compounds, which can cause environmental and public health problems (Tesseme et al., 2022). Similarly, landfill sites that are used for the disposal of MSW can also generate dangerous leachate that contains toxic metals and greenhouse gases like methane which poses harm to the environment; hence, to scrub those multiple problems reducing wastes moving to landfills, and recycling and reusing it for various purposes is essential (Sharma et al., 2023).

On the other hand, MSW consists of huge potential resources that can be reused again and again. For instance, in Ethiopia over 85% of MSW can be reused or recycled, of which 73.13% is decomposable and processed into compost, while 11.86% is recyclable (Gebrekidan et al, 2024). Hence, using such potential resources becomes necessary not only for better MSW management and safeguarding the environment but also to address poverty and unemployment. Studies showed that in 2022, the average annual unemployment rate of Assosa town was 19.4 while for all major towns was 22.4 (ESS, 2022). To this effect, the conventional waste management approach that follows the linear approach or waste to landfill should be shifted into waste reduction, recycling, reuse, and recovery to realize the benefits of a circular economy (Kalkanis et al., 2022).

The circular economy approach is an emerging concept applied to waste management, and it encompasses the ideas of waste-to-wealth (Reddy et al., 2023; Yadav and Sinha 2022). It can be applied in production, manufacturing, and services provision (OECD, 2020, 2025). The circular economy requires a significant change from the traditional linear approach to waste management, and waste should be perceived as a precious asset to be reclaimed, repurposed, and rejuvenated through a closed loop of waste-to-wealth (Reddy et al., 2023). Furthermore, Yadav and Sinha (2022) have described that the objective of 'waste- -wealth' is mainly focused on identifying, deploying, and developing technologies for SW recycling and reusing, and obtaining valuable resources from the waste streams. Thus, circular economy strategies encompassing waste is wealth or returning waste for money (Jongsuksomsakul et al., 2024). In light of this fact, a circular approach can benefit cities/towns from improved waste materials use efficiency (OECD,

2025) as enhanced resource use efficiency is central to the principle of a circular economy (Reddy et al., 2023).

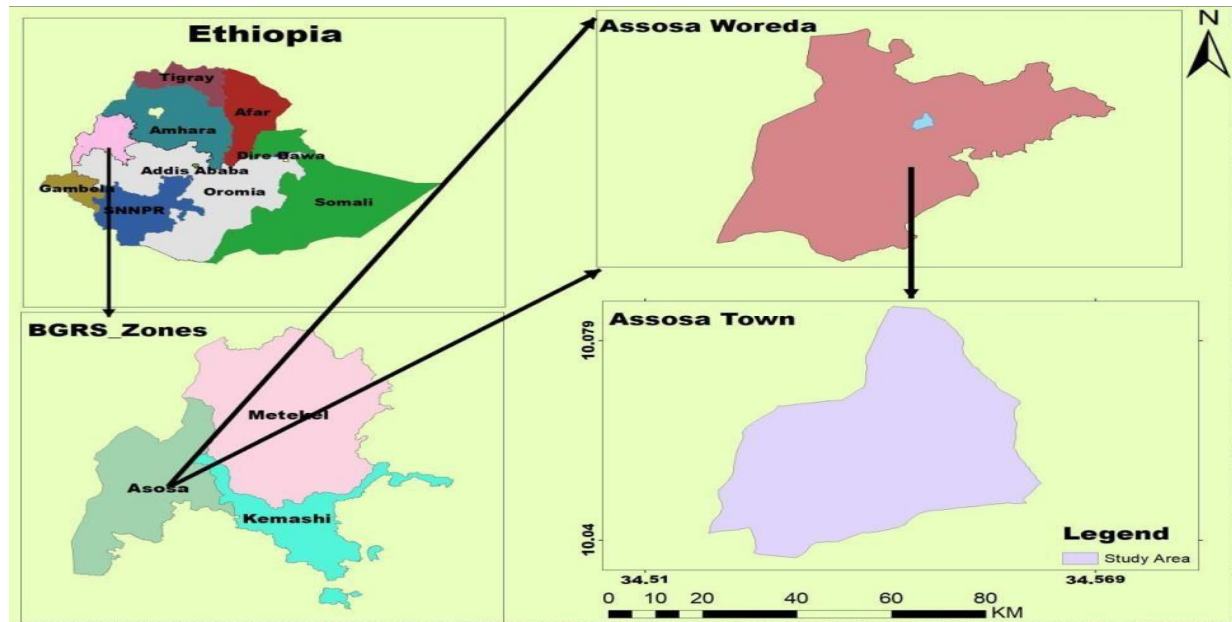
Many developed countries like Belgium, Finland, and Spain have been implementing circular economy approaches to minimize waste generation (OECD, 2020; 2025). For instance, Sofia City in Belgium has implemented a circular economy and reduced municipal waste generation, improved separate waste collection, increased reuse and recycling of waste, and reduced waste at sources (OECD, 2025). However, there are many critical challenges in planning and implementing a circular economy in managing MSW in towns and cities; these include a lack of adequate information and data on recyclable and reusable solid wastes which can be used as a milestone to track progress, technical knowledge and low awareness (OECD, 2025). In this regard, the studies were not conducted in Ethiopia, as well as, in Assosa town that aimed to explore the existing potential for planning and implementing a circular approach in MSW management. Hence, this is the first study attempt to determine the existing potential and quantities of MSW that can be reusable, recyclable, and recoverable. More importantly, the application of the concept of circular economy to municipal SWM service and its benefits has never been assessed and documented in Ethiopia. Thus, the study is important to generate data and information that can be used to design a sound solid waste management plan, leading to converting waste-to-wealth or waste to money and creating job opportunities.

Therefore, the objectives of the study were (i) to assess and determine recyclable, reusable, and recovery SW generated from households, commercial, private small enterprises, and public institutions in Assosa town, (ii) to assess and document income generation and job creation potential of the MSW management, if the circular economy principle is applied. Thus, the study findings help to demonstrate the application of the circular economy approach in municipal solid waste (MSW) management to promote awareness of recyclable, reusable, and recovery resources, and improve understanding of the circular economy that ensures sustainable municipal solid waste management.

## **2. Materials and Methods**

### **2.1 Description of the Study Area**

The study was conducted in Assosa town which is the capital city of Benishangul Gumuz Regional State. The town is located at 34° 51'67" E and 10° 06' 67" North, at an elevation of 1570 meters above mean sea level. Figure 1: shows the map of the study area. The topography of the town is dominantly flat and undulating land. The average of annual temperature is 29°C and average annual rainfall is 1,222 mm (Bekele, 2023). Based on Ethiopia Statistical Service (2022), population of all cities and towns official projections for the year 2022, the population of Assosa town was 69,700. Most of the town dwellers are engaged in trade and commerce, work for different government offices, private sectors, and NGOs, and engage in small-scale urban agriculture, and traditional gold mining outside the town, among others.



**Figure 1: Map of the study area**

## 2.2 Sampling Techniques

In Assosa town, the sample kebeles' were selected after obtaining relevant information from the town municipality and local community representatives. Five target sample kebeles' were selected based on a set of criteria: accessibility to the road; the presence of different organizations/ institutions, such as small enterprises, public institutions, and commercial centers; the number of HHs, and representatives of the town in terms of socio-economic conditions. Having determined sample size, random sampling techniques was applied to select specific of HHs to measure and collect data on SW generation.

The number of public institutions, small enterprises, and commerce (trade) listed, and the samples were determined systematically based on their lists gathered from selected kebeles' and Woreda Offices. Accordingly, 7 public institutions, 10 commercial centers, and 8 small private enterprises were selected and the amount of solid waste they generated was sorted and recorded for three consecutive Feb 2024- April 2024) months.

### 2.2.1 Household sample size determination

The total number of HHs found in selected the five kebele's were 8,854. Using the formula described in (Mekonen, 2022; Yemane 1967), with acceptable margins of error (5%), the number of households that participated in the study was determined as follows:

$$n = \frac{N}{1 + N(e)^2} \quad \text{Eq (1)}$$

$$n = \frac{8854}{1 + 8854(0.0025)}$$

$$n = 385$$

Where: n = sample size, N = total number of households in 5 kebeles, and e = (0.05) stands for margin of error.

### 2.2.2 Determination of Recyclable, Re-useable, and Recoverable MSW,

After identifying sample HHs, institutions, commerce centers, and small enterprise centers, awareness was given of the objective research work and requested their support and cooperation. One of the major supports expected from them was to store SW in bags given to them rather than dispose of them in other places. Having reached a consensus, coded waste storage bags were distributed among sample HHs, institutions, commerce centers, and enterprises, so that they could store their solid waste in the bags. The researcher carefully transferred all stored HHs, and SW to a clean sheet and carefully separated and categorized them into different classes, and the weight of each category was determined using weighting balance. The same procedures were applied to measure commercial, institutional, and small enterprises' waste generation.

Indeed, the composition of solid waste was identified and groped into foodstuffs and leftovers, fruits and vegetables, grass, plant leaves, wood, glass bottles, plastic bottles, rubber, iron, tin, cloth, and papers. In short, following the methods applied in (Hamid and Asgha 2018), the collected waste was weighed, and the weight of each component was recorded. After recording solid waste generation data, total SW, and percentage composition of MSW were computed using the formula described in Hamid and Asgha (2018).

$$\begin{aligned} &\text{Percentage of waste composition (e.g., food stuff)} \\ &= \frac{\text{Weight of food in (gm)}}{\text{Total weight all types of wastes(gm)}} \times 100 \end{aligned} \quad \text{Eq (2)}$$

Knowing the composition of SW, the recyclable, reusable, and recoverable solid wastes was identified and categorized as follows:

(i) Recyclable and re-useable categories of SW were glass bottles, plastic bottle, rubber, metals (iron), and Tin. (ii) Recovery SW categories (a) biomass energy- from wood, plant materials, (b) recovering nutrients for agricultural crop production in the form of compost /manure -from foodstuffs, food left over, fruits and vegetables, grass, plants, paper, leaves, organic matters,

Using the computational formula (Hamid and Asgha, 2018), the recyclable or reusable and recovery percentage was computed as follows:

$$\text{Percentage of recoverable SW} = \frac{\text{Weight of recoverable waste}}{\text{Total weight of waste}} \times 100 \quad \text{Eq (3)}$$

$$\text{Percentage of reusable \& recyclable SW} = \frac{\text{Weight of reusable \& recoverable waste} \times 100}{\text{Total weight of waste}} \quad \text{Eq (4)}$$

### 2.2.3 Assessing market value for recoverable, recyclable, and reusable SW waste

The market value of recyclable, reusable, and recoverable materials in Assosa Town was assessed by approaching local shops and private enterprises like garages, woodwork, metal workshops, used item purchasers, bottled water distributors, alcohol and soft drink sellers and determined purchasing price for each type of waste. Once the quantity produced and purchasing price are known, the income that can be generated from selling can be estimated as follows:

$$\text{Total market price (ETB)} = (\text{recoverable materials quantity}) \times (\text{unit price}) + (\text{recyclable materials quantity}) \times (\text{unit price}) + (\text{reusable materials quantity}) \times (\text{unit price}) \quad \text{Eq (5)}$$

**2.2.4 Determining employment opportunities**

The number of jobs that can be created was estimated based on the income generated from selling of recyclable reusable, and recoverable waste considering the average monthly payment for municipal SW cleaners in the town.

$$\begin{aligned} &\text{Number of jobs created per day} \\ &= \frac{\text{total income from recycle + reuse + recoverable waste per day}}{\text{daily payment per person } (\frac{\text{bir}}{\text{day/pers}})} \end{aligned} \quad \text{Eq (6)}$$

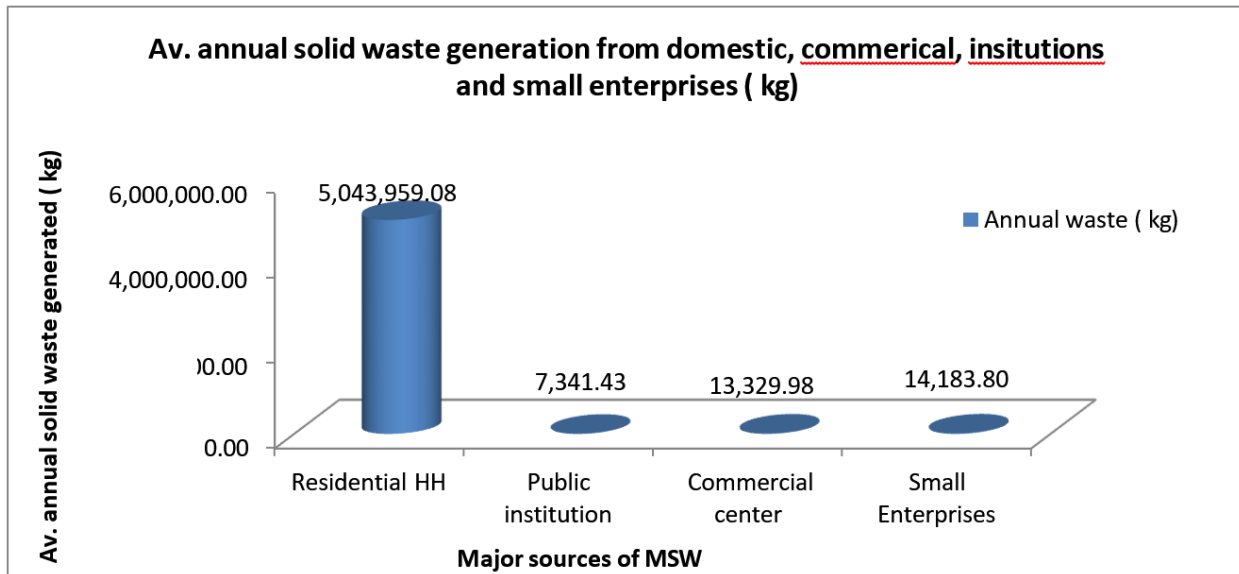
**2.3 Data Analysis**

Descriptive statistics such as frequency, average value, and percentage were computed using MS Excel version 2010. The results of the data analysis were presented in tables and simple figures.

**3. Results and Discussion**

**3.1. Total MSW Generation from Residential, Institutions, Commerce, and Enterprises**

The average annual solid waste generation in the town is presented in Figure 2. The highest solid waste generated from domestic households (5,043,959.08 kg / y) may be due to daily consumption of food items and the presence of a large number of HHs. The lowest average annual solid waste (7,341.43 kg / y) generated from public institutions, mainly consisting of paper and cardboard that is largely used in public institutions for routine activities such as writing and documentation activities.



**Figure 2: Av. annual solid waste generation in Assosa Town**

The decreasing order of average annual total SW generation was: HHs > small enterprises > commercial centers > institutions. This result implies that large quantities of SW are generated from HHs so that attention must give to it and handle HHs SW in applying a closed loop approach. This means the

municipality, which is responsible for MSW management, needs to give priority to domestic SW without ignoring SW generated from small enterprises, commercial centers, and institutions. Hence, in pursuing a circular approach of MSW recycling, recovering, and reusing determining major sources of waste and managing it in accordance with closed loop approach is essential to address environmental pollution. In another study, Kedir et al.,( 2022) have reported 14,702,316.8 kg SW was annually generated from HHs in Jigjiga Town, Somali Regional State, which is higher than the present findings for HHs (5, 043,959.08 kg /y) may be due to varied number of populations living in the town, incomes, and food consumption behavior of household.

### 3.2. Composition of MSW-generated HHs, institutions, commercial and small enterprises

The result of the physical separation and identification of major composition of Assosa town MSW are presented in Table 1.

Table: Composition of MSW generated from HHs, institutions, commercial centers, and small enterprises

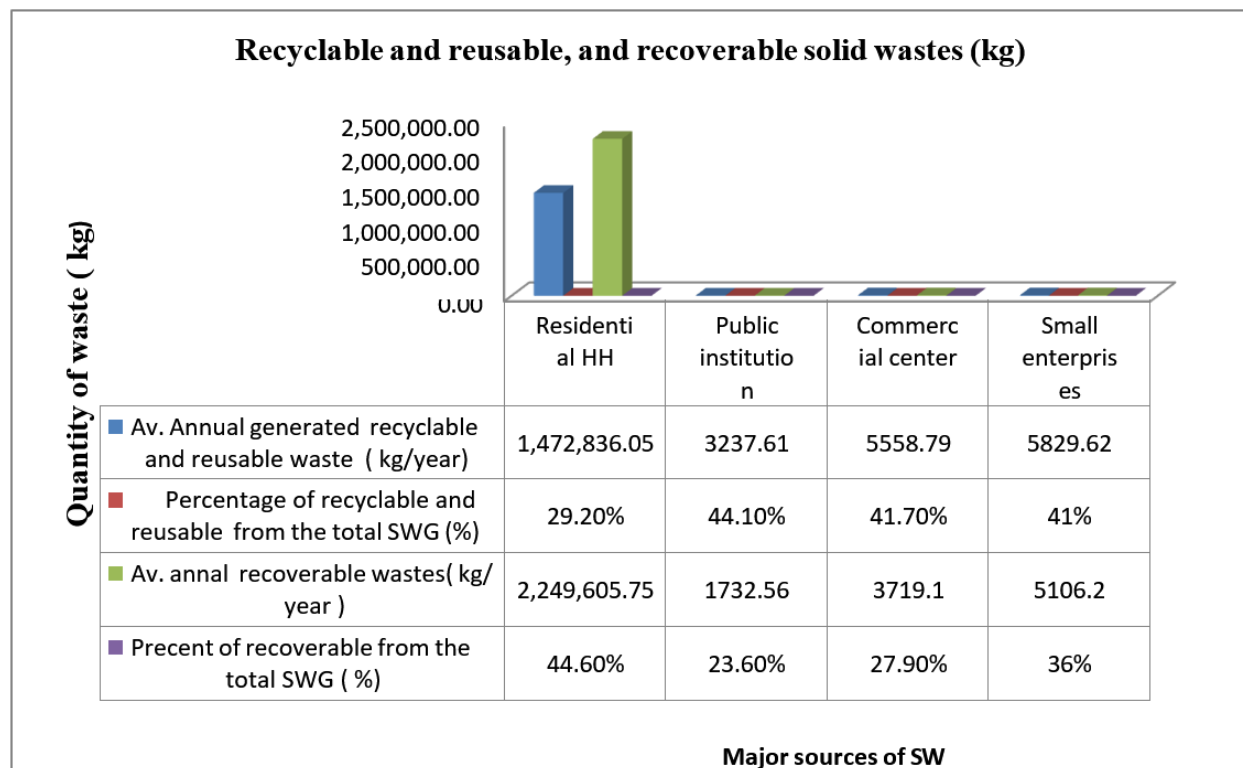
Sources of MSW	HHs (%)	Institutions (%)	Commercial centers (%)	Small enterprise (%)
Fruits and vegetables	22	-	15	-
Food left over	16		13	
Plastic bags and bottles	15	25	26	2
Wood	13	9	6	44
Cloth	8	-	10	-
Glass bottle	7	10		4
Plant leaves	6	3	4.6	6
Paper and board	5	38	7.4	
Rubber	3	11	6.6	10
Grass	2	1	3.4	4
Iron	1	2	2.8	23
Tin	2	1	5.2	7
<b>Total</b>	100	100	100	100

As shown in Table 1, the highest HH SW compositions constitute fruits and vegetables (22%), followed by food leftovers (16%), while the list percentage of composition was iron (1%). This result implies that in circular economy principle, fruits and vegetables, and food stuffs play vital role in recovering nutrients through composting SW while iron can be directly reused as the case may be. This high percentage of fruits and vegetables may be attributed to the consumption behavior of people in Assosa town. Public institutions largely generate paper and cardboard (3%), and plastic bags and bottles (25%) and generate paper wastes from routine activities, while plastic bottles from drinking bottles water at workplaces. Commercial waste is also composed of the highest percentage (26%) of plastic waste that can be directly reused or recycle.

The highest composition of enterprise wastes is composed of wood (44%) followed by iron (23%), which may be attributed to the use of wood as a raw material, packaging, and operational efficiency. Kedir et al.,( 2022) who have conducted studies on HHS SW in Jigjia Town, Ethiopia, have reported that the household food waste constitutes the highest percentage (35%) which is higher than the present findings for food left over (16%) , while the reported percentage composition of metals was (0.11%), lower than the current findings (1%). Similarly, Birhanu and Genemo (2015) who have also reported that the largest constituent of residential HHS solid waste was food waste (37%). Literature showed that the amount of SW generated form HHS is often influenced by socio-economic factors like HHS income, number of family size, level of education, marital status, cultural or traditions of peoples , population density, and the level of commercial activity (Khan *et al.* 2016).

### 3.3. Recyclable and Reusable and Recoverable SW

The average annual recyclable and reusable, and recoverable SW was quantified and the results are presented in Figure 4.



**Figure 4: Recyclable, reusable, and recovery of solid waste**

As shown in Figure 4, 29.2% (1,472,771.35 kg / y) of the average annual SW (5,043, 959. 08 kg/y) generated from households; 44.1% ( 3237.61 kg/y) of the average annual (7,341.43 kg / y) of SW generated from public institutions; 41.7% (5, 558.79 kg / y) of the average annual (13, 329.9 kg/y) generated from commercial centers and 41% (5,829.62 kg/y) of the average annual (14, 183.80 kg/y) generated SW from small enterprise were recyclable and reusable. In total, about 1,487,462.07 kg / y MSW was generated from these four sources. Even though small percentages of recyclable and reusable (29.2%) SW were generated from HHS, the highest quantities of SW (1, 472, 771.35 kg/y) were generated from residential HHS as compared to public institutions, commercial and small enterprises. This result implies

that the focus of MSW management activities and in recycling and re-using SW as per the circular economy principle, HHs generate huge potential resources to be deployed.

The recyclable and reusable solid wastes generated from HHs, institutions, and commerce largely constitute plastic bottles and bags, glass bottles, cloth, paper, rubber, iron, and tin. However, the highest quantities recyclable and reusable SW was plastic waste which may attributed to the day-to-day use of plastic bags for household items, the use of plastic bottled water for drinking, and the disposal of plastic after use. Studies showed that globally the generation of plastic waste will increase to over 700 million tons over the coming 20 years (Jongsuksomsakul et al., 2024).

With regard to the quantities of recyclable and reusable SW, the present study finding aligns with other studies; for instance, studies done in Ghana showed that 47% of institutional waste was suitable for recycling (Osei et al, 2019), while research done in some educational institutions in India, reported 42% recyclable SW (Kumar et al., 2021) which agrees with present findings for institutional SW. Similarly, research conducted in Kampala City, Uganda, indicated that recyclable materials constituted about 35% of total industrial waste (Nabugoomu et al., 2019) which is slightly lower than the present findings for small enterprises may be due to differences in scale of operations and types industries/enterprises, types raw materials used, efficiency, technology used, waste management practices, economic conditions, and community awareness regarding recycling (Abdullah et al., 2020; Kassa et al., 2018).

Whereas the recyclable and reusable SW originated from small enterprises, irons, tins, and wood were the major constituents of recyclable and reusable small enterprises' waste. Normally, irons were largely generated from garages and metal workshops found in the towns. The demand for iron and tin in the town is high as it can be recycled into metallic products in garages or metal workshops. Hence, applying the circular principle in Assosa town, particularly in small-scale enterprises can be beneficial for competence and reduce waste generation (OECD, 2025). Applying circular closed-loop techniques to recyclable and reusable SWs enables efficient use of resources to save costs of SW disposal and generate income when they are sold in the local market. Thus, characterizing and identifying non-hazardous HHs, institutional, commercial, and small enterprises SW and recycling them have an immense contribution to successful adaptations of waste management strategies toward a circular economy and waste-to-wealth transformation (Kalkanis et al., 2022).

On the other hand, 44.6% or (2,249,600.99 kg / y) of the average annual SW generated from the HHs; 23.6% ( 1,732.56 kg/y) of the SW generated from public institutions; 27.9% ( 3719.1 kg / y) of the SW generated from commercial centers, and 36% ( 5106.2 kg / y) of the SW generated from small enterprises was recoverable SW. In sum, 2,260, 163.43 kg/y recoverable MSW generated from these four sources. The major recoverable HHs and commercial centers SW mainly consist of fruits and vegetables, food leftovers, and wood, with small quantities of plant leaves and grass which is showed potential organic waste. In a closed-loop approach, organic wastes such as fruits and vegetables, food leftovers, grass, and plant leaves represent can be decomposed to compost to recover plant nutrients that can be used to improve soil fertility boost urban agricultural productivity, and reduce waste sent to landfills (Bernardo et al., 2020, thereby contributing to meeting food security while generating income for unemployed persons (Dominguez et al., 2019). In Addis Ababa City, the practice of producing and selling compost for income generation is well-established (Yenebebe et al., 2016). Furthermore, recovering plant nutrients from SW reduces reliance on chemical fertilizers that pollute the environment through leaching into surface and groundwater, and enables wise- use of resources through a circular approach (Kalkanis et al., 2022; OCED, 2025).

The recoverable SW originated from public institutions and enterprises and mainly consists of materials such as wood, cardboard, plant leaves, and grass. These SWs can be used for recovering energy (biomass energy); hence, it is possible to reduce SW transport and disposal costs at land-fill maintain the aesthetic value of urban areas contribute to reducing deforestation and generate income when wood cardboard is sold in local market (Zaman & Lehmann, 2013).

### 3.4 Income Generation from MSW

Recyclable and reusable, as well as recoverable solid wastes are potential sources of income that create wealth, especially for the jobless segment of the local population. Generating income from reusable recyclable and recoverable SW becomes an incentive for unemployed youth to engage in such green jobs that return waste for money (Jongsuksomsakul et al., 2024)

#### 3.4.1 Income Generation from Recyclable Reusable, and Recoverable Residential SW

The estimated average annual income generated from recyclable, reusable, and recoverable SW generated from HHs is presented in Table 2.

**Table 2: Income generation potential of Assosa town MSW**

Sources of MSW	Av. Annual income from recyclable and reusable SW (ETB / Y)	Av. Annual income from recoverable SW ETB/Y)	Total Av. annual income ( ETB / Y).
Households(HHs)	46,579,903.95	2,920,384.30	49,500,287.90
Public institutions	76,894.09	2,217.09	79,111.18
Commercial centers	179,560.95	4,397.12	183,958.06
Small enterprises	196,589.89	13,049.10	209,639.11
Total	47,032,948.88	2,940,047.61	49,972,996.25

Notes: ETB-Ethiopian Birr, Y-year

As shown in Table 2, the estimated total average annual income generated from domestic (HHs) recyclable and reusable, and recoverable SW was 49,500,287.90 ETB / y; 79,111.18 ETB/Y from Public institutions SW; 183,958.06 ETB/y from commercial centers, and 209, 639.11 ETB

/y from small enterprises. In sum, 47, 032, 948. 88 ETB/y was generated from recyclable and reusable waste, while 2,940, 047.61 ETB/y was generated from recoverable MSW. The variation in the income across different sources is attributed to the quantities of SW generated, types of SW, consumption of resources and processing, and the unit prices of each type of waste at Assosa Town. The highest income is generated from HHs SW, followed by small-scale enterprises, and commercial centers while the least from public institutional wastes. The highest income is captured mainly from recyclable and reusable HHs and institutional SWs such as plastic bottles, cloth, and iron; and from recoverable SWs such as fruits and vegetables, food left over, and wood when they are converted to manure /compost and sold in local markets. This result showed that if the SW generated from domestic sources is efficiently exploited and

converted to money, it becomes an important source of income. Thus, applying the novel idea of waste-to-income or wealth has a paramount contribution to having a clean environment, and reducing the cost of SW collection, transport, and disposal.

Like HHs and institutional SW, the high average annual income derived from commercial centers was from recyclable and reusable wastes such as plastic bottles, cloth, tin, and from recoverable wastes like fruits and vegetables, and wood. Whereas the high income generated from small enterprises largely originated from recyclable and reusable iron, rubber, and tin. Invaluable raw materials such as iron, tin, and plastic bottles have high demand on the local market and can generate income. In this respect, Kalkanis et al., (2022) have described that metals in waste streams such as aluminum tin have up to 100% purity so the production of Al cans from used empty collected Al cans, and other window frames requires 95% less energy and 97% less water.

The total average annual income (49,972,996.25 ETB/y) derived from all sources of MSW considered under this study, implies that if the municipality of Assosa town sticks to the novel concept of waste-to-income /money and thoroughly applies waste recycling, reusing, and recovering, can earn quite good economic. In countries like Ethiopia in general, and Assosa in particular, where unemployment is high, involving jobless people in SW management can benefit from such income. Besides income generation, the environmental benefits of recycling and recovering circular economy in reducing SW at sources can be immense. Gebrekidan et al., (2024) have also described that the majority of the SW produced in towns and cities in Ethiopia can be recycled and they are a source of income if managed correctly in such a way to produce organic compost, briquette production, renewable energy among others, and create green job opportunities.

### 3.5 Job creation opportunities from MSW

Recycling reusing and recovering SW are essential techniques leading to converting waste into income in accordance with the principle of circular economy. Assuming the average monthly salary (4,000 ETB /month/pers) in Assosa Town, the result of job creation opportunities from MSW analysis is presented in Table 3.

**Table 3: Job creation potential of MSW**

No	Activity	Monthly	Annually
1	Average income generated from SW (ETB)	4,107,369.56	49,972,996.31
2	Labor wage norm (ETB/day)	4,000	48,665.45
3	Number of jobs to be created	30,870	375,585

As shown in Table 3, from SW recycling, reuse, and recovery, it is possible to create an average annual income (49,972, 996. 31 ETB /y), that helps hire a total of 375,585 persons per annum. This result implies that if the SW of Assosa town is efficiently utilized, it can create employment opportunities for many jobless people including jobless youth to reduce rampant unemployment and address poverty in urban areas. In this regard, the Ethiopian Statistical Services (ESS), (2022), reported that in 2022, the annual average unemployment rate in Assosa town was 19.4%. Studies conducted elsewhere in China showed that waste streams have created 1.5 million direct jobs and 10 million indirect jobs, while in India, around 1.75 million

people are working in the metal recycling activities, which contribute up to 2% of Gross Domestic Product (GDP) (David et al., 2019). Thus, employing a circular economy approach not only addresses environmental challenges but also creates job and business opportunities (EPA, 2024).

#### 4. Conclusion and Recommendations

The study conducted in Assosa Town aimed to explore recycling reusing and recovering potential of municipal solid waste (MSW). The results of the study showed that the MSW consists of large quantities of recyclable and reusable 1,487,462.07 kg/y), and recoverable (2,260, 163.43 kg /y) SW. Thus, following the principle of circular economy in waste management, it was possible to reduce SW that moved to landfill site through recycle and reuse large quantities of resources and create an opportunity recovering plant nutrients from organic wastes and biomass energy. Applying the concept waste-to-income can generate about 49,972, 996. 31 ETB per annum that enables employment opportunities for 375,585 persons per year. Thus, managing MSW in town in accordance with the circular economy is beneficial to reduce wastes that pollute the environment, and make wise use of resources.

The study has contributed to improving understanding of the application of emerging concepts and ideas like waste-to-income and circular economy, and their applications in MSW management to achieve multiple benefits. Thus, it suggested that Assosa municipality should apply closed-loop solutions and promotes key circular economy techniques like recycling, reusing, and recovering MSW waste to achieve sustainable environmental social and economic benefits.

#### 5. Acknowledgements

The author's would like to thank the Assosa Town dwellers, public institutions, commercial centers and private enterprises who have genuinely participated and supported the research work in many ways.

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## 7. Conflict of Interest

The authors declared that there was no relevant financial or non-financial conflict of interest.

## 8. Funding

Since this research work was conducted as an M.Sc. student research work supported by Assosa University, Ministry of Education.

## 9. Author Contribution

Dinkensh Dessalign has contributed in conceptualization, designing of the experiment, data analysis, writing draft manuscript; Deshu Mamo has been contributed in conceptualization, designing of the experiment, data analysis, writing and editing the manuscript.