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Economic Analysis of Recyclable Waste Management Systems in Bheemdatt Municipality, Kanchanpur, Nepal

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Abstract

This study investigates the economic analysis of recyclable waste management systems in Bheemdatt Municipality, Kanchanpur, Nepal. It aims to analyze the current state of recyclable waste management, focusing on understanding the situation and analyzing economic perspectives. Employing a mixed-methods approach, it utilizes Key Informant Interviews (KII) and semi-structured questionnaires for primary data collection, supplemented by secondary data sources.The findings highlight despite challenges such as poor technology and limited municipal involvement, the municipality demonstrates resilience in regulating scrap collection activities and revenue generation through taxation, facilitated by private sectors, underscoring the economic viability of recycling initiatives. Major findings from analysis shows an increasing ratio of e-waste, poor technological and management practices by the municipality, and a notable presence of female workers in the waste management sector. The study concludes that e-waste, such as batteries and electronic devices, is on the rise in municipal waste, offering recyclable possibilities and contributing significantly to the recyclable materials. Additionally, it can be concluded that recyclable waste is economic viability of recycling initiatives for local government in which female workers are more prevalent than male workers in the collection and management of recyclable waste in the study area. Continuous review and adjustment of taxation policies, investment in recycling infrastructure, promotion of circular economy principles, exploration of emerging market opportunities, and capacity building for waste collectors and scrap center workers are recommendations of the study which can enhance the economic sustainability of recycling initiatives for the local government.

Keywords: Bheemdatt Municipality, Recyclable waste, Economic analysis, Revenue

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Introduction

Recycling is the process of transforming recyclable waste materials into new materials and objects for use it again and again. The recyclability of a material basically depends on its ability to reacquire the properties it had in its original state before (Mastellone, 2019). Recycling prevents the waste of potentially useful materials and minimizes the frequency of consumption of fresh raw materials every time, reducing ultimately supports the environmental cleanness and by reducing the energy use, air pollution and water pollution including landfilling of waste materials (Mastellone, 2019; Zhao et al., 2016). It upgrades environmental sustainability by removing huge amount of raw material input for new production and redirecting waste output by recycling (Mastellone, 2019; Zhao et al., 2016). Improvement of technology supports the recycling of different materials including many kinds of glass, plastic waste, paper, cardboard, electronic equipment, metal, etc. (Mastellone, 2019; Zhao et al., 2016). These materials are either collected from a household or picked up from waste materials of market area waste collection center (Mastellone, 2019; Zhao et al., 2016).

According to the latest constitutional provision of Nepal and by the Solid Waste Management Act 2068, local levels governments are responsible for construction of infrastructures like transfer station, landfill site, processing plant, compost and biogas plant including waste collection, processing, and disposal (Government of Nepal, 2011). A local government may also empower the company, organization, and agency, producing solid wastes, for segregating, reducing the solid wastes at its source, reuses, and recycling using solid wastes and mobilize the community and nongovernmental organization for creating awareness for the management of the solid waste (Government of Nepal, 2011). Local Governments have also the authority to determine service charges for solid waste management related business and activities (Government of Nepal, 2011). Accordingly article 2, sub-section 1 of the Local Government Operation Act 2017, to be a municipality, there should be proper management of municipal waste and landfill sites (Government of Nepal, 2017). Safe management of healthcare waste (segregation at source, collection, treatment of risky waste, transportation including recycle/ reuse, safe disposal, and fixing tariff of these services and regulation) is defined as roles of local government (Government of Nepal, 2017).

Waste management is a critical issue facing municipalities worldwide, including those in Nepal. To study the current situation of recyclable waste management in Bhimdatta Municipality Kanchanpur this study was conducted. Solid waste management

is a major problem for long time in the municipality. Daily waste collecting and dumping records of municipality shows that around 2 to 4 tons of garbage is collected per day within the municipality and is collecting mixed waste. However, collection is limited in the market and selected public places. Bheemdatt Municipality, situated in the Kanchanpur district, is no exception, grappling with the challenges of effectively managing recyclable waste amidst rapid urbanization and population growth. As the municipality seeks to address these pressing concerns, a comprehensive understanding of the economic dimensions of recyclable waste management becomes imperative.

Existing waste management system of municipality is not capicated to manage recyclable waste. Recyclable and non-recyclable all waste collected from the market by municipality was dump in road site and fill down with concrete waste. For a long time, the municipality had issued several public notices to searching for land to construct a dumping site with the support of different donor projects, but none of the landowners in the municipality is willing to provide land plots to municipality authority for the purpose to construction of the landfill site. Protest by the local residents was the major obstacle which leads to the failure of all previous plan of municipality towards proper waste management. However, few private sectors were success to grab the weakness of municipality in solid waste management and established as well-known recyclable waste collector in the market area. Few private vendors collecting the certain types of recyclable waste and manage the market for these materials themselves.

The economic analysis of recyclable waste management systems in Bheemdatt Municipality aims to provide valuable insights into the current state of waste management practices and their economic implications. By examining the economic perspectives of recyclable waste within the study area, this research endeavors to inform decision-makers, policymakers, and stakeholders about the financial aspects of waste management operations.

Objectives

General objective of the study is to analyze the current situation of recyclable waste management in Bheemdatt municipality. The specific objectives are given below:

1) To know the situation of recyclable waste management in Bheemdatt municipality.
2) To analyze the economic perspectives of recyclable waste in the study area.

Literature Review

Waste management, particularly the economic aspects of recyclable waste, has garnered significant attention in academic literature due to its relevance for sustainable development and environmental conservation. This literature review provides an overview of key studies and findings related to the economic analysis of recyclable waste management systems, with a focus on the context of Bheemdatt Municipality, Kanchanpur, Nepal. Economic analysis plays a crucial role in understanding the feasibility and efficiency of waste management systems.

According to Wang, Zhang, & Liu (2020), economic factors such as costs of collection, transportation, processing, and market demand for recyclable materials significantly influence the viability of waste management strategies. In the context of Bheemdatt Municipality, these economic perspectives provide a framework for assessing the financial implications of waste management operations. Several studies have examined the cost-effectiveness of recycling programs in various settings. For instance, Hoornweg & Bhada-Tata (2012) conducted a global analysis of solid waste management and highlighted the potential economic benefits of recycling, including resource conservation and job creation. Similarly, Wilson & Velis (2015) emphasized the importance of incorporating economic considerations into waste management policies to optimize resource allocation and maximize societal welfare. These insights underscore the relevance of conducting a cost-benefit analysis of recyclable waste management systems in Bheemdatt Municipality to identify opportunities for economic optimization.

The socio-economic dimensions of waste management are also significant factors to consider. According to Medina (2016), waste management practices can have far-reaching impacts on livelihoods, public health, and environmental sustainability. In the context of Bheemdatt Municipality, socio-economic factors such as income levels, employment opportunities, and community engagement are essential considerations for designing effective waste management interventions.

Effective waste management requires supportive policy and regulatory frameworks. Gupta & Sharma (2018) highlighted the role of government policies in promoting sustainable waste management practices, including incentives for recycling and penalties for improper waste disposal. In Nepal, initiatives such as the Solid Waste Management Act (2011) provide a legal framework for waste management, but challenges remain in implementation and enforcement, particularly at the municipal level. The literature reviewed underscores the importance of conducting an economic analysis of recyclable

waste management systems in Bheemdatt Municipality. By integrating insights from existing studies on the economic perspectives of waste management, cost-benefit analysis of recycling programs, socio-economic implications, and policy frameworks, this research can provide valuable guidance for policymakers, municipal authorities, and stakeholders in optimizing waste management strategies to promote economic efficiency and sustainability.

Methods of Study

Study area

Bheemdatt Municipality, with its rich geographical heritage and demographic diversity, serves as a vital hub within Kanchanpur District, contributing significantly to the socio-economic fabric of the Sudurpaschim province, Nepal. Bheemdatt Municipality, previously known as Mahendranagar Municipality, encompasses an area of 171.34 square kilometers within the Kanchanpur district of the Sudurpaschim province, Nepal (Bheemdatt Municipality Profile, 2021). Situated approximately 750 kilometers to the far-west of the capital city Kathmandu, it holds the distinction of being the oldest municipality in Kanchanpur.

Geographically, Bheemdatt Municipality is bordered by the Mahakali River to the west, while the eastern boundary is shared with Bedkot Municipality. To the north lies Parshuram Municipality in the Dadeldhura district, and to the south is the expansive territory of Shuklaphanta National Park. Administratively, the municipality is segmented into 19 wards, which are further categorized into urban, semi-urban, and rural wards. The urban classification includes three wards, six wards are designated as semi-urban, and the remaining ten wards are classified as rural (Bheemdatt Municipality Profile, 2021).

As per the latest statistics from the Central Bureau of Statistics (CBS) in 2021, Bheemdatt Municipality boasts a total population of 122,320 individuals, residing in 27,570 households (Bheemdatt Municipality Profile, 2021). The average family size within the municipality is reported to be 5.31 persons per household, indicative of the community's familial structure. Moreover, the literacy rate in Bheemdatt Municipality stands at an admirable 84.3%, underscoring the importance of education within the community (Bheemdatt Municipality Profile, 2021).

Research Design and Data

The research methodology employed in this study is empirical, utilizing both quantitative and qualitative data collection methods. Both primary and secondary data

were gathered to provide a comprehensive understanding of the subject matter. Primary data were collected through Key Informant Interviews (KII) with municipality stakeholders, including section officers, finance officers, and representatives of the municipality's scrap contractor and owner of scrap center. in total 5 KIIs were conducted in this study. Additionally, semi-structured questionnaires were administered to registered waste collectors. These primary data sources offer firsthand insights into the waste management practices within the municipality.

On the other hand, secondary data were also incorporated into the study. These secondary data sources include literature reviews, published documents, the municipality's official website, and available project reports from local organizations. Secondary data provide contextual background information and supplement the primary data collected.

Given the mixed methods approach, the data collected comprise both quantitative and qualitative elements. Quantitative data are numerical in nature, offering statistical information about various aspects of waste management, such as quantities of waste generated, recycling rates, and financial expenditures. Qualitative data, on the other hand, offer descriptive insights, opinions, and perspectives from stakeholders, providing a deeper understanding of the social, economic, and environmental aspects of waste management practices.

Results and Discussions

The research conducted in Bheemdatt Municipality provides significant insights into the composition and generation rates of solid waste, revealing key contributors and waste types within the community. Household waste emerges as the primary source, comprising 23.3% of the total waste generated, with an average household waste generation rate of 0.69 kg and a daily per capita generation rate of approximately 0.138 kg (Bheemdatt Municipality, 2023). Notably, organic waste constitutes the majority of household waste at 63.3%, followed by plastics at 13.79%. Commercial establishments, including hotels, lodges, and shops, collectively contribute substantially to the solid waste stream, with organic waste being the predominant component at 52.64%, accompanied by glass and plastics (Ramesh Joshi & Yadav Josh, 2018). Institutions such as schools, colleges, and offices also play a significant role in waste generation, with organic waste, plastics, and paper being the primary components. Particularly noteworthy is the substantial presence of paper in institutional waste, indicating potential for recycling

initiatives. Except for organic waste, all other types of waste demonstrate potential for reuse and recycling based on their composition and material nature.

These findings of literature review underscore the critical need for comprehensive waste management interventions tailored to the specific characteristics of each waste type, focusing on organic waste management in households and institutions and implementing targeted recycling initiatives for paper, plastics, and glass from commercial and institutional sources. These findings highlight the urgent need for comprehensive waste management interventions within the municipality. Targeted initiatives aimed at recycling paper, plastics, and glass from commercial and institutional sources can contribute to waste reduction and environmental sustainability.

Recyclable Waste Management System:

Bheemdatt Municipality adopt the public private partnership in recyclable waste management. Existing scrap collection system of municipality is shown in following figure. There are three registered waste collectors in municipality who directly deals with the recyclable waste. They are registered as private business form as per the Section 6 (ka) of Financial act 2078 of Bheemdatt municipality and perform accordingly. Informal waste collectors called *Pheriwala* are the individual people who collect the reusable and recyclable waste materials from households and sold to registered waste collector. Registered waste collectors segregate plastic waste, paper waste, metals and others as per their requirements of recycling. Registered waste collectors did not have any balling and shredding machines due to which there was problems for packing of plastic and paper waste.

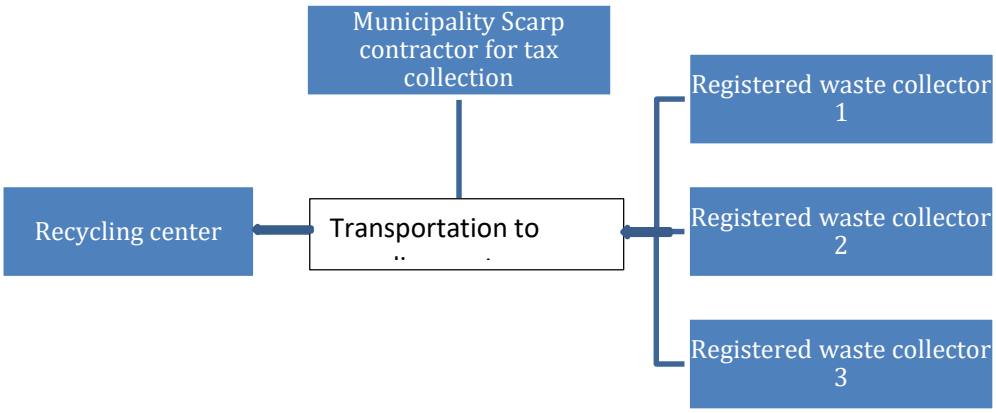

Figure 1: Recyclable waste management practices at Bheemdatt municipality

Registration and Fees

Municipality fixed the registration fees to register and renewed the forms who wants to work in this sector. The registration fee will be changed as per the provision of the financial act 2078 of Bheemdatt municipality. The fee structure is shown in following figure. In the annex 4 (5) of financial act 2078, there was provision for registration of 41 different types of forms and businesses and scrap collection business is comes in the same category in 32nd serial out of 41 items. Registration fee is as below.

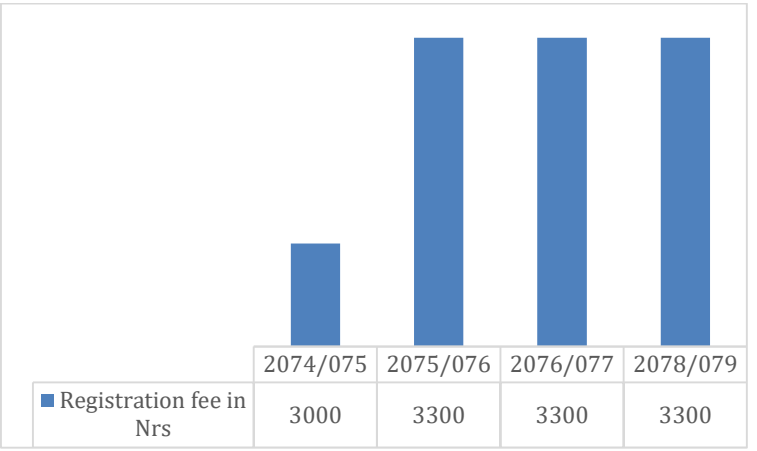

Figure 2: scrap form registration fee, Source: Financial act 2078 of Bheemdatt municipality

Figure 2 (above) shows that to increase the number of private waste collector municipality did not change the registration fee of farm registration. Any individual can registered their farm to work in waste collection sector by providing basic registration requirements within one days.

Revenue Generated from Scrap

Scrap contractor was selected two years ago for three years and then reselection process was followed by procurement process of municipality for contract agreement for tax collection of recyclable waste materials. Scrap contractor pay tax to municipality with aggregated sum amount per year as per agreement in bid documents. The three years revenue status from recyclable waste is as shown in trend line.

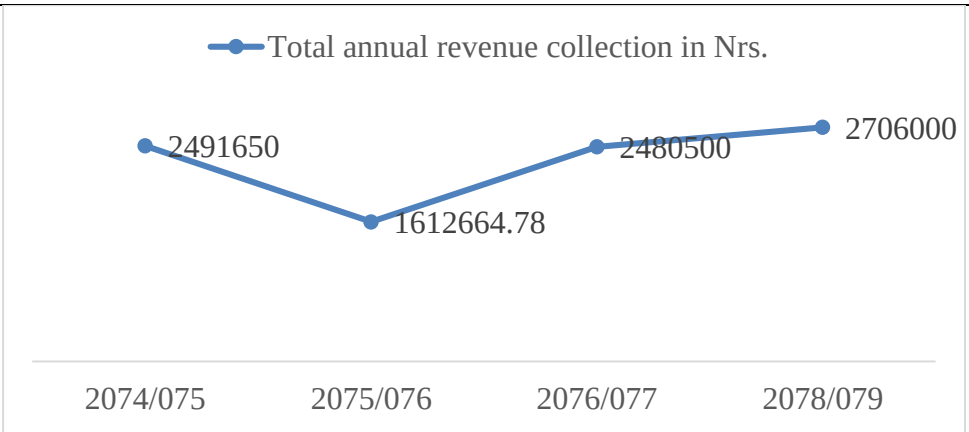

Figure 3: Revenue generated from scrap items of Bheemdatt municipality

The data of above figure presents the collected revenue from the scrap vendors in Bheemdatt Municipality over several years in Nepalese rupees, indicating an increasing trend over time. In the fiscal year 2074/075, the revenue collected from scrap vendors amounted to 2,491,650 Nepalese rupees. The revenue dropped significantly to 1,612,664.7 rupees in fiscal year 2075/076. This decrease is attributed to the impact of the COVID-19 pandemic, particularly due to lockdown measures that restricted the waste collection activities. In 2076/077 the revenue bounced back and increased to 2,480,500 rupees. This indicates a recovery from the previous year's drop and a return to the upward trend. Moreover, Revenue continued to rise, reaching 2,706,00 rupees fiscal year 2078/079. in the recent fiscal year 2079/80 it was 3,05,9680 rupees. This demonstrates sustained growth in revenue collection, suggesting an increase in the quantities of recyclable materials being processed from municipal waste.

The trend line drawn from these data points would depict a generally upward trajectory, indicating a consistent increase in revenue collected from scrap vendors over the years. The significant drop observed in 2075/076 could be directly linked to the adverse effects of the COVID-19 pandemic, as lockdown measures likely hampered waste collection activities, thereby reducing revenue from scrap sales.

The subsequent recovery and continued growth in revenue in the following years suggest resilience in the waste management sector and a probable increase in the quantities of recyclable materials being recovered from municipal waste streams. This could be attributed to various factors such as increasing awareness of recycling, improved waste management infrastructure, and potentially a growing emphasis on environmental sustainability.

In summary, the trend line visually represents the positive correlation between revenue from scrap vendors and the quantities of recyclable materials in municipal waste, with the COVID-19 pandemic serving as a notable anomaly in the data.

Taxable Scrap Items

All types of recyclable waste were not collected by the collectors due to the poor management and less profit range. According to annex 5 of financial act 2078 of Bheemdatt Municipality, there was fixed tax rate for 19 different scrap items. However, only about 12 items were collected till 2023. The detailed about the tax amount of 19 different scrap items is as shown in 5 of financial act of Bheemdatt Municipality 2078.

Quantity of Recyclable Easte Generated in Bheemdatt

Overall production of waste in market area is not too large quantity. Municipality records shows 11 to 14 tons of garbage per day is generated in the municipality. The average monthly recyclable and reusable waste generated at municipality is shown in the table below. In general, we can see that the used paper including newspaper, newsprint, copies, books, etc. are the major scrap materials in the municipality which were collected upto 72 tons per months. The glasses are the second largest and plastics and irons are third and fourth largest quantity monthly supplied by scrap contractor to recycling center outside the district.

S.N.	Items	Unit	Quantity (Per Month)	Tax Rete	Monthly Expected Tax Amount Nrs
1	Burnt Mobil	Kg	3600	1	3600
2	Tyre, Tube	Kg	1750	2	3500
3	Useless Tin Plate	Tons	10	0.5	5000
4	Used Papers -Newspapers/ News Prints	Tons	72	0.5	36000
5	Other Papers With Cartoons	Tons	12.85	1	12850
6	Iron	Tons	13	2	26000
7	Other Metals (Copper, Brass Etc.)	Kg	1470	4	5880

S.N.	Items	Unit	Quantity (Per Month)	Tax Rete	Monthly Expected Tax Amount Nrs
8	Pieces Of Polythene Pipes Ppc	Tons	14.4	1	14400
9	Powdered/ Broken Pieces Of Glasses	Tons	50	1	50000
10	Glass Bottles (Bear Bottles Etc.)	Numbers	28200	0.5	14100
11	Old Batteries	Tons	6	10	60000
12	Glass Bottles (Except Bear Bottles Etc.)	Numbers	77000	0.5	38500
	Total Per Months				269880
	Grand Total Per Year				3238560

Source: field visit with KII checklist 2023 and municipality website.

The provided data was collected from KII and audit report of scarp contractor in fiscal year 2078 and financial act of Bhemdatt Municipality 2078. This data offers a comprehensive breakdown of various scrap items collected monthly in Bheemdatt Municipality, along with their respective tax rates and anticipated tax revenues. Among the items listed are burnt mobiles, tires, useless tin plates, used papers, iron, other metals like copper and brass, polythene pipes, powdered or broken pieces of glass, glass bottles, and old batteries.

For instance, while burnt mobiles incur a tax rate of NRS 1 per kilogram, old batteries are taxed at NRS 10 per ton. These taxes contribute to the municipality's revenue, with an estimated total of NRS 269,880 per month and NRS 3,238,560 annually. In the following fiscal year, tax revenue from scarp vendor was collected more than expected in fiscal 2078 as in above data, which may be due to the increased the recyclable items, increased e waste items and improved governance system too. This detailed breakdown sheds light on the municipality's efforts to regulate scrap collection activities and generate revenue through taxation. It reflects a proactive approach toward waste management and recycling practices, aiming to both mitigate environmental impact and capitalize on the economic opportunities presented by the recycling industry.

Through such initiatives, the municipality not only promotes sustainable practices but also contributes to its fiscal stability by harnessing the potential of scrap materials as a valuable resource.

As per the nature and properties of items the average monthly scrap collection and selling to waste recycling center outside the district is shown in figure. This shows that paper based recyclable waste is dominating to other scrap items. These all items were packed manually before loading on the vehicles for transportation.

Status of Registered Waste Collection Farms

There were three registered recyclable waste management centers established by private sector. These all are located near to city area. Two farms were registered about 5 years ago and remaining one farm was registered in last fiscal year. Informal waste collectors collect the recyclable waste from households and sell them to the registered farms. This shows that registered farms focus on segregation of recyclable waste trade the quantity as per market demand than collection from households. Data shows that scrap business comparatively new in Bheemdatt, however, informally few Indian citizens had been working with scrap for long time. The details of the registration time is shown in pai chart.

Figure 4: Percentage of farms as per their time period

Available waste collection center in Bheemdatt Municipality are in small size an average per day 300kg waste is collided. All farms took land on rent for their business and the size of land is not more than 5 katta (2000sq.mtr). Field data shows that that there is potential market for reusable and recyclable waste items.

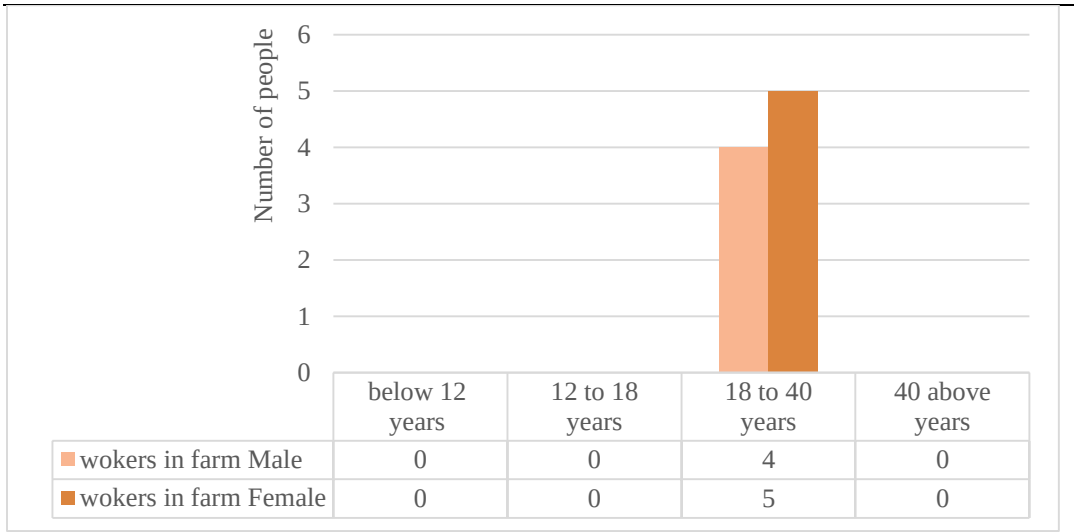

Figure 5. Number of workers in registered waste collectors' farms

Basically, the registered waste collectors buy scarps from *pheriwala*. However, all registered waste collectors have full time working staffs to work in farm for segregation, packing, loading on vehicles and sometimes collect materials from households too. The data shows that there are workers of 18 to 40 years of age group in the farms. The detailed of worker data is as shown in the above figure 5.

Conclusion and Recommendation

The economic analysis of recyclable waste in Bheemdatt Municipality underscores its potential as a valuable resource for revenue generation and sustainable development. The research findings reveal household waste as a primary contributor, with organic waste comprising the majority. Commercial establishments and institutions also significantly contribute to the waste stream, highlighting the diversity of potential recyclable materials.

Despite some challenges such as poor management and limited profit margins, the municipality has shown resilience in regulating scrap collection activities and generating revenue through taxation. The upward trend in revenue collection from scrap vendors over the years indicates the economic viability of recycling initiatives. The significant drop observed in revenue during the COVID-19 pandemic underscores the vulnerability of the waste management sector to external shocks but also highlights its importance in the local economy. Findings also show a substantial potential to earn revenue from scrap materials in the municipality. It is concluded that all types of recyclable waste are not

collected by the collectors due to management issues and less profit range. The shows that market price and available management technology is more important than available of any recyclable waste in local market. Electronic-waste like batteries and electronic devices are increasing in the municipal waste, presenting recyclable possibilities and contributing significantly to the recyclable materials. This shows the increasing luxurious life style of local people than previous years. Additionally, it is noted that female workers are more prevalent than male workers engaged in the collection and management of recyclable waste in the study area. Based on the findings of the study following recommendations are made for the local government.

Continuously review and adjust taxation policies to optimize revenue generation from recyclable waste. Consider revising tax rates based on the economic value and market demand for different types of scrap materials. Implement incentives to encourage increased collection and recycling of high-value items.

Allocate resources to invest in recycling infrastructure, including equipment for sorting, processing, and packaging recyclable materials. To enhance efficiency and productivity in waste management operations and maximize revenue potential, the local government support should be provided for technological and infrastructural development in the sector.

Promote circular economy principles to extract maximum value from recyclable waste streams. Encourage collaboration between stakeholders in the waste management supply chain to create value-added products and services from recycled materials.

Identify and explore emerging market opportunities for recycled materials both domestically and internationally. Foster partnerships with businesses and industries that can utilize recycled materials in their production processes, thereby creating new revenue streams for the municipality.

Invest in capacity building and training programs for waste collectors and workers of scrap center operators. Equip them with the necessary skills and knowledge to improve efficiency, quality, and health safety standards in waste management practices.

By focusing on the economic analysis of recyclable waste, Bheemdatt Municipality can unlock the full potential of its waste management sector as a driver of economic growth and sustainability. Implementing these recommendations will not only enhance revenue generation but also contribute to job creation, resource conservation, and environmental protection in the municipality.

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