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Socio-economic determinants of the occurrence and type of municipal solid waste collected by waste pickers within the greater Letaba municipality, Limpopo province, South Africa

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ABSTRACT

This study assessed the socio-economic determinants of the type of solid waste collected by waste pickers at Tzaneen landfill site in Greater Letaba Municipality (GLM). A purposive sampling (total population) technique was used, with 50 waste pickers from the study area participating voluntarily. A quantitative research approach was employed, involving the administration of structured questionnaires to the waste pickers for data collection. The Statistical Package for the Social Sciences (SPSS) version 29.00 and multinomial logit model were used to analyze the data. Results revealed that more male (80%) than female respondents engaged in waste collection. At 36%, cans were the most frequently collected solid waste items. The multinomial regression results indicated that determinants such as age, gender, level of education, and race significantly influenced the choice of solid waste collected, mode of transport, and storage capabilities. The insights provided by this study are crucial for recommending effective policies and interventions that could inclusively assist waste pickers with transportation of waste, landfill infrastructure, recycling training, and support programs, as the world moves towards a circular economy.

Contribution/ Originality: This study documents socio-economic determinants of solid waste collection, with findings having the potential to contribute to effective policies and interventions in support of waste pickers through training and support programmes. Initiatives aim to assist municipalities in low- and middle-income countries in managing solid waste successfully as the world moves towards a circular economy.

1. INTRODUCTION

Municipal solid waste management has become a critical environmental and socio-economic challenge for urban areas, especially in low- and middle-income countries (LMICs). As urbanization increases, so is the consumption patterns and, consequently, the generation of solid waste. This often outstrips the capacity of municipal systems to manage solid waste effectively. Based on this, the role of informal waste pickers becomes crucial. Driven by economic hardship, waste pickers risk their lives daily to access landfills to reclaim potentially useful materials for sale or personal use (Samson, 2008). Some individuals have been collecting recyclable and reusable materials for many years (over 30 years), and there are families in which several generations have worked

as waste pickers (Samson, 2021). Globally, waste pickers access landfills to collect, transport, and process waste to earn an income (Kain et al., 2022). However, they are hardly recognized for the important role they play in creating value from the waste generated, resource recovery, and minimizing greenhouse gases, among other environmental benefits (Mlotshwa et al., 2022). Worldwide, large numbers of people from LMICs and disadvantaged communities make a living through waste collection, sorting, and then selling the reclaimed waste through intermediaries to the recycling industry (Chironda, 2022). For example, there are an estimated 1.5 to 4 million waste pickers in India who collect, clean, sort, and segregate recyclables from landfills and sell them further up the value chain to make a living (Aggarwal, 2021). These waste pickers collect approximately 80 to 90% of all post-consumer packaging and recyclables (Walsh, 2020). In Brazil, more than 500,000 people make a living by gathering and selling recyclables, and interestingly, they became the first country to incorporate waste pickers into municipal solid waste management systems through their cooperatives (Gutberlet & Carenzo, 2020). Moreover, thousands of people in cities, especially in developing countries, including South Africa, depend on waste reclamation of recyclable materials for their livelihoods (Wilson, Velis, & Cheeseman, 2006).

Waste reclamation is the process of recycling waste products to create economically useful materials, and is normally carried out by disabled, uneducated, marginalized, vulnerable, and poor people to generate income (Edokpayi, Odiyo, Popoola, & Msagati, 2021; Ravish, 2025). According to Benson and Vanqa-Mgijima (2010), South Africa has a long history of waste pickers collecting waste off the streets and in landfills to survive, with others going door-to-door collecting waste. Thus, they are regarded as the forerunners of a system that plays a part in alleviating economic hardship by creating jobs (Bell, 2018). Waste pickers are a common sight in the urban informal economy and engage in this work to survive, create jobs, and work for themselves (Blaauw, Schenck, & Viljoen, 2016). Waste reclamation provides between 60,000 and 90,000 informal self-employment opportunities in South Africa (Derick Blaauw, Yu, & Schenck, 2021). At the landfills managed by the City of Johannesburg Metropolitan Municipality (Gauteng Province, South Africa), more than 5,000 individuals rely on waste reclamation and recycling as their primary source of income (Whittles, 2017). Waste reclamation saves municipalities a lot of money since it helps divert recyclable and reusable materials away from landfills. Therefore, formalizing this waste reclamation would help to ensure the safety and protection of these currently vulnerable workers. Postman (2019) explains that waste pickers help divert waste from landfills by collecting recyclable materials from households as well as from the city's landfills, and Godfrey and Oelofse (2017) report that waste pickers reclaim recyclable waste materials from landfills and deliver them to the buyback centres. A study conducted by Boampong, Britwum, and Akorsu (2020) found that waste pickers in Kpone, Ghana, collect about 800 tonnes of recyclable material from the landfill annually, thereby making a substantial environmental contribution (Boampong et al., 2020).

Waste pickers collect different types of waste depending on value and availability. They are the main contributors to the waste recycling industry and the circular economy (Chen & Vásquez, 2016; Chitaka, Moyo, Gihring, & Schenck, 2022). In developed countries like the United States of America, waste pickers are known to reclaim cardboard, boxes, and plastics. In Chicago, 9.6% of the material collected by waste pickers was recycled (Chitaka et al., 2022). Additionally, in England and Wales, waste pickers collect materials such as plastics, glass, and paper from households, streets, and dumpsites; these materials are then sorted and sold for recycling or reuse (Tearfund, 2023). However, municipal waste collection in Mozambique was found to focus on mixed solid waste, picked up by garbage trucks, and valuable recyclable materials such as cans, boxes, and glass are being sorted, with the remaining solid waste being sent to the city landfill site (Fordham, 2024). In Johannesburg, South Africa, waste pickers separate recyclable materials from non-recyclable waste in residential bins and landfills. They fill a gap by reclaiming recyclables and directing raw material inputs into the formal recycling chain (Dias, 2016). Samson (2020) placed the number of waste pickers working in South Africa at over 60,000, gathering an astounding 80 to 90% of paper and packaging waste, which is used as vital raw material for manufacturing. Additionally, waste pickers make a global contribution by recovering a variety of products from domestic waste, including cardboard,

paper, plastics, and glass (Gutberlet & Carenzo, 2020). This demonstrates how waste pickers estimate the amount of waste reclaimed from landfills. Waste pickers prevented South Africa from being overwhelmed by its own garbage, redirecting tonnes of recyclables away from overflowing landfills (Mndebele, 2021). Furthermore, it was estimated that this informal sector saves municipalities up to almost R750 million annually in potential landfill costs by diverting recyclable materials out of waste streams (Krige & Panchia, 2020). However, these people are exposed to a myriad of health and occupational issues in their daily routines and practices; thus, safety measures need to be put in place (Mukucha & Jaravaza, 2025).

Since the type and amount of waste collected by waste pickers at landfill sites could be influenced by various socio-economic determinants such as education, income levels, household size, urbanization, and consumption behaviors of the surrounding communities, it is crucial to understand these determinants in order to improve waste management systems and promote inclusive policies tailored for waste pickers to enhance the efficiency of resource recovery. Therefore, this study sought to explore the socio-economic factors that could influence both the occurrence and types of municipal solid waste at Tzaneen landfill site, with a special focus on the waste materials targeted and collected by waste pickers. Through analyses of the linkages between socio-economic determinants of local communities and the waste stream, this research aims to inform policy interventions that can improve waste segregation, support the livelihoods of informal waste pickers, and contribute to more sustainable solid waste management practices in Greater Letaba Municipality (GLM) in Limpopo Province, South Africa.

2. MATERIAL AND METHODS

2.1. Study Area

GLM, which covers an area of roughly 1891 km², is in the Mopani District Municipality in Limpopo Province. It is bordered by Greater Giyani to the east, Modimolle to the west, Makhado to the north, and Greater Tzaneen to the south. The Geographical Positioning System (GPS) coordinates of GLM are -23.513074, 30.259072. The Modjadjiskloof and Ga-Kgapane are two towns declared under GLM, located in the farthest south of the municipal territory. Senwamokgope is also included in the municipality, situated in the northwest of the area of jurisdiction, as indicated in Figure 1 (Integrated Development Plan, 2019). There are more than 200 rural villages within the municipal area, and the municipality consists of 30 wards. The GLM includes economic sectors such as water and sanitation, roads, electricity, agriculture, community services, and finance (Integrated Development Plan, 2019).

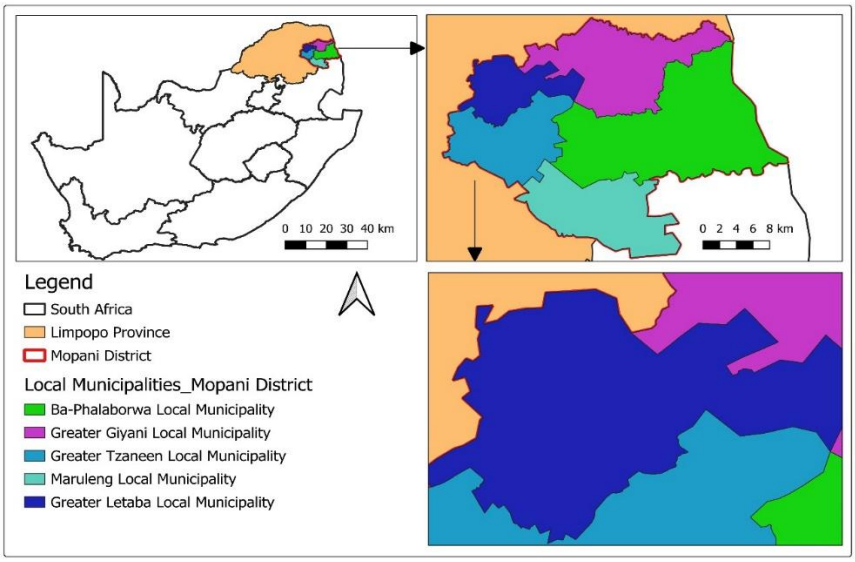

Figure 1. Map of Greater Letaba Municipality in Limpopo Province of South Africa.

Source: Nkosi (2025).

2.2. Sampling Procedure

Slovin's formula for determining sample size, as adopted by Anugraheni, Izzah, and Hadi (2023) was used to calculate the sample size for the study. The total population of waste pickers in the GLM is 50, and the sample calculations were as follows:

$$n = N / (1 + Ne^2) \quad (1)$$

Where:

n = Number of samples, N = Total population and e = Error tolerance (Level).

= 50 / (1 + 50 x 0.05^2).

= 50 / (1 + 50 x 0.0025).

= 50 / 1 + 0.125.

= 50 /1,125.

= 44.

The sample size of waste pickers in the study area is 44, which represents 88% of the population. However, all 50 waste pickers in the study area were willing to participate in the study, and the structured questionnaire was administered to all of them once they had completed the consent form. The inclusion criterion was waste pickers or participants who were over 18 years old. Therefore, a total population sampling technique was used in the study.

2.3. Data Collection and Analysis

A structured questionnaire was used to collect data from the waste pickers at the landfill site. The questionnaire was prepared in English; however, in some instances, and to the benefit of the waste pickers, translation was made into the local languages at their request. Data from the questionnaires was coded and analyzed by means of Statistical Package for the Social Sciences (SPSS) version 29.0.

2.4. Study Model Specification

Descriptive statistics and the multinomial logit model were employed to assess the socio-economic determinants of the type of solid waste collected by waste pickers in the study area. The model test consisted of five possibilities., P_j $(j = 1,..,5)$, associated with the type of solid waste collected by waste pickers. The probability of a can was P_1, plastic was P_2, paper was P_3, a bottle was P_4, and a box was P_5. The multinomial logit model adopted by Mothiba, Mthombeni, and Antwi (2023) was used to estimate the following equation.

$$log_e \left(\frac{p_j}{p_1}\right) = \alpha_{j+} \beta_{jk} X_{ki} + \mu_{ji} \quad (2)$$

Where:

J = 1, 2, 3, 4, 5 categories (Types of solid waste collected).

i = 1,….,n observations.

α = Intercepts.

β = Coefficients.

X_k = 1,….,m explanatory variables.

μ = error terms.

Those set of estimated coefficients" J″ was used to calculate the five probabilities of the linkages between the types of solid waste collected by waste pickers.

3. RESULTS AND DISCUSSION

3.1. Socio-Economic Analysis of the Waste Pickers (Descriptive Statistics)

The descriptive statistics results on the socio-economic determinants of the type of solid waste collected by waste pickers in the study area are presented in the form of percentages in histograms and pie charts.

3.1.1. Gender

Figure 2 shows that 80% of the respondents in the study were male and 20% female, indicating that more males than females engaged in recycling. In a study by Arruda, Aragão, Silva, Valença, and Santos (2020), the majority of waste pickers were reported to be men and to experience greater inequalities and disproportionate economic and health impacts than their female counterparts. However, Ocean Conservancy (2023) argued that women and men engaged equally in informal recycling.

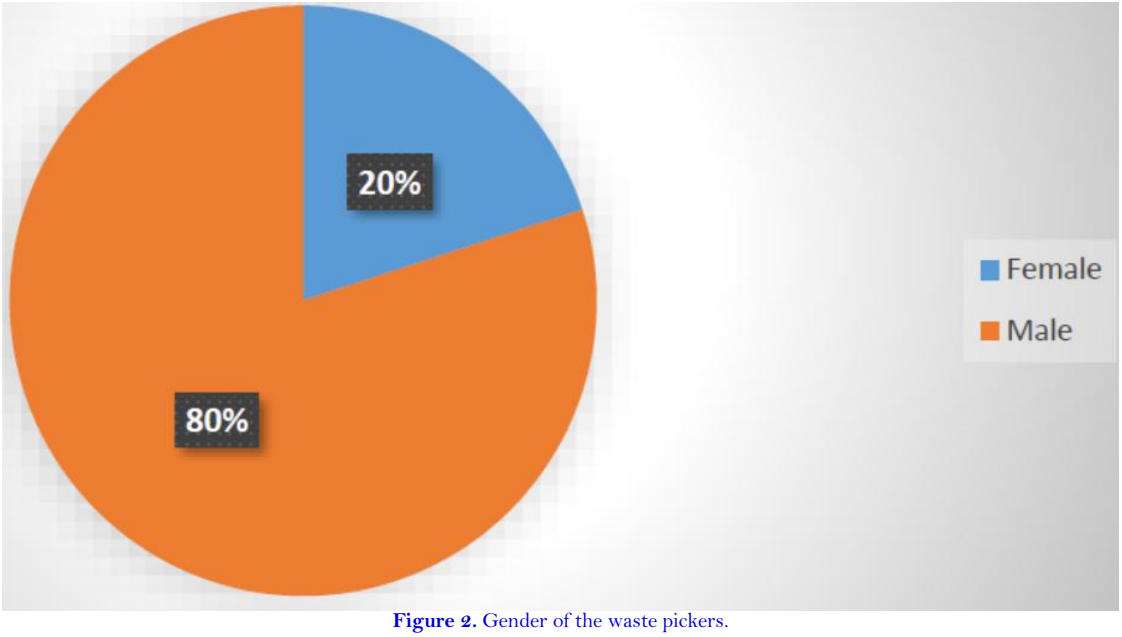

Figure 2. Gender of the waste pickers.

3.1.2. Age

Figure 3 shows that the largest percentage of waste pickers (36%) were between the ages of 36 and 45 years. According to a Statista Research report dated 2023, the majority of those working as waste pickers fell within the age group of 18 to 55 years.

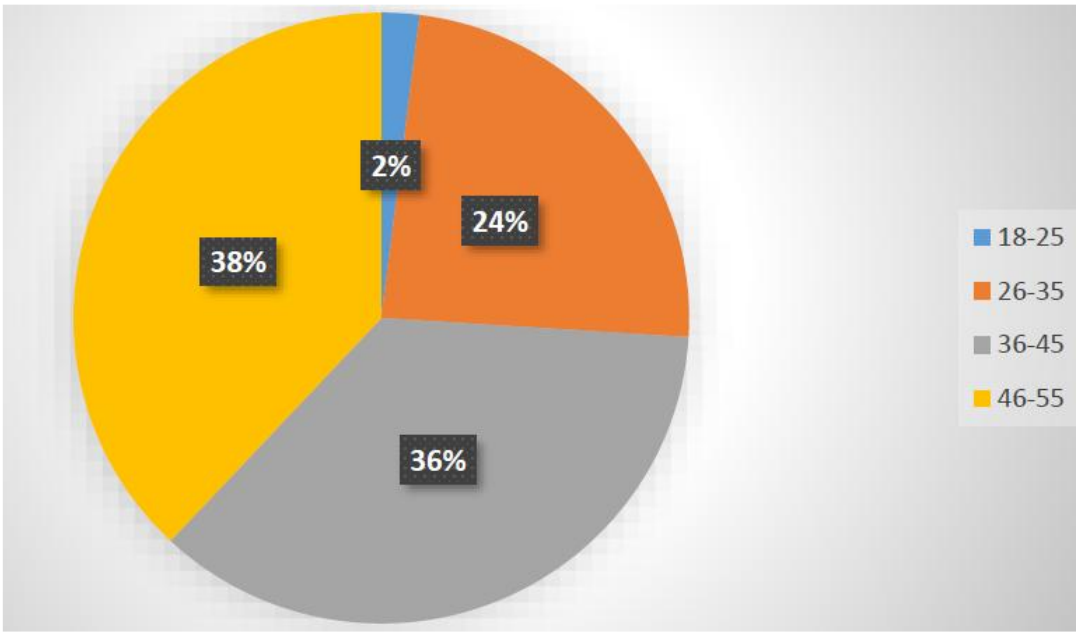

Figure 3. Age of the waste pickers.

3.1.3. Race

Figure 4 shows that of the 50 respondents, 49 were Black people, and 1 was a Coloured person. This appears to relate to some extent to the race profile of the study area, which is 41.5% Black, 25.0% Coloured, and 5.7% White (Statistics South Africa (StatsSA), 2022).

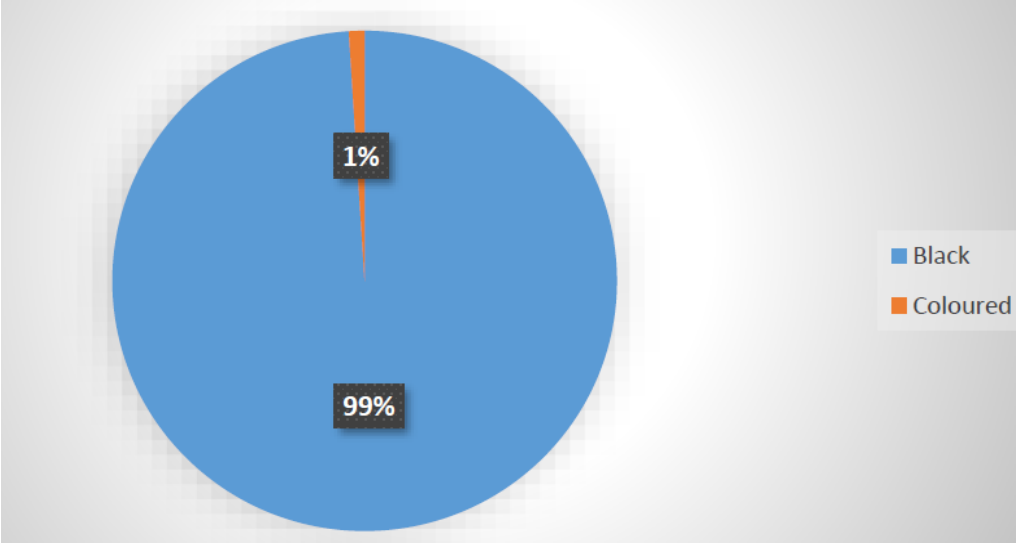

Figure 4. Race of the waste pickers.

3.1.4. Educational Background

As shown in Figure 5, the majority of the respondents (60%) had a secondary school education, and only 2% had no formal education. According to Morais, Corder, Golev, Lawson, and Ali (2022), waste pickers have low education and employment skills, which exclude them from obtaining formal employment; hence, they become involved in the waste picking sector, limiting their educational and livelihood opportunities in other sectors.

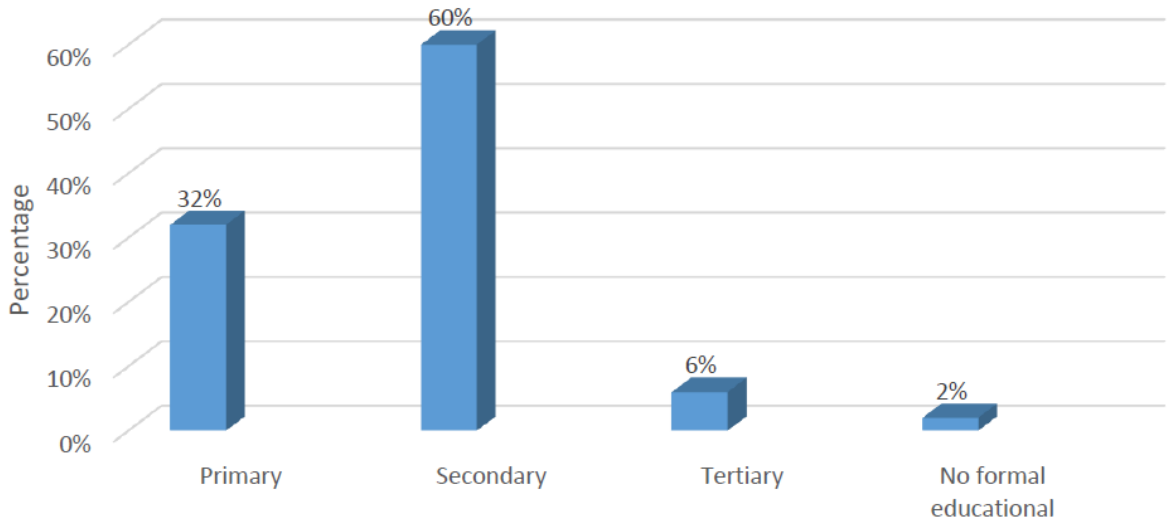

Figure 5. Educational background of the waste pickers.

3.1.5. Employment Status

Figure 6 shows that 18% of the waste pickers were employed elsewhere, and 16% were self-employed, meaning they operated their own businesses. This study revealed that waste picking as a job is not restricted to being a source of livelihood for unemployed people. Both employed and self-employed individuals, such as small business owners, are also interested in waste reduction and identifying sources of revenue.

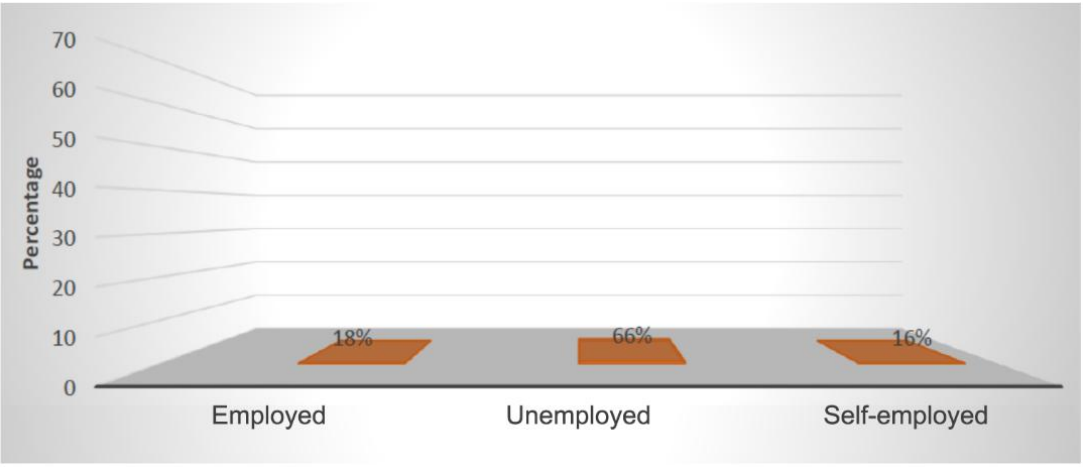

Figure 6. Employment status of the waste pickers.

3.1.6. Monthly Income

Figure 7 shows that the largest percentage of waste pickers (32%) earn from R3,000 to R4,000 per month. Morais et al. (2022) state that waste picking has social utility, as it constitutes a source of revenue for some of the most vulnerable communities. Yu (2020) found waste pickers' salaries to range from R2,900 to R5,000 per month, with 70% earning below the average. Most waste pickers earning these amounts are responsible for their families and contribute to youth job creation.

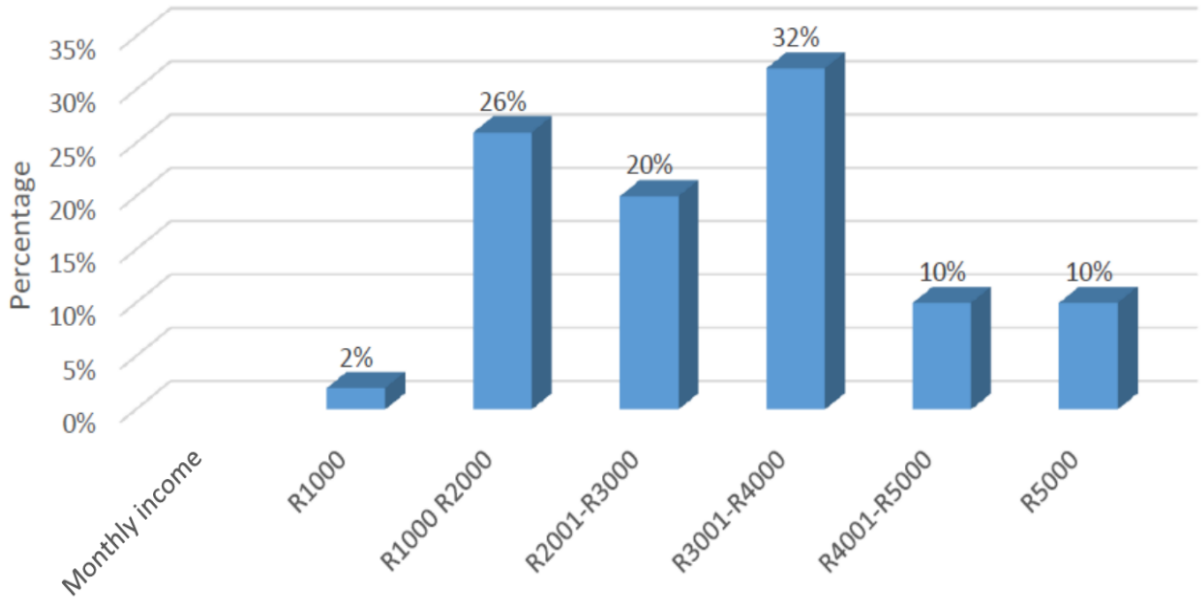

Figure 7. Monthly income of the waste pickers.

3.1.7. Types of Waste Collected

Figure 8 shows that at 36%, cans were the most frequently collected form of solid waste, followed by bottles at 22%, boxes at 20%, and plastics at 18%. These findings are in line with those of the study by Harrisberg (2019), which reported that waste pickers collected all forms of waste that were usable or recyclable, ranging from bottles, plastics, steel, and cardboard boxes to cans. Most waste pickers made a significant contribution to the diversion of reusable materials such as plastics, cardboard boxes, bottles, cans, and packaging recyclables away from landfills to buyback centres (Godfrey, 2021; Morais et al., 2022; Walsh, 2020).

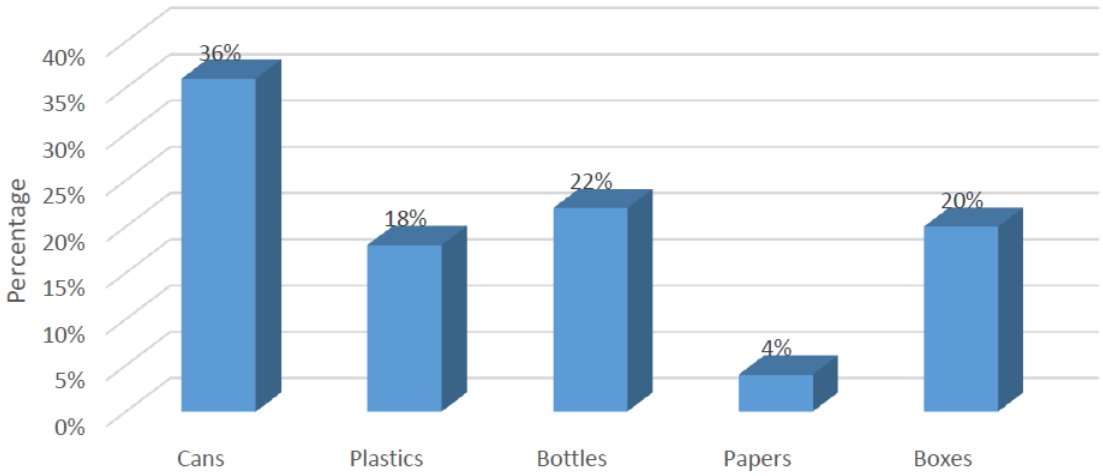

Figure 8. Types of waste collected by waste pickers.

3.2. The Socio-Economic Factors Influencing the Type of Solid Waste Collected by Waste Pickers (Multinomial Regression Analysis)

Tables 1, 2, 3, and 4 show the analysis of the socio-economic factors influencing the type of solid waste collected by waste pickers. Multinomial regression analysis was used to compute the data, and the variable boxes was extracted as a basis of comparison with the variables bottles, paper, cans, and plastics.

3.2.1. Socio-Economic Determinants of the Collection of Cans Vs. Boxes

In Table 1, race is a statistically significant variable with a positive coefficient at $p < 0.05$ in relation to the collection of cans; this suggests that racial background influences the type of waste collected. This may be due to the predominance of a specific race within the study area in terms of access to waste collection opportunities. The findings are in line with those of Blaauw, Pretorius, and Schenck (2019), who found the majority of waste pickers at landfills to be Black, followed by Whites and Coloureds, and the majority to be men. Seamster and Purifoy (2021) found that 75% of waste pickers are Black people.

The variable majority collected, indicating the largest proportion of a certain type of waste collected, was statistically significant, with a negative impact in terms of can collection at $p < 0.10$; this implies that when large numbers of cans were collected by the waste pickers in comparison with other types of waste, the other types of waste may have been limited. Figure 8 shows cans to have been the majority type of waste collected by the waste pickers. There was a strong and positive association between the type of transport used to transport the cans collected and the variety of waste collected at $p < 0.001$. Better or specialized transportation enables waste pickers to access and carry different types of waste more efficiently. Schenck, Blaauw, and Viljoen (2016) identified trolleys as being the best mode of transportation for transporting collected waste to the buyback centres, and Langenhoven and Dyssel (2007) found that those collecting with trolleys earned more than those collecting with bulk bags, simply because more can be loaded onto a trolley.

Storage availability for cans was statistically significant with a negative impact related to the type of waste collected at $p < 0.10$. This may mean that limited or inadequate storage may restrict the types of waste that can be safely or practically collected by the waste pickers. In most cases, waste pickers do not earn enough to pay for shelter or storage, and do not have a place to leave their trolleys or to sort and store what they have collected (Schenck et al., 2016).

Table 1. Socio-economic determinants of the collection by waste pickers of cans versus boxes.

Variables	Coefficients	Standard	Wald	P-value
Age	3.112	5.341	0.339	0.560
Gender	-0.007	9.778	0.000	0.999
Education	-0.862	6.614	0.017	0.896
Race	0.768	0.353	4.733	0.030**
Monthly income	-0.009	0.037	0.063	0.801
Employment	-0.710	1.667	0.182	0.670
Protective clothes	-1.000	0.802	1.556	0.212
Majority collected	-1.959	1.054	3.457	0.063*
Mode of transport	0.048	0.016	9.283	0.002***
Storage	-1.364	0.819	2.770	0.096*
Landfill accessibility	0.344	1.020	0.113	0.736
Municipal role	0.076	0.767	0.010	0.921
Waste collected (tonnes)	2.014	186.990	0.000	0.991
Constant	-0.911	0.796	1.308	0.253

Note: *, **, *** represent significant levels at 10%, 5% and 1% respectively.

3.2.2. Socio-Economic Determinants of the Collection of Plastics Vs. Boxes

Age as a variable in Table 2, indicating how old the respondent was in years, was statistically significant with a negative coefficient at $p < 0.10$, suggesting the likelihood of younger respondents engaging in plastic collection in the study area to be greater, possibly because younger people generally have more energy and may be more active when going around collecting waste. A study by Edokpayi et al. (2021) revealed a large number of waste pickers to be within the age group 25 to 40 years, and thus to be mature people responsible for feeding their families. Yu (2020) similarly stated that the majority of waste pickers are mature people.

Gender was statistically significant with a positive impact at $p < 0.10$ in the context of plastic waste collection. This could indicate that male respondents were more likely to be involved in the day-to-day operations of collecting plastic waste, possibly because male waste pickers are physically more capable than female waste pickers to carry heavy loads of solid waste for recycling. Loan et al. (2023) reported that males were more likely than females to engage in waste picking, with 66% of waste pickers being male and 34% female, and to carry heavy loads of waste for recycling purposes. Furthermore, Strydom (2018) found that South African women are not interested in recycling because of the health risks.

Table 2. Socio-economic determinants of the collection of plastics versus boxes by waste pickers.

Variables	Coefficients	Standard	Wald	P-value
Age	-0.144	0.077	3.535	0.060*
Gender	1.779	0.994	3.201	0.074*
Education	-0.025	0.032	0.600	0.439
Race	0.002	0.049	0.368	0.544
Monthly income	-0.612	0.634	0.932	0.334
Employment	0.054	0.099	0.295	0.587
Protective clothes	-0.227	0.263	0.722	0.395
Majority collected	0.855	0.773	1.226	0.268
Mode of transport	-0.342	0.186	3.383	0.066*
Storage	-0.714	0.690	1.073	0.300
Landfill accessibility	0.566	0.666	0.721	0.396
Municipal role	-0.004	0.004	0.791	0.374
Waste collected (Tonnes)	0.639	0.622	1.055	0.304
Constant	-0.529	3.989	0.018	0.894

Note: * Represent significant levels at 10%.

3.2.3. Socio-Economic Determinants of the Collection of Bottles Vs. Boxes

Table 3 shows that the monthly income of the respondents was statistically significant at $p < 0.001$ and had a negative impact in relation to bottle waste collection. This may mean that the respondents received less income when collecting bottles than when collecting other types of solid waste for recycling. Viljoen (2022) reports that

waste pickers earn between R1,000 to R5,000 per month. However, a study conducted at the City of Johannesburg landfills by Velis, Hardesty, Cottom, and Wilcox (2022) revealed that waste pickers earn between R2,400 and R3,640 per month.

Municipal roles such as collecting waste from households and towns, transporting and storing the waste at the landfill, hosting waste pickers, and allowing them access to the landfills to collect different types of waste for recycling are crucial. The variable municipal role was statistically significant at p <0.10, with a negative impact on bottle collection, suggesting that the greater the role played by the municipality in waste picking or management, the less likely waste pickers are to collect bottles.

Table 3. Socio-economic determinants of the collection by waste pickers of bottles versus boxes.

Variables	Coefficients	Standard	Wald	P-value
Age	-0.472	0.652	0.525	0.469
Gender	0.314	0.623	0.254	0.614
Education	-0.071	0.635	0.012	0.911
Race	-0.030	0.049	0.368	0.544
Monthly income	-0.100	0.032	9.701	0.002**
Employment	-0.416	0.263	2.503	0.114
Protective clothes	-0.513	0.810	0.400	0.527
Majority collected	0.055	0.095	0.329	0.566
Mode of transport	-0.510	0.627	0.661	0.416
Storage	0.008	0.007	1.203	0.230
Landfill accessibility	-0.001	0.002	-0.410	0.682
Municipal role	-0.016	0.009	-1.737	0.084*
Waste collected (tonnes)	0.004	0.008	0.591	0.555
Constant	7.576	4.058	3.486	0.062

Note: * and ** represent significant levels at 10% and 5% respectively.

3.2.4. Socio-Economic Determinants of the Collection of Paper Vs. Boxes

Table 4 shows again that the variable municipal role was statistically significant at p < 0.001, with a negative impact regarding paper waste, suggesting that the greater the role played by the municipality in paper waste picking or management, the smaller the likelihood of waste pickers collecting different types of solid waste.

Table 4. Socio-economic determinants of the collection of paper waste by waste pickers.

Variables	Coefficients	Standard	Wald	P-value
Age	0.000	0.004	0.011	0.917
Gender	-0.934	0.664	1.979	0.159
Education	-0.542	0.664	0.666	0.414
Race	0.252	0.626	0.162	0.687
Monthly income	-0.001	0.004	-0.328	0.743
Employment	-0.005	0.005	-1.029	0.304
Protective clothes	0.017	0.011	1.512	0.132
Majority collected	0.009	0.006	1.467	0.144
Mode of transport	0.005	0.004	1.437	0.152
Storage	-0.002	0.004	-0.586	0.559
Landfill accessibility	0.001	0.003	0.332	0.740
Municipal role	-0.339	0.044	-7.742	0.001***
Waste collected (Tonnes)	0.003	0.003	0.943	0.347
Constant	0.985	0.034	29.277	0.001

Note: *** Represent significant levels at 1%.

4. CONCLUSION

The results of the study reported in the present study showed that 36% of waste collected were cans, which were the most frequently collected form of solid waste. This may be because cans and tins have a higher monetary value when recycled compared to other forms of solid waste. The study further revealed that 80% of waste pickers were male. The multinomial regression results highlight several key determinants of the type of waste collected by

waste pickers, with socio-economic characteristics such as age, gender, education, and race playing a significant role in the choice of the type of solid waste collected. Factors such as mode of transport and storage capabilities also significantly influence the type of waste collected.

Waste pickers help in reducing waste by generating jobs and providing individuals with a means to earn income through collecting waste at landfill sites and selling it to buyback centres, which then sell it to recycling businesses. The insights provided by the study are crucial for recommendations related to effective policies and interventions to support waste pickers, transportation of waste, landfill infrastructure, and inclusivity across the study area. The availability of better transport options such as trolleys and carts has the potential to significantly expand the types of waste and increase the volume that waste pickers can handle. Provision of adequate storage facilities for waste pickers with limited infrastructure in the study area could resolve waste storage problems. Waste handling and recycling training and support programs based on age, education level, and gender could be offered to waste pickers to ensure equitable access to more lucrative and less hazardous waste types.

The future perspectives of this study will be shaped by ongoing changes in urbanization, economic inequality, environmental policy, and technological innovation. Rapid urbanization, especially in developing countries, is expected to increase waste generation per capita, and persistent socio-economic disparities will likely keep informal waste picking relevant, especially in LMICs. However, socio-economic factors such as education and access to tools may determine who can engage in higher-value material recovery in the near future.

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