

Solid waste recycling behaviour: A case study from Gauteng, South Africa

ABSTRACT

Thea Schoeman
Geography, Environmental
Management & Energy Studies
University of Johannesburg
Johannesburg, South Africa
theas@uj.ac.za

This study investigated recycling behaviour in the smallest, but most populous province in South Africa. Only 10% of total waste is recycled in South Africa and landfills in Gauteng is running out of airspace. There is a scarcity of land for waste disposal in the province and it has become imperative to find ways to divert waste from landfills. Knowing the recycling behaviour and measurements to increase participation in recycling, the objectives of this study, provide information to develop waste management systems that would increase recycling rates. This study employed a mixed-methods research design, utilising a questionnaire survey. Quantitative data were analysed using descriptive and inferential statistics, while qualitative data were examined through thematic analysis. The results revealed a notable discrepancy between respondents' positive attitudes toward recycling and their actual practices. Despite high levels of agreement regarding the benefits of recycling, only 10.1% of respondents could be classified as committed recyclers. The primary barriers to participation identified were lack of time (32.1%) and insufficient space (25.8%). Respondents proposed various strategies to enhance recycling participation, with the majority (64.6%) emphasising the need for increased education and knowledge regarding recycling. A factor analysis conducted to explore the underlying knowledge dimensions of the perceived benefits of recycling yielded two components. Furthermore, multivariate analysis revealed that three socio-demographic variables—age, employment status, and education level—had a statistically significant influence on recycling participation. This study provides a better understanding of recycling practices in South Africa and how participation can be increased.

KEYWORDS: Waste management. Recycling. Socio-demographic variables. Increase participation.

INTRODUCTION

The rapid growth of urban populations, economic expansion, and shifting consumption patterns have significantly accelerated municipal waste generation, making it a critical global environmental management issue (Al-Khatib et al., 2010; Marshall & Farahbakhsh, 2013). In developing countries in particular, Particularly in developing countries, local authorities encounter persistent challenges in solid waste management (SWM), including escalating volumes of municipal waste, constrained financial allocations, insufficiently trained personnel with expertise in waste management dynamics, limited public participation in recycling initiatives, and the scarcity of suitable land for landfill development (Filho et al., 2016; Kirama & Mayo, 2016; Schoeman & Rampedi, 2022; Rana et al., 2025).

Solid waste management (SWM) consists of two principal components: the management of municipal solid waste to mitigate environmental impacts, and the reduction of waste at its source (Miller & Spoolman, 2011). Scholars such as Dos Muchangos et al. (2017) and Derdera and Otago (2023) emphasize the necessity of adopting an integrated waste management approach, which incorporates a range of complementary strategies aimed at both waste management and reduction. To this end, many countries have implemented integrated solid waste management (ISWM) frameworks guided by the waste hierarchy, which prioritises prevention, reduction, recycling, recovery, treatment, and final disposal (McDougall et al., 2001; Gertsakis & Lewis, 2003; Marshall & Farahbakhsh, 2013). Developed countries such as Germany and Sweden have achieved considerable success in the implementation of ISWM (Schwarz-Herion et al., 2008; Linden & Carlsson-Kanyama, 2003). By contrast, while progress has been noted in developing countries (Wilson et al., 2013), challenges persist, particularly in the form of low recycling rates and limited institutional capacity. Adeleke et al. (2021) highlight that municipalities in developing contexts often struggle with SWM due to financial constraints and public resistance to paying for waste services, further straining already under-resourced local authorities.

South Africa exemplifies these challenges. As a developing country, it continues to rely predominantly on landfill disposal as the most practical waste management method. However, economic development, rapid urbanisation, and population growth are expected to increase waste generation substantially (DEA, 2018). This trajectory underscores the urgent need for effective waste management policies and programmes, with particular emphasis on prevention, minimisation, and avoidance. Since 2009, the adoption of the waste hierarchy has been formalised in South Africa's policy framework through the promulgation of the National Environmental Management: Waste Act (Act No. 59 of 2008) and the subsequent National Waste Management Strategy (NWMS) (DEA, 2016). The primary aim of this policy framework is to reduce reliance on landfilling. The NWMS operationalises the objectives of the Waste Act, requiring all spheres of government to give effect to its provisions (DFFE, 2020).

Urban areas in Gauteng, South Africa, face challenges similar to those experienced by many urban centres in developing countries, including Islamabad in Pakistan (Ali et al., 2014), Maputo in Mozambique (Dos Muchangos et al., 2017), and Abuja in Nigeria (Imam et al., 2008). One of the most pressing concerns is the scarcity of land suitable for new landfill development, particularly in Gauteng where competition for land is intense (GDARD, 2011). Diverting waste from landfill disposal is therefore critical, as it directly extends the lifespan of existing sites and mitigates the risk of capacity being reached prematurely.

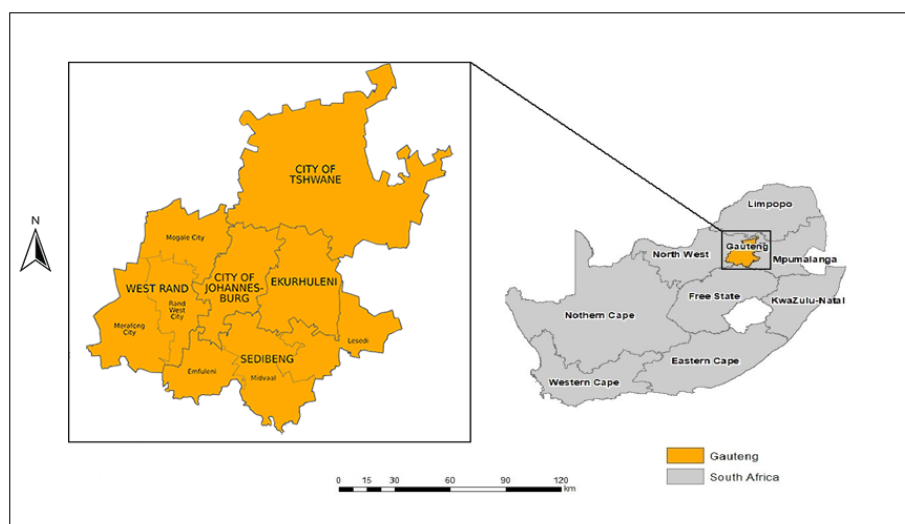
Household recycling behaviour is shaped by multiple factors, including attitudes, perceptions, and levels of awareness regarding waste management (Strydom, 2012; Da Silva & Franz, 2025). International research has extensively examined the drivers, barriers, and outcomes of recycling initiatives (Bohm et al., 2010; Halvorsen, 2012; Chen & Gao, 2021; Alremeithi et al., 2025). The success of recycling programmes depends heavily on household participation, making it essential to identify the demographic, social, and behavioural attributes that predict higher or lower levels of engagement (Anderson et al., 2013). Such insights can inform the design of targeted interventions to enhance participation rates. Therefore, this study investigated the recycling behaviour of residents of Gauteng, South Africa.

METHODOLOGY

Study area

Gauteng is the smallest province in South Africa by land area, comprising only 1.4% of the national territory. Despite its limited size, it is the most densely populated province, with approximately 16.1 million residents, representing 25.5% of the national population (StatsSA, 2025). Gauteng is recognised as the wealthiest province and the financial hub of South Africa. It encompasses three metropolitan municipalities—the City of Tshwane, the City of Johannesburg, and the City of Ekurhuleni (Figure 1). Given its demographic and economic profile, Gauteng is also the largest generator of municipal solid waste, accounting for 26.3% of the national total (DEA, 2018).

Figure 1: Gauteng Province, South Africa.



Source: author.

Aim and objectives

The main aim of the study was to investigate waste separation behaviour and factors which underpin recycling behaviour of households in the Gauteng and includes six objectives:

- determine residents' awareness of environmental problems associated with solid waste;
- investigate households agreement on the advantages or recycling;
- determine if respondents recycle and if so, what amount, items and reasons for recycling participation;
- conduct factor analysis to identify the underlying knowledge dimensions of the perceived benefits of recycling; and
- determine the relationship between gender, age, employment status, education level, and income level and recycling behaviour.

Research approach

A mixed-methods research design was adopted, as neither quantitative nor qualitative approaches alone were sufficient to provide a comprehensive understanding of the recycling behaviour of residents in Gauteng. Creswell (2015) defines mixed-methods research as an approach that involves the collection, analysis, and interpretation of both quantitative and qualitative data. In this study, both forms of data were collected within the same timeframe, constituting a concurrent mixed-methods design (Onweugbuzie & Collins, 2007).

Data collection and analysis

Data was collected by means of a questionnaire that assessed recycling behaviour. Ethical clearance for the study was granted by the Faculty of Science Ethics Committee, University of Johannesburg (2018/02/15/Schoeman). A convenience sampling strategy was applied, consistent with the approach described by Onwuegbuzie and Collins (2007) and Golzar et al. (2022). Convenience sampling involves selecting participants who are readily available and willing to take part in the study. The sampling frame was limited to Gauteng Province, and 1 115 responses.

Data analysis employed both descriptive and inferential statistical techniques. Responses to open-ended questions were examined using thematic analysis, a qualitative analytic method that identifies the frequency of words and phrases and applies a coding frame to derive quantifiable insights (Byrne, 2022).

Statements regarding the benefits of recycling were measured using a five-point Likert scale. Internal consistency of these items was assessed using Cronbach's alpha ($\alpha = 0.83$), indicating a high level of reliability (Pallant, 2013).

Factor analysis was employed to identify the underlying knowledge factors related to recycling. Items addressing the perceived benefits of recycling were subjected to principal components analysis (PCA) for factor extraction, with oblimin rotation and Kaiser normalisation applied. Prior to conducting the PCA, the suitability of the dataset for factor analysis was evaluated. Two criteria are commonly applied: adequate sample size and sufficient inter-item correlations (Pallant, 2013). Tabachnick and Fidell (2013) recommend a minimum of 300 cases, and this study exceeded that threshold with 1 115 respondents. Inspection of the correlation matrix revealed that the majority of coefficients were greater than 0.3, suggesting that the data were appropriate for factor analysis. To further assess sampling adequacy, the Kaiser-Meyer-Olkin (KMO) measure and Bartlett's Test of Sphericity (BTS) were calculated.

The KMO value was 0.907, surpassing the recommended minimum of 0.6 (Pallant, 2013; Tabachnick & Fidell, 2013) and qualifying as “superb” (> 0.9) according to Hutcheson and Sofroniou (1999). Bartlett’s Test of Sphericity was statistically significant ($p < 0.05$), confirming that the correlation matrix was factorable. The decision on the number of factors to retain was guided by the eigenvalue criterion (values > 1.0) and Cattell’s scree test (Pallant, 2013).

To assess the relationship between socio-demographic characteristics and waste separation behaviour, cross-tabulations and chi-square tests for independence were conducted. Independent variables included gender, age, race, employment status, education level, income level, residence type, and household size. Among these, only age showed a statistically significant association with recycling participation.

Limitations

The pilot survey was administered through an online platform. Feedback from respondents, including comments and direct messages to the researcher, indicated that participation was skewed toward individuals exhibiting positive recycling behaviour. To mitigate this potential bias, both online and in-person data collection methods were subsequently employed; however, the possibility remains that respondents with pro-recycling behaviour were overrepresented in the sample.

This study examined waste separation behaviour among respondents in Gauteng, a province characterised by high levels of urbanisation and containing three of South Africa’s eight metropolitan areas. South Africa, however, represents what Baffi et al. (2018:285) describe as “an unusual and extreme case in geography,” marked by complex territorial dynamics and diverse urban settlement patterns. Urban settlements in the country range from metropolitan centres and secondary cities to large and small towns serving surrounding rural areas. Consequently, while the findings of this study are likely to be applicable to other metropolitan areas and potentially to secondary cities, they cannot be generalised to smaller towns where settlement structures and local government arrangements differ significantly from those of large urban centres.

RESULTS AND DISCUSSIONS

Socio-demographic

The study surveyed 1 115 respondents regarding their recycling behaviour. The socio-demographic profile indicated that the majority were female (55.2%) and predominantly within the 20–29 age group (38.7%) (Table 1). Although Gauteng is the only province in South Africa where the male population marginally exceeds the female population (50.5% vs. 49.5%), the sample was skewed towards female respondents. This pattern is consistent with earlier research in South Africa, which found that females are generally more likely than males to participate in questionnaire-based studies (Schoeman & Rampedi, 2022). Gauteng is also characterised by a relatively young population, with more than one-third (35.6%) falling within the 20–39 age cohort (StatsSA, 2024b). Accordingly, the predominance of younger respondents in this study aligns with the province’s demographic composition. In terms of racial distribution, Gauteng’s population is largely Black (84.6%), followed by White (10.0%) (StatsSA, 2024b). The sample

reflected this pattern, with 73.7% of respondents identifying as Black and 12.4% as White. However, the study participants exhibited notably higher levels of educational attainment compared to the provincial average, with 61.8% holding a post-matric (post-secondary) qualification, compared to 16.4% among the broader population. Similarly, the income levels of respondents were higher than the provincial average, with 67.3% earning above R100 000 per annum. With respect to household characteristics, the majority of participants resided in private houses (52.6%) and lived in households comprising four to five members (46.9%).

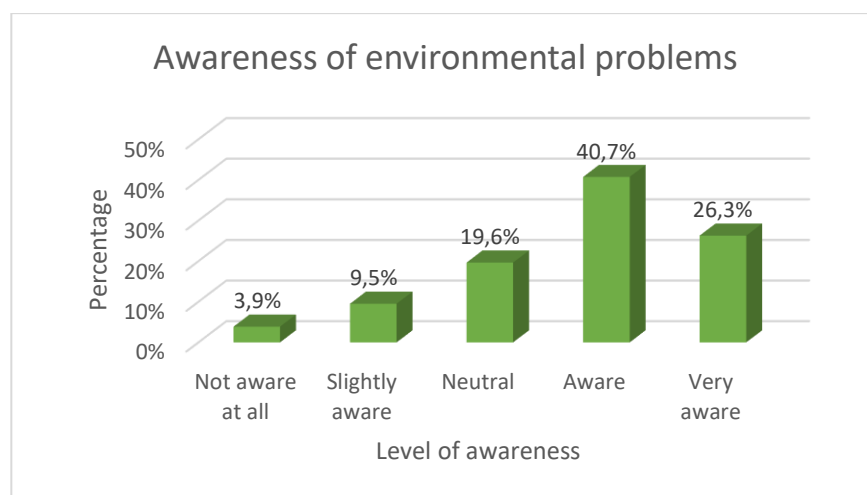
Table 1: Socio-demographic characteristics of respondents.

Characteristics	Class	N	%
Gender	Female	615	55.2
	Male	500	44.8
Age group	20-29	432	38.7
	30-39	258	23.1
	40-49	276	24.8
	50-59	105	9.4
	60+	44	3.9
Race	Black	820	73.7
	White	135	12.4
	Coloured	81	7.3
	Indian/Asian	77	6.9
Employment	Economically inactive	403	36.2
	Part- and full-time	709	63.8
Education	Up to Matric	424	38.2
	Post-matric	685	61.8
Income	Lower (<R50 000 p/a)	352	32.7
	Emerging middle (R100 000 – R300 000)	354	32.9
	Realised middle (R300 001 – R500 000)	214	19.9
	Upper middle to affluent (>R500 000)	156	14.5
Residence	Private house	560	52.6
	Complex, flat, estate, townhouse	276	25.9
	Commune, residence, student accommodation	119	11.2
	Other (e.g. renting cottage/room)	109	10.2
Household size	1-3 people	374	35.0
	4-5 people	502	46.9
	6 or more	194	18.1

Source: author.

Respondents were asked to rate their level of awareness regarding environmental problems associated with solid waste on a scale ranging from ‘*not at all aware*’ to ‘*very aware*’ (Figure 2). Just more than two-thirds of the respondents (67.0%) reported being either aware or very aware of such problems, while only a small proportion (3.9%) indicated no awareness of the environmental impacts of solid waste.

Figure 2: Awareness of environmental problems associated with solid waste.



Source: author.

Respondents evaluated nine statements on the benefits and challenges of recycling using a five-point Likert scale (1 = *Strongly Disagree* to 5 = *Strongly Agree*). Descriptive statistics (frequency, mean, and standard deviation) (Table 2). Cronbach’s alpha (α) coefficients for all items were ≥ 0.7 , indicating good internal consistency (Pallant, 2013).

Table 2: Agreement on statements regarding recycling.

Statement	Strongly agree (%)	Disagree (%)	Neutral (%)	Agree (%)	Strongly agree (%)	Mean	StdDev	α
Recycling reduces pollution	0.9	1.3	7.4	26.0	64.5	4.52	0.763	0.798
Recycling saves landfill space	0.9	1.6	8.8	28.9	59.8	4.45	0.791	0.798
Recycling conserves natural resources	0.8	1.6	10.5	28.1	59.0	4.43	0.805	0.792
Recycling improves environmental quality	1.0	1.4	8.2	28.6	60.8	4.47	0.785	0.794

Recycling provides job opportunities	1.4	2.9	14.2	27.4	54.1	4.30	0.914	0.806
Recycling saves energy	1.6	4.1	19.6	33.1	41.6	4.10	0.952	0.807
People know about the benefits of recycling	16.3	36.6	36.4	4.9	5.9	2.48	1.01	0.877
People need to be educated on recycling	0.4	1.0	3.3	17.1	78.2	4.72	0.614	0.824
It is important to recycle household waste	0.9	1.0	7.5	25.6	65.0	4.53	0.753	0.803

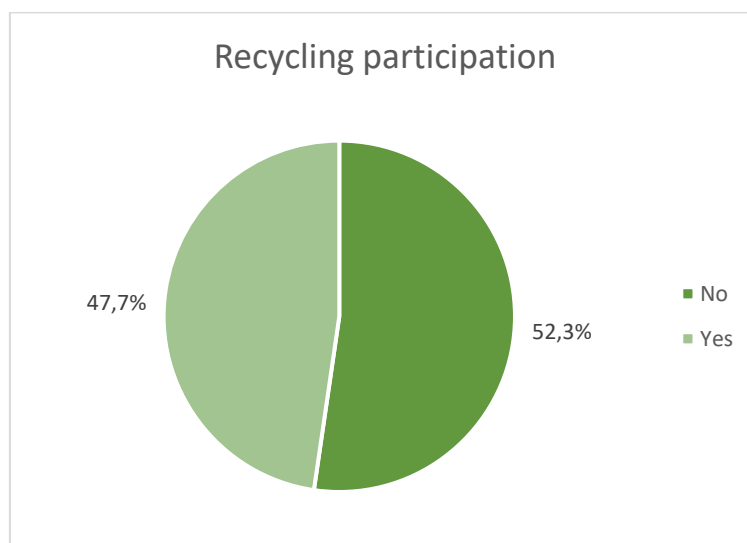
Source: author.

Overall, the results suggest that respondents possess a sound understanding of the benefits and issues associated with recycling. The highest level of agreement was observed for the statement emphasising the need to educate people on recycling, with 78.2% of respondents strongly agreeing. By contrast, only 5.9% strongly agreed that people are aware of the benefits of recycling. This finding suggests that, in the context of Gauteng, residents perceive a lack of awareness regarding the advantages of recycling. Taken together, these responses underscore the importance of education and awareness-raising initiatives, particularly those aimed at informing residents both about how to recycle and the broader benefits associated with recycling.

Separation of household waste

Respondents were asked whether they separate household waste streams such as plastic, paper, and metal (Figure 3). In this study, 47.7% reported separating household waste at source, which represents a substantially higher level of participation compared to national survey data. The 2023 General Household Survey (StatsSA, 2024a) reported that in metropolitan areas of Gauteng the majority of residents do not separate waste, with non-separation rates of 87.9% in the City of Tshwane, 86.0% in the City of Johannesburg, and 68.7% in the City of Ekurhuleni. These findings suggest that, relative to broader metropolitan trends, respondents in this study demonstrate considerably greater engagement in household waste separation practices.

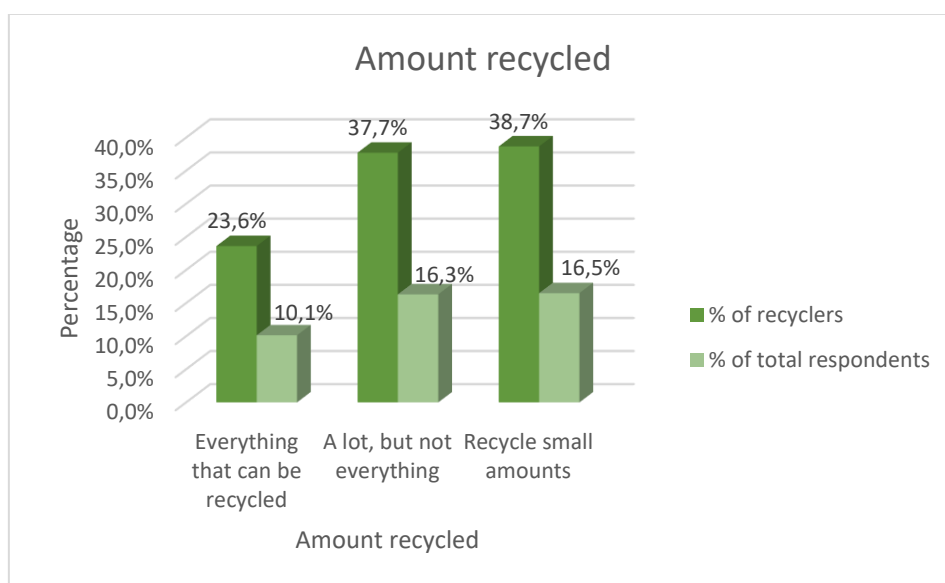
Figure 3: Separation at source for recycling.



Source: author.

Martin et al. (2006), in a study conducted in Burnley (United Kingdom), identified three levels of recycling participation: non-recyclers, casual recyclers (those who recycle some items), and full recyclers. Following this classification, respondents in the present study who reported recycling were asked to indicate their behaviour by selecting one of three options: '*I recycle everything that can be recycled*' (23.6%), '*I recycle a lot, but not everything*' (37.7%), and '*I recycle small amounts*' (38.7%) (Figure 4). However, when recalculated against the total sample, a different distribution emerged. Based on Martin et al.'s (2006) typology, only 10.1% of respondents in Gauteng qualified as full recyclers, 32.8% as casual recyclers, and 57.1% as non-recyclers.

Figure 4: Amount of solid waste recycled.



Source: author.

The motivations for participating in waste separation at source are summarised in Table 3. Respondents were allowed to select multiple options. The most common reason was *'to protect the environment'* (97.2%), followed by *'it is the right thing to do'* (70.1%) and *'to conserve natural resources'* (62.8%). A small proportion (5.5%) reported uncertainty about their reasons for recycling. Among those who selected *'Other'*, seven of the 16 respondents stated that they recycle either to generate income from recyclables or to reduce household expenses.

Table 3: Reasons for household waste separation.

Reason	Frequency	Percentage
To protect the environment	423	97.2
To conserve natural resources	273	62.8
To save energy	218	50.1
To save landfill space	249	57.2
It is the right thing to do	305	70.1
I do not know	24	5.5
Other	16	3.7

Source: author.

These results suggest that pro-environmental values and moral obligations are the primary motivators for recycling among respondents in Gauteng, while economic considerations play only a minor role. This pattern is broadly consistent with international research. Halvorsen (2012) found that environmental concern and a sense of civic duty were the strongest motivations for household recycling in Norway, while Corsini et al. (2018) highlighted that awareness of the negative consequences of not recycling is a critical driver of participation. The Gauteng findings therefore align with the broader literature in emphasising normative and environmental motivations, though the small subset of respondents citing financial incentives points to the potential role of economic drivers in contexts where income generation from recyclables is feasible.

Table 4: Items that were recycled.

Item	Frequency	Percentage
Plastic (bottles, containers, etc.)	470	83.2
Paper (newspapers, cardboard, etc.)	399	70.6

Glass (bottles, jars, etc.)	302	53.5
Metal (tins, cans, etc.)	204	36.1
Organic waste (grass, peels, etc.)	118	20.9
Broken household items	104	18.4
Batteries	80	14.2
E-waste (cellphones, fridges, etc.)	62	11.0
Used motor oil	48	8.5
Building rubble	43	7.6
Light bulbs	23	4.1
Other	6	1.1

Source: author.

Plastics, paper, glass, and metal are the most commonly separated household waste fractions globally (Schultz et al., 1995; Miafodzyeva et al., 2013; Miliute-Plepiene et al., 2016; Zhang et al., 2016), a trend also reflected in Johannesburg (Table 4). Plastics were separated most frequently (83.2%), followed by paper (70.6%), glass (53.5%), and metal (36.1%). ‘Other’ reported recyclables included jewellery and clothing.

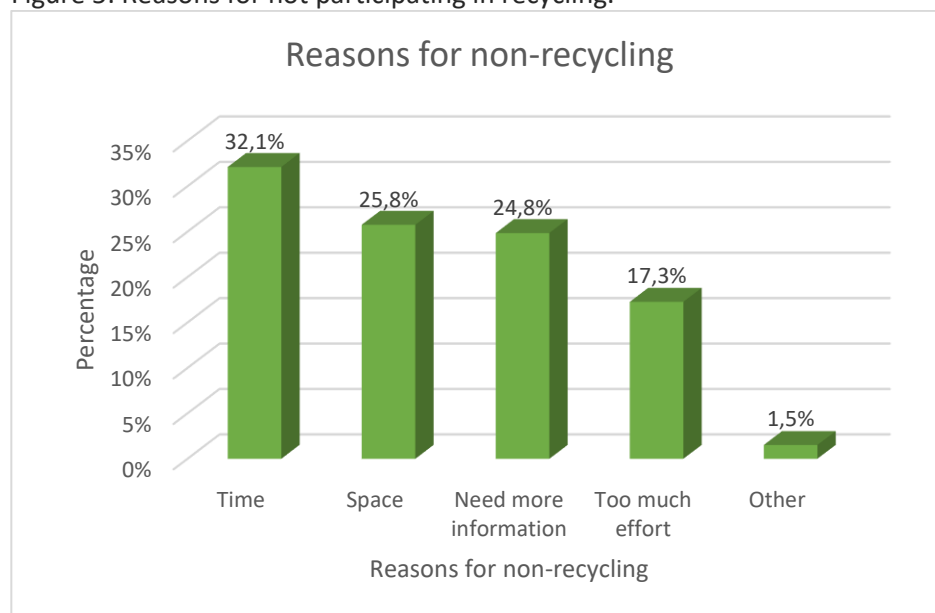
By contrast, light bulbs (4.1%) and e-waste (11.0%) recorded markedly low recycling rates. This is concerning given the hazardous substances they contain, such as mercury in fluorescent bulbs and lead and arsenic in light emitting diode bulbs (Ogunseitan et al., 2013), as well as the rapid growth of e-waste, which in South Africa is increasing at three times the rate of municipal solid waste (Forti et al., 2020). National estimates suggest only 11% of e-waste is recycled (Lydall et al., 2017), a figure consistent with this study’s findings. Low recovery of these streams represents both a loss of valuable secondary raw materials and a risk of adverse human health and environmental impacts from inappropriate disposal.

Reasons for not participating in waste separation

The main reasons cited by respondents for not separating waste were lack of time (32.1%) and insufficient storage space (25.8%) (Figure 5). These findings align with previous studies, which consistently report time constraints and limited storage as the dominant barriers to recycling (Strydom, 2012; Owusu et al., 2013; Tonglet et al., 2014; Mbida, 2014; Babaei et al., 2015). Additional reasons included the need for more information on recyclable materials (24.8%) and perceptions

that recycling requires excessive effort (17.3%). Under “Other,” respondents mentioned never having considered recycling, reliance on waste pickers, distance to recycling facilities, and, in one instance, “*Laziness and ignorance.*”

Figure 5: Reasons for not participating in recycling.



Source: author.

Comments of respondents mostly addressed the lack of space and the time recycling consumes.

“I would definitely recycle if it was easier, less time consuming.”

“I do not have time to be sorting out the recyclables at home.”

“The city must provide wheelie bins as most people do not have space to store the recyclables.”

Measurements to increase recycling participation

Both recyclers and non-recyclers were presented with a set of scenarios and asked whether these would positively influence their recycling participation. In addition, an open-ended question invited suggestions on what measures should implement to increase participation. These data provide valuable insights for enhancing recycling rates among current recyclers and promoting uptake among non-recyclers.

Three specific interventions were tested (Table 5): the provision of wheelie bins, improved access to recycling facilities, and the establishment of buy-back centres closer to households. Among current recyclers, 88.5% indicated that the provision of wheelie bins would increase their participation, 87.3% identified improved access to recycling facilities, and 78.4% favoured buy-back centres. Responses from non-recyclers were comparable, with 79.2%, 82.6%, and 78.0% respectively endorsing these measures.

Table 5: Access to wheelie bins, recycling facilities and buy-back centres.

Scenario	Recyclers			Non-recyclers		
	Yes	No	Not sure	Yes	No	Not sure
Would you recycle/recycle more if a wheelie bin is provided?	88.5%	3.3 %	8.3 %	79.2%	6.9 %	13.9%
Would you use recycling facilities if it were closer to your home?	87.3%	4.3 %	8.4 %	82.6%	5.9 %	11.5%
Would you recycle/recycle more if you can sell your recyclables at a buy-back centre?	78.4%	4.2 %	5.5 %	78.0%	9.1 %	12.9%

Source: author.

These findings are consistent with international evidence highlighting the importance of convenience and infrastructure in promoting recycling behaviour. Studies have shown that access to kerbside recycling (Barr et al., 2003; Halvorsen, 2012; Strydom, 2012; Struk, 2017), increased availability of recycling facilities (Halvorsen, 2012; Latif et al., 2013; Struk, 2017; Wang et al., 2018), provision of recycling bins (Jenkins et al., 2003; Fiorillo, 2013; Wang et al., 2018; Geiger et al., 2019), and overall perceptions of convenience (Sidique et al., 2010; Struk, 2017; Meng et al., 2019; Roust & Bolton, 2019) are critical factors influencing participation. The results of this study reaffirm these findings and suggest that such measures should be integrated into recycling programme. Illustrative quotations from respondents further reinforce these points.

"The bins would be an excellent start. I do think if there is a subsidized way for all households to get the bins we would be taking a huge step in the right direction."

"The municipality needs to provide resources such as trucks for deliveries, bins for separation of recyclable material."

"I would like the City of Johannesburg to create or bring recycling centers closer to people to make it possible to walk or drive to get to the waste recycling centers. Provision of wheelie bins could help people to engage in recycling as well."

"I would consider recycling if there were recycling bins available."

"Closer recycling facilities and wheelie bins."

Three questions were designed to assess respondents' knowledge regarding the recyclability of items and the availability of recycling facilities (Table 6). The results indicate a substantial demand for such knowledge. Among recyclers, 90.1% expressed a desire to learn more about the recyclability of specific items, compared to 85.6% of non-recyclers. Similarly, 92.7% of recyclers and 89.4% of

non-recyclers indicated a preference for a recycling logo on items to facilitate identification. Additionally, respondents expressed a need for greater awareness of the location of local recycling facilities, with 87.3% of recyclers and 85.4% of non-recyclers reporting interest in this information. These findings highlight the importance of targeted educational initiatives and improved information dissemination to support effective recycling behaviour.

Table 6: Knowledge needed to increase recycling.

Scenario	Recyclers			Non-recyclers		
	Yes	No	Not sure	Yes	No	Not sure
Would you like to know more on whether an item is recyclable or not?	90.1 %	5.8 %	4.1%	85.6%	6.9 %	7.5%
Would you prefer a recycling logo on items to know whether it is recyclable?	92.7 %	4.3 %	3.0%	89.4%	5.3 %	5.3%
Would you like to know where recycling facilities in your area are?	87.3 %	6.0 %	6.7%	85.4%	7.7 %	6.9%

Source: author.

In an open-ended question, respondents were given the opportunity to provide their views on measures that could be implemented to increase recycling participation. A total of 774 (70%) usable responses were recorded. Thematic analysis was conducted, and comments were categorised accordingly. The results, presented in Table 7, are ordered from the most to the least frequently mentioned themes.

Table 7: Measurements needed to increase recycling.

Comment theme	Frequency	Percentage
Education and knowledge	500	64.6
Provision of wheelie bins	147	19.0
Establish community recycling facilities	123	16.3
Recycling bins in public places	107	13.8

Campaigns and advertisements	66	8.5
Incentives	54	7.0
Weekly collection of recyclables	53	6.8
Monetary incentives	52	6.7
Make use of waste pickers	43	5.6
Provision of plastic bags	35	4.5
Create additional jobs	34	4.4
Issue fines	25	3.2
Make recycling easier	21	2.7
Law enforcement	19	2.5
Recycling logo on items	19	2.5
Provide recycling infrastructure	19	2.5
Community forums and input	19	2.5
Establish buy-back centres	10	1.3
Involve private businesses	8	1.0
Dedicated organisations/people	5	0.6
Provide feedback on progress	5	0.6
Mobile recycling facilities	3	0.4
Provide transport	2	0.3

Source: author.

Previous research has consistently highlighted that effective recycling and waste separation at source depend on adequate knowledge, information, and education to enhance environmental awareness. As early as the 1990s, Oskamp et al. (1991) emphasized that positive recycling behaviour is closely linked to understanding the specific processes involved, while Vining and Ebreo (1990) argued that the primary distinction between recyclers and non-recyclers lies in knowledge of materials eligible for collection. Schultz et al. (1995) further demonstrated that familiarity with a recycling programme is positively associated

with participation, and more recent studies confirm that lack of relevant knowledge and information continues to hinder recycling engagement (Babaei et al., 2015; Meng et al., 2019).

The findings of this study reinforce these conclusions. Both recyclers and non-recyclers expressed a strong desire for greater knowledge regarding the recyclability of items, the use of recycling logos, and the locations of local recycling facilities. In addition, thematic analysis of open-ended responses revealed that 64.6% of respondents identified education and awareness as the key factors that would increase participation. These results underscore the critical role of targeted educational initiatives and information dissemination in promoting recycling behaviour and suggest that improving access to knowledge could enhance both current participation and engagement among non-recyclers in Gauteng. Respondents' statements alluded that if they knew more about recycling and the benefits, then their recycling behaviour might change as recommended in the following statements.

"Educate me more about recycling. We tend to overlook or turn down things we don't understand and recycling is one of them."

"Maybe if I know the benefits of it, I may take interest in it but now am clueless and thus, not engage in recycling."

"Provide more information on recycling and educate people like me why it should be done. I personally do not know much and I never even paid that much attention until now. So maybe if we got more information and education on this matter, things could change for a lot of people."

Effective recycling and waste separation at source are strongly influenced by knowledge, education, and awareness initiatives. Previous research has demonstrated that individuals who are informed about recyclable materials and recycling procedures are more likely to participate in recycling programmes (Oskamp et al., 1991; Vining & Ebreo, 1990; Schultz et al., 1995; Babaei et al., 2015; Meng et al., 2019). Promotion and educational campaigns have also been shown to improve recycling rates and increase waste diversion from landfills (Sidique et al., 2009; Rhodes et al., 2014; Bergeron, 2016), with publicity efforts positively correlating with residents' engagement in recycling (Wang et al., 2018). The findings of this study support these conclusions, with 8.5% specifically recommended recycling campaigns and advertisements as effective measures. Statements from respondents to support this:

"Create an awareness, eg: TV ads to reduce the stigma around recycling. Put more posters to increase people's interest in recycling. We live in a more social network world so developing more awareness on social networks. Find a way to get the young people involved in such things and social networks would be a good platform to attract the youth."

"Advertise more on the local newspapers about recycling and how it must be done."

Incentives were suggested by 7.0% of respondents, while 6.7% specifically recommended monetary incentives to encourage recycling. Previous research indicates that incentive programmes can increase waste separation; for example, Struk (2017) reported positive effects of such programmes on recycling participation. However, Koford et al. (2012) found that while small monetary rewards for paying households may have some impact, the effect is generally limited. In contrast, studies in Malaysia have shown that rewards and incentives can have a negative effect, with respondents strongly opposing monetary incentives (Tiew et al., 2019). Similarly, Owusu et al. (2013) observed in Kumasi, Ghana, that low-income households were less likely to respond positively to cash incentives compared to middle- and high-income households. In this study, some respondents expressed a desire to receive payment for recycling, while others suggested alternative forms of incentives, as illustrated by the following quotations:

"The city must pay us for our rubbish. Then only will I recycle."

"I think they should create recycling systems with immediate rewards, like points you can buy data with. Something new and operating to the modern person."

"Offer water and electricity discounts to people that recycle."

"Allow tax rebates for individuals who participate in recycling."

Factor analysis: Benefits of recycling

A factor analysis was conducted to identify the underlying knowledge dimensions of the perceived benefits of recycling. Principal components analysis (PCA) was performed on the nine statements related to recycling benefits after confirming that the dataset was suitable for factor analysis. The PCA revealed the presence of two components with eigenvalues exceeding 1 (Table 8). Catell's scree test was also used to determine the appropriate number of components, and the scree plot indicated a clear break after the second component. Consequently, the nine statements were grouped into two components.

Table 8: Calculated eigenvalues (PCA).

Component	Initial eigenvalues			Rotation sums of squared loadings		
	Total	% of variance	Cumulative %	Total	% of variance	Cumulative %
Recycling benefits	4.372	48.583	48.583	4.372	48.583	48.583
Recycling knowledge	1.023	11.364	59.947	1.023	59.947	59.947

Source: author.

The two-component solution accounted for 60% of the total variance, with Component 1, labelled 'Recycling benefits,' explaining 48.6% of the variance, and Component 2, labelled 'Recycling knowledge,' explaining 11.4%. Oblimin rotation was applied to facilitate interpretation, resulting in a pattern and structure matrix (Table 9). The pattern matrix presents loadings that reflect the effect of a given factor on each item while controlling for other factors, whereas the structure matrix represents the zero-order correlations between items and factors without controlling for other factors (Pett et al., 2003). For oblique rotations, Pett et al. (2003) recommend using the structure matrix as the primary basis for factor identification and interpretation.

Table 9: Pattern and structure matrices.

Item	Pattern matrix		Structure matrix	
	Recycling benefits	Recycling knowledge	Recycling benefits	Recycling knowledge
Recycling reduces pollution	.801	-.080	.798	-.051
Recycling saves landfill space	.791	-.055	.789	-.026
Recycling conserves natural resources	.831	-.061	.829	-.031
Recycling improves environmental quality	.811	-.027	.810	.003
Recycling provides job opportunities	.693	.080	.695	.106
Recycling saves energy	.678	.141	.683	.166
People know about the benefits of recycling	-.002	.981	.034	.981
People need to be educated on recycling	.549	-.092	.546	-.072
It is important to recycle household waste	.718	.113	.722	.139

Source: author.

Analysis of the structure matrix showed that only one item, 'People know about the benefits of recycling' loaded unambiguously on the 'Recycling knowledge' component, with a loading of 0.981. All other items loaded on the 'Recycling benefits' component, with loadings ranging from 0.546 to 0.829. The highest loading (0.829) was observed for the statement 'Recycling conserves natural resources', indicating that the 'Recycling benefits' component accounted for 68.7% of the variance in this item. In contrast, the 'Recycling knowledge'

component explained 96.2% of the variance for '*People know about the benefits of recycling*', while the '*Recycling benefits*' component contributed less than 1% (0.0012%).

Influence of socio-demographic variables

The relationship between socio-demographic variables—including gender, age, employment status, education level, and income level—and waste separation behaviour was examined. Cross-tabulations and chi-square tests of independence were conducted to determine whether associations exist between these socio-demographic factors and recycling participation. For each variable, two hypotheses were tested: the null hypothesis posited that no relationship exists between the socio-demographic variable and recycling behaviour, while the alternative hypothesis proposed that the variable significantly influences recycling participation. Statistical significance was assessed using a p -value, with values less than 0.05 indicating a significant relationship at the 95% confidence level.

The following hypotheses were tested regarding the relationship between gender and recycling participation:

- **H₀**: There is no association between gender and participation in recycling.
- **H_a**: Gender influences participation in recycling.

The chi-square test for independence yielded $\chi^2(1) = 0.29$, $p = 0.59$, $\phi = 0.017$. These results indicate no significant association between gender and household waste separation for recycling, leading to the acceptance of the null hypothesis. This finding is consistent with previous studies that reported gender does not significantly influence waste minimisation behaviour (Tonglet et al., 2004; Miafodzyeva et al., 2013; Schoeman & Schmidt, 2016; Oztekin et al., 2017; Wang et al., 2018). Accordingly, the City of Johannesburg does not need to consider residents' gender when designing, expanding, or promoting recycling programmes in Gauteng.

The following hypotheses were tested regarding the relationship between age and recycling participation:

- **H₀**: There is no association between age and participation in recycling.
- **H_a**: Age influences participation in recycling.

The chi-square test for independence yielded $\chi^2(5) = 24.21$, $p < 0.001$, $\phi = 0.154$, indicating a statistically significant relationship between age and household recycling participation. Accordingly, the null hypothesis is rejected, confirming that age influences waste separation behaviour in Gauteng households. However, the effect size is small, as indicated by the weak correlation ($\phi = 0.154$).

Non-recycling respondents commonly cited lack of time as a barrier to participation. Younger individuals are often occupied with studies, career development, and family responsibilities, limiting their availability for waste separation. In contrast, older adults generally have more time to engage in household recycling. These findings are consistent with previous research

demonstrating that age is positively associated with recycling participation (Tonglet et al., 2004; Sidique et al., 2010; Fiorillo, 2013; Tabernero et al., 2015).

The following hypotheses were tested regarding the relationship between employment status and recycling participation:

- **H₀**: There is no association between employment status and participation in recycling.
- **H_a**: Employment status influences participation in recycling.

The chi-square test for independence yielded $\chi^2(1) = 14.851$, $p < 0.001$, $\phi = 0.121$, indicating a statistically significant relationship between employment status and household waste separation behaviour. Accordingly, the null hypothesis is rejected. However, the correlation is weak, suggesting that the effect of employment status on recycling participation is limited.

These findings contrast with those of Sidique et al. (2010), who reported that full-time employed individuals are less likely to engage in recycling activities compared to unemployed individuals. One might expect that unemployed persons would have more time for household recycling; however, this was not observed in the current study. A possible explanation is that economically inactive individuals are often lower-income or living below the poverty line. Economically inactive residents likely consume fewer products, resulting in a lower availability of recyclables for separation.

The following hypotheses were tested regarding the relationship between education level and recycling participation:

- **H₀**: There is no association between education level and participation in recycling.
- **H_a**: Education level influences participation in recycling.

The chi-square test for independence yielded $\chi^2(1) = 15.666$, $p < 0.001$, $\phi = -0.124$, indicating a statistically significant association between education level and household waste separation behaviour. Consequently, the null hypothesis is rejected, demonstrating that education level influences recycling participation in Gauteng households. Although the effect is statistically significant, the correlation is weak, suggesting that education level exerts only a modest influence on recycling behaviour.

These findings align with previous research, which identified education level as an important determinant of recycling participation (Sidique et al., 2010; Fiorillo, 2013; Latif et al., 2013; Owusu et al., 2013; Babaei et al., 2015).

The following hypotheses were tested regarding the relationship between income level and recycling participation:

- **H₀**: There is no association between income level and participation in recycling.
- **H_a**: Income level influences participation in recycling.

The chi-square test for independence yielded $\chi^2(3) = 7.805$, $p = 0.05$, $\phi = 0.089$, indicating no statistically significant association between income level and household waste separation behaviour. Accordingly, the null hypothesis is accepted, suggesting that income does not influence recycling participation among respondents.

This finding contrasts with previous studies, which reported that individuals from higher-income groups are more likely to participate in recycling (Schultz et al., 1995; Sidique et al., 2010; Halvorsen, 2012; Fiorillo, 2013).

FINAL CONSIDERATIONS

The findings indicate that respondents demonstrated a relatively high level of awareness regarding the environmental problems associated with waste, and they expressed strong agreement on the benefits of recycling. Nonetheless, this awareness did not translate into corresponding pro-environmental behaviour, as only 10.1% of respondents reported being committed recyclers. The primary barriers to participation cited by non-recyclers included lack of time, insufficient space, and limited knowledge about recycling practices. Several measures to enhance recycling participation were identified. The most prominent of these, as emphasised by the majority of respondents, was the need for education and the dissemination of information about recycling and related programmes.

The analysis of socio-demographic variables in relation to recycling participation in Gauteng revealed that only certain factors exert a statistically significant influence on household waste separation behaviour. Age, employment status, and education level were found to be significant determinants, although their effects were small, indicating weak correlations. In contrast, gender and income level showed no significant relationship with recycling participation, aligning with some studies but diverging from others in the existing literature.

The findings indicate that recycling behaviour in Johannesburg cannot be sufficiently accounted for by socio-demographic characteristics alone. Only three variables demonstrated marginal effects on recycling participation, none of which were statistically significant in explaining recycling behaviour. This is particularly noteworthy given that respondents reported substantially higher levels of education and employment compared to the general Gauteng population. Instead, structural, informational, and contextual determinants—such as accessibility of recycling facilities, awareness of recycling initiatives, and time availability—are likely to exert greater influence. Accordingly, policy interventions should focus on enhancing knowledge, education, and accessibility, while simultaneously addressing socio-economic barriers to participation. By shifting emphasis from demographic profiling toward systemic enablers, more inclusive and sustainable strategies can be designed to strengthen household recycling practices.

Further research should investigate the behavioural, cultural, and psychological barriers that prevent residents from translating environmental awareness into recycling action. Longitudinal research is required to assess changes in recycling participation over time, particularly in response to interventions such as education campaigns, the provision of infrastructure (e.g.,

wheelie bins), and recycling facilities closer to residential areas. Such studies would enable the evaluation of the long-term effectiveness of different strategies. Research should also explore the role of technological innovations, such as mapping of recycling facilities, and household-level monitoring tools, in supporting recycling participation. Cross-country comparative studies could provide insights into the recycling behaviour of more of South Africa's residents.

Comportamento de reciclagem de resíduos sólidos: um estudo de caso em Gauteng, África do Sul

ABSTRACT

Este estudo investigou o comportamento de reciclagem na menor, porém mais populosa província da África do Sul. Apenas 10% do total de resíduos é reciclado no país, e os aterros em Gauteng estão próximo do limite de capacidade. Há escassez de áreas para disposição de resíduos na província, tornando imperativo encontrar formas de desviar resíduos dos aterros. Conhecer o comportamento de reciclagem e as medidas para aumentar a participação — objetivos deste estudo — fornece informações para desenvolver sistemas de gestão de resíduos que elevem as taxas de reciclagem. O estudo empregou um desenho de métodos mistos, utilizando um questionário. Os dados quantitativos foram analisados com estatística descritiva e inferencial, enquanto os dados qualitativos foram examinados por análise temática. Os resultados revelaram uma discrepância notável entre as atitudes positivas dos respondentes em relação à reciclagem e suas práticas reais. Apesar do alto nível de concordância quanto aos benefícios da reciclagem, apenas 10,1% dos respondentes puderam ser classificados como recicladores assíduos. As principais barreiras à participação identificadas foram falta de tempo (32,1%) e espaço insuficiente (25,8%). Os respondentes propuseram várias estratégias para ampliar a participação, e a maioria (64,6%) enfatizou a necessidade de mais educação e conhecimento sobre reciclagem. Uma análise fatorial realizada para explorar as dimensões de conhecimento subjacentes aos benefícios percebidos da reciclagem resultou em dois componentes. Além disso, a análise multivariada revelou que três variáveis sociodemográficas — idade, situação de emprego e nível de escolaridade — tiveram influência estatisticamente significativa na participação em reciclagem. Este estudo oferece uma melhor compreensão das práticas de reciclagem na África do Sul e de como a participação pode ser ampliada.

KEYWORDS: Gestão de resíduos. Reciclagem. Variáveis sociodemográficas. Aumento da participação.

ACKNOWLEDGEMENT

This research was funded by the National Council for Scientific and Technological Development (CNPq), grant numbers 403798/2024-8 and 407021/2023-0.

REFERENCES

- Adeleke, O., Akinlabi, S., Jen, T. C., & Dunmade, I. 2021. Towards sustainability in municipal solid waste management in South Africa: a survey of challenges and prospects. *Transactions of the Royal Society of South Africa*, 76(1):53–66.
- Ali, S.M., Pervaiz, A. Afzal, B. Hamid, N. & Yasmin, A. 2014. Open dumping of municipal solid waste and its hazardous impacts on soil and vegetation diversity at waste dumping sites of Islamabad City. *Journal of King Saud University – Science*, 26(1):59-65.
- Alremeithi, A.A., Riaz, Z. & Khan, M. 2025. What constitutes citizens' recycling behavior: insights from handling municipal solid waste in the UAE. *Smart and Sustainable Built Environment*, 14(4): 1017–1037.
- Al-Khatib, I.A., Monou, M., Abu Zahara, A.S.F., Shaleen, H.Q. & Kassinos, D. 2010. Solid waste characterization, quantification and management practices in developing countries. *Journal of Environmental Management*, 91(5):1131-1138.
- Anderson, B.A., Romani, J.H., Wentzel, M. & Phillips, H.E. 2013. *Recycling behaviour among urban South Africans: The role of race and social status*. Population Studies Center Research Report No. 1-790.
- Babaei, A.A., Alavi, N., Goudarz, G., Teymouri, P., Ahmadi, K. & Rafiee, M. 2015. Household recycling knowledge, attitudes and practices towards solid waste management. *Resources, Conservation and Recycling*, 102:94-100.
- Baffi, S., Turok, I. & Vacchani-Marcuzzo, C. 2018. The South African urban system. In *International and transnational perspectives on urban systems*:285-314. Edited by Rozenblat, C., Pumain, D. & Velasques, E. New York: Springer.
- Barr, S. 2007. Factors influencing environmental attitudes and behaviors. A UK case study of household waste management. *Environment and Behaviour*, 39(4):435–473.
- Bergeron, F.C. 2016. Multi-method assessment of household waste management in Geneva regarding sorting and recycling. *Resources, Conservation and Recycling*, 115:50-62.
- Bohm, R.A., Folz, D.H., Kinnaman, T.C. & Podolsky, M.J. 2010. The costs of municipal waste and recycling programs. *Resources, Conservation and Recycling*, 54(11):864-871.
- Byrne, D. 2022. A worked example of Braun and Clarke's approach to reflexive thematic analysis. *Quality & Quantity*, 56:1391–1412.
- Chen, L. Gao, M. 2021. Formal or informal recycling sectors? Household solid waste recycling behavior based on multi-agent simulation, *Journal of Environmental Management*, 294:113006.
- Corsini, F., Gusmerotti, N.M., Testa, F. & Iraldo, F. 2018. Exploring waste prevention behaviour through empirical research. *Waste Management*, 79:132-141.
- Creswell, J.W. 2015. *A concise introduction to mixed methods research*. Los Angeles: SAGE Publications.

da Silva, C.L.; Franz, N.M. A Framework for Public Policy Development in BRICS Countries to Support Circular Economy Development in the WEEE Value Chain. *Recycling* 2025, 10, 7. <https://doi.org/10.3390/recycling10010007>

DEA (Department of Environmental Affairs). 2016. *2nd South Africa Environment Outlook: A report on the state of the environment*. Available from: http://soer.environment.gov.za/State_of_the_Environment.html.

DEA (Department of Environmental Affairs). 2018. *South Africa State of Waste Report*. Available from: <http://sawic.environment.gov.za/documents/11766.pdf>.

Derdera, S.E. & Ogato, G.S. 2023. Towards integrated, and sustainable municipal solid waste management system in Shashemane city administration, Ethiopia. *Heliyon*, 9(11):e21865.

DFFE (Department of Forestry, Fisheries and the Environment). 2020. *National Waste Management Strategy*. Pretoria: South Africa.

Dos Muchangos, L.S., Tokai, A. & Hanashima, A. 2017. Stakeholder analysis and social network analysis to evaluate the stakeholders of a MSWM system – A pilot study of Maputo City. *Environmental Development*, 24:124-135.

Filho, W.L., Brandli, L., Moora, H., Kruopienė & Stenmarck, A. 2016. Benchmarking approaches and methods in the field of urban waste management. *Journal of Cleaner Production*, 112(5):4377-4386.

Fiorillo, D. 2013. Household waste recycling: National survey evidence from Italy. *Journal of Environmental Planning and Management*, 56(8):1125-1151.

Forti, V., Bladé, C.P., Kuehr, R. & Bel, G. 2020. *The global e-waste monitor 2020: Quantities, flows and the circular economy potential*. UNU/UNITAR/ITU/ISWA. Available from: <https://globalewaste.org/>.

GDARD (Gauteng Department of Agriculture and Rural Development). 2011. *State of the Environment Report*. Available from: http://soer.deat.gov.za/dm_documents/Gauteng_full_report_low_res_kksoy_fk-nn.pdf.

Geiger, J.L., Steg, L., Van der Werff, E. & Ünal, A.B. 2019. A meta-analysis of factors related to recycling. *Journal of Environmental Psychology*, 64:78-97.

Gertsakis, J. & Lewis, H. 2003. *Sustainability and the waste management hierarchy – A discussion paper on the waste management hierarchy and its relationship to sustainability*. Available from: www.sustainability.vic.gov.au/~media/resources/documents/publications%20and%20research/publications/q%20-%20t/publications%20towards%20zero%20waste%20sustainability%20and%20the%20waste%20hierarchy%202003.pdf.

Golzar, J., Noor, S. & Tajik, O. 2022. Convenience sampling. *International Journal of Education & Language Studies*, 1(2):72-77.

Halvorsen, B. 2012. Effects of norms and policy incentives on household recycling: An international comparison. *Resources, Conservation and Recycling*, 67:18-26.

Hutcheson, G.D. & Sofroniou, N. 1999. *The multivariate social scientist*. London: SAGE Publications.

Jenkins, R.R., Martinez, S.A., Palmer, K. & Poodolsky, M.J. 2003. The determinants of household recycling: A material specific analysis of recycling program features

and unit pricing. *Journal of Environmental Economics and Management*, 45(2):294-318.

Kirama, A. & Mayo, A.W. 2016. Challenges and prospects of private sector participation in solid waste management in Dar es Salaam City, Tanzania. *Habitat International*, 53:195-205.

Koford, B.C. Blomquist, G.C., Hardesty, D.M. & Troske, K.R. 2012. Estimating consumer willingness to supply and willingness to pay for curbside recycling. *Land Economics*, 88(4):745-763.

Latif, S.A., Omar, M.S., Bidin, Y.H. & Awang, Z. 2013. Analyzing the effect of situational factor on recycling behaviour in determining the quality of Life. *Journal of Asian Behavioural Studies*, 3(8), 37-46.

Linden, A. & Carlsson-Kanyama, A. 2003. Environmentally friendly disposal behaviour and local support systems: Lessons from a metropolitan area. *Local Environment*, 8 (3): 291-301.

Lydall, M., Nyanjowa, W. & James, Y. 2017. Mapping South Africa's waste electrical and electronic equipment (WEEE) dismantling, pre-processing and processing technology landscape. Mintek External Report #74. Pretoria, DST. Policy Report. Available at: <https://www.ewasa.org/wp-content/uploads/2018/04/weee-technology-landscape-assessment-report.pdf>.

Marshall, R.E. & Farahbakhsh, K. 2013. Systems approaches to integrated solid waste management in developing countries. *Waste Management*, 33(4):988-1003.

Mbida, B. 2014. Urban solid waste characteristics and household appetite for separation at source in Eastern and Southern Africa. *Habitat International*, 43:152-162.

McDougall, F.R., White, P.R., Franke, M. & Hindle, P. 2001. *Integrated solid waste management: A life cycle inventory*. 2nd edition. Oxford: Blackwell.

Meng, X., Tan, X., Wang, Y., Wen, Z., Tao, Y. & Qian, Y. 2019. Investigation on decision-making mechanism of residents' household solid waste classification and recycling behaviors. *Resources, Conservation and Recycling*, 140:224-234.

Miafodzyeva, S., Brandt, N. & Andersson, M. 2013. Recycling behaviour of householders living in multicultural urban area: A case study of Järva, Stockholm, Sweden. *Waste Management and Research*, 31(5):447-457.

Miller, G.T. & Spoolman, S.E. 2011. *Living in the environment*. (17th Ed.). Canada: Nelson Education.

Miliute-Plepiene, J., Hage, O., Plepys, A. & Reipas, A. 2016. What motivates households recycling behaviour in recycling schemes of different maturity? Lessons from Lithuania and Sweden. *Resources, Conservation and Recycling*, 113:40-52.

Ogunseitan, O.A., Allgood, J.M., Hammel, S.C. & Schoenung, J.M. 2013. Translating the materials genome into safer consumer products. *Environmental Science & Technology*, 47(22):12625-12627.

Onweugbuzie, A.J. & Collins, K.M. 2007. A typology of mixed methods sampling designs in social science research. *The Qualitative Report*, 12(2):281-316.

- Oskamp, S., Harrington, M., Edwards, T., Sherwood, P.L., Okuda, S.M. & Swanson, D.L. 1991. Factors influencing household recycling behavior. *Environment and Behavior*, 23(4):494-516.
- Owusu, V., Adjei-Addo, E. & Sundber, C. 2013. Do economic incentives affect attitudes to solid waste source separation? Evidence from Ghana. *Resources, Conservation and Recycling*, 78:115-123.
- Oztekin, C., Teksöz, G., Pamuk, S., Sahin, E. & Kilic, D.S. 2017. Gender perspective on the factors predicting recycling behavior: Implications from the theory of planned behavior. *Waste Management*, 62:290–302.
- Pallant, J. 2013. *SPSS survival manual: A step by step guide to data analysis using IBM SPSS*. 5th Ed. Miadenhead: McGraw-Hill.
- Pett, M.A., Lackey, N.R. & Sullivan, J.J. 2003. Rotating the factors. In *Making sense of factor analysis*:131-165. Edited by Pett, M.A., Lackey, N.R. & Sullivan, J.J. Thousand Oaks: SAGE Publications.
- Rana, Md. S., Uddin, Md. K., Uddin, Md. S., Hossain, Md. I. & Rana, Md. S. 2025. Bibliometric analysis on sustainable waste management: Special evidence from municipal solid wastes. *Cleaner Waste Systems*, 12:100386.
- Rhodes, R.E., Beauchamp, M.R., Conner, M., DeBruijn, G-J., Latimer-Cheung, Kaushal. N. 2014. Are mere instructions enough? Evaluation of four types of messaging on community depot recycling. *Resources, Conservation and Recycling*, 90:1-8.
- Rousta, R. & Bolton, K. 2019. Sorting household waste at the source. In *Sustainable resource recovery and zero waste approaches*:105-114. Edited by Taherzadeh, M.J., Bolton, K., Wong, J. & Pandye, A. Amsterdam: Elsevier.
- Schoeman, T. & Schmidt, J. 2016. An explorative study on household recycling behaviour in the City of Johannesburg. *Proceedings of the Centenary Conference of the Society of South African Geographers*. Stellenbosch, South Africa, 25-28 September 2016. Available from: <http://www.ssag.co.za/wp-content/uploads/2019/06/proceedings-final-2016.pdf>.
- Schoeman, D.C. & Rampedi, I.T. 2022. Drivers of household recycling behavior in the City of Johannesburg, South Africa. *International Journal of Environmental Research and Public Health*, 19:6229.
- Schultz, P.W., Oskamp, S. & Mainieri, T. 1995. Who recycles and when? A review of personal and situational factors. *Journal of Environmental Psychology*, 15(2):105-121.
- Schwarz-Herion, O., Omran, A. & Rapp, H. 2008. A case study on successful municipal solid waste management in industrialized countries by the example of Karlsruhe City, Germany. *Annals of the Faculty of Engineering Hunedoara – Journal of Engineering*, 6: 266-273.
- Sidique, S.F., Joshi, S.V. & Lupi, F. 2010. Factors influencing the rate of recycling: An analysis of Minnesota counties. *Resources, Conservation and Recycling*, 54(4):242-249.
- StatsSA (Statistics South Africa). 2024a. *General household survey – 2023*. Available from: https://www.statssa.gov.za/?page_id=16405.

StatsSA (Statistics South Africa). 2024b. *Census 2022 provincial profile: Gauteng*. Available from: <https://www.statssa.gov.za/publications/03-00-21/03-00-212024.pdf>.

Struk, M. 2017. Distance and incentives matter: The separation of recyclable municipal waste. *Resources, Conservation and Recycling*, 122:155-162.

Strydom, W.F. 2012. *Highlights of a recycling behaviour study in South Africa's large urban areas*. Paper presented at the 4th CSIR Biennial Conference: Real problems relevant solutions, CSIR, Pretoria, 9-10 October 2012.

Tabachnick, B.G. & Fidell, L.S. 2013. *Using multivariate statistics*. (5th Ed.). Boston: Pearson.

Taberner, C., Hernández, B., Cuadrado, E. & Luque, B. 2015. A multilevel perspective to explain recycling behaviour in communities. *Journal of Environmental Management*, 159:192-201.

Tiew, K., Basri, N.E.A., Deng, H., Wantanabe, K., Zain, S.M. & Wang, S. 2019. Comparative study on recycling behaviours between regular recyclers and non-regular recyclers in Malaysia. *Journal of Environmental Management*, 237:255-263.

Tonglet, M., Phillips, P.S. & Bates, M.P. 2004. Determining the drivers for householder pro-environmental behaviour: Waste minimisation compared to recycling. *Resources, Conservation and Recycling*, 42(1):27-48.

Vining, J. & Ebreo, A. 1990. What makes a recycler? A comparison of recyclers and nonrecyclers. *Environment and Behavior*, 22(1):55-73.

Wang, Z., Dong, X. & Yin, J. 2018. Antecedents of urban residents' separate collection intentions for household solid waste and their willingness to pay: Evidence from China. *Journal of Cleaner Production*, 173:256-264.

Wilson, D.C., Velis, C.A. & Rodic, L. 2013. Integrated sustainable waste management in developing countries. *Waste and Resource Management*, 166(2):52-68.

Zhang, C., Li, X., Li, Y. & Zhi, Q. 2016. The status of municipal solid waste incineration (MSWI) in China and its clean development. *Energy Procedia*, 104:498-503.

Recebido: 15/09/2025

Aprovado: 20/09/2025

DOI: 10.3895/rts.v21n66.20859

Como citar:

SCHOEMAN, Thea. Solid waste recycling behaviour: A case study from Gauteng, South Africa. *Rev. Tecnol. Soc.*, Curitiba, v. 21, n. 66, p.174-200, seção temática, 2025. Disponível em:

<https://periodicos.utfpr.edu.br/rts/article/view/20859>

Acesso em: XXX.

Correspondência:

Direito autoral: Este artigo está licenciado sob os termos da Licença Creative Commons-Atribuição 4.0 Internacional.

