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Constraints Facing Metal Waste Pickers in OR Tambo District Municipality: Barriers and Pathways to Inclusive Circular Economy Livelihoods

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Abstract

Metal waste pickers are central to South Africa's circular economy, yet their livelihoods remain precarious and poorly supported. This paper draws data from a study that investigated the socio-economic and institutional conditions shaping metal waste picking in OR Tambo District Municipality, a rural-urban district in the Eastern Cape. A mixed-methods design was employed, combining a structured survey (n = 102), semi-structured interviews, and direct observation through time-location sampling. Guided by the sustainable livelihoods framework, the analysis identifies three major constraints: (i) occupational health risks; (ii) low and highly unstable incomes; and (iii) fragmented governance. Additional challenges include lack of storage, exposure to weather, and competition from municipal clean-ups. The paper proposes a sequenced set of interventions: short-term measures to improve safety and health; medium-term cooperative development and transparent pricing mechanisms; and long-term legal recognition, regulated access to collection sites, and integration into social protection schemes. By providing novel district-level evidence from a rural-urban South African context, the study contributes to the debates on informality, inclusion, and circular economy transitions. Implemented together, these measures can strengthen livelihoods, reduce vulnerability, and advance more inclusive and just circular economic systems.

Keywords: *circular economy, informal recycling, occupational health, OR Tambo, sustainable livelihoods.*

1. Introduction

Informal waste pickers play a critical—and yet undervalued—role in material recovery systems worldwide, particularly in developing economies where municipal waste services are uneven and recycling markets are weakly regulated (Ntusi, et al., 2022). They contribute a substantial share of recycled materials to supply chains and, where measured, generate significant

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economic value from recovered resources (Godfrey, 2021; Zisopoulos et al., 2023). Despite this contribution, waste pickers often work in precarious conditions marked by health risks, unstable incomes, limited social protection, and exclusion from formal governance processes (Mlotshwa et al., 2022; Agarwal, 2023; Zolnikov et al., 2021).

In South Africa, informal recycling supports the livelihoods of thousands of households, but remains insufficiently integrated into municipal and national circular economy strategies (DEFF & DST, 2020; Littlewood et al., 2022). The OR Tambo District Municipality (hence, OR Tambo DM) in the Eastern Cape provides an instructive case: the district faces high unemployment, limited formal recycling infrastructure, and a sizeable informal sector: conditions that shape both the opportunities and vulnerabilities of metal waste pickers (OR Tambo District Municipality, 2022; Chen, 2018). Existing research has tended to focus on large metropolitan contexts, leaving limited empirical evidence on waste pickers operating in rural-urban districts such as OR Tambo. This metropolitan bias constrains the design of context-sensitive policies (Buch et al., 2021; Morais et al., 2022).

Against this backdrop, the study pursues three objectives, namely to:

1. Document the livelihood constraints and health burdens of metal waste pickers in OR Tambo DM.
2. Identify cross-cutting barriers—including limited PPE and training, intermediary capture of value, weak organisation, and exposure to climate-sensitive hazards—that impede inclusive circular economy participation.
3. Propose sequenced, actionable policy measures to strengthen livelihoods while advancing circular material flows.

By providing district-level, and empirically grounded evidence, the paper contributes to debates on informality, social inclusion, and circular economy transitions. The findings are directly relevant to municipal planners, NGOs, and development partners seeking to operationalise just and locally appropriate circular economy strategies.

2. Conceptualisation and Research Gap

Informal recycling is widely recognised as a critical component of urban material recovery systems, particularly in developing economies where municipal waste services are uneven, and recycling markets are weakly regulated (Ntusi, Tshimbana & Baloyi, 2022; Godfrey, 2021; Zisopoulos et al., 2023). As mentioned earlier, despite this contribution, waste pickers often work under precarious conditions marked by health risks, unstable incomes, limited social protection, and exclusion from formal governance processes (Mlotshwa et al., 2022; Agarwal, 2023; Zolnikov et al., 2021).

In South Africa, existing scholarship has largely focused on metropolitan contexts such as Johannesburg, Durban, and Cape Town, where informal recycling intersects with large-scale municipal systems and private sector actors (DEFF & DST, 2020; Littlewood et al., 2022). In contrast, rural-urban districts such as OR Tambo remain under-researched, despite facing high unemployment, limited recycling infrastructure, and having a sizeable informal sector (OR Tambo DM, 2022; Chen, 2018). This metropolitan bias constrains the development of context-sensitive policies, and leaves significant knowledge gaps regarding the livelihood realities of waste pickers in smaller and mixed-economy districts (Buch et al., 2021; Morais et al., 2022).

2.1 Theoretical Lens: Sustainable Livelihoods Framework

To address the identified research gap, this study uses the sustainable livelihoods framework (SLF) as its conceptual lens. The SLF emphasises how households combine human, social, natural, physical, and financial capital to pursue livelihood strategies under conditions of vulnerability and change (Natarajan et al., 2022; Serrat, 2017). It also highlights how access to these assets—mediated by institutions and policies—shapes livelihood outcomes and resilience (Matiwane & Matiwane, 2023).

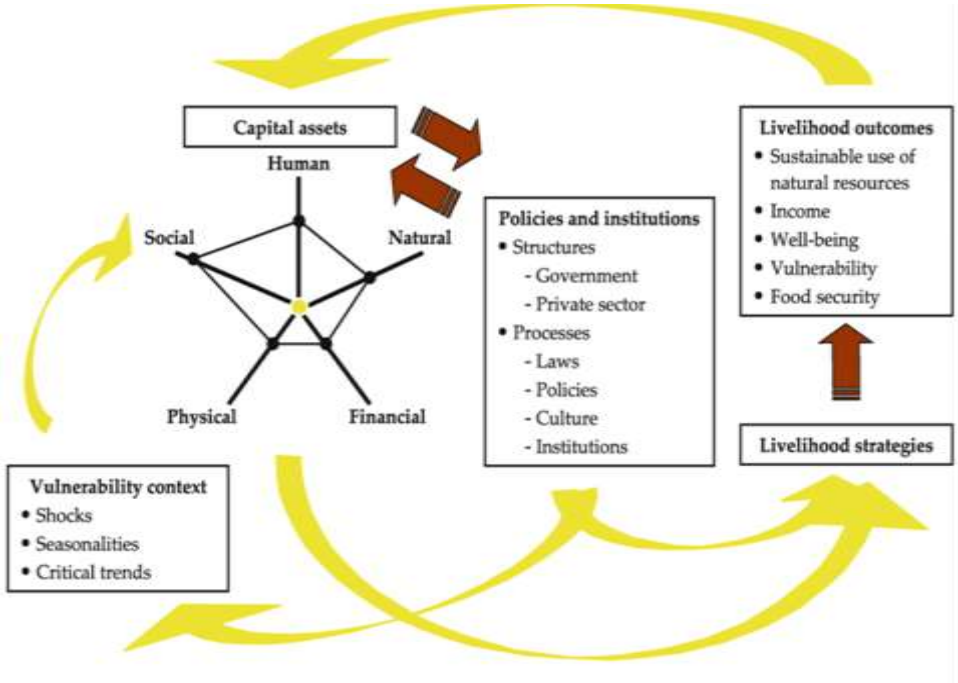

Figure 1: Sustainable Livelihoods Framework
(Adapted from Serrat, 2017)

Figure 1 illustrates the SLF's five capital categories and their interconnections, providing a structured framework for analysing the constraints faced by metal waste pickers in OR Tambo DM. Guided by this framework, the study examines:

- *Human capital:* constraints limiting waste pickers' ability to secure safe and stable incomes, including health burdens and limited skills.
- *Social capital:* barriers to collective organisation, market access, and exposure to stigma or harassment.
- *Natural capital:* access to recyclable material streams and competition with formal collectors.
- *Physical capital:* deficits in tools, transport, protective equipment, and storage facilities.
- *Financial capital:* income volatility, price bargaining power, and lack of access to credit.

By situating waste pickers' experiences within the SLF, the study links occupational health, market relations, and governance barriers to broader debates on circular economy transitions (Morais et al., 2022; Velenturf & Purnell, 2021). Applying the SLF enables an analysis that moves beyond descriptive accounts of informal recycling towards actionable diagnosis. Mapping deficits in each capital category helps identify targeted interventions—such as training and health support, cooperative formation, municipal buy-back points, and microfinance—which strengthen livelihoods while advancing inclusive circular economy objectives (Tabares et al., 2022)

2.2 Contribution

Accordingly, this paper contributes to the literature by:

- Documenting the livelihood constraints and health burdens of metal waste pickers in OR Tambo DM.
- Identifying cross-cutting barriers—limited PPE and training, intermediary capture of value, weak organisation, and exposure to climate-sensitive hazards—that impede inclusive circular economy participation.
- Proposing sequenced actionable policy measures to strengthen livelihoods while advancing circular material flows.

3. Materials and Methods

This study used a descriptive, mixed methods design to characterise the working conditions, constraints, and livelihood strategies of metal waste pickers in OR Tambo DM. A descriptive approach is suitable for systematically documenting practices in understudied informal sectors, and for generating evidence to inform policy and targeted interventions (Siedlecki, 2020). The design combined structured surveys, semi-structured interviews, and direct observation to

capture both the prevalence of key outcomes (quantitative), and the lived experiences and institutional dynamics shaping those outcomes (qualitative) (Ahmed, Pereira & Jane, 2024). The SLF guided instrument development and analytical organisation by focusing on human, social, natural, physical, and financial capitals.

3.1 Study Area

The research was conducted in OR Tambo DM, Eastern Cape Province, South Africa. The district covers approximately 12,141km² and includes five local municipalities: King Sabata Dalindyebo, Nyandeni, Port St Johns, Ingquza Hill, and Mhlontlo. It is characterised by extreme poverty and inequality (Gini coefficient 0.56), limited formal employment, and a large informal economy. The population is estimated at 1.5m, with persistent youth educational deficits and uneven access to municipal services (Statistics South Africa, 2018; OR Tambo DM, 2022). Rapid demographic change and urbanisation have increased municipal waste generation and intensified competition for recoverable materials, shaping both opportunities and constraints for informal recyclers (Chen, 2018). These contextual conditions informed site selection and the interpretation of findings.

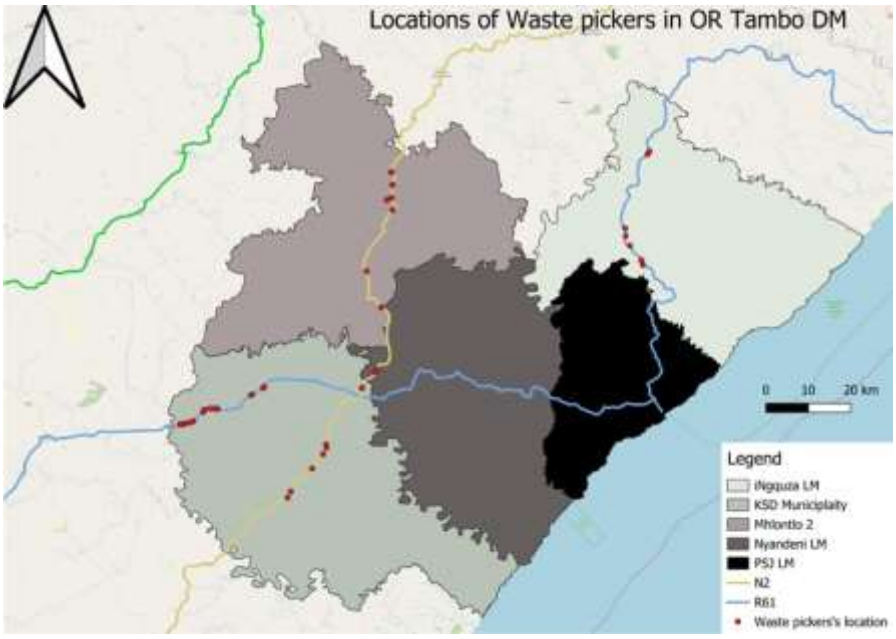

Figure 2: Study Area and Sampling Hotspots in OR Tambo DM, Eastern Cape [The Map shows the five local municipalities (King Sabata Dalindyebo, Nyandeni, Port St Johns, Ingquza Hill, and Mhlontlo) and key activity corridors (N2 and R61) where metal waste pickers operate. Hotspots were identified using municipal records, key informant interviews, and reconnaissance visits.] **Source:** OR Tambo District Municipality, 2022.

3.1 Research Design and Rationale

A mixed-methods approach ensured complementarity and triangulation. The quantitative component consisted of a structured survey (n = 102) measuring demographics, daily routines, PPE access, transport and tools, interactions with intermediaries, income sources, and self-reported occupational morbidities. The qualitative component—semi-structured interviews with waste pickers, recycling facility managers, and municipal officials, supplemented by direct observation—explored institutional relationships, pricing dynamics, safety practices, and perceptions of formalisation. Combining these components enabled quantitative patterns to be explained through qualitative mechanisms, and supported the identification of practical policy entry points.

3.2 Sampling and Fieldwork

As no registry of metal waste pickers exists in the OR Tambo DM, a pragmatic, mixed non-probability sampling strategy was adopted to maximise coverage while acknowledging the limits to statistical generalisability. The approach included:

- *Time-location sampling (TLS)***:** Field teams visited known activity hotspots—particularly along the N2 and R61 corridors, and near municipal transfer stations—during morning and late afternoon periods when waste-picking activities peak (Karon & Wejnert, 2012).
- *Snowball referral***:** Initial respondents referred peers working on adjacent routes or informal collection points, enabling access to less visible workers (Parker, Scott & Geddes, 2019).
- *Convenience sampling:* Enumerators approached eligible individuals, who were encountered opportunistically, to expand the sample size and capture variations in practices.

Hotspot identification relied on municipal records, key informant interviews, and reconnaissance visits. The fieldwork was conducted from 1 February 2024 to 28 June 2025. Refusals were recorded when possible. The final analytic sample included 102 respondents across all five municipalities and site types (roadside, landfill edge, and transfer station). This cross-site strategy mitigated selection bias and enabled contextual interpretation.

We acknowledge that the non-probability design limits representativeness: hence, results should be interpreted as indicative of patterns among active metal waste pickers rather than as population estimates. To mitigate bias, purposive sampling across municipalities and site types was employed, and site characteristics were documented to support contextual interpretation.

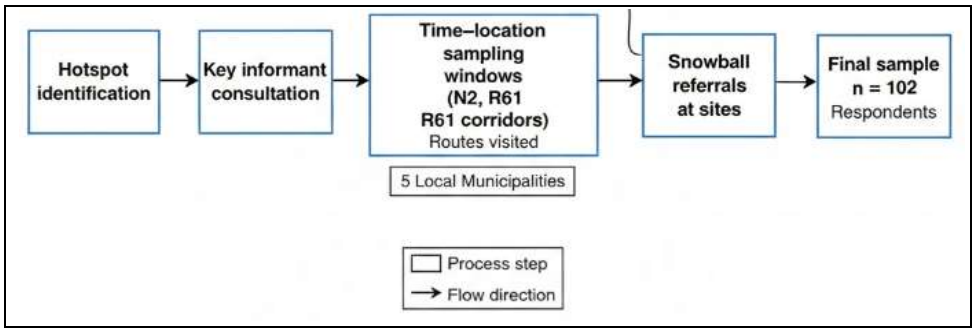

Figure 3: Sampling and Fieldwork Flowchart. [Diagram summarising the mixed non-probability sampling strategy, including time-location sampling, snowball referrals, and convenience sampling. The flowchart illustrates the sequential steps from hotspot identification to the final sample (n = 102).]

3.3 Instrument Development, Pilot, and Data Collection

Survey and interview instruments were developed from literature on informal recycling, occupational health, and the SLF; and then refined in consultation with municipal waste managers and local recycling businesses. The questionnaire included closed and open-ended items on demographics, household involvement, work routines, PPE and tool use, transport type, income and price negotiation, interactions with intermediaries, and self-reported health outcomes such as musculoskeletal pain, cuts, and respiratory symptoms.

A pilot study involving 12 respondents at two sites assessed comprehension, timing, and cultural appropriateness. The feedback resulted in minor wording changes, and the inclusion of probing prompts. The instruments were translated into isiXhosa and back-translated to ensure semantic accuracy. Trained enumerators collected data using tablet-based forms (Survey Solutions, ODK, or equivalent). Enumerators received one day of training on ethical procedures, consent, question phrasing, safety protocols, and data quality assurance. Observation checklists and qualitative guides supported the triangulation of survey responses, and a systematic documentation of contextual details (e.g., tool types, sorting practices, load weights, environmental exposure).

3.4 Ethics and Consent

Ethical clearance was granted by the Walter Sisulu University (Ref. WSU/FNS-GREC-2022/02-11/G3). Participation was voluntary and based on informed consent: either verbal or written. Respondents were informed of their right to withdraw at any time. Also, all data were anonymised at the point of collection, and identifiers were removed from transcripts and datasets. Digital files were stored on password-protected drives. The anonymised data may be shared upon reasonable request, subject to ethical conditions.

3.5 Data Analysis

Quantitative analysis: Survey data were exported to SPSS (Version 28) for cleaning and analysis. Descriptive statistics (frequencies, means, medians) summarised demographic characteristics, PPE access, transport types, and morbidities. Cross-tabulations and chi-square tests examined bivariate associations (e.g., PPE use by gender; morbidity by PPE). Logistic regression models explored associations between predictors (e.g., PPE access, hours worked, gender, age group) and binary morbidity outcomes. Odds ratios, 95% confidence intervals, and p-values were reported, with $p < 0.05$ considered statistically significant. Given the non-probability sample, inferential results are interpreted cautiously as indicative rather than generalisable.

Qualitative analysis: Interviews and observation notes were transcribed and thematically coded. Two researchers independently coded an initial subset to generate a coding frame; discrepancies were resolved through discussions. The final coding structure captured themes related to occupational risks, market relations, institutional interactions, coping strategies, and aspirations for formalisation. Coding and retrieval were conducted in NVivo (or equivalent). Representative anonymised quotations are used in the results to contextualise quantitative patterns.

3.6 Data Availability and Appendices

The survey instrument, interview anonymised data, and analytical code are available upon reasonable request, subject to ethical approval and data-sharing agreements.

4. Results and Discussion

This section presents descriptive results from the mixed-methods fieldwork (survey n = 102, semi-structured interviews, direct observation). The findings are organised using the SLF, and are reported without analytical interpretation. Summary indicators are provided in tables in subsequent sub-sections.

4.1 Sample Profile and Overview

The respondents were drawn from the five local municipalities of the OR Tambo District. Women made up 62.7% (64) of the sample, while men accounted for 37.3% (38). The age distribution was concentrated in the 31–45 years (46.1%) and 46–60 years (29.4%) groups. Only seven respondents (6.9%) were aged 15–30 years, while 18 (17.6%) were aged between 61–75 years. Most of the respondents worked alone in waste picking (74.5%), with smaller proportions reporting the involvement of 2–3 members (15.7%), or 4–5 members (9.8%). Table 1 summarises the household demographic data.

Table 1: Demographic Composition and Household Involvement (n = 102)

Indicator	Count	Percent
Total respondents	102	100%
Female respondents	64	62.7%
Male respondents	38	37.3%
Age 15–30	7	6.9%
Age 31–45	47	46.1%
Age 46–60	30	29.4%
Age 61–75	18	17.6%
Household: only respondent involved	76	74.5%
Household: 2–3 members involved	16	15.7%
Household: 4–5 members involved	10	9.8%

4.2 Human Capital: Health, Skills, and Labour Capacity

Health-related indicators are summarised in Table 2. A total of 77 respondents (75.5%) reported noticeable negative health changes attributed to waste picking, while 19 (18.6%) reported some changes, and six (5.9%) reported none. The most frequently reported morbidities were back pain (34.3%), shoulder pain (28.4%), finger cuts (25.5%), and skin irritation (11.8%). No respondents had received formal training in safe handling, ergonomics, or business management. Access to health services was described as limited or inconsistent, with most relying on ad-hoc clinic visits or self-medication.

Table 2: Human Capital Indicators (health, skills, labour capacity)

Indicator	Count	Percent
Noticed negative health changes	77	75.5%
Noticed health changes to some extent	19	18.6%
No health change	6	5.9%
Back pain	35	34.3%
Shoulder pain	29	28.4%
Finger cuts	26	25.5%
Skin irritation	12	11.8%
Formal training in safe handling	0	0%
Regular access to health services	Limited / inconsistent	—

4.3 Social Capital: Public Support, Stigma, Harassment, and Organisation

As shown in Table 3, half of the respondents (50.0%) reported receiving some form of community support, most commonly from neighbours who offered scrap or informed them about materials. Thirty respondents (29.4%) reported no support, while 21 (20.6%) reported receiving partial support. Police-related experiences were mixed: 82 respondents (80.4%) reported no harassment, while 20 (19.6%) described incidents such as verbal intimidations, accusations of

theft, or interferences by local gatekeepers. No respondents belonged to associations or cooperatives. A small minority reported isolated incidents of confiscation or extortion.

Table 3: Social Capital Indicators (Public support, harassment, organisation)

Indicator	Count	Percent
Receive public support (Yes)	51	50.0%
Receive public support (No)	30	29.4%
Receive public support (Partial)	21	20.6%
Reported police harassment (Yes)	20	19.6%
Reported police harassment (No)	82	80.4%
Membership in formal association/cooperative	0	0%
Reported confiscation/extortion	Reported by a small minority (qualitative)	—

4.4 Physical Capital: Tools, Transport, and Protective Equipment

The respondents relied primarily on manual transport and basic tools (Table 4). Hand-carrying, head loading, wheelbarrows, and improvised carts were common at all sites. Fewer respondents reported access to motorised transport. Regular access to personal protective equipment (gloves, boots, masks) was low; and mostly irregular or absent. Access to secure storage was limited; many respondents stored materials outdoors or temporarily at buyers' premises. Observation records documented consistent exposure to heat, sun, rain, and roadside hazards.

Table 4: Physical Capital Indicators (tools, transport, PPE, storage)

Indicator	Count	Percent
Primary transport: hand/head carried	Common across majority	59.8
Primary transport: wheelbarrow/cart	Common across sites	24.5
Access to motorized transport	Least common across respondents	12.8
Regular access to basic PPE	Low / mostly irregular or absent	—
Access to secure storage facilities	Very limited	—
Exposure to weather/road hazards	Observed at all sites	—

4.5 Natural Capital: Access to Waste Streams and Competition

The respondents accessed materials from several site types (Table 5), including roadside corridors (especially the N2 and R61), transfer stations, landfill edges, and residential neighbourhoods. Competition for recyclable materials was frequently reported among municipal clean-ups, formal contractors, and other informal collectors. Several respondents noted that municipal clean-ups occasionally resulted in significantly reduced daily yields. Activity clusters were consistently located along major road corridors and near transfer nodes.

Table 5: Natural Capital Indicators (Access to Waste Streams, Competition)

Indicator	Count	Percent
Primary collection at roadside corridors	Common	60%
Primary collection at transfer stations	Moderate prevalence	40%
Primary collection at landfill edges	Regularly reported	55%
Competition from formal collectors/clean-ups	Frequently reported	70%
Reduction in recoverable material due to clean-ups	Commonly reported	65%

4.6 Financial Capital: Incomes, Market Relations, and Intermediaries

Self-reported monthly incomes ranged from R200 to R20,000, with an estimated mean of approximately R2450, indicating substantial income variability among the respondents. Most respondents sold metals directly to recycling firms, while a smaller proportion relied on intermediaries or aggregators. No respondents had access to formal credit facilities, and only a small minority participated in informal savings or rotating credit schemes.

Table 6: Financial Capital Indicators (Income Levels, Market Engagement)

Dimension	Indicator	Observed Value	Percentage / Notes
Financial Capital: Income	Monthly income range	R200–R20,000	Wide income variability across respondents
	Mean monthly income	≈ R2,450	Indicates generally low average earnings
Financial Capital: Market Relations and Intermediaries	Primary buyers: intermediaries / aggregators	Occasional to rare	30% of respondents
	Direct sales to recycling firms	Predominant market channel	70% of respondents
	Access to formal credit	None reported	0%
	Participation in informal savings or rotating credit schemes	Limited participation	20% of respondents

5. Discussion

5.1 Overview: Constrained Assets and Fragile Livelihoods

The findings show that metal waste pickers in OR Tambo DM operate under significantly constrained asset conditions across all five sustainable livelihoods capitals. Human capital deficits are particularly severe, with 75.5% of the respondents reporting negative health changes—including musculoskeletal pain, cuts, and skin irritation—compounded by the lack of formal training and irregular access to health services. Physical capital is similarly restricted, as most rely on manual transport methods and improvised carts, with limited or no access to personal protective equipment or secure storage facilities.

Financial capital remains weak, characterised by low mean monthly incomes (approximately R2,450), high variability, and continued reliance on intermediated market relations. Social capital shows mixed patterns: half of the respondents report neighbourly support, nearly one-fifth experience harassment, and none participate in cooperatives or formal associations. Collectively, these patterns suggest livelihoods that are adaptive in the short-term, but structurally fragile; thereby leaving waste pickers vulnerable to health shocks, market fluctuations, and environmental exposure. These findings are consistent with comparable studies documenting precarious informal recycling livelihoods in Latin America and Southern Africa (Gutberlet, 2019; Sibanda, Sibanda & Phesa, 2025).

5.2 Legal Recognition, Inclusion and Governance

The absence of legal recognition exacerbates the identified constraints. Without formal identification or recognised status, waste pickers face insecure access to collection sites, increased exposure to harassment, and limited bargaining power in interactions with intermediaries and municipal authorities. Formal inclusion in municipal waste governance frameworks—through registries and explicit incorporation into integrated waste management plans—could enable structured engagement between waste pickers and local authorities. Such measures would also reduce arbitrary enforcement, facilitate the provision of basic service support (storage facilities, PPE, training), and clarify rights of access to collection territories. Legal recognition may also create pathways for integrating informal collectors into municipal contracts or material recovery initiatives, thereby strengthening their market position, and reducing dependence on intermediaries (Lindner, 2025; Sibanda, Sibanda & Phesa, 2025).

5.3 Health, Safety and Physical Capital Interventions

Occupational health burdens are evident across the study sample, with musculoskeletal disorders and contact-related injuries widely reported. When considered alongside limited access to PPE, reliance on manual transport, and sustained exposure to roadside and weather-related hazards: these highlight significant deficiencies in physical capital, and underscore urgent health and safety concerns. Hence, targeted interventions should prioritise the provision of context-appropriate PPE, ergonomically designed carts and lifting aids, and the establishment of shaded and/or weather-resilient collection points, complemented by basic first aid and hygiene facilities. Also, periodic health outreach delivered directly at collection sites could help address inconsistent access to formal health services, and hence reduce the accumulation of untreated conditions. Strengthening physical capital through such measures is central to reducing injury risks, enhancing occupational safety, and sustaining labour capacity over the longer term (Lindner, 2025).

5.4 Market Access, Incomes, and Financial Resilience

The respondents' incomes were generally low, highly variable, and strongly influenced by dependence on intermediaries within recycling value chains. This reliance limits price transparency, and also restricts waste pickers' ability to capture value from recovered materials. Strengthening market access requires measures to reduce intermediary dominance, while improving transparency and direct engagement with recycling firms. Establishing aggregation points with calibrated weighing scales, publicly displayed price schedules, and facilitated buyer-seller linkages could similarly contribute to greater income stability and improved returns. Financial resilience may be further enhanced through targeted small-scale capital support, such as shared transport trolleys, weighing and grading tools, and access to microfinance or appropriately designed credit facilities that reflect the realities of informal work. Collective marketing arrangements could also offer a potential for strengthening bargaining power and reducing vulnerability to price exploitation (Kwemoi, 2025).

5.5 Collective Organisation, Capacity Building, and Social Capital

The absence of cooperatives or organised structures significantly restricts access to shared assets, weakens market position, and limits effective engagement with government and private stakeholders. Establishing cooperatives, producer groups, or community-based organisations—co-designed with waste pickers to reflect local contexts—could enable pooled transport, shared storage infrastructure, and coordinated marketing arrangements. These organisational platforms also provide mechanisms for delivering targeted capacity-building interventions, including training in occupational safety, basic financial and business management, material grading, and governance skills required for transparent collective functioning. Beyond organisational formation, strengthening social capital requires broader public awareness initiatives to reduce the stigma associated with waste picking, while also building on neighbourly support reported by half of the respondents. Together, these measures could enhance collective agency, improve livelihood outcomes, and support more inclusive waste governance (Medina, 2020; Samson, 2022).

5.6 Climate Resilience, Transport and Social Protection

Field observations revealed that waste pickers are widely exposed to sun, heat, rainfall, and roadside hazards; which are worsened by the reliance on manual transport methods. These conditions increase the vulnerability of waste pickers to climate variability and extreme weather events, risks that are expected to intensify in urban and peri-urban areas of South Africa. Strengthening climate resilience requires investment in weather-resilient infrastructure—such as shaded shelters, protected sorting areas, and designated collection points—along with improvements in transport options that reduce physical strain and exposure. In addition to physical interventions, including waste pickers in local

social protection and welfare schemes could help mitigate climate-related and economic shocks. Integrating infrastructure improvements with targeted social protection measures—such as emergency assistance or context-appropriate cash support—can stabilise incomes, reduce vulnerability, and support transitions towards safer and more resilient livelihood pathways (Ziervogel, 2019).

5.7 Research Priorities and Monitoring

Future research should assess the relative effectiveness of alternative integration pathways—including cooperatives, municipal partnerships, and social enterprise models—in improving health outcomes, income stability, and market inclusion under South African conditions. Particular attention should be given to identifying institutional and contextual factors that influence the success or failure of these models. In parallel, the development of longitudinal monitoring systems—ideally embedded within municipal data infrastructures—would enable systematic tracking of key indicators such as occupational health outcomes, access to PPE, income trajectories, market practices, and incidents of harassment or confiscation. Also, a systematic documentation of both successful and unsuccessful pilot interventions would generate an evidence base to support adaptive learning; thereby informing the design of scalable, context-sensitive approaches to waste picker integration and livelihood support (Godfrey et al., 2019).

5.8 Policy Implications

Synthesising the findings across the SLF capitals highlights the need for a coordinated package of complementary policy and programme interventions. Key priorities include:

a) Legal recognition and formal inclusion of waste pickers within municipal waste governance frameworks, supported by registries and regulated access to collection sites.

b) Targeted investment in occupational health and safety, including the provision of PPE, ergonomically designed transport aids, periodic health outreach, and site-based hygiene facilities.

c) Market-oriented reforms to reduce intermediary dominance, such as the establishment of aggregation points, transparent pricing mechanisms, and strengthened linkages with recycling firms.

d) Support for collective organisation through cooperatives or producer groups, complemented by governance and management training.

e) Investment in transport infrastructure and secure storage facilities to enhance safety and productivity.

f) Extension of social protection and climate resilience measures to buffer economic and environmental shocks.

When co-designed with waste pickers and implemented through coordinated partnerships involving municipalities, civil society organisations, and private sector actors, these interventions can address the cross-cutting vulnerabilities identified in Tables 1–6. Collectively, they can contribute to the development of more adaptive, resilient, and sustainable livelihoods; while advancing inclusive waste governance and a just circular economy (Godfrey et al., 2019; Schröder et al., 2020).

6. Conclusion

This study demonstrates that metal waste pickers in the OR Tambo DM sustain their livelihoods under highly constrained and precarious conditions. Across the sustainable livelihoods capitals, deficits are evident: health and physical risks are widespread—including musculoskeletal injuries, cuts, and skin irritations—while formal training, regular healthcare, personal protective equipment (PPE), secure storage, and motorised transport are largely absent. Earnings remain low and volatile as they are shaped by dependence on intermediaries, and social organisation is minimal. Although some community support exists, harassments and occasional confiscations persist, resulting in adaptive but fragile livelihoods that are highly vulnerable to health shocks, market fluctuations, and seasonal or climate-related disruptions.

The findings highlight clear priorities for policy and practice. Improving occupational health and safety through accessible PPE, ergonomically designed carrying aids, basic hygiene and first-aid facilities, and mobile health outreach is essential to reduce cumulative work-related harm. Strengthening market access and infrastructure—including local aggregation points, transparent weighing and pricing, shared transport, and secure short-term storage—would also enhance bargaining power and income stability. Moreover, legal recognition and municipal inclusion through registries, integration into integrated waste management plans, and regulated access to collection sites would reduce harassments, clarify operational rights, and facilitate formal support and partnerships. Collective organisation—such as cooperatives or producer groups—and capacity-building can further enable pooled resources, coordinated sales, and training in safe handling, material grading, and basic business management. Social protection and climate-resilient infrastructure at collection nodes are also critical to buffer shocks and reduce exposure to environmental hazards.

When implemented together—co-designed with waste pickers and coordinated across municipal, civil society, and private sector actors—these interventions can address the multifaceted constraints identified; thereby promoting more dignified, resilient, and sustainable livelihoods within a just circular economy. Importantly, the study contributes novel district-level evidence from a rural-urban South African context, addressing a gap in the literature that has been

dominated by metropolitan case studies. By situating findings within the sustainable livelihoods framework, the analysis provides a structured diagnosis of constraints and entry points, offering actionable pathways for inclusive circular economy transitions.

Ongoing monitoring of health outcomes, income stability, access to PPE, and experiences of harassment will be essential to evaluate progress and refine scalable models for inclusion in waste management systems. Future research should explore the comparative effectiveness of cooperative, municipal, and social enterprise models; and assess how climate resilience and social protection measures can be integrated into waste governance. Taken together, these efforts can advance both livelihood security and circular economy objectives, ensuring that waste pickers are recognised not as marginal actors, but as central contributors to sustainable urban and peri-urban systems

Author Contributions: T.W.O. provided research supervision, methodological oversight, project administration, and contributed to review and editing. Z.X. led conceptualisation, methodology, investigation, data curation, formal analysis, software development, and drafted the original manuscript. G.E.O. co-supervised the study, validated findings, and contributed to review and editing. L.C. supported the literature review, formal analysis, and manuscript editing. G.M. contributed to validation, data curation, project administration, and review. L.M. participated in joint data collection, validation, and review. B.M. provided postdoctoral support, drafting, and review. S.S.M. assisted with joint data collection, software support, and review. J.D. contributed to drafting and review. All authors approved the final manuscript.

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Ethics Statement: Ethical approval was obtained from the Walter Sisulu University Research Ethics Committee (Ref. WSU/FNS-GREC-2022/02-11/G3, 13 June 2022). Informed consent was obtained from all participants prior to data collection.

Data Availability: The data are not publicly available due to confidentiality agreements and ethical restrictions. De-identified data may be requested from the corresponding author, subject to approval by the ethics committee.

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