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DATES:
Received: 26 Sep. 2021
Revised: 20 July 2022
Accepted: 22 July 2022
Published: 31 Aug. 2022

HOW TO CITE:
Chitaka TY, Moyo T, Gihring K, Schenck C. The myth of livelihoods through urban mining: The case of e-waste pickers in Cape Town. S Afr J Sci. 2022;118(Special issue: Waste as a Resource), Art. #12456. https://doi.org/10.17159/sajs.2022/12456

ARTICLE INCLUDES:
☒ Peer review
☐ Supplementary material

DATA AVAILABILITY:
☐ Open data set
☐ All data included
☒ On request from author(s)
☐ Not available
☐ Not applicable

EDITOR:
Floretta Boonzaier

KEYWORDS:
informal sector, e-waste, sustainable livelihoods, informal jobs, recycling

FUNDING:
South African National Research Foundation (grant UID 128149)

The myth of livelihoods through urban mining: The case of e-waste pickers in Cape Town

Waste pickers are widely acknowledged as an integral part of the formal and informal economy, diverting waste into the secondary resource economy through urban mining. Urban mining in itself is considered to be a source of livelihoods. We investigated the livelihoods of e-waste pickers through 110 surveys in Cape Town, South Africa. Waste pickers often indicated that they were engaged in the sector not by choice but by necessity, expressing that earning money is the only enjoyable aspect of their job. The results from the study substantiate that it is unlikely that waste pickers could survive on e-waste picking alone as 83.3% of reported incomes were below minimum wage, with 22.9% below the food poverty line. Thus, the majority of waste pickers collected a wide array of recyclables. We also found that the waste pickers in Cape Town engage in multiple e-waste related activities, including collection, dismantling and processing to a lesser extent. They work long hours in arduous working conditions which present multiple hazards for their health and safety. Ultimately, e-waste pickers' incomes cannot be considered commensurate with the nature of the work. Further, e-waste picking cannot be regarded to significantly contribute to livelihoods, but is rather a survivalist strategy. The survivalist nature of the work does not allow for waste pickers to move upwards in the waste value chain and benefit from greater income opportunities. Furthermore, their lack of skills prohibits waste pickers' transition to formal employment. With a lack of options, it is necessary to ensure that the waste sector provides opportunities for decent work to enable workers to lift themselves out of poverty.

Significance:

- E-waste pickers participate in multiple activities across the e-waste value chain including collection, dismantling, processing, and repair and refurbishment.
- E-waste pickers in Cape Town cannot make a living on e-waste alone, and supplement their income from collecting other recyclables.
- E-waste pickers work long hours in difficult working conditions which pose a threat to their health and safety.
- E-waste picking is a survivalist strategy.

Introduction

Urban mining denotes the systematic reuse of anthropogenic materials from urban areas.[1] This reuse is achieved through the reclaiming of compounds, elements and energy from waste and obsolete products that have been discarded, often to landfills, in urban areas.[2-4] Urban mining introduces the reclaimed raw materials back into the manufacturing economy and thus has potential to create jobs and improve livelihoods.[5-7] Jobs created in the waste electrical and electronic (e-waste) economy are a subcategory of green jobs. There is much interest in estimating these circular economy jobs, especially in the Global North whose economies are largely formal; yet there are concerns about total factor productivity and wage stagnation in the sector. According to Barford and Ahmad[8]: 'In low- and middle-income countries, waste pickers underpin the recycling loop of the circular economy'. The contributions of waste pickers have been studied internationally by Gutberlet and Carenzo[9], Buch et al.[10] and Amorim de Oliveira[11], amongst others. Waste pickers are broadly defined as small-scale, self-employed people who are mostly active in the urban informal economy.[12]

The informal economy is as old as humankind itself as historically all employment was informal until policies were introduced that created the divide between formal and informal.[13] In 1973, Keith Hart coined the term 'informal economy'.[14] Chen and Carre[13] and the International Labour Organization[15] estimate that up to 61% of all people worldwide are working informally, and around 80% of the workforce in developing countries consists of informal workers. Originally, informal work was considered by economists as a transitory or temporary phenomenon which would decline when economic growth took place. That expected transition never happened. Clearly, the complexity of informality needs to be viewed with a much more multi-perspective lens.

Polese[16] and Banks et al.[17] argue that it depends on the theoretical (e.g. socio- economic, political, geographical) perspective that is taken on how informality is viewed and responded to. If informality is seen as the abnormal and inferior in relation to the 'formal' as the norm, the policy responses will be repressive, such as evicting of informal street vendors.[17] Marxist academics view the informal sector as integral to capitalist dynamics, while for Polese[16], informality is seen as the art of bypassing the state where informality steps in to provide where the state has failed to provide. We agree with Banks et al.[17] and Roy[18] that we should start to value and recognise the potential and merits of informality and view urban informality as 'an organising logic, a system of norms that governs the process of urban transformation itself' and as 'a series of transactions that connect different economies and spaces to one another'[18]. Polese[16] further argues for considering informality-centred approaches as a way to reshape the political order of a system. Informality-centred approaches are taken as a starting point for critical exploration of the relationships, attitudes, agency, and strategies. Only then, according to Banks et al.[17], can we reveal deeper insights into the broader spectrum of actors involved in urban informality, including their roles, relationships, and strategies.

To summarise, to be able to research, understand and respond to the complexities of informality, requires transdisciplinarity. Transdisciplinarity or transdisciplinary research is defined as 'knowledge production activities spanning across disciplinary boundaries and meaningfully involving non-academic partners'[19]. Transdisciplinary research transcends separate disciplinary sectors, transgresses disciplinary and institutional boundaries, and is context specific.

In accepting that informality is here to stay, the International Labour Organization focus on the promotion of decent work and the elimination of the negative aspects of informality, while preserving the significant job creation and income generation potential of the informal economy.[20]

The notion of 'jobs' in the informal e-waste recycling sector can be contentious because of how the word 'job' is defined, i.e. a piece of work or task performed regularly for an agreed price. Chen[21] indicates that informal employment can be divided into two categories: informal self-employment and informal wage-employment. According to this categorisation, informal e-waste pickers would mostly fall under informal self-employment. They can be considered to be the subcategory that is working on survivalist strategies as opposed to the better-resourced self-employed entrepreneurs. In general, self-employed workers have to deal with various social risks, including the risk of poverty in old age, the risk of disability, and the risk of unemployment.[22] Thus, informal e-waste recyclers would be plagued by several challenges typical of the nature of their employment, one of which is low incomes which are not sufficient to reduce poverty.[12] Consequently, there is a high chance they would get caught in a poverty trap, i.e. a self-reinforcing mechanism whereby poverty begets poverty in the absence of a significant external injection of capital. This situation is cause for concern and should be reviewed, with strategies put in place to address the sustainability of incomes and livelihoods in the sector.

There has been a debate in the literature regarding informal employment that has spanned decades.[23-25] Questions revolve around whether informal employment is both a symptom and a reproductive and perpetuating factor of precariousness, inequality, and of social and individual poverty. Or, in contrast, 'is it a reflection of economic initiative and business potential, which, if channelled and fostered properly, could contribute to social and economic development?'[23]. Viljoen et al.[12] analysed the livelihoods of street waste pickers in South Africa and cited high levels of unemployment to be the driver for pursuing waste picking, despite the hardships, unbearable working conditions, and poor income. Similarly, researchers in Ghana[26,27] and Nigeria[28] have reported on the difficult working conditions and the related risks faced by informal e-waste recyclers. Informal e-waste recycling is a physically demanding type of work that entails lots of lifting, carrying, pushing and pulling, with workers covering significant distances, usually on foot.[29,30] As such, in Ghana, e-waste workers were found to have a high risk of musculoskeletal disorders and disabilities.[29] They are also exposed to arsenic and heavy metals which could have adverse effects on their health.[31-33] Questions around satisfaction from this type of work arise, and considerations regarding the waste pickers' awareness of their contribution to the developing e-waste economy are relevant, as this could feed into job satisfaction, i.e. an awareness that one's line of work contributes to a greater good.

Waste picking is a form of urban mining and is recognised to generate an income stream and be a source of livelihood for many people in the developing world.[6,7,12,34-36] E-waste is a fraction of urban waste that contains valuable metals and sells for relatively higher value compared to other recyclables, and thus the urban mining of e-waste is of interest from both a solid waste management perspective and from achieving circularity in the metals industry. However, the overall contribution of e-waste to livelihoods may have some nuances relative to other waste streams. It is important to understand the extent of participation of e-waste pickers in the value chain, their motivations and remuneration to determine to what extent the practice contributes to sustainable livelihoods.

The South African government recognises what they refer to as 'the pioneering role of waste pickers in the development of recycling collection systems in South Africa' and this recognition is in line with the new global best practice on waste picker integration[6,37-39], with the publication in 2020 of the 'Waste picker integration guideline for South Africa'.[39] The guideline provides a framework for integrating waste pickers into local and regional waste management systems and recycling economies.[39] South Africa has taken the first step by including the incorporation of the informal sector and the recognition of their value in its National Waste Management Strategy 2020.[40] Furthermore, the country has created provision for a collection service fee to be paid to all registered waste pickers under the Extended Producer Responsibility (EPR) Regulations.[41]

Recent research has covered various aspects of the informal sector in South Africa – such as socio-economic conditions[12], well-being[42,43], health risks[44] and integration[39,45-47]. However, there has been little distinction between the different resources with which the waste pickers work. Thus, the extent to which different waste streams contribute to waste pickers' livelihoods remains vague. This study is the first to focus on e-waste activities in the informal economy.

We aimed to investigate the claim that waste picking can be a source of livelihoods for waste pickers, using the case of e-waste pickers in the City of Cape Town, South Africa. We argue that this claim is a myth, using evidence from this informal e-waste sector. This paper contributes to the development of an understanding of the nature of these informal jobs related to e-waste activities and the extent to which they contribute to livelihoods. These insights will provide a realistic perspective on the livelihoods of e-waste pickers.

Methods

Primary data were sourced via questionnaires administered to informal e-waste pickers in Cape Town. The questionnaire was adapted from that developed and used by Viljoen[48] in several studies in South Africa. It included both quantitative and qualitative questions. The questionnaire explored several themes including waste pickers' motivations for operating in this sector, the activities in which they participated (collection, dismantling, processing), and the earnings derived from these activities.

Six experienced fieldworkers were recruited and trained to administer the questionnaires. The training was conducted online whereby the fieldworkers were familiarised with the questionnaire and trained on how to approach certain questions that may be considered sensitive. The fieldworkers consisted of a core group who were involved in other studies on informal waste pickers in Cape Town. The leader of the fieldworkers was a retired teacher who is knowledgeable about the townships and how to navigate and negotiate with the waste pickers. The other fieldworkers were postgraduate students from the University of South Africa and the University of the Western Cape.

Buy-back centres play an important role in connecting informal sector activities with the formal economy of recyclers.[49] In addition, some scrap metal dealers play a similar role. Thus, the surveys were conducted at buy-back centres and scrap metal dealers where e-waste pickers are known to sell their wares. A combination of convenience and availability sampling was implemented. Interviews were conducted from 10 May 2021 to 27 May 2021, and adhered to COVID-19 requirements as prescribed by the University of the Western Cape. In total, 110 surveys were conducted; each survey took 5–15 min per participant depending on the fieldworker. The data were digitised through entry into SurveyMonkey by a research assistant.

Following completion of the surveys, a 90-min focus group was held with the fieldworkers. During the focus group, the fieldworkers gave accounts of their experiences and observations whilst conducting the surveys. These accounts were recorded and transcribed.

Open-ended qualitative questions were analysed using ATLAS.ti v9.1. A priori thematic analysis was employed whereby the themes were identified during development of the questionnaire. Statistical analyses were conducted on quantitative questions using Statistica software. Multiple regression analysis was used to investigate the relationship between income, education and collection days. The relationship between income and happiness was investigated using the Spearman's Rank test.

Whilst 110 surveys were conducted, only 85 were completed. Furthermore, the waste pickers did not respond to questions that were not relevant to them. Thus, the results presented are based on the responses received.

The research was approved by the University of Cape Town Engineering and Built Environment Ethics Committee and the University of the Western Cape Research Ethics Committee.

Results

Demographics

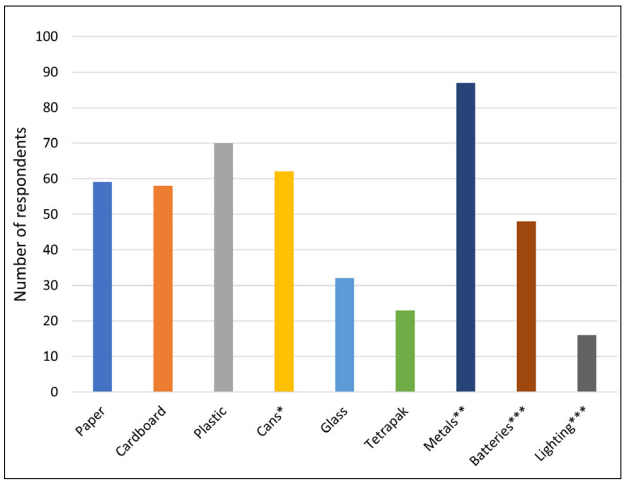
Almost all the people interviewed were South African, with 88.7% born in the Western Cape and 9.4% from the Eastern Cape. Only two respondents were from other countries, namely Namibia and Mozambique. Afrikaans was the predominant language spoken, with English to a lesser extent. The majority of respondents (87.7%) did not complete high school; only one person had proceeded to tertiary education, although they did not complete their qualification. In terms of gender, 75% of respondents were male.

Activities

Respondents were asked about their participation in various e-waste related activities, specifically collection, dismantling, processing (metal recovery), repair and refurbishment, and the sale of the e-waste.

Collection

Respondents sourced e-waste from a variety of sources, including industrial areas, directly from shops/businesses, landfills and schools. The most popular sources were reportedly dustbins outside houses and directly from residents. Some respondents had built relationships with residents, who then kept items aside for them. It was reported in the focus group discussions that a few respondents had admitted to stealing items. Respondents collected a wide variety of items including screens, cables and household appliances. Copper, printed circuit boards and other metals were perceived to be the top three most valuable fractions. Most waste pickers do not primarily specialise on e-waste alone, which was also reflected in this study as 98 respondents indicated that they also collected other types of recyclables (Figure 1).



**Cans are often collected and sold separately which is why they were considered a separate category*

***Metals which are not e-waste related*

****In South Africa, batteries and lighting are considered separately from e-waste*

Figure 1: Other types of recyclables collected by respondents.

Of the respondents, 70.1% reportedly collected e-waste at least 5 days a week, with some working daily. They worked a mean(±standard deviation) of 9.1±2.8 hours a day. As shown in Figure 2, 48.4% of respondents had been collecting e-waste for less than 5 years, whilst 22.1% had at least 10 years' experience. For those also collecting other recyclables, 50.6% had less than 5 years of experience; 56.0% of respondents collecting both e-waste and other recyclables started collecting them at the same time, whilst 21.3% started by collecting e-waste before moving onto other recyclables.

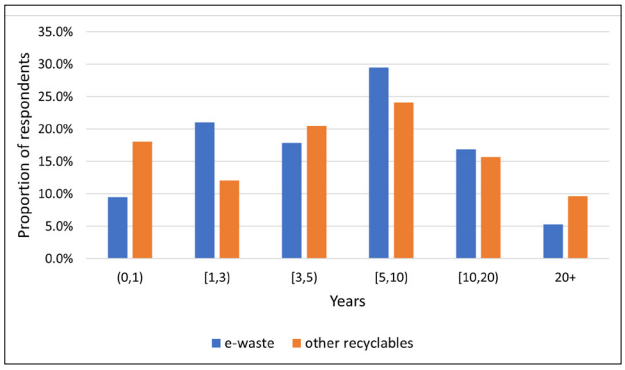


Figure 2: Years collecting e-waste and other recyclables.

Most respondents (60.4%) stated that they decided to collect e-waste to generate an income, which included their primary livelihood, because they received a higher profit compared to other recyclables, or as an additional income. Another 20.8% of respondents indicated that they engaged in e-waste collection because they were unemployed and could not find other work. Other reasons were because family and friends had been doing it, cleaning the environment, and being self-employed.

Dismantling

The results show that 82.7% of the interviewees indicated that they dismantled e-waste. Almost none of them reported any formal training, with only one receiving training on-the-job while working at a buy-back centre. The most commonly used tools for dismantling were hammers and screwdrivers (examples shown in Figure 3). Left-over materials deemed to have low economic value are commonly dumped in the area in which they are working. The majority indicated that they dismantled the goods at home (88.5%) whilst some dismantled at buy-back centres. The primary motivation reported for dismantling is that they can obtain higher prices for the different fractions of dismantled goods.

Photo: Professor Mapendere

Figure 3: Examples of tools used for dismantling.

Processing

Whilst 81.4% of respondents indicated that they participated in processing, when asked what they process and how, it became clear that some respondents misunderstood the distinction between processing and dismantling. The most common form of processing was the burning of cables to recover copper (as demonstrated in Figure 4). Processing was conducted at home or in open spaces. None of the respondents had received any form of training. No other methods of pre-processing laminated or insulated copper materials was mentioned by informal recyclers, giving the impression that, in the informal sector, cables were either sold with the insulation intact or the insulation was

removed through open burning. Similarly to dismantling, the motivation for processing was to obtain higher prices.

Photo: Brenda Diedericks

Figure 4: Demonstration of copper burning by waste pickers.

A minority of the respondents (24.5%) cited that they found nothing difficult about processing e-waste. Of those who reported difficulties, the health and safety risks they faced during the process were reported by 30.0% of respondents. The respondents' challenges related to access to appropriate tools, space and the process itself, which may also be attributed to the lack of appropriate equipment.

Repairing and refurbishing

Fewer than half the respondents reported collecting goods for repair or refurbishment, of which 82.2% would repair or refurbish the goods themselves; none of them received any training, formal or informal. The goods were either kept for personal use or resold for income.

Selling of e-waste

Respondents sold their e-waste at a variety of places. The majority sold e-waste to e-waste buy-back centres (60.0%) and general buy-back centres (56.2%) as well as scrap metal dealers (42.9%). Relatively fewer respondents (29.5%) sold directly to e-waste recyclers.

Cooperation amongst workers

When it comes to cooperation amongst e-waste workers, 51.7% of respondents indicated that they worked alone when dismantling. Slightly less cooperation was reported during processing, with 60% of respondents indicating they worked alone.

Health and safety considerations

Respondents were aware of the health and injury risks associated with their activities, particularly dismantling and processing. Injuries reported included cuts, scratches, burns, and broken appendages. Other reported health risks emanated from inhalation of fumes during processing.

Respondents are also vulnerable to gang activity in the areas where they operate. Gangs reportedly charge workers a 'tax' to operate, which constitutes a fraction of their daily earnings. This 'tax' serves as a form of protection money or a licence to operate; without it, workers risk attacks from the gang members. Respondents also indicated risk of robbery and attack.

Only one respondent openly admitted that they collected e-waste to support their drug habit.

Income

Respondents reported average weekly incomes ranging from less than ZAR10 up to ZAR4500 (USD0.70–315.35). The mean weekly income from e-waste activities was ZAR537.71±653.62 (USD37.68±45.80), and median was ZAR377.50 (USD25.45) (Figure 5). Gender differences in income were observed, with women earning a mean weekly income of ZAR333.13±347.93 (USD23.34±24.38) whilst men earned a mean of ZAR605.90±716.62 (USD42.46±50.22). No relationships were observed between e-waste income and education ($p>0.05$), nor income and total working hours ($p>0.05$).

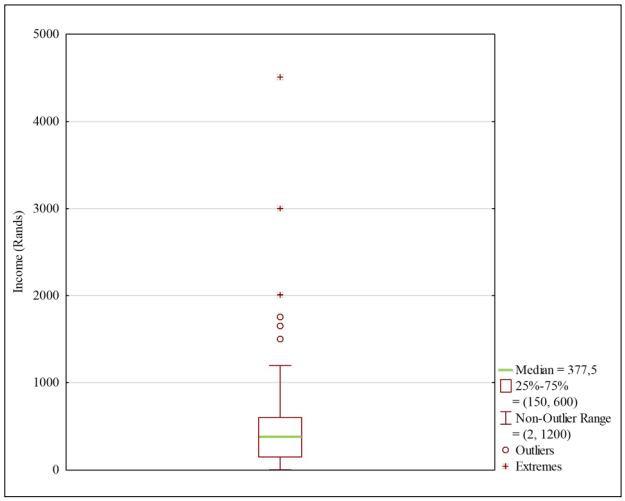


Figure 5: Average self-declared weekly incomes from e-waste collection.

For those respondents who collected e-waste along with other recyclables, the mean weekly income was ZAR805.20±680.73 (USD56.43±47.70). E-waste contributed a mean of 53.2±19.1% to the total income. As shown in Figure 6, the contribution of e-waste to total income ranged from 16.7% to 90.9%. About half (47.2%) of respondents obtained more than 50% of their income from e-waste, whilst 18.1% of respondents earned at least 75% of their income from e-waste alone.

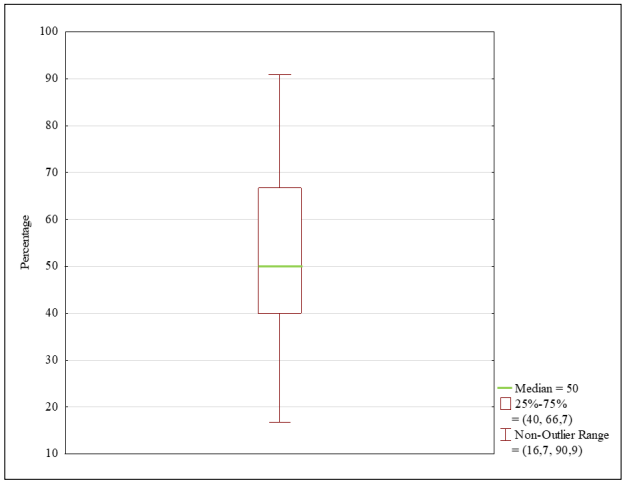


Figure 6: Percentage contribution of e-waste to total income for respondents collecting both e-waste and other recyclables.

Based on the income from e-waste alone for all respondents, 83.3% earned less than the national minimum wage of ZAR21.69 (USD1.52) per hour, which equates to USD243.20 per month (shown in Table 1). Furthermore, 22.9% were earning below the food poverty line of ZAR585 (USD41) per person per month. When considering respondents who collected a wide array of recyclables, fewer earned below minimum wage. A considerable difference was observed for food poverty, with 4.2% in food poverty. 75.6% of those who solely collected e-waste earned below minimum wage, with 17.1% facing food poverty.

Table 1: Proportion of incomes lower than the 2021 national minimum wage and 2020 poverty datum lines on a monthly basis

	Minimum wage	Food poverty line	Lower bound poverty line	Upper bound poverty line
E-waste income from all respondents	83.3%	22.9%	36.5%	44.8%
Income for respondents collecting e-waste and other recyclables	67.3%	4.2%	6.3%	12.5%

Buy-back centres were observed to rarely display prices for e-waste, unlike other materials such as plastic and cardboard. Furthermore, price disparities were observed for similar items across buy-back centres. Thus, the income earned by respondents is also dependent on which buy-back centres they sell to.

Subjective well-being

The pioneers of 'subjective well-being' or happiness studies are Easterlin et al.[50] Since the term was coined, economists, in particular, have shown much interest in determining or measuring happiness and whether an increase in income will lead to an increase in happiness.[51] Researchers like Easterlin et al.[50], Diener[52] and Proctor[53] are of the opinion that subjective well-being can be determined when a person reports on their own experiences of satisfaction or happiness. Diener[52] states that subjective well-being can be defined as the cognitive and effective evaluations of one's life. This means that the respondents give their own view of how happy they are with their current life situation.[51]

In this study, we requested the waste pickers to rate how satisfied or happy they were with life collecting e waste, on a scale of 1–10, with 1 being the least happy. A mere 29.7% reported scores of 9 or 10 whilst 38.6% reported scores of 5 and below. There was no correlation between income and happiness ($r_s = 0.17$, $p > 0.05$). Van Wyk et al.[51] also found in their study on landfill pickers that there was no relationship between income and happiness; however, in this study, when asked what they enjoy about their work, money was mentioned by 48) respondents whilst 9 specifically mentioned income as an enabler to put food on the table. The second most common response was 'nothing' which was given by 24 respondents. Only six respondents mentioned that the environmental aspect (i.e. diversion of waste to recycling) was what they enjoyed the most. Another aspect that was mentioned was that the work kept them 'away from trouble'; it kept them occupied so they did not engage in criminal activity.

Discussion

This study was an attempt to understand some of the roles, relationships and activities of informal e-waste collectors. The informal sector is characterised by impoverished workers who have been drawn to it as a matter of survival[27,54,55], and where the state has failed to provide safety nets[16]. It has a low barrier to entry, with no educational requirements (respondents learn on the job) and no start-up costs.[12] This makes it an attractive option for people without the necessary skills to enter the formal labour market. In Cape Town, only 12.3% of respondents had completed high school; this is similar to a previous study conducted in Cape Town in which 16% had completed high school.[56] In addition, a study conducted in Ghana found that only 5% had completed high school, and 65% had no formal education at all.[57]

Respondents participated in multiple activities, including collection, dismantling, processing and refurbishment. This is characteristic of the e-waste informal sector, with similar activities observed in Ghana[58], Kenya[59] and Nigeria[60]. Respondents in Cape Town played a multitude of roles and participated in various activities. This is unlike the sector in Ghana, whereby workers had distinct roles and could be categorised according to their activities.[27,61] The primary reason cited for participating in multiple activities was the prospect of higher incomes. The differences in net monthly income per activity were demonstrated during a study conducted in Kumasi, Ghana, wherein waste pickers earned USD122.76, refurbishers USD135.56 and dismantlers USD372.3 per month.[27]

Working with e-waste is associated with many health and safety risks. It is a physically demanding job requiring lots of pushing, pulling, lifting, walking and standing for long periods of time.[62] In addition, unsafe dismantling and processing practices expose workers to more hazards including smashing and breaking goods and open burning of materials. In Cape Town, respondents had a superficial understanding of the risks associated with their work. They reported short-term risks such as experiencing cuts or scratches, or broken bones. However, they did recognise that smoke from burning should not be inhaled. A multitude of serious health risks have been identified for those working in e-waste, including respiratory issues as well as musculoskeletal, neurological and genetic disorders.[33,62] Workers are also at risk of developing disabilities.

The mean income for all recyclables collected was ZAR805.20±680.73 (USD56.43±47.70), which equates to approximately ZAR3221 (USD225.72) per month. This is slightly higher than the average monthly income of ZAR2900 (USD217.95) reported in a previous study conducted in Cape Town in 2017.[56] An earlier national study on waste pickers conducted in 2016 found an average weekly income of ZAR505.06 (USD61.52).[12] These differences may be attributed to changes in market dynamics over time increasing the value of recyclables or simply differences in the value of the recyclables collected. In comparison to Ghana, the mean weekly income from e-waste alone (USD37.65±45.77) in this study was higher than that found for Ghana by Oteng-Ababio et al.[55] who estimated weekly incomes of USD14.00–24.50. Whereas in Kenya, Tocho and Waema[59] estimated monthly earnings of USD217.12–325.50. This suggests that the potential income opportunity presented by e-waste is region dependent.

When considering the extent to which waste picking activities can contribute to livelihoods, in Cape Town, the likelihood of surviving on e-waste activities alone is low. In this study, of those participating in e-waste picking alone, 22.9% were below the food poverty line. In addition, 83.3% of them reported earnings below minimum wage. Those who collected a wide array of recyclables fared better, with only 4.2% under the food poverty line. When we go beyond the income and consider the health and safety risks of waste picking, the risk is not commensurate with the reward. Thus, in reality, e-waste picking can be considered a survivalist strategy – a finding which is supported by the results of a study conducted in Ghana.[26] This finding is characteristic of informal self-employment, a category of informal employment where the focus is on survivalist strategies.[21]

The low incomes may be attributed to limited access to waste streams. Large businesses and institutions and the government commonly have contracts directly with e-waste recyclers or stockpile e-waste not knowing what to do with it.[63] This represents a large proportion (80%) of the e-waste generated in South Africa.[63] Furthermore, waste picking on landfills is prohibited in Cape Town, unlike in other large cities such as Johannesburg and Pretoria.[64] However, 18.8% of waste pickers admitted to accessing them. As such, workers primarily rely on scavenging in dustbins or obtaining e-waste directly from residents who only generate 20% of e-waste.[63] This urban mining is conducted at the generation level and the e-waste is not given the opportunity to be locked into 'urban mines' such as landfills. Instead the 'urban mines' may be considered to be households and businesses where the e-waste is locked in stockpiles, which is aligned with the definition put forward by Cossu and Williams[4]. With limited access to large mines (i.e. landfills), waste pickers are forced to diversify their income stream by collecting a variety of recyclables. This is not a necessity in areas with a steady stream of

readily accessible e-waste such as Agbogbloshie, Ghana, the largest global open dump for e-waste exclusively.[65]

Despite informal workers being recognised as playing a vital role in the recovery of recyclables, as an occupation, waste picking is not officially recognised.[54] Informal work does not have the protections afforded those in formal employment. They work long hours under unpleasant working conditions and are vulnerable to exploitation. They are at the lowest tier of the recycling value chain, earning the least value for their goods.[12] The recently enacted EPR Regulations recognise the potential for exploitation of informal workers and aim to mitigate this through the implementation of a 'collection service fee' to all waste pickers registered on the National Registration Database.[66] However, the regulations do not provide guidance on how this fee will be determined. The integration of waste pickers into EPR systems has been implemented around the world in various forms.[37] For example, in Brazil, municipalities can hire waste picker collectives as a private service provider in the municipal solid waste system.[6,67,68]

The question of how the informal sector may be integrated into the formal sector has been a focus area in many countries.[59,60,69] A number of motivations have been cited for the incorporation of the informal sector, such as an avenue to further grow the formal industry and create jobs, as well as a way to encourage safe dismantling and processing practices. In addition, waste picker integration may be viewed as a way of ensuring decent work by improving their working conditions, increasing wages and ensuring job security.[45] South Africa has adopted the International Labour Organization recommendations for formalising the informal sector targeted towards ensuring decent work, that is, work that is:

> *productive and delivers a fair income, security in the workplace and social protection for families, better prospects for personal development and social integration, freedom for people to express their concerns, organize and participate in the decisions that affect their lives and equality of opportunity and treatment for all women and men.*[20]

Waste picker integration guidelines[45] have been developed, and are targeted at those who work with waste pickers, including industry and local governments. Furthermore, the National Waste Management Strategy 2020, which is a statutory requirement of the *National Environmental Management: Waste Act (No. 59 of 2008)*, prescribed waste picker integration in all metropolitan municipalities by 2021[40] – however, this is yet to be accomplished. Ultimately, waste picker integration may be considered inevitable in South Africa and should be a goal to which to aspire.

Conclusions

Waste collection is widely touted as an opportunity for income. However, the nature of the job is hardly discussed alongside the 'income opportunity'. Waste pickers work long hours in arduous working conditions which present multiple hazards for their health and safety. This presents the question of whether their income is commensurate with the work they do. In this study, 83.3% of the waste pickers surveyed reported incomes from e-waste alone that were below minimum wage, with 22.9% below the food poverty line. When considering the total income from all recyclables, 67.3% of incomes were below minimum wage. Along with low income, it was found that there was no relationship between how many hours they worked and how much they earned. This brings into question the extent to which waste pickers can sustain a livelihood from their urban mining activities.

Workers may be considered to be trapped in their situation. The survivalist nature of the job does not afford the waste pickers the opportunity to move up the value chain as incomes do not allow one to save for start-up costs. Furthermore, waste pickers have limited opportunities to transition into the formal economy due to their lack of skills and the current unemployment rate in South Africa. Whilst waste picker integration seems to be on the horizon, it is essential that key interventions are implemented in the meantime. These interventions include providing space for waste pickers to work, providing opportunities for safe dismantling and processing practices, and guaranteeing fair compensation for their work. Ultimately, there is a necessity to ensure that the waste sector provides opportunities for decent work, as highlighted by the International Labour Organization, that enables workers to lift themselves out of poverty, for the myth of livelihoods through urban mining to become a reality.

We have attempted here to unravel the lives, roles, relationships and activities of the e-waste pickers. We have, by far, not addressed all the complexities of the informal Oe-waste pickers in the waste economy. The way forward will require researchers to move in the direction of more qualitative and transdisciplinary research and Polese's[16] informality-centred approach in search of collaboratively developed support systems.

Acknowledgements

We thank the fieldworkers who conducted the surveys and the waste pickers who took the time to respond. This work was supported by the National Research Foundation (NRF) of South Africa within the Community of Practice: Waste to Value (grant UID 128149). The NRF cannot be held liable for any of the authors' stated opinions, findings and conclusions.

Competing interests

We have no competing interests to declare.

Authors' contributions

T.Y.C.: Conceptualisation; methodology; data analysis; writing – the initial draft; writing – revisions; project management. T.M.: Methodology; writing – the initial draft; writing – revisions. K.G.: Methodology; writing – the initial draft; writing – revisions. C.S.: Conceptualisation; writing – revisions; project leadership; funding acquisition.

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