



# Quantifying economic activity in the informal recycling sector in South Africa

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Informal waste reclaimers are a key part of South Africa's recycling economy, being responsible for around 51% of all paper and packaging waste collected in South Africa in 2017. Active in the waste and recycling landscape for more than three decades, their activity predates the earliest voluntary paper and packaging Extended Producer Responsibility schemes. However, these voluntary schemes have been instrumental in scaling South Africa's recycling economy. Investment by brand owners, retailers, converters and recyclers has helped develop local end-use markets, creating a demand for paper and packaging recyclables and a resultant increase in their collection. An analysis of tonnage and price data shows that the mean estimate of money paid by the private sector to the informal waste sector through the purchase of recyclables at intermediaries such as buy-back centres, was ZAR625 million in 2012, increasing to ZAR872 million in 2017. This private sector 'investment' in the local recycling economy has led to direct and indirect job creation and improved livelihoods, particularly for a large, well-established and effective informal waste sector, and has indirectly funded municipal waste diversion strategies, saving municipalities in both the collection and disposal of waste.

### Significance:

- Informal waste reclaimers make a significant contribution to the diversion of paper and packaging recyclables from landfill to recycling in South Africa.
- Limited information exists on the earnings of informal reclaimers.
- This paper provides new insights on the annual financial payments made by the private sector to informal reclaimers for the collection of recyclables.

## Introduction

South Africa's 2nd National Waste Management Strategy<sup>1</sup> set the goal that 'all metropolitan municipalities, secondary cities and large towns have initiated separation at source programmes' by 2016, with '25% of recyclables diverted from landfill sites for re-use, recycling or recovery'. This goal was not achieved, with only a handful of cities and towns to date having implemented separation-at-source programmes, none of which cover the full spatial extent of the city or town. However, informal waste reclaimers, also referred to as waste pickers, have operated in this space for years, collecting recyclables through what Samson<sup>2</sup> calls 'separation-outside-source'.

Informal waste reclaimers have been active in the collection of paper and packaging recyclables in South Africa for more than three decades, with early policy documents such as the 1st National Waste Management Strategy<sup>3</sup> and the White Paper on Integrated Pollution and Waste Management<sup>4</sup> referencing their activity in the waste sector. Some of the earliest research on the informal waste sector in South Africa is thought to be that of De Kock<sup>5</sup> and Naidoo<sup>6</sup>, who recognised waste picking as a means of survival for the 'unemployed, urban poor' who had no alternative means to financially support themselves and their families.

However, informal waste reclaimers play a key, although largely unrecognised, role in the South African recycling value chain.<sup>2,7,8</sup> They provide an important bridge between the municipal service chain and the formal, private sector value chain in developing countries, effectively moving 'waste' from kerbside and landfill into the recycling economy.<sup>9,10</sup> Early data published by the packaging sector, suggested that 80–90% (by weight) of post-consumer paper and packaging collected in South Africa in 2014, was done so by informal waste reclaimers at little to no cost to government or business.<sup>10,11</sup>

Recycling has been taking place in South Africa for many decades. Steelrec, the predecessor to Collect-a-Can which supports the collection and recycling of used beverage cans, was established in 1976 by Metal Box and Crown Cork (the predecessors of Nampak and ArcelorMittal).<sup>12,13</sup> Waste sorting facilities in major metropolitan areas such as Johannesburg and Pretoria were already operating in the 1970s.<sup>14</sup> However, as noted by Collect-a-Can<sup>13</sup>, local end-use markets were limited in the 1970s, resulting in the stockpiling of beverage cans. Early paper and packaging (input) recycling rates were low, typically  $\leq 20\%$  in 1990, with the exception of paper which had already reached a recovery rate of 29%.<sup>10</sup>

For many waste streams, recycling is a negative value-added process requiring some form of market intervention, such as subsidies.<sup>15–17</sup> This is often due to the cost of collection, which accounts for a disproportionate share of the overall cost of recycling.<sup>16</sup> As noted by Nahman<sup>18</sup>, the purpose of Extended Producer Responsibility (EPR) is, amongst others, to provide funding for the provision of incentives, subsidies and infrastructure to increase the supply of recyclables. As with recycling economies in many developed countries, the South African paper and packaging recycling economy has been subsidised by brand owners, converters and retailers through a number of voluntary EPR schemes, managed by Producer Responsibility Organisations (PROs)<sup>19</sup> such as PETCO, Polyco, FibreCircle, MetPac and TGRC. The earliest established PROs in South Africa include Collect-a-Can, established in

1993, and PETCO, which was established in 2004. Collect-a-Can was able to increase beverage can collection rates from 18% in 1993 to 72% in 2015.<sup>20</sup> Since the establishment of PETCO, post-consumer bottle PET recycling increased from 16% in 2005 to 55% in 2016.<sup>21</sup> Prior to 2000, only around 2% of PET was collected annually for recycling. According to the Sustainability Business Handbook<sup>22</sup>: 'At the time, PET recycling was a small-scale and uncoordinated activity that functioned without any industry direction or intervention.'

While the informal collection of recyclables predates the establishment of voluntary EPR schemes in South Africa, it appears that these EPR schemes, and the mandated PROs, were able to significantly scale-up recycling activities, by directing private sector funding into the development of local recycling infrastructure and local end-use markets. This created demand for recyclables, further fuelling collection and growing local recycling rates. As at 2017, an estimated 58.2% of paper and packaging put into the South African market was collected for recycling.<sup>10,19</sup> This investment in the local recycling industry is expected to continue as national government moves to implement mandatory EPR. The draft Paper and Packaging Industry Waste Management Plan submitted to government outlined a planned investment of ZAR2.85 billion over the period 2019–2023.<sup>19</sup>

The informal waste sector has, however, asserted that it too has been subsidising South Africa's recycling economy, with little compensation. As noted by Mr Kodisang<sup>23</sup> of WIEGO,

*The invisible subsidy we don't see, is the subsidy of free labour of our informal waste reclaimers, a marginalized sector of our community forced to seek out a livelihood through the resource value only from the sale of recyclables. We can't have a recycling industry based on the free labour of poor people, this has to change.*

Informal reclaimers have, to date, typically only been paid the market-related, although highly variable, resource value upon sale of recyclables at intermediaries such as buy-back centres. Informal reclaimers are not paid for the collection service they provide, unlike many formal collectors. This issue of compensation for the currently free 'labour costs' of South Africa's informal waste sector, is addressed in the Waste Picker Integration Guideline for South Africa<sup>24</sup>, and is currently the subject of a number of pilot projects. However, it is likely that payment for both the resource value and collection service will have significant cost implications for South Africa's recyclers, and ultimately producers.

A number of studies have explored the individual daily, weekly or monthly earnings of waste reclaimers in South Africa.<sup>7,25,26,27</sup> However, the author is unaware of research that has attempted to quantify the total annual payment made by the private sector to the informal waste sector. In this paper, therefore, an attempt is made to calculate the amount of money paid to the informal waste sector in South Africa, through intermediaries such as buy-back centres. Framed differently, the paper addresses the question: How much money has the informal waste sector earned through value-creation from paper and packaging recyclable waste in South Africa?

## Methods, assumptions and data sources

To determine the payments made to the informal waste sector, tonnage and price data were sourced for South Africa. Because price data formed the limiting data set, the calculations were made for the years 2012 and 2017. Further information on each of the data sets is provided in the following sections.

### Tonnages collected

Accurate, reliable waste data in South Africa, like most developing countries, are limited.<sup>28,29</sup> As such, data on the tonnages of paper and packaging recyclables collected in South Africa in 2012 and 2017 were sourced from industry<sup>19,30</sup> (Table 1).

The data provided annually by BMi Research is for high-level paper and packaging categories. As the price data were available for sub-categories, further data on waste tonnages were sourced from the individual PROs, through their annual reports (Table 2).

### Plastic

High-level plastic data were sourced from BMi<sup>30</sup> and Packaging SA<sup>31</sup>, with the disaggregated data by polymer type, sourced from Plastics SA<sup>32,33</sup>. For 2012, both packaging and non-packaging tonnages were used.<sup>32</sup> The tonnages of waste plastic exported, as reported by Plastics SA, while it should be included in the calculations (as it was collected in South Africa despite the end-destination for reprocessing), could not be included, as the export tonnages were not assigned to specific polymer groups. The excluded export tonnages account for 5.2% of the waste plastic collected in 2012.

The 2017 collected plastics data were more challenging to obtain. The Plastics SA report<sup>33</sup> notes 'Since 2015, plastics report on input figures, aligned with international reporting methods', which would suggest that all figures provided in the report are collection figures. However, the different figures provided in the report for (only) PET (67 872 recycled and 93 235 collected), suggests that the data in the report are in fact output (recycled) figures. As such, the BMi data for total plastic collected, total polyolefins collected and total PET collected were used.<sup>31</sup> The total polyolefins figure was subdivided into the sub-polymers using the ratios of recycled tonnages, assuming the same 'wastage' across the different polyolefins.

### Paper

Detailed tonnages for the various sub-grades of paper were accessed from the Paper Recycling Association of South Africa.<sup>34,35</sup> It is noted that there are minor discrepancies in tonnage data between BMi, Packaging SA and PRASA. For this reason, the data were sourced directly from the PRO responsible for paper recycling in South Africa. Only the 'paper recovered in South Africa' data were used (excluding imports), as it is unlikely that the local informal waste sector would have been involved in the collection of imported paper.

**Table 1:** Paper and packaging consumed and collected in South Africa<sup>19</sup>

Packaging type	2012			2017		
	Consumption ('000 tonnes)	Collected ('000 tonnes)	% Collected	Consumption ('000 tonnes)	Collected ('000 tonnes)	% Collected
Plastic	734.1	291.0	39.6	867.8	395.1	45.5
Paper	2051.8	1151.3	56.1	2067.1	1393.6	67.4
Metal	230.2	148.7	64.6	183.3	138.9	75.8
Glass	865.4	339.2	39.2	758.8	330.7	43.6
<b>Total</b>	<b>3881.4</b>	<b>1930.2</b>	<b>49.7</b>	<b>3877.0</b>	<b>2258.3</b>	<b>58.2</b>



### Metal

High level data for metals were also sourced from BMi. According to Packaging SA<sup>19</sup>: ‘Since 2013, more than R1.258 billion in capital investments have been made by industry players ... to convert the beverage can industry from steel to aluminium’. As such, it has been assumed that the metal collection data given for 2012<sup>30</sup>, do not yet include aluminium. The tonnages for steel/tinplate and aluminium for 2017 were sourced from BMi.<sup>31</sup>

### Glass

Only one data set was provided by BMi for ‘glass’.<sup>30,31</sup> No further subdivision of glass by colour was used, as price data also were not available for sub-categories.

### Prices for recyclables

Recyclable price data for the year 2012, as paid-for recyclables at buy-back centres across South Africa, were sourced from Viljoen<sup>36</sup> and Viljoen et al.<sup>37</sup> Price data for 2017 were sourced from Schenck et al.<sup>38</sup> The 2012 data were captured at buy-back centres in 11 of South Africa’s large cities, i.e. Bloemfontein, Cape Town, Durban, East London, Johannesburg, Kimberley, Mafikeng, Mbombela, Pietermaritzburg, Gqeberha (Port Elizabeth) and Pretoria. The 2017 data were captured at the provincial level. The average provincial price per paper and packaging grade was used here, i.e. Gauteng, Eastern Cape, Western Cape, KwaZulu-Natal, Mpumalanga, Free State and Northern Cape.

Where no price data were available for a specific sub-category of paper or packaging, the lowest value from another city/town or region was applied. As such, the resultant total values are likely to be conservative underestimates of the money paid to informal reclaimers.

The 2017 price data contained much greater detail in prices for sub-categories compared to the 2012 data. However, the 2017 price detail for sub-categories could often not be used, as the matching tonnage data were not available, e.g. for 2017 prices, the average for the five different low-density plastic grades was used. Because there is no recorded data on the breakdown of the tonnages of clear/brown/green PET bottles collected in South Africa (Schoitz C 2020, written communication, 23 December) it is assumed that the majority of bottles collected (driven by the higher value) are clear PET bottles and as such, the prices for clear bottles have been used.

### Informally collected recyclables

There is also very little reliable data on the number of informal waste reclaimers in South Africa, and the tonnages of recyclable waste collected by the informal sector. Available data published by BMj<sup>30,39,40</sup> on the percentage of paper and packaging recyclables collected by informal trade, including sub-categories where available, are shown in Table 2. ‘Informal trade’ is defined by BMi<sup>40</sup> as ‘informal businesses that sell directly to you’.

**Table 2:** Percentage of paper and packaging recyclables collected through informal trade

Packaging type	2012	2014	2015
Plastic	68%	17.1%	4%
PET	90%	85%	85%
Paper	Mostly informal	Mostly informal	30%
Metal	30–40%	30–40%	–
Glass	80%	–	–

PET, polyethylene terephthalate

The reports also note that ‘informal trade is responsible for the bulk of collection’<sup>30,39</sup>. None of the PROs were able to provide accurate figures on the percentage of paper and packaging collected by informal waste reclaimers.

According to Plastics SA<sup>41</sup>, an estimated 70% in 2011 and 58% in 2012 of recyclable plastic waste was sourced from post-consumers and landfills. The Plastics SA report<sup>33</sup> shows that, in 2017, this number had increased, as ‘The largest quantity of recyclables, 74%, was obtained from landfill and other post-consumer sources’. As this is where informal reclaimers work, it is assumed that a high percentage of this post-consumer waste is collected by the informal sector. The same percentage (68%) was therefore used for plastic (with the exception of PET) for both 2012 and 2017. The percentage of PET plastic collected by informal reclaimers is reported as being higher, due to its higher value (prices). For paper, the BMi reports<sup>30,39</sup> noted ‘mostly informal’ for paper collection (assumed here to be around 80%), which decreased to 30% in 2015. While paper and cardboard are highly sought after by informal reclaimers, the Paper Manufacturers Association of South Africa has suggested a maximum of 50% collection by the informal sector in 2017 for most paper grades, with corrugated paper as low as 33% (Molony J 2020, written communication, 10 January). These figures are based on what they know to be collected by the formal sector. Metals are reported as 30–40% collected by informal trade; however, this number may in fact be higher given the prices for metal, in particular aluminium, and the resultant demand by the informal sector. Using this figure of 30–40% will also likely result in an underestimate in the calculation of money paid to informal waste reclaimers.

Based on the information provided by the PROs, the contribution by the informal sector to the local recycling economy, in terms of the reported percentage of recyclable waste collected, appears to have declined over the years. It is not clear if this is due to improved data by the private sector, or whether this is a real decrease in the informal sector’s contribution, due to erosion by the formal sector.

In terms of the number of informal reclaimers, the Waste Sector Survey<sup>42</sup> indicated that the informal waste sector could be 2–3 times larger than the formal waste sector, at 60 000–90 000 people. The South African Department of Environmental Affairs estimated the number at 62 147.<sup>43</sup> As there is no agreement on the number of informal reclaimers in South Africa, assessments have been made for two different scenarios – 60 000 and 90 000.

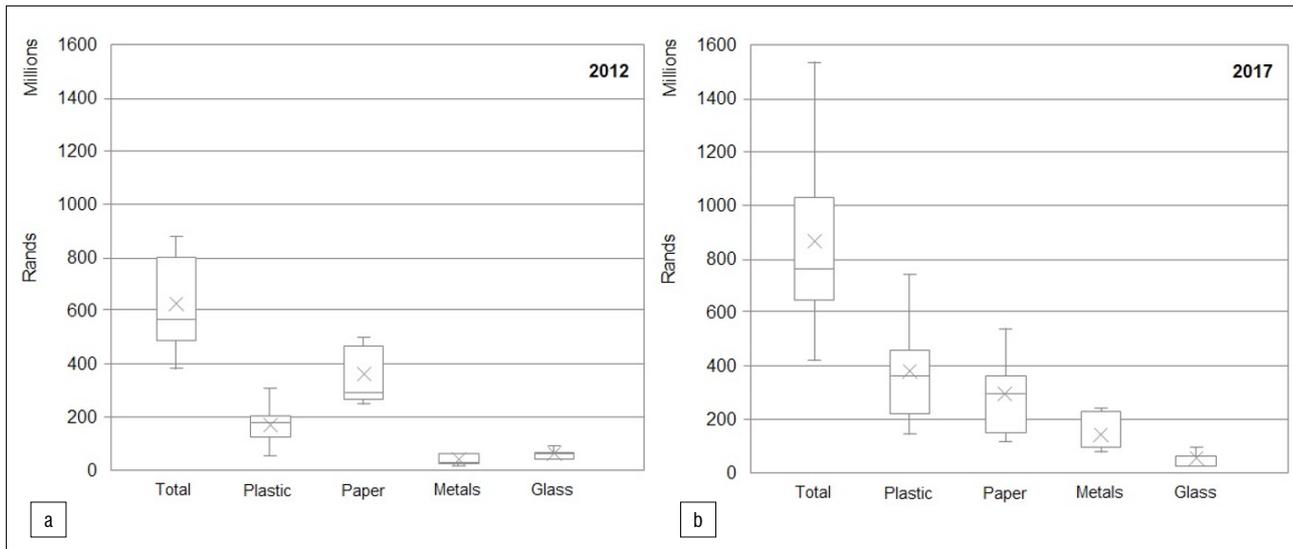
### Uncertainty

The uncertainty in the percentage of recyclable waste collected by the informal sector has an impact on the results presented in the following section. This is particularly evident for waste paper, where a significant decline in the percentage of paper collected by informal reclaimers between 2012 (80%) and 2017 (50%) was reported by the sector. For this reason, a range in figures is provided in the following section.

## Results and discussion

Based on the above assumptions and available data sets, the results (presented in Tables 3 and 4 and Figure 1) show that between ZAR383 million and ZAR882 million was paid to the informal waste sector, via buy-back centres, in 2012. This increased to between ZAR423 million and ZAR1.54 billion in 2017. The mean estimate of total annual payments made to the informal waste sector in South Africa, via buy-back centres, is estimated to have increased from ZAR625 million in 2012 to ZAR872 million in 2017. Without data on the geographic distribution of collected recyclables, it is not possible to say where in this income range the answer lies. However, given that a large percentage of the paper and packaging recyclers reside in the major metropolitan areas, ‘in close proximity to their incoming material sources’<sup>33</sup>, e.g. Gauteng, where prices are also generally higher than in other parts of the country, it is likely that these average values are conservative.

According to the data provided by industry, the total tonnages collected by the informal sector decreased from 1.45 Mt in 2012 to 1.10 Mt in 2017. While the overall percentage of paper and packaging collected by the informal sector in South Africa decreased from 76% in 2012 to 51% in 2017, the average money paid to informal reclaimers increased by around 40% over the same period, highlighting the increase in recyclable prices over this 5-year period. The waste streams which supported the largest average payments to informal waste reclaimers in 2017 were PET plastic, corrugated paper and aluminium (Table 4).



**Figure 1:** Estimated range (total and per recyclable stream) of money paid by business, via buy-back centres, to informal waste reclaimers in (a) 2012 and (b) 2017.

**Table 3:** Estimated payment to informal reclaimers in South Africa via buy-back centres in 2012

Recyclable waste type	Apparent South African consumption (ASAC) (t)	Total collected*		Range in prices paid to informal reclaimers at buy-back centres (ZAR/t)	Estimate of waste quantities collected by informal reclaimers		Estimate of total money paid by business (via buy-back centres) to informal waste reclaimers		
		Tonnes (t)	% ASAC		% Collected informally	Tonnes collected informally	Minimum (ZAR)	Maximum (ZAR)	Average (ZAR)
<b>Plastic</b>	<b>710 700</b>	<b>268 548</b>	<b>37.8</b>			<b>193 674</b>	<b>55 470 408</b>	<b>307 692 904</b>	<b>171 664 100</b>
PE-LD/LLD		98 971		330–1380	68%	67 300	22 209 092	92 874 386	56 471 053
PE-HD		45 949		330–1200	68%	31 245	10 310 956	37 494 384	20 905 960
PP		47 081		150–1630	68%	32 015	4 802 262	52 184 580	24 331 461
PET		50 280		330–2800	90%	45 252	14 933 160	126 705 600	55 618 822
PS		3 395		150–600	68%	2 309	346 290	1 385 160	440 733
PVC		16 812		150–5000	68%	11 432	1 714 824	57 160 800	11 951 804
Other		6 060		280–830	68%	4 121	1 153 824	3 420 264	1 944 268
<b>Paper</b>	<b>2 689 994</b>	<b>1 151 315</b>	<b>42.8</b>			<b>921 053</b>	<b>249 214 784</b>	<b>497 352 760</b>	<b>358 451 780</b>
Newspapers		116 831		170–330	80%	93 465	15 889 016	30 843 384	21 072 064
Magazines		66 574		180–350	80%	53 259	9 586 656	18 640 720	13 121 130
Corrugated		751 951		200–520	80%	601 561	120 312 160	312 811 616	219 296 255
Office, graphic papers		96 955		350–1850	80%	77 564	27 147 400	143 493 400	71 640 931
Mixed and other		119 005		130–1000	80%	95 204	12 376 520	95 204 000	33 321 400
<b>Metal</b>	<b>230 400</b>	<b>148 700</b>	<b>64.5</b>			<b>59 480</b>	<b>10 706 400</b>	<b>61 859 200</b>	<b>35 633 927</b>
Steel/tinplate	230 400	148 700		180–1040	40%	59 480	10 706 400	61 859 200	35 633 927
Aluminium		–		–	–	–	–	–	–
<b>Glass</b>	<b>865 500</b>	<b>339 200</b>	<b>39.2</b>	<b>150–330</b>	<b>80%</b>	<b>271 360</b>	<b>40 704 000</b>	<b>89 548 800</b>	<b>59 205 818</b>
<b>Total</b>	<b>4 496 594</b>	<b>1 907 764</b>	<b>42.4</b>	<b>–</b>	<b>76%</b>	<b>1 445 567</b>	<b>383 231 592</b>	<b>881 958 472</b>	<b>624 955 626</b>

PE, polyethylene; LD/LLD, low density/linear low density; HD, high density; PP, polypropylene; PET, polyethylene terephthalate; PS, polystyrene; PVC, polyvinyl chloride

\*The tonnages collected and the collection as a percentage of consumption, as reported here, are lower than the official published figures, due to the focus here on what waste is likely to be collected by the informal sector (e.g. excludes imports where available).

**Table 4:** Estimated payment to informal reclaimers in South Africa via buy-back centres in 2017

Recyclable waste type	Apparent South African consumption (ASAC) (t)	Total collected <sup>a</sup>		Range in prices paid to informal reclaimers at buy-back centres (ZAR/t)	Estimate of waste quantities collected by informal reclaimers		Estimate of total money paid by business (via buy-back centres) to informal waste reclaimers		
		Tonnes (t)	% ASAC		% Collected informally	Tonnes collected informally	Minimum (ZAR)	Maximum (ZAR)	Average (ZAR)
<b>Plastic</b>	<b>867 800</b>	<b>395 077</b>	<b>45.5</b>			<b>284 496</b>	<b>144 116 771</b>	<b>742 841 126</b>	<b>379 118 608</b>
PE-LD/LLD		129 088		460–2000	68%	87 780	40 378 695	175 559 541	88 782 968
PE-HD		77 747		450–2880	68%	52 868	23 790 693	152 260 434	57 626 345
PP		58 112		600–3130	68%	39 516	23 709 679	123 685 491	41 887 099
PET		93 200		580–3570	85%	79 220	45 947 600	282 815 400	166 927 857
PS		6 609		–	68%	4 494	–	–	–
PVC		21 905		350–3880	68%	14 896	5 213 445	57 794 759	19 087 592
Other		8 415		680–1360	68%	5 722	3 891 176	7 782 352	4 806 747
<b>Paper</b>	<b>2 255 075</b>	<b>1 282 120</b>	<b>56.9</b>			<b>496 391</b>	<b>119 257 365</b>	<b>542 482 585</b>	<b>295 141 611</b>
Newspapers		146 509		100–640	50%	73 255	7 325 450	46 882 880	25 220 478
Magazines		30 955		300–930	50%	15 478	4 643 250	14 394 075	7 075 429
Corrugated		850 992		200–890	33%	280 827	56 165 472	249 936 350	150 844 411
Office, graphic papers		139 421		450–1900	50%	69 711	31 369 725	132 449 950	79 768 729
Mixed and other		114 242		100–1730	50%	57 121	5 712 100	98 819 330	32 232 564
<b>Metal</b>	<b>183 252</b>	<b>138 939</b>	<b>75.8</b>			<b>55 576</b>	<b>78 188 804</b>	<b>242 708 740</b>	<b>143 372 195</b>
Steel/tinplate		133 896		390–830	40%	39 509	15 408 588	32 792 636	19 867 483
Aluminium		49 356		3760–14 000	40%	16 066	60 409 664	224 929 600	123 504 712
<b>Glass</b>	<b>758 817</b>	<b>330 700</b>	<b>43.6</b>	<b>100–350</b>	<b>80%</b>	<b>264 560</b>	<b>26 456 000</b>	<b>92 596 000</b>	<b>54 045 829</b>
<b>Total</b>	<b>4 064 944</b>	<b>2 146 836</b>	<b>52.8</b>	<b>–</b>	<b>51%</b>	<b>1 101 023</b>	<b>423 137 396</b>	<b>1 537 636 907</b>	<b>871 678 242</b>

PE, polyethylene; LD/LLD, low density/linear low density; HD, high density; PP, polypropylene; PET, polyethylene terephthalate; PS, polystyrene; PVC, polyvinyl chloride

<sup>a</sup>The tonnages collected and the collection as a percentage of consumption, as reported here, are lower than the official published figures, due to the focus here on what waste is likely to be collected by the informal sector (e.g. excludes imports where available).

**Table 5:** Estimated average monthly income per informal waste reclaimer

Year	Mean annual total paid to informal waste reclaimers (ZAR)	Estimated annual informal reclaimer income (ZAR)		Equivalent monthly informal reclaimer income (ZAR)	
		60 000 reclaimers	90 000 reclaimers	60 000 reclaimers	90 000 reclaimers
2012	624 955 626	10 416	6 944	868	579
2017	871 678 242	14 528	9 685	1 211	807

Given the uncertainty in the informal waste sector data, and the large variations in the price data, the external validity<sup>44</sup> of this research was tested through triangulation with other studies. Because total country-wide payments made to informal reclaimers had not previously been calculated for South Africa, validity was tested against individual reclaimer earnings, thereby adopting a ‘bottom-up’ approach.

The estimated annual income per waste reclaimer in South Africa was calculated for two different scenarios (Table 5). At a conservative 60 000 informal waste reclaimers, the monthly income equates to ZAR868 in

2012, increasing to ZAR1211 in 2017. It is acknowledged that, while these are average amounts, the monthly income per reclaimer can vary significantly, depending on, for example, the number of hours worked; whether working at kerbside or on landfill; the geographic areas in which they work; and the type of material collected.<sup>26,36</sup> Based on the buy-back centre price data used in this study, it is clear that there are significant differences in the earnings of waste reclaimers, given variation in prices of different recyclables as well as the geographic area within which they work.

Blaauw et al.<sup>45</sup> note a range in the average monthly income of informal waste reclaimers working in Pretoria, South Africa (in 2010), based on a 'bad week' and a 'good week' of waste picking, of ZAR449 and ZAR1142 respectively. Viljoen et al.<sup>27</sup>, who presented a national study of the socio-economic dynamics and vulnerability of street waste pickers (between April 2011 and June 2012), calculated the mean informal reclaimer income 'usually earned for a day's waste' at ZAR72.11. While the number of days worked by informal reclaimers varies significantly<sup>26</sup>, a daily earning of ZAR72.11 could equate to a monthly income of around ZAR1440–R1730. Finally, a national study conducted by the South African Department of Environmental Affairs<sup>46</sup> showed a mean monthly earning of informal waste reclaimers of ZAR1430. These studies have noted the long work days of informal reclaimers, often 8 h or more per day, and the long work weeks, often 5–7 days per week.<sup>26,27,46</sup>

While there is considerable variation in the income earned by waste reclaimers, a comparison with these studies<sup>26,27,45,46</sup> suggests that this bottom-up triangulation approach provides findings of the same order of magnitude as the results from this study (Table 5). As comparison, the South African minimum wage<sup>47</sup> of ZAR20 per hour, based on an 8-h working day, five days per week, would generate a minimum monthly income of ZAR3500 per month.

The apparent decrease in the tonnages of recyclables informally collected and the monthly income paid to reclaimers were also discussed with representatives of the African Reclaimers Organisation, to assess whether these modelled results were actually 'observed' on the streets of South Africa. The main findings were supported by the African Reclaimers Organisation, highlighting the growing risk to informal waste reclaimers. The erosion in the informal sector's contribution to South Africa's recycling economy was noted by the African Reclaimers Organisation as being due to greater involvement by formal actors, which are often contracted by local municipalities. This risk is further compounded by an increase in the number of informal reclaimers, due to an escalating unemployment rate, which creates greater competition for easily accessible material. Reclaimers noted that due to this 'formal sector erosion', they were forced to diversify into other materials, including different types of plastic. The increasing contribution of plastic to the recyclables collected by the informal sector is evident in the results (Tables 3 and 4). Plastic made up 13.4% of the paper and packaging recyclables collected by the informal sector in 2012, which increased to 25.8% in 2017. While the tonnages of paper and packaging recyclables collected by informal reclaimers appears to have decreased between 2012 and 2017, this may not have been immediately noticeable to reclaimers, due to the increase in prices paid by buy-back centres over the same period, supporting increased earnings. However, with the slowing in the local recycling economy in 2019, the impact of the COVID-19 pandemic in 2020 and the resultant drop in local prices, this 'price buffer' may be eroded, with significant implications for the livelihoods of informal waste reclaimers.

## Conclusions

In conclusion, using two data sets, the tonnages of paper and packaging collected for recycling, and the prices of various sub-categories of paper and packaging paid at buy-back centres around the country, estimates were determined of the total amount of money paid to the informal waste sector in 2012 and 2017. The mean estimate of total money paid by the private sector to the informal waste sector, through the sale of recyclables at intermediaries such as buy-back centres and scrap dealers in South Africa, was ZAR625 million in 2012. This increased to ZAR872 million in 2017. These actions have resulted in the collection (formal and informal) of over 2 million tonnes of paper and packaging waste, and ultimately the diversion of this waste away from municipal landfills, and from the environment. This private sector expenditure, combined with the work of the informal waste sector, not only saves municipalities in landfill airspace (estimated at between ZAR309 million and ZAR749 million in 2014)<sup>11</sup>, but could also be considered an investment in municipal diversion strategies. However, if industry is to understand and harness the contribution of the informal and formal sectors to the South African recycling economy, and to better integrate informal reclaimers into the new mandatory EPR schemes, there is an urgent need for improved data collection.

## Competing interests

I have no competing interests to declare.

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