

Waste collection and recycling benefits and challenges in tribal rural areas - the case of Umkhanyakude and Zululand Districts in the KwaZulu-Natal province in South Africa

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Waste management and its minimization is an extremely challenging municipal function in the developing countries. This is worsened by rapidly growing populations, high poverty levels, poor municipal governance and institutional arrangements to enhance waste collection, storage, transportation, disposal and recycling rates. Despite recycling being internationally recognized as a sustainable municipal solid waste management strategy, there is a scarcity of relevant information on waste generation in the deep rural municipal areas of South Africa, as well as types and characteristics of such waste. Nearly 40% of South Africa's inhabitants live in rural areas and with a growing population size, poor waste management and its minimisation is undermining human health in these areas and the assimilative capacity of their natural environment [23]. In addition, in South Africa new environmental laws and regulations have been introduced over the last 15-20 years [15]. However, there is limited understanding on how this new regulatory framework is impacting the effectiveness of waste management and recycling, especially in remotely located rural areas.

This study has investigated and characterized the status of waste management and recycling in the rural districts of uMkhanyakude and Zululand in the KwaZulu-Natal Province in South Africa. To address this aim, two research objectives were formulated, namely (1) to describe the involvement of informal waste pickers in waste collection and recycling activities and (2) to identify benefits and challenges faced by waste pickers and municipalities. Study districts selected have poor economic conditions, a large areal extent and high population growth rates compared with other districts in this province [14]. Nearly 50% of their land is under the jurisdiction of traditional and tribal authorities while the remainder of the land is divided between commercially owned farms and conservation areas. Overall, the proportion of households provided with weekly household refuse removal services is less than 10% compared to the overall provincial figure of 52%.

Both quantitative and qualitative methods were used for data collection, analyses and interpretation. With quantitative methods, the demographic characteristics of informal waste pickers were collected by means of a structured questionnaire. Furthermore, aspects of their waste collection, types and sources of recyclable waste as well as benefits and challenges were also recorded for analyses. Qualitative methods were also used to capture primary data on municipal recycling initiatives, transportation modes, market accessibility and also benefits to municipalities.

In Table 1, the demographic characteristics of informal waste pickers are exhibited. Seventy five (75%) percent of informal waste pickers are women and 25% are men. Fifty five percent (55%) of those who are self-employed are earning nothing more than R1000 (USD74.91) per month. Nearly 50% of them had no educational background. They collect recyclable waste materials mainly from regulated landfill sites (64%) and illegal dumpsites (54%) and street corners (17%).

Table 1. Demographic characteristics of informal waste pickers in the districts surveyed.

Variable	Category	F	%
Name of district municipality	Umkhanyakude	86	68.3%
	Zululand	40	31.7%
	Total	126	100.0%
Gender	Male	30	24.6%
	Female	92	75.4%

	Total	122	100.0%
Employment status	Employed	2	1.6%
	Self employed	120	98.4%
	Total	122	100.0%
Income	Not more than R500	36	28.6%
	R501 to R1 000	34	27.0%
	R1 001 to R1 500	13	10.3%
	R1 501 to R5 000	41	32.5%
	R5 001 to R10 000	2	1.6%
	Total	126	100%
Level of education	No education at all	62	49.6%
	Under Grade 12 Matriculation	52	41.6%
	Certificate holder	11	8.8%
	Total	125	100.0%

Main benefits for informal waste recycling included earning money for buying food, employment creation and reduced amounts of litter in the CBDs of settlements. Challenges experienced by informal waste pickers entailed lack of financial and political support from all spheres of government. They also mentioned lack of proper recycling workstations and market inaccessibility. What also lessens their productivity is daily suffering and exposure to a range of occupationally induced illnesses.

Municipal officials maintained that municipalities are the main providers of waste collection services in the districts surveyed. To some municipalities, there is increased tendency of using private contractors to render waste management services. The average number of households being serviced by municipalities ranged from 51 to 5386 with a standard deviation of 7 311, giving a coefficient of variation of 135.7%. On the other hand, households in formal residential areas ranged from 1200 to 17 969, with a standard deviation of 7 660 indicating a coefficient of 87.3% which is still very high.

The waste management collection services in both districts are very poor. Inadequate facilities, poor infrastructure, financial resources and shortage of staff are major barriers to a successful sustainable solid waste management systems. From the analysis of the results of this study, it is concluded that despite the involvement of informal waste pickers in waste recycling, their livelihoods remain poor. Furthermore, lack of transport and inaccessible market has exposed informal waste pickers to more exploitation by the formal market in terms of price determination.

As long as the government does not have empirical evidence that show the amount of waste generated from rural areas, there would no proper planning that will respond to the needs of the informal waste pickers and the municipalities whose capabilities may be compromised with shrinking resource bases.

INTRODUCTION

In developing countries, the mismanagement of solid waste and poor recycling trends associated with it pose an increasing risk to the environment and human health [7, 22, 17]. South Africa has introduced a number of environmental laws and regulations whose main goal is to protect human health and the environment and to ensure that waste management is undertaken in sustainable manner. More importantly, amounts of solid waste must be reduced, recycled and recovered in environmentally friendly manner and where this is not possible such waste must be safely treated and disposed off [13]. However, there is limited understanding on how this new regulatory framework is impacting the effectiveness of waste management and recycling, especially in remotely located rural areas.

Local municipalities everywhere in the country are expected to undertake the responsibility to provide effective delivery of waste services to all citizens and to ensure that all communities are aware of the detrimental impact of waste on human health and the environment. Although some of the available literature has addressed municipal waste challenges in urban areas [16,4,5,11], very few detailed studies have examined waste management challenges outside of urban areas and the plight of rural municipalities who lack financial resources, appropriate infrastructure as well as institutional arrangements for effective and efficient waste management [23]. As a result, there is a scarcity of relevant information on the effectiveness of waste management and potential for its recycling in the deep rural municipal areas, as well as types and characteristics of such waste. Moreover, no empirical studies in South Africa have addressed the plight of informal waste pickers who play a very important towards waste recovery and its recycling. To address this literature gap, this study has examined and characterised the current status of waste management and recycling challenges in the rural districts of uMkhanyakude and Zululand District Municipalities in the KwaZulu-Natal Province of South Africa. In responding to this aim, two research objectives were formulated, namely (1) to describe the involvement of informal waste pickers in waste collection and recycling activities and (2) to identify benefits and challenges faced by waste pickers and municipalities. Knowledge generated from this study is essential in providing baseline information required by rural municipalities for improving their waste management practices as well as developing strategies that can enhance the involvement and operation of informal waste pickers and their recycling rates.

MATERIALS AND METHODS

Both quantitative and qualitative methods were used for data collection, analyses and interpretation. With quantitative methods, the demographic characteristics of informal waste pickers were collected by means of a structured questionnaire. Furthermore, aspects of their waste collection, types and sources of recyclable waste as well as benefits and challenges were also recorded for analyses. Qualitative methods were also used to capture primary data on municipal recycling initiatives, transportation modes, market accessibility and also benefits to municipalities.

DESCRIPTION OF STUDY AREAS

The study focused on two district municipalities (Umkhanyakude and Zululand) in the KwaZulu-Natal province, as shown in Figure 1. Both of these districts were chosen because of their poor socio-economic conditions, marked physical size and population growth, which is higher compared with other districts in the province [25,20].

The Umkhanyakude District Municipality is comprised of five local municipalities. Nearly 50% of their land is under the jurisdiction of traditional authorities, while the remainder is divided between commercially owned farms and conservation areas. This district covers an area of approximately 13 855 km² with a population totalling 625 846 and 128 195 households. It is one of the poorest districts not only in the province but also in the country [21]. The provision of regular refuse removal services is limited mostly larger population centres within the district. Overall the proportion of households provided with a weekly household refuse removal services is less than 10% compared to the overall provincial figure of 52%.

Zululand District Municipality is comprised of five local municipalities, where nearly 50% of their land is also under the jurisdiction of traditional authorities, while the remainder is divided between commercially owned farms and conservation areas. The district covers an area of approximately 14 799 km² with population totalling 803 575 and 157 748 households [25]. This district has a lack of large economic investments to boost the local economy. There has been a steady and significant increase between 1996 and 2001 and between 2001 and 2011 in the number of households which have received solid waste removal services from a local authority or private company. Over the same time period, there has also been a significant increase in communal or communal refuse dumps. Although the Integrated Development Plans (IDPs) for the 2011-2012 period for both district municipalities indicate that solid waste management is a critical issue by both municipalities, no serious prioritization has been made in terms of budget allocation for recycling projects or waste minimization programmes. Nevertheless, the priorities of both districts seem to lie in poverty alleviation, service delivery

(provision of piped water, sanitation and refuse management), and provision of electricity, job creation, basic education and housing.

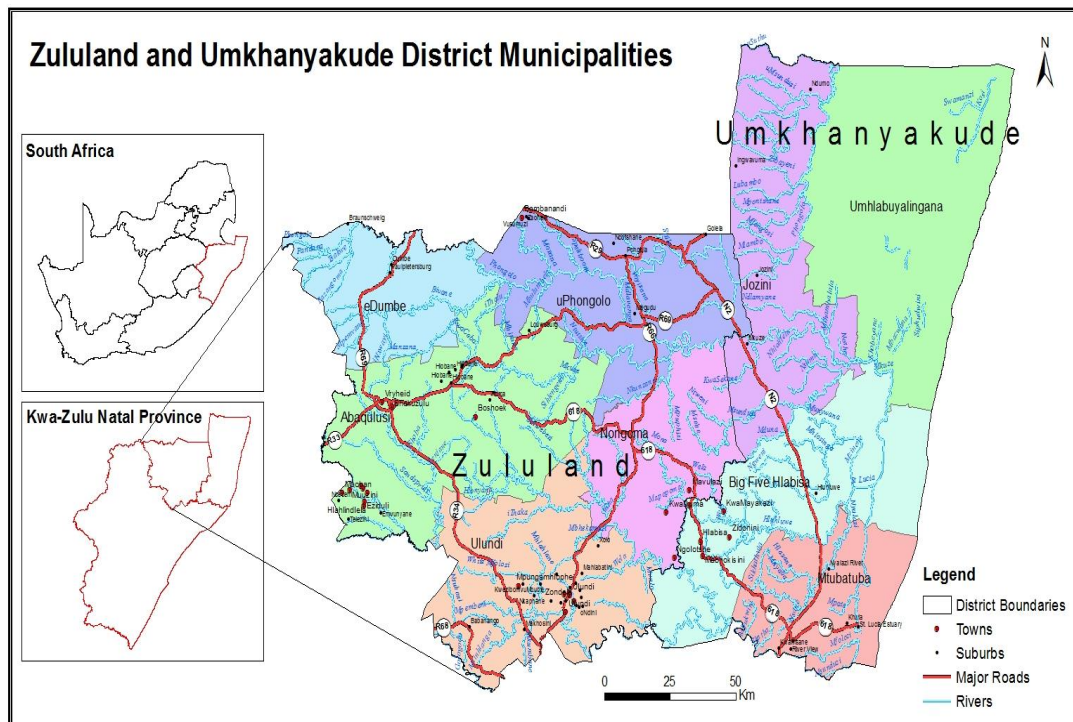


Figure 1: Map showing location of Umkhanyakude and Zululand District Municipalities.

SAMPLING FRAMEWORK AND SURVEY

A total of 126 informal waste pickers were randomly chosen for the study on the basis of their direct involvement in waste picking activities in both municipal districts. Informal waste pickers were interviewed on their socio-economic aspects and other characteristics including gender, educational background, employment status and individual income. Such primary data was collected by means of a structured questionnaire only after they have provided prior informed consent to the interviewers. The questionnaire instrument was divided into six sections. Section A focused on socio-economic characteristics of respondents; Section B was based on the experiences of waste pickers regarding the delivery of waste services in their neighbourhoods where they live; and Section C focussed on the perceptions of informal waste pickers on waste collection services rendered by municipalities. Section D dealt waste minimization and recycling initiatives undertaken in the study area; Section E was on waste picker's willingness to participate in recycling initiatives; meanwhile Section F dealt with the waste picker's experiences regarding benefits derived from recycling activities as well as challenges in the waste management and recycling sector. The reliability of the items or aspects included in the questionnaires was established using Cronbach alpha to measure internal consistency. The reliability of the questionnaire was found to range from 0.60 to 0.9. However, the whole questionnaire instrument has a reliability coefficient of 0.748. All the primary data collected was analysed by means of descriptive statistics and was represented by tables and graphs.

RESULTS AND DISCUSSION

Socio-demographics characteristics of waste pickers

The socio-demographic characteristics of informal waste pickers, including their gender, employment status, income and level of education are presented in Table 2. The majority of the respondents were females, comprising 75.4% of the total sample meanwhile 24.6% were males. A study conducted in some of the rural villages of the Czech Republic found closely resembling proportions of female and female recyclers [18]. However, the results obtained in the current study differed with findings in Botswana where 80% of the informal waste pickers were males while 20% of the respondents were females [12]. As mentioned earlier, both district municipalities are located in deep rural areas characterised by poor economic conditions where men tend to leave and migrate to urban areas in search of job opportunities. By contrast, women remain at home due to limited mobility and the responsibilities of looking after children and their households. About 98.4% of the respondents were self-employed in municipal waste picking, while only 1.6% was in formal employment outside of the waste sector. There is generally a high unemployment rate in the study area and therefore to

survive local inhabitants establish their own small businesses, of which waste recovery and its sales are providing an important escape out of poverty.

Table 2: Socio-demographic characteristics of informal waste pickers in the study areas.

Variable	Category	F	%
Name of district municipality	Umkhanyakude	86	68.3%
	Zululand	40	31.7%
	Total	126	100.0%
Gender	Male	30	24.6%
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	Under Grade 12 Matriculation	52	41.6%
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	Total	125	100.0%

In both study areas, more than 55% of respondents were earning not more than R1000 (~75.5 USD) meanwhile 32.5% were earning between R1 500 (~113,3 USD) and R5 000 (~377, 9 USD). Only a tiny minority (1.6%) of respondents was earning an income of at least R5 000 which explains the level of existing poverty in these areas. In many parts of the world, the participation of informal waste pickers in recycling activities is always motivated by an escape from challenging socio-economic circumstances including high unemployment levels and poverty [8,10,19]. Their adverse socio-economic setting is also worsened by their poor educational background which means lack of technical skills and competencies to join the formal economic sector. In the current study, nearly 50% of the informal waste pickers lacked formal education and only a marked minority (8.8%) of them had important educational attainments and certificates (Table 2).

Waste management services in the study areas

Patterns in the provision of waste management functions are depicted in Figure 3. Based on feedback from respondents, 47.6% of them indicated that private contractors are responsible for the collection and removal of recyclable waste from domestic premises as well as collection stations. Another function of private contractors involves collection of solid waste and garden waste from domestic premises and illegal dumpsites (48.4%). According to 47% of informal waste pickers, private contractors seemed to be spearheading and taking much responsibility for these functions. On the other hand, 59.5% of respondents mentioned that local municipalities are responsible for the management of landfill sites or waste disposal facilities. By contrast, during one of the site visits, it was found out that environmental awareness campaigns were initiated and driven by the provincial Department of Environmental Affairs in collaboration with local municipalities. These results are inconsistent with the findings of previous work conducted in Belgium [7] where local municipalities are responsible for waste prevention, recovery, collection and treatment of waste.

Less than 40% of informal waste pickers indicated that their solid waste is collected once a week and twice per week and the rest is either not collected or collected on a monthly basis. The majority of the informal waste pickers who mentioned no access to waste management services were mostly located in very remote rural areas. Given these waste collection patterns, a large majority (97.6%) of informal waste pickers claimed not to be satisfied with municipal service quality. However, when asked if they are willing to pay for waste collection services, all the respondents expressed their unwillingness to pay for such services. Similarly with trends on

poor waste collection in the study areas, a study by Taboada-Gonzalez *et al.* [17] also reported insufficient waste collection services in the rural communities located in the Ensenada municipality of Mexico. In the Ensenada municipality, residents simply burned their MSW in their homesteads or dumped it illegally on open places near ravines, uncultivated land and canals.

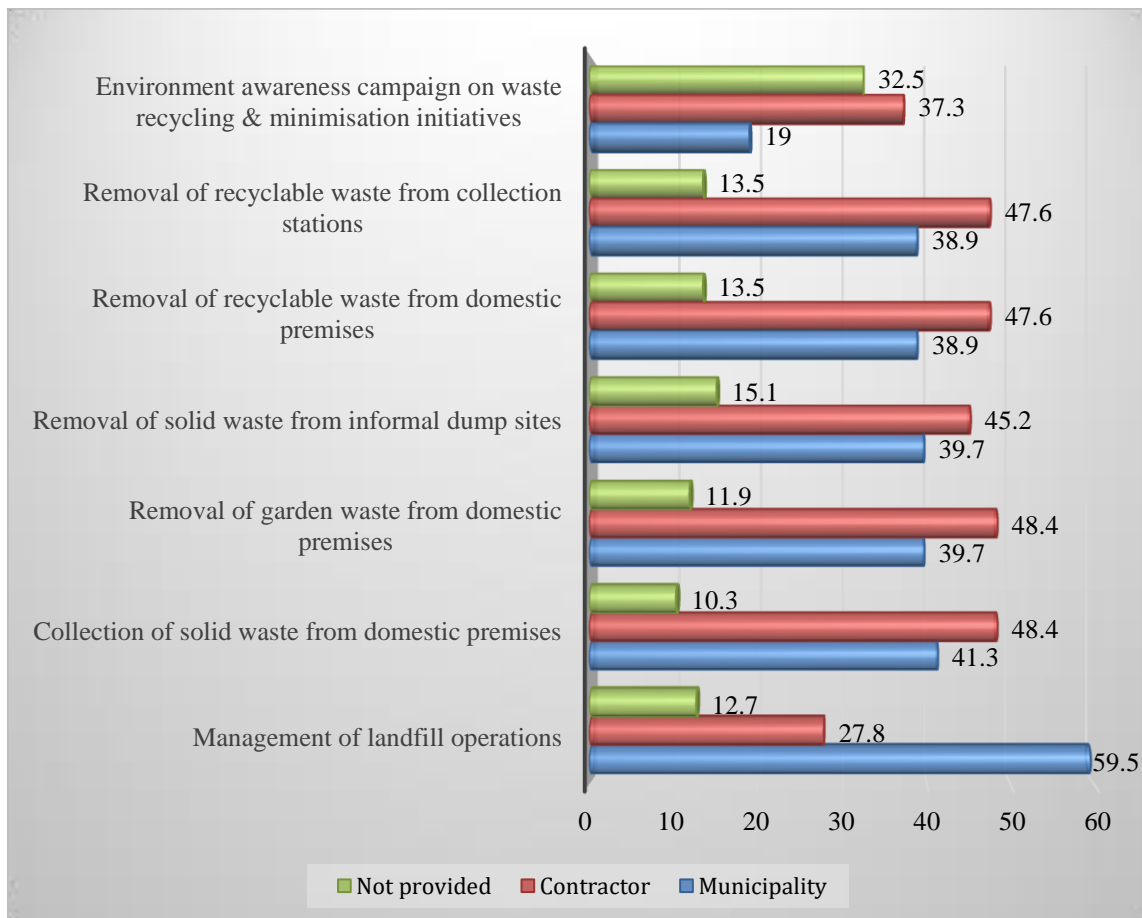


Figure 2: The provision of waste management services in the study area.

Recyclable waste collection and initiatives

The majority (92.9%) of respondents mentioned that there are no community recycling facilities that are provided by local municipalities except those which were initiated by the Informal Waste Pickers themselves (Table 3). However, almost 98%-99% of them are involved in the community-driven recycling activities outside of the scope of municipal jurisdiction. They were also willing to be involved in future recycling initiatives, respectively, even though there were no tangible incentives for waste recycling offered by local municipalities. These findings are consistent with those of studies conducted in the peri-urban parts of the Haidian District in Beijing (China) where there was little effort in the way of government recycling initiatives [24]. Under such circumstances, waste recycling and recovery initiatives were strongly conducted by the “informal” sector. According to Nnoroma *et al.*[9], if communities are thinking that recycling schemes are set up mainly for private profit then this may undermine their willingness to participate. This indicates that municipalities have a responsibility to design and introduce recycling programs with the public perception of ‘improving environmental quality’ and not just for private profitability. Furthermore, based on the results obtained in the current study, 97.6% of informal waste pickers complained about the lack of provision of separate bins for recyclable wastes nor projects (60%) that can promote waste separation at source or waste minimisation (Table 3). These findings indicate a lack of adequate resource allocation on the part of local municipalities, thus failing to prioritise waste minimisation and recycling initiatives. Without separate bins and appropriate infrastructure, improved waste recovery and recycling will continue to be an unattainable goal.

Table 3: Aspects on waste recyclable collection’s collection, minimisation and recycling initiatives.

Statement	Level of acknowledgement	
	Yes	No
Are you willing to participate in recycling initiatives?	99.2%	.8%
Are you involved in recycling initiatives in your area?	98.4%	1.6%
Do you recover organic waste or food waste from landfill sites?	84.9%	15.1%
Do your municipality have projects that promote waste separation at source or waste minimisation?	39.7%	60.3%
Do residents have communal recycling facilities?	7.1%	92.9%
Have separate bins been provided by municipality for recyclable waste?	2.4%	97.6%
Is there an incentive for the public if they do contribute to recycling? e.g. discount on waste collection charges	-	100%

Benefits to waste minimization and recycling initiatives

Based on the results, respondents mentioned various benefits from waste minimization and recycling activities and this included earning money to buy food, creation of employment opportunities and street cleaning and keeping their settlements clean. These results are in agreement with findings reported by Buque and Riberio; and Ezeah *et al.* [1, 3], where waste recycling created some socio-economic and environmental benefits. This indicates that waste minimization activities can change the socio-economic circumstances of rural informal waste pickers in a positive light. However, their involvement and willingness to participate can only be improved and rendered more effective if local municipalities can provide necessary resources and support.

Barriers in recycling and waste minimisation

Despite benefits associated with recycling activities, the results also showed that there are barriers that are being experienced by informal waste pickers. All of the informal waste pickers (100%) mentioned to a very large extent that their main barriers to effectiveness and efficiency in waste recycling was lack of support from all government spheres, and these also included lack of financial schemes to help them in their day-to-day operations. To a little extent, there is very limited community recycling in these neighbourhoods. These results are inconsistent with findings obtained in Serbia by Ili and Nikoli [6], where bottlenecks and barriers that restricted sustainable waste management included low levels of municipal waste recovery, reuse and recycling, shortage of appropriate technology, increasing waste quantities, and weak economic incentives for waste minimization. This finding indicate that support from government plays a critical role towards effective and efficient waste minimization and recycling in rural communities.

Operating without an enabling infrastructure (59.2%), including bailing machines, electricity, sanitation and water supply militated against recycling effectiveness. Even so, the majority (96.8%) of informal waste pickers complained about the lack of appropriate shelter or space where they can undertake their recycling facilities unhindered by others and optimally. They believe that their local recycling activities can be enhanced if they can have their own working space for operational purposes, as well as cheap transport for their recyclables and a reliable market where they can sell their recovered waste materials. Their productivity is also constrained by occupationally induced illnesses such as skin disease, tuberculosis, earaches, headaches, and even dizziness. When it came to problems with logistics, most informal waste pickers mentioned (58.4%) that it takes considerable time for them to recover and accumulate waste materials of a sufficient weight enough to

warrant selling. This was worsened by the lack of market access (56.3%) where they can sell their recyclables on time. Without such market accessibility, the collected waste materials would simply accumulate on-site and these can end up being burned (49.6%) in order to make space for those materials that are selling fast. Furthermore, although to a little extent, the lack of formalization of this sector (46.8%) was not a concern or important priority for them as they may end losing their business if such an arrangement was to be introduced by the government. In other words, they do not see the formalization of the sector as something that can really improve their chances of success. It is clear that government support in terms of financial resources and infrastructural development is of critical importance for the efficiency and effectiveness of waste recycling programmes. Without proper infrastructure, informal sector will always find it difficult to access the market on time which in turn expose them to exploitation by itinerant buyers.

CONCLUSION

This study has provided the first base line information on the status and current problems facing municipal solid waste management in the selected rural areas of the Kwa-Zulu-Natal province of South Africa. The prospects of effective and efficient waste recycling by informal waste pickers have also been examined. Based on the results emanating from this study, it can be concluded that municipal solid waste management practices and attendant services in the uMkhanyakude and Zululand District Municipalities are very poor and are not in line with the goals of the new waste-related laws and regulations in South Africa. This in turn has a negative impact on existing waste minimization and recycling initiatives by informal waste pickers who have very limited resources at their disposal. Barriers to successful recycling entailed inadequate facilities and poor infrastructure, lack of financial resources and unreliable market accessibility. Lack of transport also worsens their plight, thus depriving informal waste pickers from meaningful participation in the recovery of municipal solid waste. Despite the involvement of informal waste pickers in municipal waste recovery, chances of recycling success amongst them remain bleak because they are not able to recover as much waste material as they could possibly do because of operational constraints.

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Reference list

1. Buque, L.L.B., Riberio, H.: Overview of the selective waste collection with pickers in Maputo Municipality, Mozambique: Challenges and perspective. Public Health School, Department of Environmental Health University of Sao Paulo, Brazil (2014)
2. Charuvichaipong, C., Sajor, E.: Promoting waste separation for recycling and local governance in Thailand. *Habitat. Int.* 30, 579–594 (2006)
3. Ezeah, C., Fazakerley, J. A., Roberts, C. L.: Emerging trends in informal sector recycling in developing and transition countries. *Waste Manag.* 33, 2509–2519 (2013)
4. Godfrey, L.; Scott, D.; Trois, C.: Caught between the global economy and local bureaucracy: the barriers to good waste management practice in South Africa. *Waste Manag Res.* 31(3), 295–305 (2013)
5. Ginindza, B.; Muzenda, E. Community Perspectives on Waste Management and Minimisation: A Case Study for Mogale City and Westonaria Municipalities. International Conference on Integrated Waste Management and Green Energy Engineering, April 15-16, Johannesburg, South Africa (2013)
6. Ili, M., Nikoli, M.: Drivers for development of circular economy: A case study of Serbia. *Habitat Int.* 56, 191-200 (2016)
7. Jacobsen, R., Buysse, J., Gellynck, X.: Cost comparison between private and public collection of residual household waste: Multiple case studies in the Flemish region of Belgium. *Habitat Int.* 33, 3-11 (2013)

8. Medina, M.: "Scavenger Cooperatives in Asia and Latin America." *Resour Conserv Recycl.* 31(1), 51–69 (2000)
9. Nnoroma, I.C., Ohakwe, J., Osibanjo, O.: Survey of willingness of residents to participate in electronic waste recycling in Nigeria: a case study of mobile phone recycling. *Journal of cleaner Production*, 17 1629-1637 (2009)
10. Nzeadibe, T. C.: Solid waste reforms and informal recycling in Enugu urban area Nigeria. *Habitat Int.* 33(1), 93-99 (2009b)
11. Ramukhwatho, F.R., Du Plessis, R.; Oelofse, S.: Household food wastage in a developing country: A case study of Mamelodi Township in South Africa. *WasteCon 2014, 22nd Waste Management Conference and Exhibition: Wired for Waste - Value, Grow, Sustain, Somerset West, 6-10 October, 468 – 475 (2014)*
12. Rankokwane, B., Gwebu, T.D.: Characteristics, threats and opportunities of landfill scavenging: The case of Gaborone-Botswana. *Geo Journal.* 65,151-163 (2006)
13. Republic of South Africa (RSA):. National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008), Pretoria, (2008)
14. Republic of South Africa (RSA):. The Statistics of South Africa, Pretoria (2016)
15. Sentime, K.: The impact of legislative framework governing waste management and collection in South Africa. *Afr Geogr Rev.* 33(1): 81-93 (2014)
16. Schenck, R., Blaauw, P.F.: The Work and Lives of Street Waste Pickers in Pretoria-A Case Study of Recycling in South Africa's Urban Informal Economy. *Urban Forum.* 22, 411-430 (2011)
17. Taboada-Gonzalez, P., Aguilar-Virgen, Q., Ojeda-Benitez, S., Armijo, C.: Waste Characterization and Waste Management Perception in Rural communities in Mexico: A case study' *Environ Eng Manag J.* 10, 1751-1759 (2011)
18. Tydlitatova, E, M., Havrland, B., Ivanova, T.: Social awareness on waste production in rural areas. *Eng Rural Dev.* 05, 29-30 (2014)
19. Uiterkamp, B. J. S., Azadi, H., Ho, P.: Sustainable recycling model: A comparative analysis between India and Tanzania. *Resour. Conserv. Recycl.* 55(3), 344-355 (2011).
20. Umkhanyakude District Municipality.: Integrated Development Plan (IDP Review 2011/2012), Mkhuze, KwaZulu-Natal, South Africa (2011)
21. Umkhanyakude District Municipality.: Integrated Development Plan (IDP Review 2014/2015), Mkhuze, KwaZulu-Natal, South Africa (2014)
22. United Nations, 2009. World Demographic Trends Report of the Secretary-General. Commission on Population and, Development. Accessed 18 June 2016.
23. Van der Merwe, H., Steyl, I.: Solid waste management in intensively farmed rural areas. : A Western Cape case study. *Acta Acad.* 37(3), 184-211 (2005)
24. Wang, J., Han, L., Li, S.: The collection system for residential recyclables in communities in Haidian District, Beijing: A possible approach for China recycling. *Waste Manag.* 28, 1672-1680 (2008)
25. Zululand District Municipality.: Integrated Development Plan (IDP Review 2011/2012), Ulundi, KwaZulu-Natal, South Africa (2011)