Article

Community Resident's Opinions and Perceptions on the Effectiveness of Waste Management and Recycling Potential in the Umkhanyakude and Zululand District Municipalities in the KwaZulu-Natal Province of South Africa

Bonginkosi Robert Dlamini [1], Isaac Tebogo Rampedi [1,*] and Ayodeji Peter Ifegbesan [2]

[1]Department of Geography, Environmental Management & Energy Studies, University of Johannesburg, PO Box 524, Auckland Park 2006, South Africa; Email: bzr.dlamini@gmail.com

[2]Department of Arts and Social Sciences Education, Olabisi Onabanjo University, Ago-Iwoye, Nigeria; Email: ayodeji.ifegbesan@gmail.com

*Correspondence: isaacr@uj.ac.za; Tel.: +27 11-559-2429.

Abstract: Whereas waste management research has focused on mostly urban municipalities in South Africa, not much is known about the current performance of waste management services from the perspective of community residents in rural municipalities. This study reports on the status and effectiveness of waste management practices from the perspective of community residents in the Umkhanyakude and Zululand Districts in the rural areas of the KwaZulu-Natal province of South Africa. Making use of structured questionnaires, primary data was obtained by interviewing 333 respondents representing households in the study area. Results have revealed several shortfalls in the provision of municipal waste management services, except for solid waste removal from households (66%), and management of landfill sites (41%). The degree of dissatisfaction for waste management services rendered was very high (97.3%). Furthermore, the majority (61.4%) of respondents were not willing to participate in waste segregation due to lack of appropriate knowledge and infrastructure. The study also pinpointed some benefits associated with waste minimization, as well as barriers constraining effective waste recycling. Based on these findings, there is a dire need for transforming current waste management practices toward increased recycling rates by creating more environmental awareness and a supporting infrastructure.

Keywords: waste management; waste minimization; recycling; rural district municipalities; community residents; households; satisfaction levels; willingness to recycle; waste separation; municipal solid waste; benefits and barriers

1. Introduction

The negative impacts of poor municipal solid waste management and the need to minimise the amounts of such waste are of environmental concern in many countries. This is especially true in developing countries where ineffective municipal solid waste management is leading to poor sanitation, increased public health risk, and other challenges regarding its collection, storage, transportation, and final disposal through landfilling [1,2,3,4]. Although municipal solid waste is comprised of solid materials deemed to be useless and not needed, if recycled effectively its quantities can be substantially decreased when its usable fraction is recovered and reused [5,6,7,8]. One of the functions of local governments is to ensure that municipal solid waste is collected and disposed of in landfill sites, in a cost effective and sanitary manner, while recoverable components are recycled efficiently [2]. Effective municipal solid waste management and its minimization has proven to be a very complex function in many countries, however, and is dependent upon adequate institutional capacity, cooperation and collaboration between municipal governments, the public as well as the

private sector, public awareness amongst residents, and enforcement of environmental laws and regulations [2,9–11].

Waste management and waste recycling rates in South Africa are negatively impacted by ineffective collection rates for a significant proportion of the population that reside outside of major cities and towns [12,13]. Due to these challenges, the Local Government: Municipal Systems Act (South Africa, Act No. 32 of 2000) [14] maintains that municipalities must involve all local communities through appropriate mechanisms, processes, and procedures, the goal being to achieve adequate performance management levels. More specifically, the National Environmental Management: Waste Act (South Africa, Act No. 59 of 2008) [15] states that municipalities are obliged to exercise executive authority in delivering services such as the removal, storage, transportation and final disposal of municipal waste, while ensuring access for all communities to such services. Municipalities must also set local standards, which can serve as benchmarks in regulating the separation or segregation of municipal solid waste. Such benchmarks also apply in regulating activities at the landfill sites, including requirements for waste avoidance or its reuse, recycling and recovery; and for the prevention and control of littering. Despite these legislative imperatives, waste minimization through separation at source, recovery and recycling is not yet accorded a top priority in line with the new regulatory and legal requirements in South Africa [16]. This will result in a weak service delivery and a failure to achieve sound waste management practices within communities if institutional resources are poorly allocated to support waste minimization practices within municipalities.[17].

To date, there is very limited empirical research [13,18] on how local municipalities and communities in South Africa are responding to the new regulatory framework, which calls for integrated waste management, along with more public participation and increased recycling rates. Adopting an integrated waste management strategy means "integrated planning, implementation, monitoring, and review of these waste management measures to ensure sustainability and to prevent detrimental impacts on human health and the environment" [19].   Unlike the majority of previous waste management studies in South Africa, which tended to focus more on cities and urban district municipalities [18,20,17,21], very few investigations [22] have been directed to the challenges of rural solid waste management and minimization, although nearly 40% of South Africa's inhabitants still live in rural areas. According to the National Waste Management Strategy [23] in South Africa, there is a major historical impediment regarding the provision of effective municipal waste management services, especially when it comes to remote rural areas and many jurisdictions under traditional and tribal authorities. It is also not clear as to how waste recycling rates in rural areas are expected to increase when these areas are often without the necessary infrastructure and logistical support. Furthermore, with a growing rural population and poor waste management practices, sustainable development in these settlements will be compromised in the long term as human health and the assimilative capacity of the natural environment to absorb more waste is reduced [22]. This point is also brought to the fore in a Brazilian case study which characterized rural domestic solid waste in some of the Amazonian villages [24].   A study investigating capacity building in rural Guatemala showed that one of the barriers hampering the widespread adoption of sustainable waste management schemes is the long distances traversed by recyclers, and the high costs of transporting small volumes of recyclable material to buy-back centres [9,25] Moreover, an understanding of community satisfaction levels on current waste management systems, as well as their willingness to recycle, is critical for improving the effectiveness of municipal solid waste management practices [26]. Factors attributed to weaknesses in some of the Chinese rural solid waste management systems included, amongst other barriers, institutional ineptness in executing waste management measures, lack of a suitable infrastructure and technical support, and poor resident participation [27]. Given the paucity of such literature in South Africa, the main aim of this article was to assess the status and effectiveness of waste management practices through an understanding of the opinions and perceptions of community residents within rural local municipalities in the Umkhanyakude and Zululand Municipal Districts, both located in the KwaZulu-Natal province of South Africa. Although such community feedback is providing only one side on the performance indicators of this municipal

waste management system, such feedback can yield key insights in locating operational barriers and challenges. The study also established the degree of willingness or unwillingness amongst community residents to pay for improved waste management services; extent of waste separation at source; and the benefits and barriers associated with their participation in recycling initiatives.

2. Materials and Methods

2.1. Study Area

The geographical location of the study area is in the Kwazulu-Natal province of South Africa and is comprised of two district municipalities, namely, Umkhanyakude and Zululand (Figure 1). Both Umkhanyakude and Zululand Districts fall within areas that have been historically neglected in terms of municipal waste services. Previous research conducted in these areas has mapped the location of illegal dumpsites, and has shown that the proportion of unpermitted disposal facilities is extremely high, with Zululand District having 83% whilst Umkhanyakude has 89% [28]. It is also important to mention that these districts are financially under-resourced, not only for waste management provisioning, but for other infrastructural developments and services.
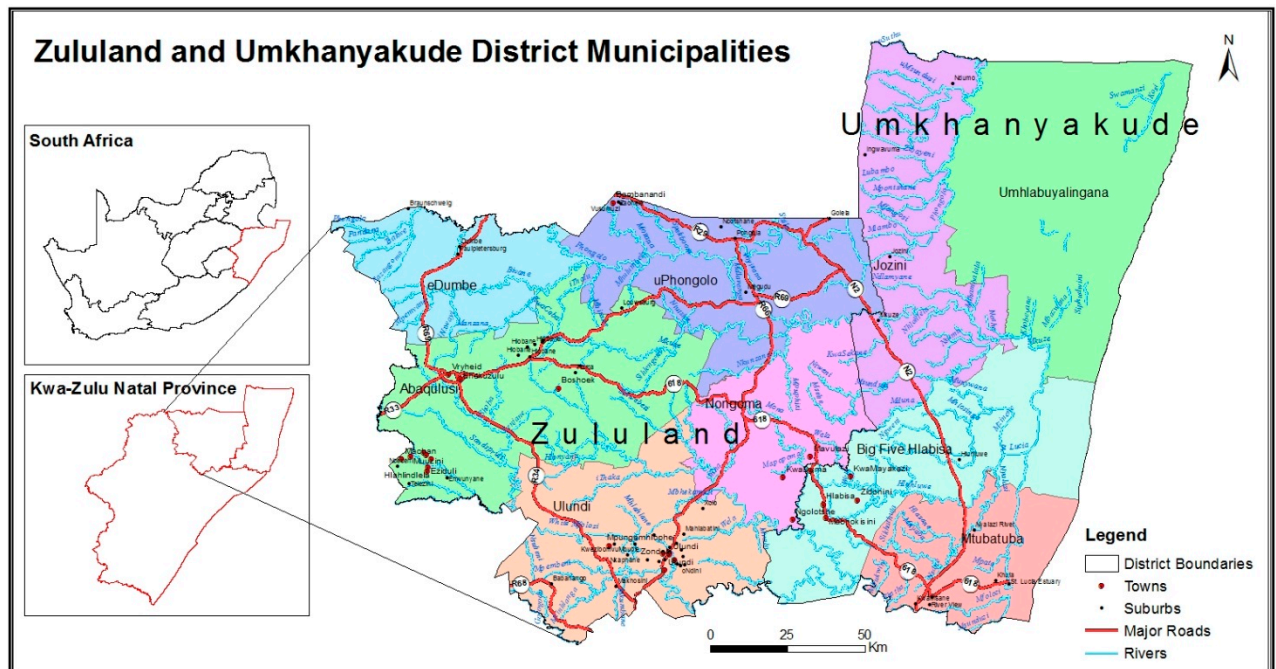

Figure 1. Map of Umkhanyakude and Zululand Districts, KwaZulu-Natal province, South Africa.

Each of the Umkhanyakude and Zululand districts are comprised of five local municipalities. The former incorporates Mtubatuba, Hlabisa, Jozini, The Big Five, False Bay and uMhlabuyalingana, while the latter covers uLundi, Nongoma, Pongola, Abaqulusi and Edumbe. Most people in these two municipalities live in rural areas characterized by poor living conditions. Income earnings are constrained by lack of jobs or unreliable self-employment opportunities and, therefore, most people are indigent [29,30]. The geographical characteristics of each district municipality are discussed below.

2.1.1. Geographical Characteristics of the Umkhanyakude District Municipality (UDM)

The Umkhanyakude District Municipality (UDM) (Figure 2) is in the far northern region of the KwaZulu-Natal province and shares a border with Mozambique and Swaziland. The district municipality covers an area of approximately 13,855 km² with a population totalling 625,846 and 128,195 households. The UDM forms part of the Lubombo Trans-Frontier Conservation area and is

the second largest district in KwaZulu-Natal in terms of size, behind the neighbouring Zululand District Municipality.
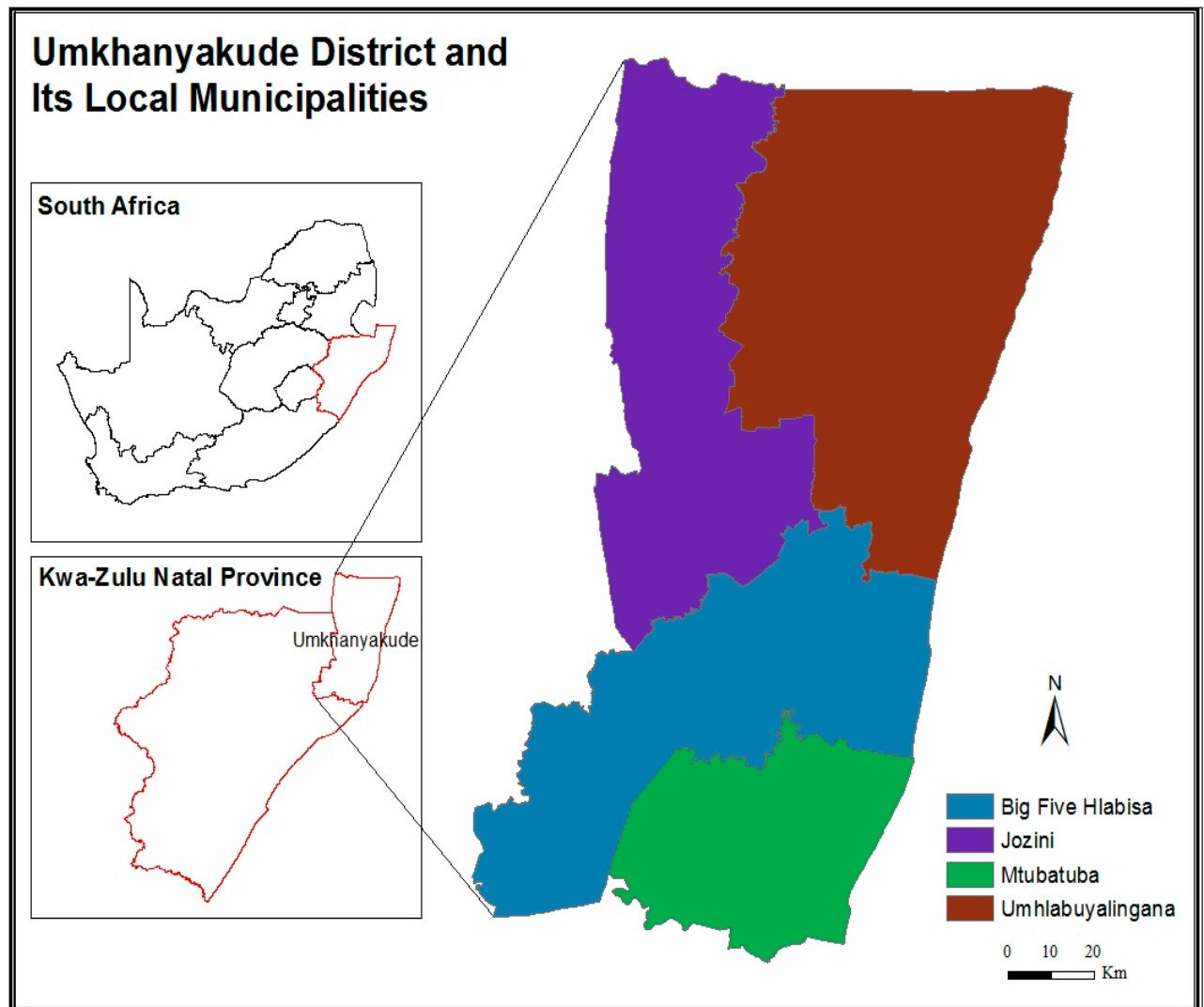

Figure 2. Map of Umkhanyakude District Municipality showing the various local municipalities constituting the study area.

The UDM is one of the poorest municipalities, not only in the KwaZulu-Natal province but also in South Africa and, hence, is one of the four district municipalities that is receiving presidential public funding to make improvements towards poverty alleviation. The UDM has a relatively small economy, contributing just 2.7% to the economy of the province and 0.4% of its population. The economic activities of the district are concentrated in two economic (trade) sectors, namely, agriculture and tourism. These two sectors together contribute 55% of the total economy of the district [**31**].

2.1.2. Geographical Characteristics of the Zululand District Municipality (ZDM)

Figure 3 shows the geographical location of Zululand District Municipality (ZDM, also referred to as Zululand) within the KwaZulu-Natal province, and the locations of local municipalities within this district. ZDM is also located in the far north of this province and is bordering Swaziland. In terms of governance, approximately 50% of the district area is allocated to traditional tribal authorities, while commercially owned farms and nature conservation areas constitute other important land-uses. This district is comprised of five local municipalities—Abaqulusi, èDumbe; Nongoma; uPhongolo; and uLundi. The district covers an area of approximately 14,799 km², with a population totalling 803,575 and 157,748 households. The total percentage of urban households is only 25.4%

while rural households make up 74.6% of the population [**29**]. Given such a predominantly rural setting, this district is characterised by a high unemployment rate of 41.1%, which is higher than the overall provincial rate of 28.5%. The local municipalities of uPhongola, Ulundi and Nongoma have the highest unemployment rate compared to other local municipalities within the district. However, the Abaqulusi Local Municipality has the highest number of households with employed inhabitants working predominantly on agricultural farms within the area.

The most important towns are Vryheid and Ulundi, while Pongola and Paul Pietersburg constitute small service centres. According to ZDM [**32**]**,** economic investments in this district are generally small, thus not enough to enhance local economic developments**.** Up to the late 1990s, the most important economic activity was coal mining, although its sphere of influence has declined markedly. The landscape outside of small towns is occupied mainly by poverty-stricken rural areas that are under tribal and traditional chieftaincies.
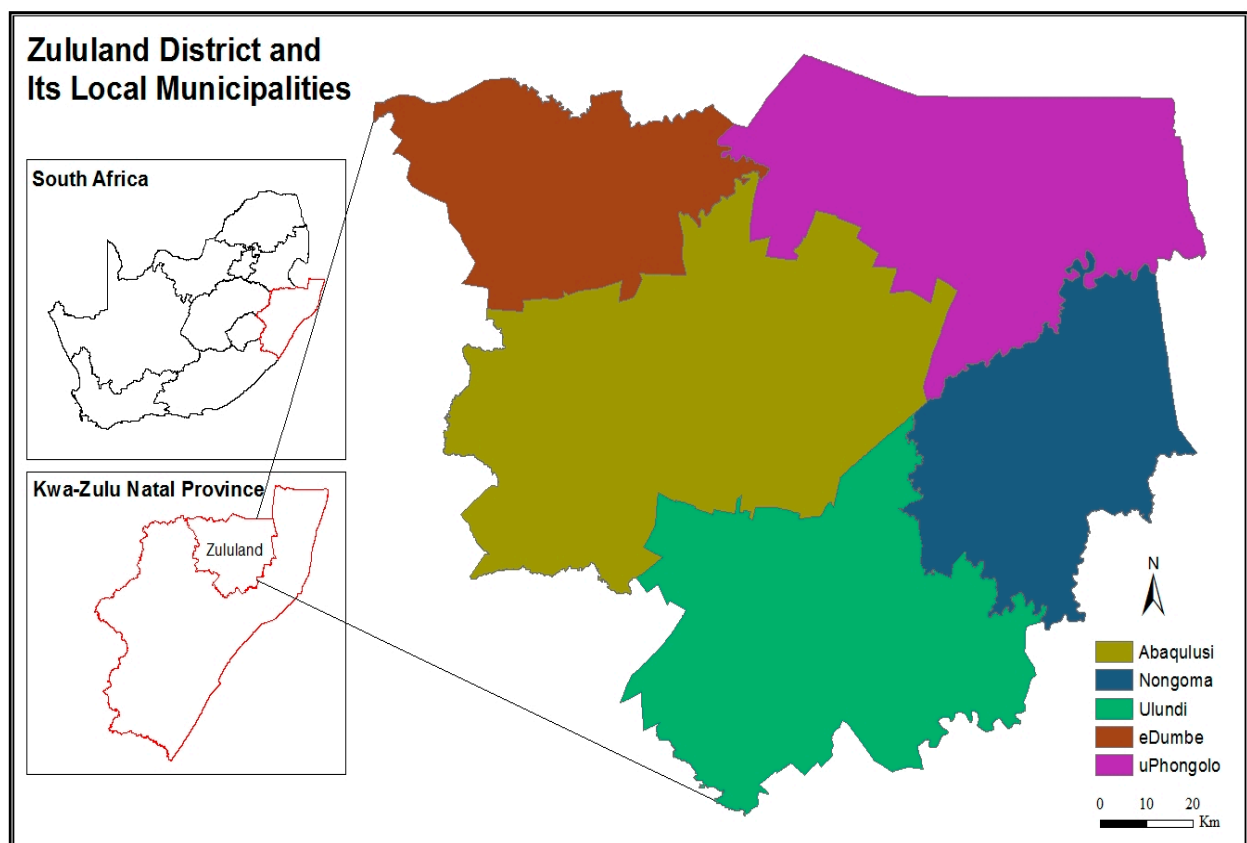

Figure 3.   Map of the Zululand District Municipality as well as the various local municipalities constituting the study area**.**

2.2. Questionnaire Survey Design

Scientific surveys entail finding relevant information on one or several groups relevant to the research and then asking relevant questions on their characteristics, knowledge or attitudes regarding a phenomenon of interest [**33**]. Surveys are usually quantitative in nature and aim to give a broad overview of a representative sample of a large population [**33,34**]**.** Primary data required for such studies are collected by questionnaires and can be summarized by means of descriptive and inferential statistics. Desktop studies, interviews and site visits were used in this study to determine the status of waste management systems (collection, storage, transportation and disposal), satisfaction levels, waste recycling potential, as well as benefits and barriers experienced by community residents toward increased recycling rates in the various local municipalities within the study districts.

2.3. Survey Procedures and Sampling Method

This study followed a random sampling approach whereby households in the two study districts had an equal chance of being included in the survey. This was preceded by obtaining prior informed consent from both household owners and relevant officials in the district municipalities. The surveys began with a small pilot study whose main goal was to establish the suitability of the questionnaires used for data collection to meet the study objectives. The testing also assessed the time taken by respondents to complete the questionnaires, and the level of support they would need in answering the questions effectively. Based on the outcome of the pilot surveys, weaknesses in the structure and content of the questionnaire were then subsequently addressed.

Four hundred community residents in total, one from each household, were invited to participate in the study. Out of these 400 residents consulted during the data collection period (August and October 2015), 333 of them provided educated prior informed consent, meaning that they understood the goal of the survey adequately and they were willing to participate or withdraw from the study without any dire consequences. The response rate for this survey was 83%. Most the respondents (60.7%; n = 202) were from the Umkhanyakude District Municipality whilst 39.3% (n = 131) of them were from Zululand. This discrepancy can be attributed to the point that the Umkhanyakude District was not only relatively easier to access, but also most tribal authorities and community residents there gave prior informed consent for the survey to proceed unhindered.

Since the understanding of English was problematic in the study area, interviews were conducted on a face-to-face manner and the *isiZulu* vernacular language was used to clarify what was required from respondents. The questionnaire survey in households was focussed on socio-economic characteristics; their opinions and perceptions regarding the provision of waste management services, level of waste collection, minimization and recycling initiatives; their willingness to separate waste at sources and participate in recycling initiatives; and the benefits derived from recycling, as well as barriers associated with recycling initiatives. The questionnaire consisted of a set of open-ended, as well as close-ended questions and Likert-type questions. Each questionnaire had a space at the bottom of the last page where respondents could comment further on any aspect under consideration. Each questionnaire was comprised of the following sections:

Section A: Demographic aspects (jurisdictions, gender, employment status, level of education, and waste management functions);

Section B: Aspects of waste management planning and development (including for example, municipal solid waste collection; collection of solid waste and recyclables, current recycling practices; waste separation at source programme, funding of waste separation at source programmes, storage of recyclables, type of recyclables, and distances travelled for recycling purposes).

2.4. Statistical Data Processing and Analysis

The validity and reliability of the investigation was undertaken using Cronbach alpha to verify whether the questionnaires were credible and internally consistent. The general agreed lower limit that was used was 0.7, while 0.6 was used as an acceptable level in the case where agreed lower limit of 0.7 could not be achieved. The reliability of questionnaires is depicted in Table 1. All the major aspects or sections of the questionnaire used met the minimum agreed level of 0.7, as proposed by Revelle and Zinbarg [**35**]**.** The reliability of the overall instrument was found to be 0.824.   Table 1 shows the results on the reliability of aspects included in the questionnaires for community residents from each household.

Table 1. The reliability of aspects in the questionnaires for community residents.

Aspect	No. of items	Cronbach's alpha	Acceptable level
Benefits from recycling and waste minimization operations	7	.803	Good
Barriers to recycling and waste minimization	16	.932	Excellent
Aspects assisting the community in recycling and waste minimization	9	.963	Excellent
Total	32	.824	Good

The data obtained from responses provided by interviewed community residents were processed into the Microsoft Excel (2010) programme and statistical analyses were carried out by means of SPSS version 24. Descriptive statistics in the form of tables, frequencies, percentages and proportions were used to describe the patterns and trends in the data set. In addition, inferential statistics was used to depict trends from the quantifiable data and to test the following hypotheses:

Hypothesis 1: Opinions on benefits of recycling and support for waste minimization differ according to respondents' gender.

Hypothesis 2: Opinions on benefits of recycling and support for waste minimization differ according to respondents' employment status.

Hypothesis 3: Opinions on benefits of recycling and waste minimization operations differ amongst respondents according to monthly net income.

Hypothesis 4: Opinions on benefits of recycling and waste minimization operations amongst respondents differ according to level of education.

Hypothesis 5: Opinions on barriers to recycling and waste minimization differ according to respondents' gender.

Hypothesis 6: Opinions on barriers to recycling and waste minimization vary according to the employment status of respondents.

Hypothesis 7: Opinions on barriers to recycling and waste management differ amongst respondents according to monthly net income.

Hypothesis 8: Opinions on barriers to recycling and waste management vary amongst respondents according to level of education.

2.4.1. Inferential statistical analysis

Exploratory factory analysis, using the principal component method with a varimax rotation, was done to establish which factors were interrelated in any given construct, where a set of highly inter-correlated measured variables were grouped into distinct factors. Latent root criterion ascertained the number of factors to be considered further and all latent roots (eigenvalues), which were more than one, determined the number of factors [36]. Thus, in this study, all factors with eigenvalues less than one were insignificant. Furthermore, in this study, factor analysis was used to shed light on the barriers to recycling and waste minimization. A comparative analysis of socio-demographic groups to determine group comparisons using the independent t-test was used to determine differences between groups. Furthermore, a comparative analysis was undertaken between socio-demographic groups by making use of independent t-tests, where composite variables were constructed by taking the mean of each Likert-scale construct and the composite variables involving questions that dealt with benefits and barriers associated with waste minimization and recycling rates.

Furthermore, a comparison of socio-demographic groups was conducted by means of the analysis of variance (ANOVA); ANOVA is a parametric procedure for determining whether significant differences exist in a survey containing two or more sample means [37]. The goal was to determine, by means of ANOVA, whether there were significant statistical differences between various socio-demographics based on gender, monthly net income, levels of education and employment status. Only significant aspects were presented in detail, and confidence interval error

bars were used to show differences. The statistical testing was conducted at the 5% level of significance, and the *p*-value approach was used; thus, a *p*-value less than .05 led to the rejection of hypotheses where equal means are involved.

3. Results and Discussion

3.1. Characteristics of Respondents

Table 2 summarises the demographic characteristics of respondents. A total of 333 community residents were interviewed and 60.7% (n=202) of them were women, while 39.3% (n = 131) were men. Respondents were largely drawn from local municipalities such as Umhlabuyalingana (18.6%), Jozini (12.0%), The Big Five (10.8%) and Hlabisa (10.8%). Others had relatively lower proportions of respondents, and entailed Mtubatuba, Abaqulusi, Edumbe, Nongoma, Pongola and Ulundi. Respondents who were formally employed amounted to 30.5% of the total, while those who were self-employed constituted 42.3%. An unemployment level amongst the respondents was found to be 27.2%, which is lower than the 41% average for both district municipalities [**38**]. Respondents without any education were equal to 16.5% of the sample, and those whose educational level was below a matriculation qualification amounted to 40.2%. Only 31.2% of the respondents had achieved a matriculation certificate. Respondents with educational qualification at college or university levels were relatively fewer as they ranged from 4.5% for university degrees to 7.5% for a college diploma certificate.

Table 2.   A summary of the demographic characteristics of respondents (N = 333).

Variable	Category	F	%
District Municipality	Umkhanyakude	202	60.7%
District Municipality	Zululand	131	39.3%
	Total	333	100.0%
Gender	Male	131	39.3%
	Female	202	60.7%
	Total	333	100.0%
Employment Status	Employed	101	30.5%
	Self-employed	140	42.3%
	Unemployed	90	27.2%
	Total	331	100.0%
Income	Not more than R500 (39.1 USD)	51	20.1%
	R501 to R1,000 (39.2-78.3 USD)	94	37.0%
	R1,001 to R1,500 (78.3-117.5 USD)	48	18.9%
	R1,501 to R5,000 (117.5-391.5 USD)	32	12.6%
	R5,001 to R10,000 (391.6-783.1 USD)	16	6.3%
	More than R10,000 (783.1 USD)	13	5.1%
	Total	254	100%
Level of Education	No Education at all	55	16.5%
	Under Grade 12 Matriculation	134	40.2%

Matric Certificate	105	31.5%
College Diploma	24	7.2%
University Degree	15	4.5%
Total	333	100.0%

Thirty seven percent of the respondents were earning about R501-R1,000 (i.e., 39.2–78.3 USD) (per month). Income brackets such as R1,001-R1,500 (i.e., 78.3–117.5 USD) and R1,501–R5.000 (i.e., 117.5–391.5 USD) per month were represented by 18.9% and 12.6% of the respondents, respectively. Respondents who were earning more than R10,000 (i.e., 783.1 USD) per month were relatively fewer (5.1%). These demographic patterns highlight the need for prioritising socio-economic development in the study area to enhance educational attainments, as well as employment levels.

3.2. Provision of Waste Management Services

The present study had 66.7%, (n = 222), of respondents indicate that the local municipalities were involved in the management of landfill operations, whilst the same proportion mentioned that, at times, there are environmental awareness campaigns on waste recycling and minimization initiatives within their neighbourhoods (Figure 4). Alternatively, activities such as the removal of solid waste in the informal dump sites (75%), removal of recyclable waste from collection stations (94.6%) and the removal of garden waste from domestic premises (95.8%) were not being adequately provided by local municipalities. The removal of solid waste from domestic premises was mentioned by 66.7% of respondents, in contrast. Based on these results, it appears that most waste management activities by municipalities are still directed toward routine solid waste collection and its disposal, with little emphasis in promoting waste recycling, especially regarding its removal from several points sources.
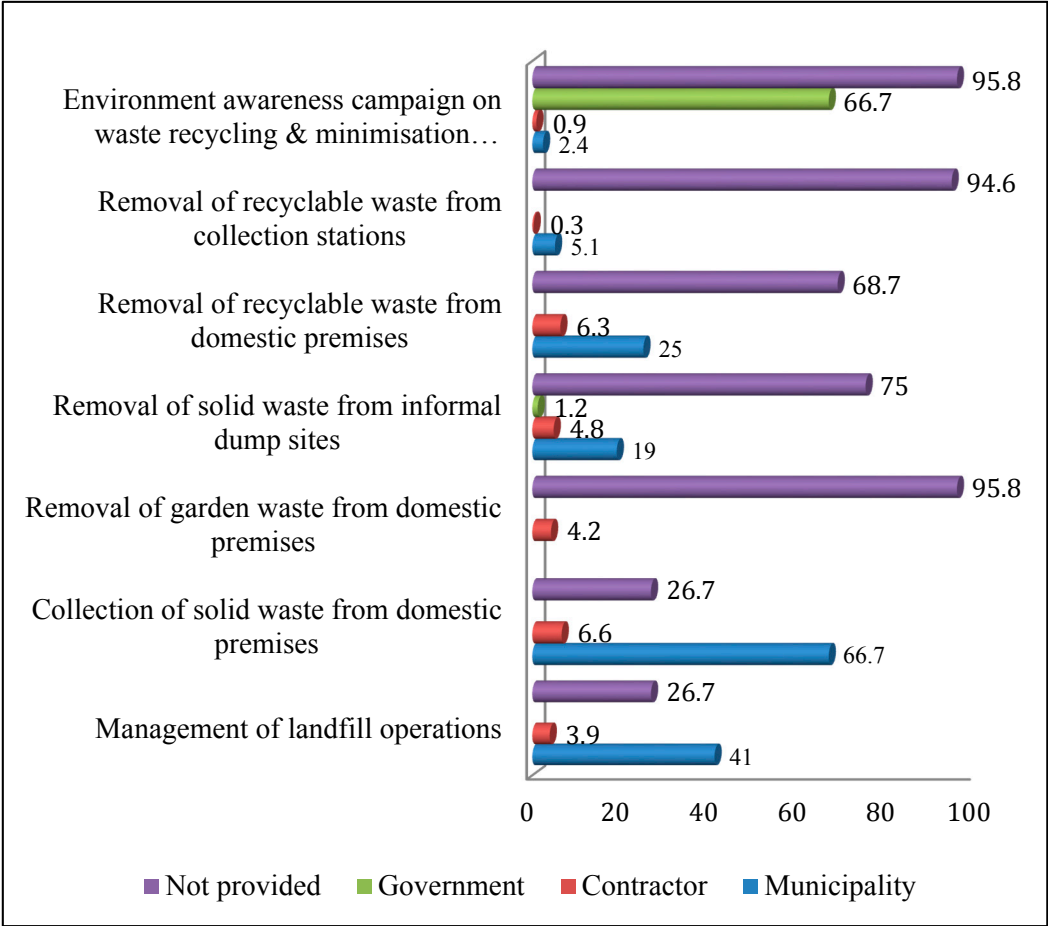

Figure 4. Opinions of respondents on the provision of waste management services.

3.3. Satisfaction Levels in Municipal Waste Collection

According to the 2014 Integrated Development Plan [**31**]**,** waste management has been a challenge throughout the Umkhanyakude District Municipality (UDM), with poor solid waste disposal posing a threat to human health and environmental components such as freshwater resources and the quality of ambient air. The provision of regular refuse removal services is limited to larger residential centres within this district. Only 10% of households (13,443) were provided with weekly household refuse removal services compared to the overall provincial figure of 52%. Approximately 96,089 households in the UDM district made use of their own refuse dumps (74%), with a further 15,989 households (13%) that were without any form of rubbish disposal sites. Regarding the Zululand District Municipality, during the 2011–2012 period, only 20% of households received formal waste disposal support functions, and this was predominantly restricted to urban areas [**29**]. The current study found, whereas 70.3% of respondents mentioned that local municipalities do collect solid waste from their households, the degree of dissatisfaction on the effectiveness of services rendered was markedly very high (97.3%). Approximately 49.1% of respondents mentioned that municipal solid waste is collected once a week, while 31.3% indicated that it is never collected. Despite these discrepancies, 93.1% of respondents were not willing to pay for improved municipal solid waste collection services; a financial contribution that can potentially increase effectiveness levels in municipal solid waste collection rates.

3.4. Willingness to Participate in Waste Recycling and its Separation at Source

Approximately 98% of respondents were not involved in any waste recycling initiatives in their neighbourhoods, and only 51.4% (n = 171) of them were willing to participate in such initiatives (Figure 5). Furthermore, those who were already involved in some sort of waste recycling complained that there were no incentives (100%) such as, discounts on waste collection charges. They claimed that such financial incentives would encourage them to participate in waste recycling initiatives. However, even if they would like to participate in waste minimization, there were no communal recycling facilities (70.0%) in their neighbourhoods. Hence, recyclable solid waste fractions such as food waste (40.5%) and garden waste (95.8%) are still being sent to landfill sites for final disposal despite their biodegradability and suitability for composting.

Table 3. Willingness to participate and knowledge on waste separation at source for community members.

Statement	Response		Rank
	Yes	No	
Are you willing to participate in waste separation at source in your area?	38.6% (128)	61.4% (204)	1
Do the residents separate waste at source in your area?	14.2% (47)	85.8% (285)	2
Do you have any knowledge about waste separation at source?	3.3% (11)	96.7% (321)	3
Do you separate waste at source?	2.4% (8)	97.6% (324)	4

When respondents were asked about practising waste separation at source in their homes, the majority (61.4%) of them were not willing to engage in this activity mainly due to widespread ignorance (96.7%) and the fact that municipalities do not have regular and sustained projects (76.6%)

that promote waste separation at source, nor provide separate bins or containers for enabling waste segregation (99.0%) at source (Table 3). Inevitably, the only important sources of recyclable waste in these neighbourhoods are landfill sites (34%), illegal dumpsites along street corners or open spaces (38%) as well as streets in the CBDs of neighbouring small towns (22.5%).Since local residents lack adequate knowledge on the critical importance of waste separation at source and recycling in general, the volume of municipal waste streams destined for landfill sites cannot be significantly reduced, thus leading to rapid saturation of remaining landfill airspace. On a comparative basis, the opinions and perceptions of community residents in the Umkhanyakude and Zululand Districts differ markedly with findings obtained in some of the rural areas of China, where most of community residents understood the value of segregating waste at source and were willing to play a meaningful role in waste separation programmes [**39**]. Therefore, to help circumvent this environmental problem in the Umkhanyakude and Zululand Districts, more focussed and sustained public awareness programmes, coupled with an enabling infrastructure, are needed to change residents' perceptions toward improved waste separation at source and household recycling rates. Additionally, such interventions must clearly explain how waste prevention in the first instance, and waste segregation at source, will benefit and enhance the standard of living or life quality of households [**40,41**].

3.6. Respondents' Opinions and Perceptions on Benefits to Increased Recycling and Waste Minimization Operations

Despite low recycling rates prevailing in the study areas, some of the respondents could associate certain benefits with increased solid waste material recovery and recycling. These benefits included the creation of jobs and the potential for income generation from selling recyclable materials to buy-back centers. To a large extent (42.8%), the creation of jobs was regarded as one of the most important benefits realized from waste recycling, and was followed by the potential to earn extra money through the selling (34.7%) of recyclable waste items. Those who could link increased recycling rates with clean streets (27.8%) and improved sanitation in the neighborhoods (26.9%) were nearly equal in terms of proportions involved.

The independent t-test was conducted per respondents' gender to determine whether mean scores were the same or different for men and women regarding the stated benefits associated with increased recycling and support for waste minimization operations. Table 4 shows that there were no statistically significant differences on the stated recycling benefits amongst respondents based on gender. Therefore, the assumption of equal variance was met for this construct and the mean scores were not significantly different from each other, since all tests had p-values of more than .05. Thus, respondents' opinions and perceptions on benefits associated with recycling and support for waste minimization initiatives were not influenced by gender.

Table 4. Comparing mean scores for opinions on the benefits of recycling and support for waste minimization, per respondent's gender.

	Levene's Test for Equality of Variances			t-test for Equality of Means			
	Equal Variances …	F	Sig.	T	Df	Sig.	Mean difference
Recycling benefits & support for waste minimization	… assumed	.93	.34	-1.19	330	.24	-.080
	… not assumed			-1.17	264.43	.24	

Table 5 depicts the statistical test of homogeneity (ANOVA) regarding opinions and perceptions for the benefits associated with recycling, and support for waste minimization, according to levels of education. The level of education was categorised into five groups: no education at all, under Grade 12 (matriculation), matriculation national certificate, college diploma and degree qualification. The Levene's test for homogeneity of variance for perceived benefits from recycling and support for waste minimization operations was .166 (Table 5). Thus, there was homogeneity in mean scores in terms of

level of education amongst respondents. This means that opinions and perceptions on perceived recycling benefits were not influenced or moderated by educational levels.

Table 5. Comparing mean scores on opinions on the benefits of recycling according to respondent's educational level.

		Sum of Squares	Df	Mean Square	F	Sig.
Benefits from Recycling and Waste Minimization	Between Groups	1.902	4	.475	1.329	.259
	Within Groups	116.959	327	.358		
	Total	118.861	331			

The results on the ANOVA test conducted to determine statistical differences in means (perceived recycling benefits) by monthly net income are provided in Table 6. The monthly net income was divided into six groups, which were as follows: not more than R500, R501 to R1000, R1001 to R1500, R1501 to R5000, R5001 to R10,000 and not more than R10,000. The Levene's test for homogeneity of variance for benefits from recycling and waste minimization operations was .395 (Table 6). This means that the assumption of homogeneity of variance was met, and in terms of the construct "benefits from recycling and waste minimization operations", there was no statistically significant differences in mean scores because all tests were more than .05. Thus, there was homogeneity within income groups. A similar outcome was also observed on statistical differences based on the employment status amongst respondents.

Table 6. Comparing mean scores on opinions on recycling benefits, according to income groups.

		Sum of Squares	Df	Mean Square	F	Sig.
Benefits from Recycling and Waste Minimization	Between Groups	2.286	5	.457	1.492	.193
	Within Groups	75.958	248	.306		
	Total	78.244	253			

3.7. Respondents' Opinions and Perceptions on Barriers to Increased Recycling and Waste Minimization Operations

To a large extent, the lack of support from the provincial government (53.6%), as well as local municipalities (56.9%) was regarded by respondents as an important constraint towards effective solid waste recycling. Similarly, the lack of working space and facilities for communal recycling operations (53.6%) also contributed to poor recycling rates in these districts. Apart from these three recycling barriers, respondents also mentioned other problems such as the long periods (46.2%) it takes to collect and accumulate recyclable waste items with a sufficient critical mass for selling purposes. Conversely, if such recyclables are assembled on-site and, due to poor market accessibility (38%) they are not sold quickly, informal waste pickers simply burn them (30.1%) to make space for other recyclable items that are selling faster due to existing demand. The barriers in selling recyclable items seem to be aggravated by lack of transport (37%), thus forcing informal waste pickers to travel long distances to reach other markets.

Incidents of burning recovered waste, simply because there is no adequate space to store it temporarily when sales are low, clearly demonstrates just how counter-productive, ineffective and inefficient are recycling practices in these districts. Resulting smoke emissions from such fires also pose a danger to ambient air quality for everyone in the vicinity of the operational sites. To circumvent some of these challenges, local governments in these districts have a crucial role to play in creating an enabling framework for environmentally sustainable waste recycling practices [42].

Furthermore, nearly half (48%) of respondents mentioned the lack of financial support as a barrier that limits their participation in recycling operations. The fact that local recycling activities by residents are not yet organized nor formalized (44.3%) into efficient supply and market networks was also mentioned as one of the negative factors militating against effective recycling. Even so, over half of the respondents (52.6%) mentioned poor community relationships between informal waste pickers and community residents. Informal waste pickers are being blamed for street littering and disorganizing mixed wastes that are stored temporarily in household bins before being dispatched to landfill sites. This is because informal waste pickers often open these bins when they are searching for salvageable wastes such as plastics, papers, metals and glass bottles. Any waste that is left outside of these bins is inevitably blamed on the activities of informal waste pickers, thus creating somewhat adversarial relations and negative perceptions in the affected neighborhoods. This clearly points out the need for the supply of separate waste bins at various waste sources and the integration of informal waste pickers in the recovery of recyclable wastes.

Tables 7 to 9 provide a comparison of mean scores depicting barriers to recycling and waste minimization, according to respondents' gender, income levels, and educational levels. All the ANOVA results revealed that there were no statistically significant differences in mean scores on all tested constructs. This means that there was homogeneity in how the various respondents expressed their opinions and perceptions in terms of barriers to recycling and waste minimization in the district municipalities surveyed for the present research. The same result also applied to barriers against waste minimization and recycling according to the employment status of respondents.

Table 7. Comparing mean scores on recycling barriers according to gender of respondents.

Construct	Levene's Test for Equality of Variances			t-test for Equality of Means			
	Equal Variances …	F	Sig.	T	Df	Sig.	Mean Difference
Barriers to Recycling and Waste Minimization	… assumed	3.36	.07	-.55	330	.58	-.035
	… not assumed			-.54	247.57	.59	

Table 8. Comparing mean scores for opinions on recycling barriers based on respondents' income groups.

Construct		Sum of Squares	Df	Mean Square	F	Sig.
Barriers to Recycling and Waste Minimization	Between Groups	.301	2	.151	.456	.634
	Within Groups	107.994	327	.330		
	Total	108.295	329			

Table 9. Comparing mean scores on recycling barriers according to respondent's level of education.

		Sum of Squares	Df	Mean Square	F	Sig.
Barriers to Recycling and Waste Minimization	Between Groups	.676	4	.169	.514	.726
	Within Groups	107.657	327	.329		
	Total	108.333	331			

4. Conclusions and Recommendations

As indicated earlier, many studies conducted on the problems and challenges associated with municipal waste management and barriers to waste minimization and recycling in South Africa have been conducted in urban environments, with very little research attention focused on the situation in rural areas. New waste management laws and regulations in South Africa require local municipalities to deliver sustainable services to all areas effectively and efficiently. Some of the provisions in the National Environmental Management: Waste Act (Act No. 59 of 2008) state that municipalities are responsible for establishing local benchmarks against which the effectiveness of services provided can be judged, along with solid waste separation at source, so that strategies to recover waste paper, plastic, metals and biodegradable components are successful. More is expected from local governments in South Africa regarding the creation of an operational framework that can support and enable communities so that they can participate meaningfully in the disposal and recycling of their household solid waste.

This study has provided important base line indicators on the effectiveness of waste management services and recycling potential in the Umkhanyakude and Zululand District Municipalities of the KwaZulu-Natal province of South Africa. Based on the findings of this study, there are serious gaps between what is currently happening and what is supposed to occur in an effort towards integrated municipal waste management in the study areas surveyed for the research. This conclusion is based on the negative opinions and perceptions expressed by some of the respondents interviewed for the study. It has become very clear in the selected study areas that the nature of waste management services provided by municipalities has not fundamentally or radically changed towards increased waste minimization and recycling practices, instead, more institutional resources are still being channeled toward the collection and transportation of solid wastes from mixed streams for their final disposal in landfill sites. It was also indicated that the removal of waste from informal dump sites is not being adequately provided by local municipalities and this also applies to recyclable wastes from domestic premises. More worrisome, from the sustainability viewpoint of the local waste management system, is that waste segregation at source is still being strongly resisted at community level, mainly because relevant knowledge is lacking amongst residents while local municipalities are failing to invest in the provision of an adequate infrastructure and logistical support for this activity. This situation is very typical of waste recycling practices outside of the private sector in South Africa whereby informal waste pickers have very limited sources from which they can collect recyclable waste except from landfill sites. Such recovery of salvageable waste usually occurs under very unhealthy working conditions [**42**]**.**

Satisfaction levels on the effectiveness of waste management services were low amongst the respondents, even though they are willing to participate in future municipal waste minimization initiatives. Payment for waste management service questions showed that most respondents were unwilling to pay for such services, thus indicating poor financial prospects for effective delivery of waste management services in these rural municipalities.

Respondents specified a few benefits that may be realised as a result of increased waste minimization, including recycling. These benefits entailed the creation of employment opportunities, earning of income to buy food and other essentials, as well as improved sanitation in the streets and

communities. of the specification of these benefits showed no statistically significant differences amongst respondents according to gender, educational levels, and different income groups.

Several barriers that constrain effective waste minimization and recycling rates have been pointed out by respondents in both district municipalities. These included the lack of support from all spheres of government, lack of recycling facilities, and appropriate operational spaces. Similarly, with recycling benefits, there were no statistically significant differences in the barriers that were mentioned by respondents.

More sustained environmental awareness interventions are recommended to help improve knowledge levels on waste management and, particularly, the importance of waste segregation at source to enhance the collection rates of recyclable materials. As shown in other countries, interventions such as environmental education are relatively successful in the short term than more technical investments, which involve hefty finances and expensive infrastructural developments [**24**] Furthermore, more integrated waste management, with an emphasis on waste prevention and waste minimization, is strongly recommended in the study districts, rather than existing practices which still direct more resources towards the landfilling of mixed wastes with little room for innovative strategies. There is also a need for more empirical research on waste generation, collection rates, and recycling rates in other rural district municipalities where supporting infrastructure is usually absent, the goal being to determine similarities and dissimilarities between these districts and how operational barriers can be circumvented.

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References

1. Fehr, M.; de Castro, M.S.M.V.; Calc¸ado, M.D.R. A practical solution to the problem of household waste management in Brazil. Resour. Conserv. Recycl. **2000**, 30, 245-257.
2. Henry, R. K.; Yongsheng, Z.; Jun, D. 'Municipal solid waste management challenges in developing countries – Kenyan case study' Waste Manage. **2006**, 26, 92-100.
3. Zhang, D. Q.; Tan, S. K.; Gersberg, R. M. Municipal solid waste management in China: status, problems and challenges. J. Environ Manage. **2010**, 91(8):1623-33.
4. Nandy, B.; Sharma, G.; Garg, S.; Kumari, S.; George, T.; Sunanda, Y.; Sinha, B. Recovery of consumer waste in India – A mass flow analysis for paper, plastic and glass and the contribution of households and the informal sector. Resour, Conser and Recycling. **2015,** 101,167–181
5. Scheinberg, A.; Spies, S.; Simpson, M. H.; Mol, A.P.J. Assessing urban recycling in low- and middle- income countries: Building on modernised mixtures. Assessing urban recycling in low- and middle-income countries: Building on modernised mixtures. Habitat. Int. **2011**, 35, 188-198.
6. Habar, K.; Yabar, H.   Historical evolution and development of waste management and recycling systems: Analysis of Japan's experiences. J. Environ. Stud. Sci .**2012**, 2, 296–307; DOI 10.1007/s13412-012-0094-8.
7. Greene, K.L.; Tonjes D.J. Quantitative assessments of municipal waste management systems: Using different indicators to compare and rank programs in New York State. Waste Manag. **2014**, 34, 825–836.
8. Moh, L.; Manaf, A.B.D. Solid waste management transformation and future challenges of source separation and recycling practice in Malaysia. Resour. Conserv. Recycl. **2017**, 116, 1-14.

9.   Zarate, M.A.; Slotnick, J.; Ramos, M. Capacity building in rural Guatemala by implementing a solid waste management program.   Waste Manag. **2008,** 28 (12), 2542-2551.

10. Obeng, P.A. Assessment of institutional structures for solid waste management in Kumasi. Water and Sanitation Group, Department of Chemistry, University of Cape Coast, Ghana. Management of Environmental Quality. Int. J. **2009**, 20 (2).

11. He, P. "Municipal solid waste in rural areas of developing country: Do we need special treatment mode? Waste Manag. **2012**, 1289-1290

12. Fiehn, H.; Ball, J.; Novella, P. Integrated waste management. Background Research paper produced for the South Africa Environment Outlook Report, Pretoria: Department of Environmental Affairs and Tourism. **2005**.

13. Matete, N.; Trois, C. Towards zero waste in emerging countries–a South African experience. Waste Manag. **2008**, 8, 1480-92.

14. South Africa. Local Government: Municipal Systems Act (Act No. 32 of 2000). South African Government Gazette. Republic of South Africa. **2000.**

15   South Africa (SA). National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008). South African Government Gazette. Republic of South Africa. **2008.**

16. 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. **2013**, 31(3), 295–305.

17. 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.**

18. Langenhoven B, Dyssel M. The recycling industry and subsistence waste collectors: A case study of Mitchell's plain. Urban Forum. **2007**, 18 (1), 114-132

19. Bosman. Integrated waste management. Fuggle and Rabie's Environmental Management in South Africa, 2nd ed.; Strydom, H.A., King, N.D., Eds.; Juta: Cape Town, South Africa, **2012**.

20. Schenck, R.; Blaauw PF. The work and lives of street waste pickers in Pretoria- a case study of recycling in South Africa's urban informal economy. In Urban Forum. **2011**, 22(4):411.

21. Gumbi, S.E. Current waste management and minimisation patterns and practices: An exploratory study in the Ekurhuleni metropolitan municipality in South Africa, Master Dissertation, University of South Africa, Pretoria, August 2015.

22. Van der Merwe, H.; Steyl, I. Solid waste management in intensively farmed rural areas: A Western Cape case study, Acta Acad. **2005**, 37(3), 184-211.

23. Department of Environmental Affairs.   National Waste Management Strategy. **2011**, https://www.environment.gov.za/sites/default/files/docs/nationalwaste_management_strategy.pdf

24. Bernardes, C.; Günther, W.M.R. Generation of Domestic Solid Waste in Rural Areas: Case Study of Remote Communities in the Brazilian Amazon, Human. Ecol. **2014**, 42, 617- 623, DOI 10.1007/s10745-014-9679-z.

25. Parrot, L.; Sotamenou, J.; Dia, B.K. Municipal solid waste management in Africa: Strategies and livelihoods in Yaoundé, Cameroon. Waste Manag.**2009**, 29, 986–995.

26. Barr, S.; Gilg, A.W. Conceptualising and analysing household attitudes and actions to a growing environmental problem Development and application of a framework to guide local waste. Applied. Geogr. **2005**, 25, 226–247.

27. Zeng, C.; Niu, D.; Zhao, Y. A comprehensive overview of rural solid waste management in China. Front. Environ. Sci. Eng. **2015**, 9(6): 949–961 DOI 10.1007/s11783-015-0816-8

28. Provincial Planning and Development Commission (PPDC). A report for the assessment of waste disposal sites in the province of Kwazulu-Natal 2004. A study commissioned by the Provincial Planning and Development Commission (PPDC). Prepared by: Sivest- environment and town planning division. Date: 25th February **2004**.

29. Zululand District Municipality. Integrated Development Plan (IDP Review 2011/2012),   Ulundi, KwaZulu-Natal, South Africa, **2011**.

30. Umkhanyakude District Municipality (UDM). Integrated Development Plan (IDP Review 2011/2012), Mkhuze, KwaZulu-Natal, South Africa, **2011**.

31. Umkhanyakude District Municipality (UDM). Integrated Development Plan (IDP Review 2014/2015), Mkhuze, KwaZulu-Natal, South Africa, **2014**.

32.   Zululand District Municipality. Integrated Development Plan (IDP Review 2014/2015), Ulundi, KwaZulu-Natal, South Africa, **2014**.

33.   Leedy, P.D.; Ormrod, J.E. Practical research planning and design (10th Ed.). Upper Saddle River, New Jersey: Pearson Education, **2005**

34.   Mouton, J. How to succeed in your Master's and Doctoral Studies. Pretoria: JL van Schaik. Sixth and Seventh Impressions, **2004.**

35.   Revelle, W.; Zinbarg, R. Coefficients Alpha, Beta, Omega, and the glb: Comments on Sijtsma. Psychometrika.**2009**, 74(1), 145-154.

36.   Hair, J.F.; Black, W.C.; Babin, B.J.; Anderson, R.E. Multivariate Data Analysis, 7th edition, Pearson Educated Limited, Essex, England.**2014**. ISBN: 9781292021904 129202190X. http://www.worldcat.org/title/multivariate-data-analysis/oclc/900353065/editions?referer=di&editionsView=true.

37.   Keller, G. Statistics for Management and Economics 10th Edition. Australia: Gengage Learning or Stamford, **2014**, USA or www.gengage combihigherd.

38.   StatsSA Census 2011. Population in the Local Municipalities, KwaZulu-Natal Province of South Africa. **2011**; http://www.statssa.gov.za/.

39.   Zeng, C.; Niu, D.; Li, H.; Zhou, T.; Zhao, Y. 2016. Public perceptions and economic values of source-separated collection of rural solid waste: A pilot study in China. Resour. Conserv. Recycl. **2016**, 107, 166–173

40.   Matter, A.; Dietschi, M.; Zurbrügg, C. Improving the informal recycling sector through segregation of waste in the Household- The case of Dhaka Bangladesh. Habitat International. **2013**,38,150-156.

41.   Mukherji, S. B.; Sekiyama, M.; Mino, T.; Chaturvedi, B. Resident Knowledge and Willingness to Engage in Waste Management in Delhi, India. Sustain. **2016**, 8, 1065; doi:10.3390/su8101065

42.   Liebenberg, C.J. Waste Recycling in Developing Countries in Africa: Barriers to Improving   Reclamation Rates. In Eleventh International Waste Management and Landfill Symposium, CISA, Environmental Sanitary Symposium Centre, Italy. 1-9. **2007**