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An Analysis of Domestic Solid Waste Management Practices within the Ethekwini Metropolitan Area

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Abstract - Waste management is an extremely challenging issue, mostly affecting developing countries, which are increasingly increasing. This study focuses on solid waste management practices in KwaZulu-Natal, within the North, South, Central and West eThekwini Metropolitan Spatial Regions. The research study was centralized around the degree of participation practiced with regards to domestic solid waste management in urban suburbs (Umhlanga, Queensburgh and Westville), peri-urban suburbs (Chatsworth, Amanzimtoti and Pinetown) and rural suburbs (Umbumbulu, Umkomaas and Cato Ridge). The motive of this research was based on the fact that many households within the EMA fail to participate in solid waste management practices which involve reducing, reusing, recycling and effectively sorting and disposing waste. This is so as while urban areas have sufficient waste disposal facilities, many rural areas are characterized by waste disposal through open dumping on streets with subsequent air, water and soil pollution. Hence, this contributes to the development of an unhealthy living environment. The residents of the EMA were given questionnaires relating to the issue of solid waste management practices. The study found that existing waste management practices including options for producing, storing, collecting, disposing of and reducing waste were not efficient and effective. Moreover, the inefficient and ineffective methods of poor waste management had adverse effects on the environment, with one of the main impacts being illegal open dumping at the EMA. Suggestions have been provided to the residents and local health authorities in order to promote more effective solid waste management activities.

Keywords: Waste management; practices; reuse; reduce; recycle; dispose; South Africa; eThekwini Metropolitan Area

1. Introduction

Solid waste management is classified as a major challenge which exists globally in every society but experienced predominantly by many developing countries [1]. According to the study, the act of effective waste management within an area is influenced primarily by the practice of efficient waste handling which is the responsibility of every resident. However, it was also revealed that the seriousness of waste management issues in developing countries is due to poor management framework which relates to the economic status and technological development of the country [1].

South Africa is identified as a developing country striving towards attaining sustainable development while trying to overcome social and economic issues and also conserving natural resources [2]. However, in terms of South Africa's waste industry, it is vital that effective waste management practices are undertaken with regards to the efficient usage of raw materials when designing products in order to prevent, minimize and avoid the generation of waste. Additionally, as economic development rises, urbanization in South Africa also increases which has resulted in increased domestic waste generation [2]. The eThekwini Metropolitan Area (EMA) located within the KwaZulu-Natal province is identified as one of the areas with an increasing population [3]. According to Aroral and Agarwal [3], waste disposal was not classified as a problem many years ago due to small population numbers and the availability of land for the storage of waste. The problem of waste management became significant when population numbers began to rise drastically which then resulted in the formation of larger societies [4].

Therefore, this study examines the level of domestic participation within various households located within the EMA in KwaZulu-Natal and identifies challenges regarding failures to practice waste management. The study was carried out within

4 spatial areas in the EMA, namely the North, South, Central and Outer West spatial regions which incorporated both urban and rural areas. Additionally, the study explored the effective and ineffective measures implemented by developed and developing countries of which can be used as recommendations to improve solid waste management in the EMA, KwaZulu-Natal, South Africa. The problem identified in this study is linked to the generation of environmental pollution as a result of inappropriate solid waste management practices which is becoming evident in the eThekwini Metropolitan Area. This is particularly evident in rural communities due to improper domestic waste disposal as well as a lack of participation with regards to recycling and sorting solid waste [5, 6,7].

Many studies have indicated the persistent problems related to the ineffective waste management services identified in rural areas/townships within the EMA. According to Doru and Smaranda [7], there was a significant impact of solid waste in rural communities/townships of Phoenix in KZN which is related to many different factors such as ineffective waste management services, poor infrastructure, a low level of environmental education/awareness and a high level of unemployment leading to residents not being able to pay for waste services thereby contributing to the formation of informal dump sites within communities [8,9]. Moreover, according to Godfrey and Oelofse [10], waste management problems in rural areas included illegal dumping and the generation of informal dump sites developed by the local communities. These issues have negatively impacted the eThekwini Municipality costing them over R180 000 000 annually in order to remove and rehabilitate the affected areas/dump sites [11].

Thus, in order to address such issues, this study will also investigate the factors which influence the degree of domestic participation such as the location, wealth/employment status and educational background within selected households in the EMA [12]. The study is worth investigating due to the fact that many households fail to participate in solid waste management practices which involve reducing, reusing, recycling and effectively sorting and disposing waste which results in dumping on streets with subsequent air, water and soil pollution and hence contributing to the development of an unhealthy living environment [12]. Additionally, the high volumes of domestic waste are still a continuous environmental issue globally in both developed and developing countries [13]. Therefore, this study will explore domestic waste management practices, the daily waste management routines of household members and the effective measures initiated by developed nations of which can be implemented by the EMA. This study aims to analyze the problem of solid waste generation within the eThekwini Metropolitan Area (EMA).

2. Methodology

A population is a large group of individuals/entities by which a sample is taken and evaluated for the purpose of deducting conclusions and further analysis [14]. The population in this study considered all household residents within the eThekwini Metropolitan Area. In order to select the respondents for the research, firstly, the study area was divided into four clusters namely: Central, North, South and West Municipal Planning Zone (CMPR, NMPR, SMPR and WMPR) [15]. Secondly, urban and rural areas were chosen from the 4 regional planning regions for the survey as shown in figure 3.2. This was to draw distinctions between low, middle and high income residential areas within the EMA. As the method used to select a portion of the population for analysis, sampling was used. The sample size was 59 households. One person from each household was interviewed for the purpose of this analysis. The criterion for the study was to select male and female residents aged 18 years and above. The questionnaire was answered by email, primarily by female respondents who were at that time available at their place of residence.

Data was gathered with the help of a questionnaire explicitly designed for the purpose of this study. For the purpose of securing their answers, a questionnaire was prepared as a simple form that allowed respondents to place an "X" in the selection box [12]. The questionnaire was designed in English and was created only after further study of the literature based on waste management. The questionnaire was divided into four sections: sections A-D. Section A included residents 'demographic information, section B included the types of waste generated by residents, section C included residents' waste management practices and, finally, section D questioned residents about their knowledge of poor waste management. Methods of data collection include the collection of existing or new data focused on answering research questions and discussing the research study's goals, objectives and hypotheses [4,16]. Data were collected via email for the purpose of this study by sending a questionnaire to residents of the EMA. Additionally, to mitigate any misunderstanding, any questions received by the residents in response to the questionnaire were clarified via email. When done, the questionnaires were then sent back to the researcher.

The questionnaire was distributed to 59 participants who reside within the eThekwini Metropolitan Area (EMA). Table 4.1 illustrates the demographic information of the study respondents, which included the age, gender, household size and

employment status. The study was dominated by female participants who numbered 46, thereby constituting 78% of the study subjects, while males numbered 13 thereby constituting 22%. The majority of the respondents were aged 18 to 30 years with a number of 29 respondents and a percentage of 49.2, followed by 31 to 40 years with a number of 14 respondents and a percentage of 23.7% and the old age of 60 and above with a number of 3 respondents and a percentage of 5.1% which represented the smallest population. The study was dominated by households which consisted of four family members numbering at 28, followed by three family members numbering 17. Households with 1 member were represented by the smallest population numbering 2.

3. Results

Table 4.1: Demographic information of respondents

Characteristic	Number	Percentage
Gender		
Male	13	22
Female	46	78
Age		
18 – 30 years	29	49.2
31 – 40 years	14	23.7
41 – 50 years	8	13.5
50 – 60 years	5	8.5
Above 60 years	3	5.1
Household size		
1 family member	2	3.4
2 family members	4	6.8
3 family members	17	28.8
4 family members	28	47.5
5 family members	5	8.5
Above 5 family members	3	5

Figure 4.1 below indicates the employment status of households of respondents. It was revealed that the majority of household members are currently employed (64%) whereas 36% of respondents are unemployed. Additionally, figure 4.2 indicates the employment status of different age groups.

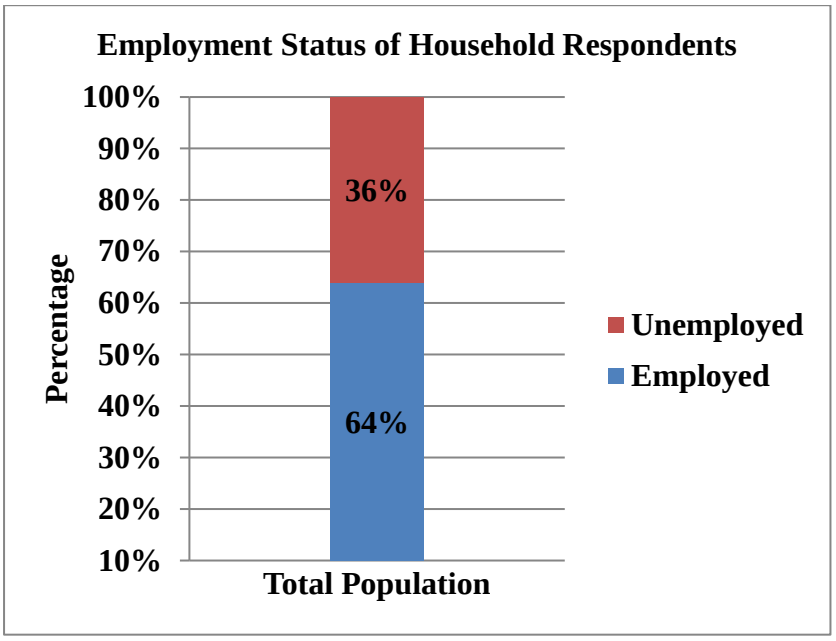

Figure 4.1: Employment status of respondents

Figure 4.2 indicates that the age group between 18 to 30 year olds was identified to have the highest unemployment rate with a percentage of 59% among young adults. The age groups between 31 to 40 and 50 to 60 year olds showed to have a low unemployment percentage of 7% and 20% respectively. Additionally, respondents above the age of 60 also showed to have a low employment percentage of 33%. Overall, the age group between 31 – 40 year olds showed to have a 100% employment rate.

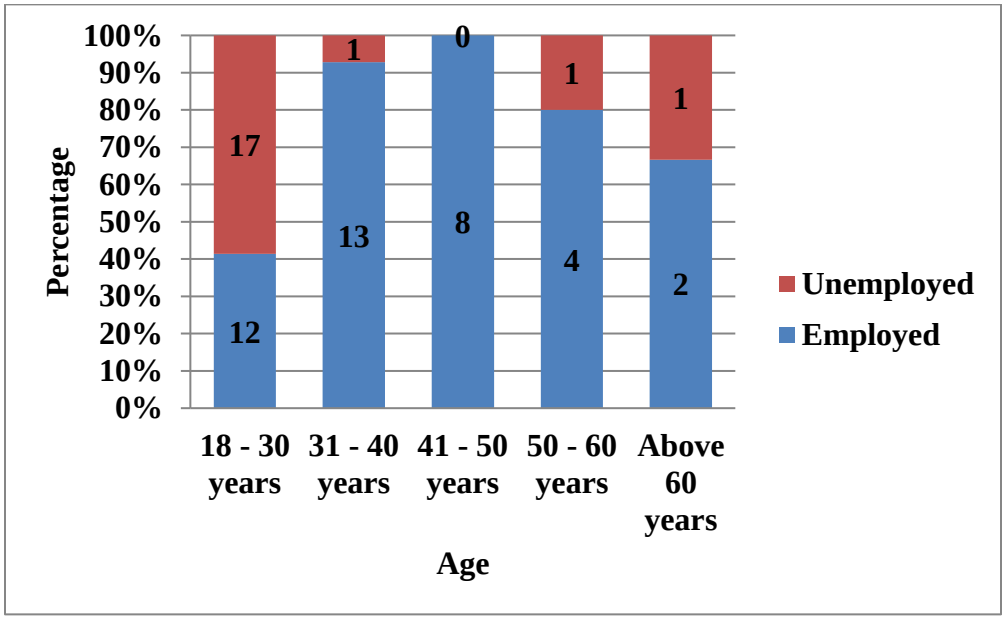

Figure 4.2: Employment status of respondents according to age group

Level of Education

Figure 4.3 below indicates the literacy levels of households of respondents. It was revealed that the 52 respondents (88.1%) have tertiary education, 4 respondents (6.8%) have secondary education and 3 respondents (5.1%) have primary education. Overall, all respondents have some form of educational background.

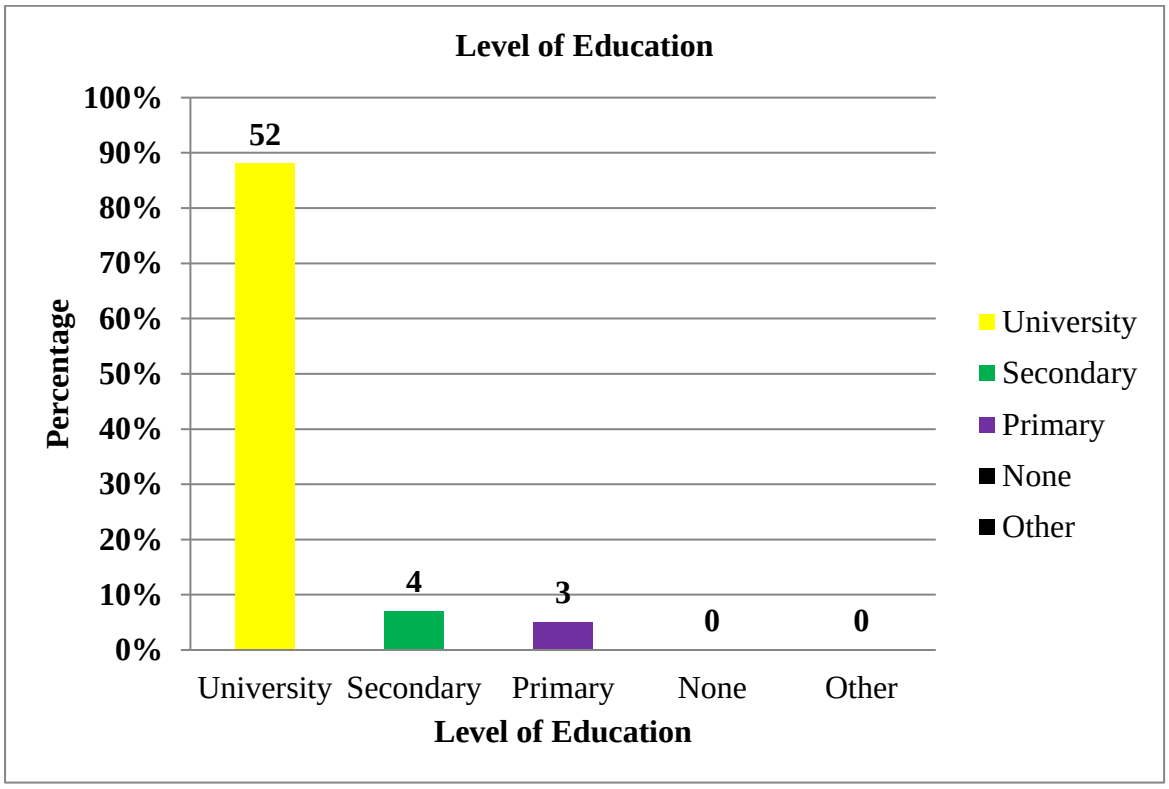

Figure 4.3: Level of education of respondents in the eThekwini Metropolitan residential area.

Table 4.2: Level of education representing dumpers versus non-dumpers within the EMA.

Question		Total	Dumpers	Non-dumpers
Number of respondents		59	6	53
Level of Education	University	53	0	53
	Secondary	3	3	0
	Primary	3	3	0
	None	0	0	0
	Other	0	0	0

It was found that 6 dumpers (10.2%) had secondary education or less and 89.8% of non-dumpers had secondary education or higher. These findings indicate that non-dumpers, therefore, were more likely than dumpers to have gone on to

higher education. The majority of respondents were classified as non-dumpers who have obtained a university degree and were more likely to move on to any form of higher education.

Types of Household Wastes in the eThekwini Metropolitan Area

This section presents the common waste types generated in eThekwini Metropolitan Area (EMA). All 59 participants felt that waste management is relevant to their community and environment. As shown in Table 4.2 below, decomposable wastes (57.6%), plastic (49.2%), and metal tins (40.7%) are the major common types of waste which are generated in the eThekwini Metropolitan residential area. However, other types, such as e-waste, wood, textiles and glass are found in smaller quantities.

Table 4.3: Types of wastes found in the eThekwini Metropolitan residential area.

Types of waste	Always		Frequently		Sometimes		Seldom		Never	
Organic food waste	34	57.6%	12	20.3%	8	13.6%	5	8.5%	0	0
Plastic	29	49.2%	18	30.5%	6	10.2%	6	10.2%	0	0
Paper/cardboard	21	35.6%	19	32.2%	10	16.9%	5	8.5%	4	6.8%
Glass	16	27.1%	15	25.4%	24	40.7%	4	6.8%	0	0
Wood	6	10.2%	11	18.6%	14	23.7%	21	35.6%	7	11.9%
Metal tins	24	40.7%	19	32.2%	9	15.3%	7	11.9%	0	0
Textiles (Fabric)	7	11.9%	9	15.3%	16	27.1%	21	35.6%	6	10.2%
E-waste (Electronic waste including batteries)	4	6.8%	6	10.2%	18	30.5%	28	47.5%	3	5.1%
Hazardous waste (Medical waste, chemicals, pesticides etc.)	19	32.2%	16	27.1%	20	33.9%	4	6.8%	0	0

Household Waste Management Practices

Table 4.4: Disposal methods of household waste

Types of waste	Open Dumping		Water Bodies		Collected by Municipality		Used as compost to fertilize plants (Refuse pits)	
a) Organic food waste	4	6.8%	-	-	14	23.7%	41	69.5%
b) Plastic	2	3.4%	-	-	57	96.6%	-	-
c) Paper/cardboard	5	8.5%	-	-	54	91.5%	-	-
d) Glass	4	6.8%	-	-	55	93.2%	-	-

e) Wood	6	10.2%	-	-	53	89.8%	-	-
f) Metal tins	3	5.1%	-	-	55	93.2%	-	-
g) Textiles (Fabric)	2	3.4%	-	-	57	96.6%	-	-
h) E-waste (Electronic waste including batteries)	4	6.8%	-	-	55	93.2%	-	-
g) Hazardous waste (Medical waste, chemicals, pesticides etc.)	4	6.8%	-	-	55	93.2%	-	-

Table 4.4 illustrates that household waste management practices in the eThekwini Metropolitan residential area, where it was found that refuse pits and the collection of waste by the municipality are the most favored practice of waste disposal. All the types of wastes generated in eThekwini Metropolitan residential area, such as organic food waste is disposed of in refuse pits whereas plastic, paper/cardboard, glass, wood, metal tins, textiles, e-waste and hazardous waste is collected by the municipality. Dumping of waste was reported by a few residents. Refuse such as plastic, glass and metal tins were observed in open dumping sites. Wastes that cannot be burned easily, such as glass, metal tins and e-waste are greatly disposed of through open dumping. Additionally, among other types of waste disposal, collection of waste by the municipality is the major practice among the eThekwini Metropolitan households, wherein 69.5% of organic food waste is stored in refuse pits. Additionally, 10% and below of the respondents have confirmed that they practice open dumping of waste.

The study revealed that if residents own a bin in their household. It was found that 6 respondents (10.2%) answered no, whereas the remaining respondents answered yes (89.8%).

Quantity of Household Waste Generated

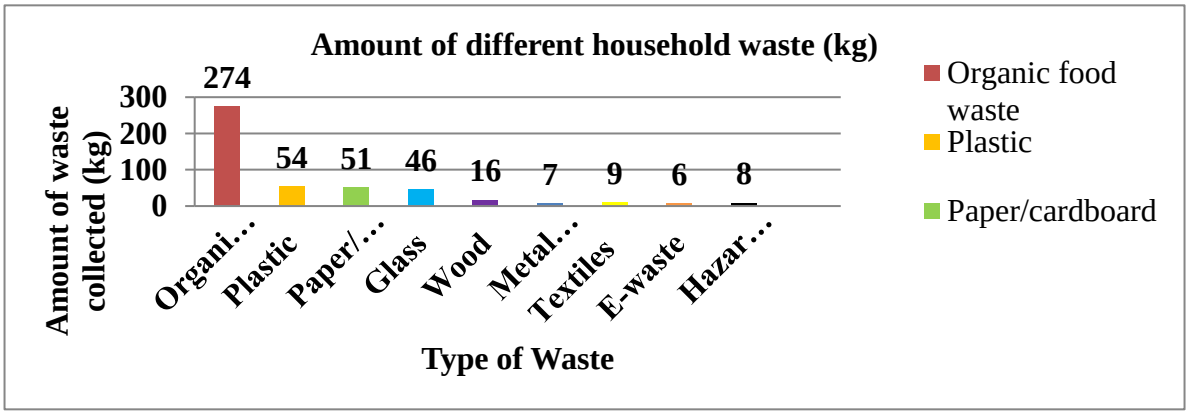

Figure 4.4: Amount of waste generated by households within the eThekwini Metropolitan area

Figure 4.5 shows that among the different types of waste generated, organic food waste was seen as the major type of waste generated within households in the eThekwini Metropolitan households with a total of 274kg. Additionally, plastic waste was the second dominant waste type generated with a weight of 54kg whereas paper/cardboard was identified as the third dominant waste type with a weight of 51kg. The lowest amount of waste generated was metal tins with a total of 7kg. The total waste generated by all 59 households was 483kg.

Knowledge of Impacts of Poor Waste Management

In terms of analyzing the level of knowledge and awareness of waste management by respondents in the EMA, responses

from the questionnaires were cross-tabulated and presented in tables 4.4 a - d. According to table 4.4a, 89.8% of respondents strongly agree that the practice of sorting, recycling and proper disposal of solid waste is the responsibility of all household members whereas a small percentage of individuals (10.2%) are undecided about this question. This indicates that most respondents feel that everyone should have some knowledge and awareness on the importance of waste management.

According to table 4.4b, the majority of respondents (93.2%) strongly agree with the statement that effective waste disposal ensures a healthier environment and wellbeing whereas 5.1% of respondents are strongly disagreed. Table 4.4c indicates that 95% of respondents strongly agreed that the generation of hazardous waste is harmful to human health and the environment whereas a small population of 5% were undecided. Additionally, table 4.4d related to the matter of dumping of waste into water sources whereby 95% of respondents strongly agreed that it is a harmful practice whereas 5% were undecided. Overall, zero respondents strongly disagreed with questions a, c and d which shows that they are aware of good waste management practices.

4. Discussion

It was found that 78 % of the respondents were female, suggesting that women manage the households and are responsible for waste management. Thus, this outcome relates to the finding of Raipal [17], who found that in most households, the responsibility for waste management is left to females. This suggests that males are generally absent from the household during the day as they attend work and school, while females remain responsible for household hygiene-related domestic duties. This is fairly true in comparison to the study which found that a small percentage of males (22%) are involved. Moreover in relation to South African context, this finding also agrees with the study conducted by Rodic-Wiesnal [18]. According to the study, due to the patriarchal culture in South Africa, women are normally the ones faced with constant contact regarding waste handling and disposal which is true, as women are usually those who take a great deal of responsibility for household waste management.

In terms of age characteristics, the findings of the study showed that the dominant age group was those respondents who were between the ages of 18 to 30. The availability of the 18 to 30 year olds to be able to answer this questionnaire is also linked to the result that they had the highest unemployment rate of 58% in the eThekwini Metropolitan area among young adults. In addition, the household size which dominated the study was the household which consisted of 4 members which was illustrated as 47.5% of the respondents. Furthermore, the few elderly people who took part in the study were found to be dependents of their family and made a living through pension and grants. In relation to employment as a whole, 64% of respondents have a stable income in comparison to 36% of unemployed residents [19-21]. Moreover, an important finding was that those who belong to the unemployed group resided in rural areas of the EMA and thus were faced with issues of affordability regarding waste management. It was found that respondents especially in rural areas within the EMA are unable to afford to transport their waste to the nearest legal dumping site. This finding is supported by Statistics South Africa (2018) as globally [22-24], the majority of urban and metropolitan residents benefit from the waste management services due to the provision of local municipalities, whereas a higher percentage of rural residents discard their waste independently due to the lack of available waste services. These results also contradict the National Domestic Waste Collection Standards (2011), which state that municipalities are responsible for collecting waste from all households and where the distance is a barrier then alternative solutions should be on-site disposal.

Additionally, 95% of respondents strongly agreed with the fact that the generation of hazardous waste as well as the dumping of waste into water sources is harmful to human health and the environment whereas the remaining 5% of respondents were undecided. Overall, zero respondents strongly disagreed with these two questions which showed that they are aware of adequate waste management practices in the EMA. Hazardous waste has detrimental effects on the environment which causes major pollution, thus posing a risk to the health of the people, which is why there is concern about uncertainty about the consequences of inadequate waste management. The confusion of the 5% of respondents is confirmed by the study conducted by Kamara [11] which indicated that the uncertainty of people means that their reaction to waste management can most likely lead to the practice of inappropriate disposal methods.

5. Conclusions

Organic waste, accompanied by plastic and metal waste, is noticeable in large amounts in each household. In urban areas, all forms of waste is poorly handled as they are not sorted and separated, resulting in a mixed state of waste in waste bins. Moreover, because plastic waste cannot be burned, open dumping practices have been evident in rural areas of the

EMA. It was found that very few respondents residing in rural areas dispose of their waste in open areas since they do not own waste collection bins and do not have access to waste facilities. The reason for this is because high percentage of residents in urban areas has their own bins of waste. The municipality does not have any visible waste disposal facilities in rural areas. In addition, the least common types of waste are textiles, wood and e-waste, which are not commonly disposed of inside the EMA. In terms of waste management awareness, most residents are aware of the impact that inadequate waste management has on other people and the environment. Most of the respondents decided that for all people in the household, waste management is a duty. Furthermore the degree of uncertainty is very low and respondents are aware of the risk posed to their health and their environment by inadequate waste management. The disposal of waste into water sources is not encouraged, which suggests that people are aware of the ramifications of this activity

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