

Impact of Solid Waste Management Practices on Environmental Protection Case of Kicukiro District

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Abstract— *This Solid waste management practices are essential component of environmental infrastructure in human settlements; its poor management can lead to health problem and environmental destruction in general, this study was conducted in Kicukiro district. The data were collected on the sample of 97 households and some authorities through questionnaires, and interview and were analyzed using SPSS Version 20 (statistical tools) and this helped in generating tables and performing descriptive statistics like percentages, frequency, and mean.*

The results obtained revealed that that in terms of waste segregation is explained excluding solid wastes from liquid wastes considering the mean of 2.73 which was interpreted as high mean. Those results influenced the grand mean to become 2.04 which is interpreted as low mean. This means that waste segregation practices is not efficiently done in households located in Kicukiro. It was revealed that transportation of wastes is characterized by the short time of loading wastes considering the mean of 2.91 which is interpreted as high mean. The findings revealed that the environmental protection in Kicukiro District is characterized by the following: little harmful materials (plastic packages) in the soils considering the mean of 3.18. This showed that there is link between solid waste management practices and environmental protection in Kicukiro District. For proper practices of waste management which is positive but only for waste transportation to have a significant relationship with environmental protection considering the correlation coefficient of 0.259 and the p-value or Sig.(2-tailed) of 0.010 which is below the p-alpha of 0.05. It is recommended that Kicukiro District has to launch a sustained, education and communication campaign informing residents on the importance of managing waste properly and its importance to their health, the environment and cleanliness of the city or use another waste reduction strategy in order to encourage recyclable production of goods to allow access to recyclable products.

Keywords— *Solid Waste Management, environmental protection.*

I. INTRODUCTION

Solid waste management practices are essential component of environmental infrastructure in human settlements. These practices encompass all activities undertaken from the point of waste generation up to the final disposal. In most of African urban areas, solid waste management is ultimately a responsibility of Municipal Councils while most cases of rural areas the wastes are handled and disposed at the household level (Frank, 2006). and Rwanda is not an exceptional (ADB, 2012).

Accordingly, Kigali town's waste contains still 70 percent of organic, biodegradable waste and in rural areas the portion of waste reach more than 95 percent. Waste sorting, composting and recycling activities have been at the very beginning and until 2015 and yet Rwanda has started to invest in environmentally safe landfills. The operating dumpsite receives about 400 tons per day of solid, not sorted waste or 140,000 tons per year (MININFRA, 2013).

Management of solid waste is a global problem and is faced by all developing countries. The rapid pace of increase in population, economic growth, urbanization and industrialization is coupled with accelerated solid waste generation.

The management of solid waste stands as the most visible environment problem facing the districts in Rwanda and is attaining a worrisome dimension with urbanization increment rate. Despite the rapid growth of its population, districts have never had any clear Master plan to re-organize the planning and settlement since colonial era. This has put pressure on the infrastructure which has resulted in many complex problems regarding settlement notably waste management, where the solid waste problem is visible in most parts of the districts' urban centers; on the roads, within the neighborhoods and around residential buildings and in different places of the urban areas. Failure to address waste management related issues is expected to lead to numerous social and environmental contaminations (Nshimiyimana, 2015).

The Government of Rwanda has made waste management one of the priority areas in achieving vision 2020. During the Economic Development for Poverty Reduction Strategy (EDPRS) I period (2008-2012), the sector aimed at improving the environmental health and hygiene conditions of the population by promoting safer methods of waste disposal from community and health facilities. EDPRS II (2013-2018) stipulates that because of the rapid urbanization which will occur in Rwanda in the next five years, with 35% of the population envisaged to live in urban areas by 2020, it is likely to have huge economic and environmental impacts, through increased pressure on urban infrastructure, such as transport and solid and liquid waste (SLW) management systems. Regarding that this study aims at inspect the impact of current waste management practices on environmental protection in Rwanda by taking the case of Kicukiro District.

II. MATERIALS AND METHODS

2.1 Population of the study

The target population of this study was composed by households and private people involved in collecting wastes in Kicukiro District, precisely Kicukiro district where 3219 are the households and the managing director of Ubumwe Cleaning Company as well as the officer in charge of environment participated.

This study was conducted in Kicukiro District which is located in Kigali city. Kicukiro district is one of the three districts of Kigali City. Kicukiro District is located Latitude :-2°0'14.08" and Longitude: 30°8'49.05" urban area have 318,564 total population (C2012) ,12 sectors, Area :167 km²,Density:1900/km²(4,900/sq.mi) and urbanization (C2012) Rural:38,623,Urban :279, 941. Kicukiro district is part of Kigali City where people emigrate from different areas for different reasons including socio-economic needs, like formal and informal jobs, business and life style. The choice of this district it has been performed well regarding waste management do by Ubumwe Cleaning Company.

2.2 Sample size

William (2004) noted that sampling is a devise or a way that is used in selecting of the members is able to question, or who are a fair presentation of all the members in a union. However the formula of Taro Yamane was used to calculate the sample size

$$n = \frac{N}{1+N(e)^2} \tag{1}$$

Source: Yamane,1967

Where N= Total population, n=Sample size, and e= Error margin

Applying the above formula, the sample employed for this study was calculated from the total 3219 households from Kicukiro district. The sample was calculated as follows

$$n = \frac{3219}{1+3219(0.1)^2} = 97 \tag{2}$$

III. RESULTS AND DISCUSSIONS

Table 1 show the main forms or types of wastes that are mostly exist in households. Majority of households revealed that the most wastes included garbage wastes with the percentage of 81.4%. This is due to that most of the wastes in the households are related to food residues and most of them are biodegradable.

TABLE 1
FORMS OF WASTES IN SURVEYED HOUSEHOLDS

		Frequency	Percent
Valid	Plastic wastes	9	9.3
	Garbage wastes	79	81.4
	Paper wastes	6	6.2
	Iron waste	3	3.1
	Total	97	100.0

Source: Primary data, 2018

3.1 Status of solid waste management practices in Kicukiro district

3.1.1 Status of waste segregation in Kicukiro

TABLE 2
PERCEPTIONS OF RESPONDENTS ON STATUS OF WASTE SEGREGATION IN KICUKIRO

	N	Mean	Std. Deviation
In households, wastes are segregated for facilitating collection process	97	1.81	.833
Households have different bins for each kind of wastes	97	2.13	1.027
Solid waste are excluded for liquid wastes	97	2.73	.930
Biodegradable and non-biodegradable are put into different bins	97	1.49	.503
Waste segregation	97	2.0438	.38190

Source: Primary data, 2018

Note: Categories of means: 1.00-1.85= Strongly Disagree (SD); 1.86-2.71=Disagree (D); 2.72-3.57=Agree (A); 3.58-4=Strongly Agree (SA) (Field, 2005)

In households it was revealed that waste segregation is explained excluding solid wastes from liquid wastes considering the mean of 2.73 which is interpreted as high mean but was revealed that households that were surveyed don't have different bins for each kind of waste considering the mean of 2.13 which is interpreted as low mean, not segregating waste for facilitating the collection process with the mean of 1.81 which is interpreted as very low mean.

Also households fail to put biodegradable and non-biodegradable wastes in different bins considering the mean of 1.49 which is interpreted as very low mean. Those results influenced the grand mean to become 2.04 which is interpreted as low mean. This means that waste segregation practices is not efficiently done in households located in Kicukiro.

3.1.2 Status of waste collection in Kicukiro

The second indicator of waste management practice that was considered in this study was waste collection. This concerns all activities for collecting wastes from households to landfill and the intention of this was to know if wastes are collected efficiently or not.

TABLE 3
PERCEPTIONS OF RESPONDENTS ON STATUS OF WASTE COLLECTION IN KICUKIRO

	N	Mean	Std. Deviation
There is a clear policy for waste collection	97	2.92	.986
Waste are collected in all households with affordable charge	97	2.76	1.248
Waste are collected by trained people	97	2.06	1.029
Collection of waste is done periodically	97	2.85	.833
Household help in easing the process of waste collection	97	2.68	1.036
Waste collection	97	2.6536	.49709

Source: Primary data, 2018

Note: Categories of means: 1.00-1.85= Strongly Disagree (SD); 1.86-2.71=Disagree (D); 2.72-3.57=Agree (A); 3.58-4=Strongly Agree (SA) (Field, 2005)

According to the above table 3, the effectiveness of waste collection is based on the following: clear policy for waste collection considering the mean of 2.92 which is interpreted as high mean, collection of waste in all households with affordable charges considering the mean of 2.76 which is interpreted as high mean, and collection of waste is done periodically considering the mean of 2.85 which is interpreted as high mean. But respondents found the following to be critical: collection of wastes by trained people considering the mean of 2.06 which is interpreted as low mean; where this means that wastes are not collected with people with trainings in wastes management, and households fail to easy the process of waste collection considering the mean of 2.65 which is interpreted as low mean. In the end the grand mean shows that waste collection is not practiced effectively efficiently since it is 2.65 which is interpreted as low mean.

3.1.3 Status of waste transportation in Kicukiro

Transporting wastes was not an easy task and requires special equipment. The intention of this was to know if transportation

of waste management fulfills all requirements in Kicukiro District.

Table 4 below shows the perceptions of respondents on how wastes are transported in Kicukiro District.

TABLE 4
PERCEPTIONS OF RESPONDENTS ON STATUS OF WASTE TRANSPORTATION IN KICUKIRO

	N	Mean	Std. Deviation
Loading time of wastes is not long	97	2.91	.925
Modern packing mechanisms followed for waste transportation	97	2.30	.854
Vehicles were covered during transportation	97	2.10	.653
Transportation of wastes is contracted to private agencies	97	2.75	.524
The money for waste transport are affordable	97	3.04	.735
People who collect waste are protected enough	97	2.42	.643
Waste transportation	97	2.5876	.26581

Source: Primary data, 2018

Note: Categories of means: 1.00-1.85= Strongly Disagree (SD); 1.86-2.71=Disagree (D); 2.72-3.57=Agree (A); 3.58-4=Strongly Agree (SA) (Field, 2005)

Table 4 showed the perceptions of respondents of respondents on waste transportation in Kicukiro District. It was revealed transportation of wastes is characterized by the short time of loading wastes considering the mean of 2.91 which is interpreted as high mean, transportation of wastes is contracted to private agencies considering the mean of 2.75 which is interpreted as high mean, and the money for waste collection is affordable considering the mean of 3.04 which is interpreted as high mean. But the following were found to be critical considering their means; that are following modern packing for waste transportation considering the mean of 2.30 which is interpreted as low mean, well covering the cars that transport wastes considering the mean of 2.10 which is interpreted as low mean, and people who collect waste are not protected considering the mean of 2.58 which is interpreted as low mean. Concluding to this transportation is not done in adequate manners considering the grand mean of 2.58 which is interpreted as low mean.

TABLE 5
PERCEPTIONS OF RESPONDENTS ON STATUS OF WASTE DISPOSAL IN KICUKIRO

	N	Mean	Std. Deviation
Landfill for waste are far away of the household	97	3.62	.620
There are adequate materials that are used for waste disposal	97	3.30	.543
There is effective mechanism of reducing the smell of wastes from landfill	97	2.31	.727
Biodegradable and non-biodegradable wastes are disposed differently	97	3.38	.620
Waste disposal	97	3.1521	.33571

Source: Primary data, 2018

Note. Categories of means: 1.00-1.85= Strongly Disagree (SD); 1.86-2.71=Disagree (D); 2.72-3.57=Agree (A); 3.58-4=Strongly Agree (SA) (Field, 2005)

According to the above table 5 the effectiveness of waste disposal is explained by the following: landfill for waste are far away for the households considering the mean of 3.62 which is interpreted as high mean, there are adequate materials that are used for waste disposal considering the mean of 3.30 which is interpreted as high mean, and biodegradable and non-wastes are disposed differently in landfills considering the mean of 3.38 which is interpreted as high mean. Finally, it was revealed that it was revealed that there is no effective mechanism for reducing smell of wastes from landfill considering the mean of 2.31 which is interpreted as low mean. And in conclusion it was revealed that wastes in general are disposed effectively considering the mean of 3.15 which is interpreted as high mean.

3.2 Solid waste management practices and environmental protection in Kicukiro District

The second specific objective of this study was to assess the relationship between waste management practices and environmental protection. This was achieved by correlating the results of the independent variable and the dependent variable meaning results of waste management practices and environmental protection. The correlation helps to show the relationship between variables where its positive value explains the positive relationship. And the significance relationship should be tested where the significance level of 0.05 was used in this study where the p-value less than the significance level indicates

the significance of the relationship.

TABLE 6
CORRELATIONS BETWEEN WASTE MANAGEMENT PRACTICES AND ENVIRONMENTAL PROTECTION

		Environmental protection
Waste segregation	Pearson Correlation	.035
	Sig. (2-tailed)	.733
	N	97
Waste collection	Pearson Correlation	.101
	Sig. (2-tailed)	.323
	N	97
Waste transportation	Pearson Correlation	.259*
	Sig. (2-tailed)	.010
	N	97
Waste disposal	Pearson Correlation	.098
	Sig. (2-tailed)	.338
	N	97
*. Correlation is significant at the 0.05 level (2-tailed).		

Note: $r_s = 1$: perfect correlation, $0.9 \leq r_s < 1$: strong correlation(very high), $0.7 \leq r_s < 0.9$:high correlation, $0.5 \leq r_s < 0.7$:moderate correlation, $r_s < 0.5$:weak(low) correlation, $r_s = 0$: absence of correlation.

Table 6 showed the correlation between waste management practices and environmental protection. To all practices of waste management practices the relationship is positive but only for waste transportation to have a significant relationship with environmental protection considering the correlation coefficient of 0.259 and the p-value or Sig. (2-tailed) of 0.010 which is below the p-alpha of 0.05.

IV. SUMMARY, CONCLUSION, AND RECOMMENDATIONS

4.1 Summary of findings

This study focus was to examine the impact of solid waste management practices on environmental protection conducted in Kicukiro district in order to evaluate solid waste management practices in terms of waste segregation, collection, transportation, and disposal in Kicukiro District.

In term of waste segregation, the results of solid wastes from liquid wastes considering the mean of 2.73 which is interpreted as high mean but households that were surveyed don't have different bins for each kind of waste considering the mean of 2.13 which is interpreted as low mean. Segregating waste for facilitating the collection process with the mean of 1.81 which is interpreted as very low mean,. Those results influenced the grand mean to become 2.04 which means that waste segregation practices is not efficiently done in households located in Kicukiro.

Concerning waste collection, it was found that the effectiveness of waste collection is based on the following: clear policy for waste collection considering the mean of 2.92 which is interpreted as high mean, collection of waste in all households with affordable charges considering the mean of 2.76 which is interpreted as high mean, and collection of waste is done periodically considering the mean of 2.85 which is interpreted as high mean.

In the end the grand mean shows that waste collection is not practiced effectively efficiently since it is 2.65 which are interpreted as low mean.

It was revealed transportation of wastes is characterized by the short time of loading wastes considering the mean of 2.91 which is interpreted as high mean, transportation of wastes is contracted to private agencies considering the mean of 2.75 which is interpreted as high mean, and the money for waste collection is affordable considering the mean of 3.04 which is interpreted as high mean. Concluding to this transportation is not done in adequate manners considering the grand mean of 2.58 which is interpreted as low mean. The effectiveness of waste disposal was revealed that wastes in general are disposed effectively considering the mean of 3.15 which is interpreted as high mean.

In general all practices of waste management practices the relationship is positive but only for waste transportation to have a significant relationship with environmental protection considering the correlation coefficient of 0.259 and the p-value or Sig.(2-tailed) of 0.010 which is below the p-alpha of 0.05. This indicates that waste transportation us key factors to environmental protection but more are need to be done for improving the whole system of waste management practices.

4.2 Conclusion

The focus of the study was to investigate the impacts of solid waste management practices on environmental protection. It was found that with the increasing in the global population and the rising demand for food and other essentials, there has been a rise of the amount of waste being generated daily by each household. To all practices of waste management practices the relationship is positive but only for waste transportation to have a significant relationship with environmental protection considering the correlation coefficient of 0.259 and the p-value or Sig.(2-tailed) of 0.010 which is below the p-alpha of 0.05.. The sustainability of our environment, an adequate sort from household level is a requirement for a good management of solid waste. This is only successful after education of the people and their involvement in waste handling and separate waste like degradable and non-degradable waste.

After the sort, some fractions must be transformed in marketable things such as: compost and biological digestion can also yield biogas that can be used as the source of energy. Other material like metal and plastic bags can be recycling of other materials. Landfill site must be the last option for treating ultimate solid waste and this must be done under environmental condition.

4.3 Recommendations

Governments have a range of policy options to encourage waste management practices that will reduce greenhouse gas emissions. Practical approaches that could be applied in most cities include:

- Public education to inform people about their options to reduce waste generation and increase recycling and composting.
- Pricing mechanisms, such as product charges can stimulate consumer behavior to reduce waste generation and increase recycling. A product charge is a cost assessment added to the price of a product and is tied to the cost of the desired waste management system. Consumers would pay for the waste management service when they buy the product. The fees collected would be directed to municipalities relative to the waste generated.
- Another pricing mechanism well suited to urban areas is user charges tied to quantity of waste disposed. Consumers who separate recyclables pay a lower fee for waste disposal. This pricing policy can work well in locations where waste collection is from individual households so that waste quantities for disposal can be readily monitored. However, it may not be practical in many areas in developing countries, particularly in those where there are communal collection points associated with multi-unit households (such as apartment user charges tied to quantity or volume).
- Preferential procurement policies and pricing to stimulate demand for products made with recycled post-consumer waste. Use of compost in public parks and other property owned by cities

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