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Resource Allocation and Solid Waste Management: A Case of Nairobi City County, Kenya

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Abstract

The management of waste remains a major challenge in developing countries. Globally, countries continue to struggle with the generation, disposal, and overall management of millions of tons of waste in cities, and the need to manage the same sustainably. The management of this waste has attracted enhanced attention as tons upon tons of waste lie uncollected across streets, which inconveniences human life, pollutes the environment, and poses a greater public health risk to the population. Municipal authorities' limited capacity to collect and dispose of solid waste safely, coupled with the exponential growth of African cities' population, has brought about the growing problem of managing solid waste. Nairobi City, with an estimated population of over 4.4 million, generates daily solid waste of about 2,400 metric tons. At least 20% of this waste is plastic. The capacity to manage all this waste effectively, a rapid increase in the population, and a myriad of challenges in the management of solid waste, increases the degradation of the environment. Inadequate financing, limited appropriate infrastructure and technology, ineffective public sensitization and awareness of proper sanitary practices, and limited good governance practices remain the critical challenges that the management of solid waste faces. One of the key components of effective solid waste management is proper resource allocation. Lack of resources leads to improper solid waste management, which in turn causes unprecedented environmental problems. This study sought to investigate the influence of resource allocation on solid waste management in Nairobi City County, Kenya. Resource Dependence theory anchored the study. Descriptive research design, simple random and stratified sampling techniques were used to meet the research objectives requirements. The study targeted 300 members of staff who were drawn from the solid waste department of the County and NEMA officials. Data was collected through a closed questionnaire from a sample size of 90. Of these, there were 74 respondents representing a response rate of 82.2%. From the results, it emerged that resource allocation was significant to the management of solid waste. Proper resource allocation was found to control overspending and lead to more efficiency in solid waste management.

Keywords: Solid waste management, resource allocation, efficiency

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1. Introduction

Management of solid waste has become an important global interest that requires an integrated approach from all stakeholders. The environment is hugely impacted by waste generation and consequently, greenhouse gases emission contributes to significant loss of materials and

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change of climate change. The amount of waste produced by human beings from their activities has been on an upward trend, while the nature of such waste has also been changing. Decomposition of materials resulting from human activities is difficult due to the complex combination orchestrated by the shift from biodegradable to non-degradable waste. It has been noticed that day by day, there is a continued experience of decline in the quantities of recyclable materials despite the development of materials like plastic and technological improvement (European Union, 2010).

According to the Environmental Protection Act (EPA) (2016), besides unwanted and discarded material, waste is also a vital and crucial resource and input for various other activities and production, like energy generation. The development of sustainable philosophy is informed by essential maintenance of balance, harmony, and also as a way of reflecting part of foundational aspirations.

According to Chithra, Anilkumar, and Naseer (2016) main urban centers in South Asia have inefficient solid waste collection. In particular, the collected solid waste in Pakistan ranges between 51% and 69% among those cities that are large but among small urban centers, garbage collection is inadequate. Lahore, for instance, has an average waste collection of about 68%. Pakistan registers scarce systems that are relied upon for recycling, and those that have been done, albeit in small quantities (27%), have been implemented by the informal sector (Masood, Barlow & Wilson, 2014).

In Tanzania, the highest volumes of waste generated are of metals, bottles, garbage, plastic, papers, food, glasses, and animal products (Owusu, Oteng-Ababio & Afutu-Kotey, 2012). The rapid urbanization and development in the City of Dodoma have enhanced employment opportunities and other socio-economic benefits. However, serious environmental problems have come alongside the vast development, including public health concerns and dangers prevalent in the marketplaces. The collection of the generated waste, including sorting, storage, transportation, and treatment as well as the ultimate disposal, has continued to bedevil the entire solid waste management in Tanzania (Ndum, 2013).

The perpetual population growth in Kenya has exposed solid waste management predicaments in the Nairobi City County. Each day, it is estimated that the city's population of 4,397,073 (KNBS, 2019) generates solid waste of about 2,475 tons. Therefore, authorities strive to upscale their management capacities to match those of solid waste generated. JICA (2010) posits that the most pressing and vexed issue is solid waste management in the City of Nairobi. Otieno (2010) posits that about half of the population does not access services related to solid waste, which enhances demand for sustainable solid waste management to manage the potential negative effects, consequently placing a demand and an urgent need for effective governance. The current waste management systems have leakages, which cause diseases, flooding, as well as pollution of the environment in general.

It is from this perspective that the current study purposes to explore the influence of resource allocation on the management of solid waste in Nairobi City County. With such large volumes of waste produced and the attendant problems of poor solid waste management, it is clear that substantial resources are needed to deal with the problem. Resource allocation is the process through which available resources are distributed across and utilized in the system (Ganesh *et al.*, 2015). Resource allocation, though, is a sensitive topic that is shaped by bureaucracy and political strength in many instances. Thus, resources tend to be allocated to those who have the power to negotiate for them, which can be detrimental to efficiently carrying out needed activities (Rodas, 2014). In some instances, the allocation of resources depends on the

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prevailing economic conditions, environmental power, rationality, core units of the firm, institutional power, and negotiation skills strategies applied. This study will thus investigate the influence of resource allocation on the management of solid waste in Nairobi City County.

1.1 Problem statement

Millions of tons of solid waste are generated every day across the globe. The management of this waste has attracted enhanced attention, with tons upon tons of waste lying uncollected across streets. This inconveniences human life, pollutes the environment (water, soil, and air), and poses a greater public health risk to the population. According to Shafiul and Mansoor (2003) solid waste management in most cities in Africa continues to be an ever-growing problem due to rapid population growth and the limited capacity of the municipalities to effectively collect and safely dispose of solid waste.

Sustainable alternative measures to handle market wastes efficiently, effectively, and ultimately prevent the pollution of the environment are a challenge to many developing Capitals around the world (Owusu *et al.*, 2012; Abarca, Maas & Hogland, 2013).

The respective urban authorities have been mandated to collect, dispose and manage the solid waste despite their limited capacity in terms of machinery, operational, human, and financial resources. However, the use of old and inefficient technologies coupled with limited managerial capabilities plays a crucial role in the management of sustainable solid waste for many cities, including Nairobi. Sustainability in solid waste management can be achieved with enhanced accountability of the allocated resources and perhaps with better resource allocation. This study sought to establish the role of resource allocation in solid waste management.

2. Literature Review

2.1 Theoretical Review

Pfeffer and Salancik (1978) were the pioneers of Resource dependency theory. The theory aims to explain how an organization's behavior is affected by its external resources. It argues that firms change and negotiate with their external environment for the purposes of securing access to survival resources that they require. The competitiveness of the firm from the theory's perspective is determined by the manner in which it handles their external resources. Therefore, the county government should ensure that external factors when managing solid waste are adhered to. Van Weele (2018) believes that for county government to have effective resource allocation, it should focus more on the external environment rather than the internal one over the firm's activities, especially management and control decisions, in order to maximize the shareholders' value.

2.2 Empirical Review

Awuorh and Oladapo (2015) carried out a study in Ibadan City in Nigeria on 'Good Governance: A Panacea to Urban Solid Waste Management Problem to determine the crucial role of prudent governance in addressing the management of solid waste. Two local government councils were chosen at random, whereby 188 respondents were also chosen randomly. More secondary data was provided by the Oyo State Solid Waste Management Authority. Revelations from the survey indicated that the waste management department was not able to carry out its mandate well due to understaffing, poor funding, insufficient equipment for the management of waste, and the utilization of unsustainable waste disposal techniques. The recommendation called for proper allocation of resources, including appropriate staffing, funding, and sufficient equipment for waste management by the city administration to the waste management department. While the study calls for proper allocation of resources to make solid

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waste management a success, the current study evaluates the effects of corporate governance practices on the management of solid waste in Nairobi City County.

Gakungu (2011) examined the generation, collection, and disposal of solid waste in the public technical training institutions by quantifying the various components of solid waste generated and evaluating the attitudes of the people responsible for the generation and management of waste. The sample size of the study comprised twenty-nine (29) out of the target population of forty-two (42) institutions that offer technical training. It was established that these institutions generated about twenty-three tons of solid waste weekly, which was composed of remains of vegetables. Further, it was also established that the cost of waste management in the institutions is dependent on both the waste generated and the institutional population. According to the study, the management and planning costs of the generated waste for every student averaged 0.13 to 0.59 and 0.28 to 0.71 kg, respectively. The study recommended for incorporation of waste management during the development of the institutional plan by the boards of management. Hence, the allocation of adequate financial and human resources and proper planning techniques dictate the collection and disposal of waste. Therefore, the Nairobi City County government should ensure proper allocation of resources for effective management of solid waste.

In Sri Lanka, Abdul Majeed (2019) carried out a study on municipal solid waste management practices and challenges. The data collection process involved document analysis, semi-structured interviews, and field observations, hence a mixed-method strategy approach in nature. Although the solid waste management (SWM) systems have in place the necessary elements, ineffectiveness and inefficiency are still there due to poor or non-segregation of waste generation points; absence of regular collection schedule and control of polluters, absence of regulation to reduce waste generation, lack of resources, and lack of technical know-how and initiatives. Rather than waiting for catastrophic social problems as a result of public health and environmental problems, the survey recommended for inclusion of immediate measures and feasible solutions for improved management of solid waste. The development of sustainable measures will be achieved based on these recommendations for cities and counties to mobilize resources necessary for effective solid waste management obligations.

3. Methodology

Descriptive design lays the roadmap for the study. As per Cuneen and Tobar (2017), research questions, particularly on which, who, when, how, and what problem is, are answered by a descriptive research design. The design involves collecting data from the target population, and its merits are reflected in seeking objects or individuals with specific characteristics (Rahi, 2017). It perfectly suits this research due to its ability to investigate, observe, and collect data from people or objects of study while in their natural environment. A descriptive research design will be used to establish corporate governance's influence on the management of solid waste in the county government of Nairobi City, Kenya. This design enables the collection of quantitative and qualitative data through in-depth inquiry of constructs and the relationship across variables.

The study targets 300 members of staff drawn from the Environment, Water, Food, and Agriculture Department in Nairobi County. These are the human resources involved in day-to-day operations with the corporate governance on the effectiveness of solid waste management, and thus, they are most conversant with the study's topic. A range of methods is facilitated by sampling techniques purposely to reduce the amount of data that needs to be collected from a sub-group of the universe. Selection of a smaller representation of the population of interest in

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order to meet study objectives sums up the study sample size (Omair, 2014). The study adopted a stratified random sampling technique to select the sample size. Stratified random sampling was essential for this research as it guaranteed that everyone in a given stratum (department) had an equal probability of being chosen. Abutabenjeh and Jaradat (2018) noted that 30% of the targeted population is sufficient to make a conclusion if the population is less than 1000. The study used 30% of the targeted population. Therefore, 90 respondents were sampled.

Data from the primary was used to draw inferences for the survey. Nairobi county members of staff responsible for solid waste management were the source of primary data. Questionnaires were used to collect data since they are cost-effective, easy to analyze, familiar to most people, reduce bias, and are considered less intrusive. The study variables were all measured using a Likert Scale of 1-5, where 1= strongly disagree, 2= disagree, 3=neutral, 4= agree, and 5= strongly agree. Since there is an involvement of sensitive documents, responses, and information, it is of paramount importance to adhere to the laid-down research ethical values for a prudent encounter with objects of the study. In strict adherence to the values and legal framework in Kenya, the study obtained relevant documents from Kenyatta University, County Government of Nairobi City, and National Commission for Science, Technology and Innovation, with purpose show the academic nature of the survey.

4. Results and Discussion

4.1 Response Rate and Demographics

The sample size for this study was 90 participants. 90 questionnaires were sent out, and of these, 74 were sufficiently filled out for analysis. This represents an 82% response rate for the study, which is a good response rate.

Respondents were asked to indicate their gender, age, and education level. There were 38 female respondents and 36 male respondents in the study. Female respondents were the majority at 51.3% and male respondents were 48.7%. The respondents were almost evenly distributed across gender lines.

Respondents were asked to indicate their age in the following categories: below 20 years, 20-24 years, 25-29 years, 30-34 years, 35-39 years, 40-44 years, 45-49 years, and 50 and above years. Most of the respondents were aged between 30-34 years. This age category made up 36.5% of the respondents, followed by the category of 35-39 years, which made up 27% of the respondents. Those between the ages of 40-44 years were 14.9% and those between the ages of 25-29 were 10.8% of the respondents. There were 6.8% of respondents between the ages of 45-49 years and 4% who were 50 years and above. There were no respondents in the categories below 20 years and 20-24 years.

Respondents were also asked to indicate their education levels from diploma level to PhD. Most of the respondents indicated that they had a bachelor's degree. Those with a bachelor's degree were 47.3% of the respondents, followed by 36.5% who indicated they had a diploma. There were fewer people with even higher degrees, with only 13.5% of respondents having a master's degree and only 2.7% having a PhD. All demographic information is presented in Table 1.

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Table 1: Demographics

Demographic Information			
Gender	Frequency	Percentage	
Male	36	48.7%	
Female	38	51.3%	
Total	74	100%	

Age Range	Frequency	Percentage
Below 20 years	-	-
20-24 years	-	-
25-29 years	8	10.8%
30-34 years	27	36.5%
35-39 years	20	27%
40-44 years	11	14.9%
45-49 years	5	6.8%
50 and above	3	4%
Total	74	100%

Education Level	Frequency	Percentage
Diploma	27	36.5%
Bachelor's degree	35	47.3%
Master's degree	10	13.5%
PhD	2	2.7%
Total	74	100%

4.2 Descriptive Analysis

Descriptive statistics for both resource allocation and solid waste management were calculated as shown in Tables 2 and 3. Resource allocation was the independent variable, while solid waste management was the dependent variable. Each of the statements under the variables was

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measured using a Likert scale from 1 to 5, with 1 being strongly disagree and 5 being strongly agree.

Table 2: Resource Allocation

Statement	Mean	SD
Resources are allocated according to the prevailing economic conditions	4.30	1.12
There is justification for the allocation of financial and human resources in the firm	4.51	0.83
Various departments negotiate to have the resources they require for effective service delivery	4.19	0.87
The department has institutional power relations with other quarters that help it get more resources	4.19	1.14
Allocation of resources is done in strict adherence to the budget statement	3.74	1.02
Aggregate mean and SD	4.19	1.00

The highest mean recorded was 4.51 for the statement on their being justification for the allocation of financial and human resources in the firm. This indicates that most of the respondents either agreed or strongly agreed with the statement. Additionally, the statement had an SD of 0.83, which indicates that there was not that much deviation in the responses, and most of the respondents agreed or strongly agreed. The second-highest mean was recorded for the first statement on resource allocation, mirroring the prevailing economic conditions. The mean was 4.31, indicating that many respondents agreed that there was evidence of resource allocation mirroring the economic conditions. A considerable number of respondents strongly agreed as well. However, the SD was 1.12, which indicates there was a lot of deviation in the responses for this question.

The third and fourth statements each had a mean of 4.19. The third statement was on negotiation by departments for resources to be allocated. The mean indicates that many of the respondents agreed and strongly agreed with the statement. The SD was 0,87, indicating that there was not that much deviation in the responses. In the fourth statement on the use of power relations to acquire more resources, the mean also indicates that many respondents agreed, and some strongly agreed. However, the SD was 1.14, indicating there was a lot of deviation in the responses, and there were considerable responses in the other three categories.

The last statement on whether resource allocation followed a strict adherence to budget had the lowest mean of 3.74. This indicates that many of the responses were in the neutral and agree categories, with some in the strongly agree category. The SD was 1.02, which indicates deviation in the responses, but not by a lot.

The average mean was 4.19, and the SD was 1.00. This is indicative that most of the responses showed agreement with the statements put forth for this question, but the SD shows that there was some deviation in the responses.

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Table 3: Solid waste management

Statement	Mean	SD
There is efficiency in how various decisions are made in the county government	3.62	1.13
Resource allocation improves team service delivery and the effectiveness with which services are discharged	4.09	0.98
Prudent allocation of resources by an organization brings about efficiency in waste handling, collection, and storage	3.77	0.82
Proper County Government planning of resource allocation prevents overspending	4.00	1.1
Implemented plans derived from county strategic plans are geared to improve the lives of the city dwellers	3.8	1.11
Aggregate mean and SD	3.86	1.03

The statement on resource allocation improving service delivery and effectiveness had the highest mean of 4.09. This indicates that most of the respondents agreed with the statement, with a few strongly agreeing. The SD was 0.98, indicating there was deviation in the responses, but not much. The second-highest mean was 4.00 on planning, preventing overspending. This indicates that most of the respondents agreed with the statement. The SD, however, was 1.1, indicating that there was some deviation in the responses despite most agreeing with the statement. The third highest mean was 3.8 on the statement about implemented plans improving the lives of city dwellers. This indicates that many of the respondents were neutral and some agreed, and some disagreed. The SD was 1.11, indicating that there was a deviation in the responses for this statement.

The statement on prudent allocation causing efficiency in solid waste collection had a mean of 3.77 and a standard deviation of 0.82. This indicates that most of the respondents were either neutral or in agreement with the statement. There was not much deviation in the responses. The lowest mean of 3.62 was recorded for the first statement on the efficiency of decision-making. The SD was also 1.13. This is indicative that most of the respondents disagreed, were neutral, or agreed with the statement. The SD was high, indicating that there was a lot of deviation in the responses.

The aggregate mean was 3.86, and the SD was 1.03. This is reflective of the deviation in the responses and the fact that there was not much agreement in all the responses. Some responses were neutral, with some agreement with the statements.

4.3 Regression Analysis

Linear regression analysis was carried out on the variables to determine if there was a relationship between the independent variables and the dependent variable. To determine whether the independent variable (resource allocation) had any influence/effect on the dependent variable (solid waste management). For resource allocation, the variables that were considered were economic conditions, justification for allocation, negotiation, institutional power relations, and adherence to budgets. This relationship was written out as:

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$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_{5+} \varepsilon$

With Y solid waste management; β_0 = constant; X_1 – economic conditions; X_2 – justification for resource allocation; X_3 – negotiation and X_4 – institutional power relations, X_5 – adherence to budgets. The results from the linear regression are presented in Table 4.

Table 4: Multiple Linear Regression

Resource Allocation and Solid Waste Management

Model Summary: R= 0.699, R square= 0.489, Adjusted R Square= 0.451

ANOVA: F= 12.990, sig.=0.000

Resource allocation	β	Significance
Constant	0.463	0.466
Prevailing economic conditions	0.462	0.000
Justification of resource allocation	0.598	0.000
Negotiation by departments	0.171	0.179
Institutional power relations	0.386	0.002
Adherence to set budgets	-0.040	0.657

The value of adjusted R-squared was 0.451, indicating that 45.1% of the changes observed for the solid waste management variable were due to resource allocation. The ANOVA F value was 12.990 (p<0.001), indicating that this model was viable and significant.

Prevailing economic conditions, justification of resource allocation, and institutional power relations were all significant. A unit increase in prevailing economic conditions would lead to a 0.462 increase in the efficiency of solid waste management, while a unit increase in justification of resource allocation would lead to a 0.598 increase in the efficiency of solid waste management, and a unit increase in institutional power relations would lead to a 0.386 increase in the efficiency of solid waste management. The constant was 0.463, but it was insignificant. Similarly, negotiation of the departments and adherence to budgets were not found to be significant to the efficiency of solid waste management. The equation can thus be rewritten as follows:

$Y = 0.462X_1 + 0.598X_2 + 0.386X_4$

4.4 Discussion of Findings

The responses showed that resources were allocated according to the prevailing economic conditions and that there was justification for how the resources were allocated. Additionally, prevailing economic conditions, institutional power relations, and the justification for resource allocation were all found to be statistically significant to solid waste management. Resource allocation was indicated by the respondents to curb overspending and lead to efficiency in solid waste management. Overall, resource allocation was significant to solid waste management. This was similar to the findings by Abdul Majeed (2019), which showed that resource

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allocation was associated with effective solid waste management. The study also indicated that a lack of proper resource allocation could lead to a situation where ineffectiveness of solid waste management could erupt in environmental and health problems.

5. Conclusion

The allocation of resources was found to be an important part of solid waste management. It was evident that resource allocation can significantly influence how solid waste is managed, and paying attention to resource allocation can lead to greater efficiency in solid waste management.

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