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Effective Waste Management in Urban Centres in South Sudan

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Abstract

Purpose: The objective of this study was to assess effective solid waste management in urban centres in South Sudan with special reference to Juba City Council. This included the types of solid waste generated, solid waste management practices and factors hindering effective solid waste management in relation to population growth and behavior.

Methodology: The study used random sampling technique to determine a sample size of 200 respondents who were versed or partly versed with the subject in question. This included the Ministry of environment officials, City council waste management directorate, Members of parliament and the residents of Juba city council. Qualitative data was obtained from interviews using interview guides which were coded, interpreted. Further data was analyzed to give it a broader and more meaningful picture of the sample.

Findings: The study findings revealed that paper and carton, yard trimmings, food, scraps, wood, glass, plastics, metal and clothes were the types of solid waste generated within the urban centres in South Sudan. The study further revealed that urban population growth significantly affects solid waste management in Juba city and poses the challenges of solid waste segregation since the waste is indiscriminately disposed of. In addition, insufficient funding led to inadequate provision of facilities and equipment for solid waste management coupled with inadequate enforcement of public health legislations and solid waste management by-laws.

Unique Contribution to Theory, Policy and Practice: The study therefore recommended the use of integrated solid waste management, adequate resourcing, law enforcement and strengthening of the capacity of the Juba City/Municipal/urban councils' policies and regulations.

Keywords: *Solid waste management, Urban centres, Juba city council*

Introduction

Solid waste management in urban centres in South Sudan continues to be a major challenge for local governments and across the world (Wagner et al., 2011). Waste management refers to the methods and processes of dealing with wastes at every stage from generation and collection through to the final disposal (Fernando, 2010). To manage solid wastes efficiently requires one to know the components needed for a successful implementation of waste management plan (Anand, 2010). The estimated quantity of Solid Waste (MSW) generated worldwide is 1.7 — 1 .9 billion metric tons per year (UNEP, 2010). According to the environmental report of Bor the capital city of Jonglei state in South Sudan, the town generated about 37,552 .32 tons of solid waste a year. This is about 0.767 kg/per capital day, which is typical of developed country as opposed to a developing country (Akuei. (2017). In comparison for example, UK is 0.73kg, Singapore 0.87kg and Nepal 0.3kg. As a result, the uncollected wastes, which are often also mixed with human and animal excreta, are dumped indiscriminately on the streets and in drains, thus contributing to stagnant water, water pollution, breeding of insect and rodent vectors and the spreading of diseases (Hoomweg et al., 2012). This situation is more alarming and is a threat to human health and the environment (Bandara & Hettiaratchi, 2010). The current practices of collecting, processing and disposing of solid wastes are also considered to be insufficient in the developing countries, South Sudan included. The typical problems are poor management practices, low collection coverage, irregular collection services, crude open dumping and burning without air and water pollution control (Remigios, 2010). According to Okot-Okumu (2012), only less than 30% of the urban population has access to proper and regular garbage removal. That poor waste management in the developing countries is a major threat to public health and environmental quality and reduces the quality of life, particularly for the poorer residents in both urban and rural areas (Wagner et al., 2011).

Although considerable efforts are being made around the globe by many governments and other entities to tackle waste-related problems, there is still much to be done. The World Bank estimates that 50% of the municipalities in urban areas budget in developing countries was on solid waste management. However, despite this remarkable expenditure across the developing world, a large proportion of urban solid wastes remain uncollected.

The condition of waste management in the urban cities in South Sudan is worsening well above the curve of these worrying global trends as the population continues to grow as a result of migration to urban centres due to the conflicts. Exact figures are not available and the existing data is somewhat contradictory.

Whatever the precise numbers it maybe; Juba, the capital city of south Sudan is one of the fastest growing cities. The city has already overstretched the waste management systems to cope with the increase in demand precipitated by this population growth. Therefore, there is an urgent need of review and improvement in the waste management practices in all urban centres in South Sudan

Background of the study

The effectiveness of solid waste management is one of the huge challenges of the urban areas of all sizes in South Sudan. From megacities to the small towns, it is always the most challenging problems for city managers (UN — HABITAT, 2010). In this regards, south Sudan is not exempted as evidences abound that the problem associated with poor solid waste management are daily realities in many cities of south Sudan (Rogge and Dc Jaeger, 2012). Handling of wastes in south Sudan is becoming more and more challenging day by day, as most of the municipalities do not have the institutional capacities and necessary financial resources to deal with these problems (Ajila, 2011). Though there is no proper data on urbanization and waste generation trends in South Sudan, it can easily be noticed that the urban populations are growing. The implication of this growth is that solid waste management and acceptable level of sanitation coverage will need closer attention.

The eruption of the civil war in December 2013, put the country under severe economic hardships which have reduced the state and public interest in addressing environmental and public health problems. As a result, the environmental pressures were evidently witnessed, especially the problems of municipal solid wastes. Inadequate resources made collection, transportation, and disposal of municipal solid wastes ineffective (Letder & Vallero, 2011). Most of these problems are related to institutional, social, technical and financial factors which hinder effective coordination in the waste management sector.

Urban households and businesses produce substantial amounts of solid waste that must be collected regularly, recycled or treated and disposed properly in order to maintain healthy and sanitary living conditions. Many cities are increasingly facing solid waste management challenges due to rapid urbanization, lack of technical and financial capacity or low policy priority. As urbanization and population growth will continue, it is expected that municipal solid waste generation will double by 2025 (UNHABITAT 2018). Also, the higher the income level of a city, the greater the amount of the solid waste produced. Therefore the economic growth to be experienced in the developing and emerging countries will pose greater challenges in solid waste management to local governments in the next decades. Adverse environmental impact of uncollected waste in a city is significant. Uncollected solid waste can end up in drains leading to the blockage of drainage systems and cause unsanitary conditions that have a direct health impact on residents. Open burning of uncollected waste produces pollutants that are highly damaging locally and globally. Vectors such as mosquitos usually breed in blocked drainages and blocked drainages also contribute to flooding.

Even when solid waste is collected, it is not uncommon that recycling and treatment facilities or landfill sites are not operated in an environmental sound manner, especially when lacking a pollution control system. Particularly in developing countries lacking technical and financial capacity, open dumping or uncontrolled landfill is the common way of disposal. Leachate generated in dumping sites pollutes surface and groundwater. Frequent fire and explosions caused by the high temperature inside the accumulated waste is a source of air pollution.

Composting and recycling facilities and incineration plants lacking pollution control systems are one of the largest pollution sources.

Improper waste management accelerates poverty and social exclusion. In an open dump site, waste pickers or scavengers are regularly collecting recyclables without any protection measures. They are exposed to extreme health threats and it is estimated that 20% of these waste pickers are out-of-school. In Juba, the number of those who drop from schools are usually found on streets collecting waste materials for sale. The frequent explosion or landslides in open dumpsites often kill these waste pickers working on the pile of waste. It is also not unusual that gangs or cartels are involved in these informal recycling activities or open dumpsites operations (UNHABITAT 2018)

In light of the increasing urban population, lack of waste management facilities, weak institutional capacities and inadequate financial resources, the households and the municipality are finding it difficult to efficiently manage solid wastes in all the urban centres in South Sudan.

Problem statement

Currently open littering and heaping of solid wastes particularly in the low class residential areas and market areas of Shirkat, konyokonyo and customs in Juba city is common. With increasing population growth and urbanisation, the situation is bound to escalate due to an increase in the volume of solid waste generated from industrial and anthropogenic activities. It is with great concern that solid waste management is one of the pressing problems facing municipal areas, arising from rapid urbanization due to the growing number of unplanned settlements (Matovu, 2002). Polythene bags and plastic waste have become a serious health and environmental hazard in residential and commercial areas because in addition to their traditional use as food containers, some residents use polythene bags as 'toilets' which are dumped in trenches, on the streets, garbage heaps, around homes and water sources leading to constant outbreaks of cholera, malaria, and typhoid. In Juba City, it is common to see heaps of garbage on the road sides or a garbage container that is long overdue for collection, buzzing with flies and emitting a foul smell. The used vehicles for garbage collection are sophisticated, expensive and difficult to operate and maintain, thereby often inadequate for the conditions in developing countries. After a short time of operation only a small part of the vehicle fleet remains in operation transport also relies on operational vehicles, and frequent breakdowns coupled with parts shortages can immobilize collection vehicles for extended periods of time This scenario is common all over the city suburbs, showing clearly a big problem in the city's garbage management and disposal system. In spite of all these, the waste management institution (city councils and municipality) are not capable of staging the measures to rescue the situation. Therefore, if the situation is left unchecked there looms the outbreak of communicable diseases which will affect people exposed to this unsanitary conditions. It is with these concerns that the researcher decided to study and find out possible suggestions of effective solid waste management in Juba city as a model to the rest of urban centres in various municipalities and cities in South Sudan.

Research Questions

The study shall be guided by providing possible answers to the questions below.

i) What are the effects of urban population growth in Juba city council on solid waste management?
ii) What are the effects of population growth behavior in Juba city council on solid waste management?
iii) How effective is Juba city council on solid waste management?
iv) Does funding affect solid waste management in Juba city council?
v) What could be done to alleviate solid waste management in Juba city council?

Research Objective

The study attempted to assess the challenges of solid waste management in urban centres in South Sudan with special reference to Juba City Council.

Theoretical Literature Review

This study relied on two theories which were considered relevant to the research questions and objectives.

Behavioral Finance Theory

Jung (2003) asserts that behavioral finance theory is focused on relevance to service providers of investment management. Service providers learning from behavioral finance ought to learn to make out their own mistakes and those of others, comprehend those mistakes, and take mitigation strategies where necessary and applicable. In Juba city and other urban centres in question, if service providers lack effective behavioral mannerisms in their service provisions then solid waste management lacks effective managerial control hence poor services in the Cities and related municipalities.

Institutional Theory

Public policy is indomitable by government institutions, enforcement bodies which provide services and provide policy legitimacy (Nyawira, 2017). The policy enforcer applies guidelines to all people of society and monopolizes the strength of the applying policy; for instance, the legislature, executive and judicial branches of government are examples of institutions that enact, amend and enforce policies both that govern assets and provision of services. Anderson (2002) considers policy as an institutional yield. Government institutions have long been an epicenter focus on service provision. The author further asserts that the policy is commandingly determined, put into effective use and enforced by the governing institutions. Nyawira (2017) asserts that the affiliation between policies and government institution is shut because a public policy cannot become a communal policy until it is opted, put into effect and enforced by government institutions. Boyne (2004) asserts that public institutions give public policy legitimacy, legal duty that authorizes loyalty of the people through universality that is only government policies enlarge to all people in the society and has the legitimate liberty to

imprison violators of public policy. The ideology of maximum social gains implies no policy should be embraced if its costs surpass its payback and among policy alternatives, policy makers should choose the policy that yields the greatest benefits over costs. So a policy is cogent when it serves the intended purpose. Therefore, in this regard the Juba City council has the constitutional mandate to enforce the polluter pays principle (PPP) to the violators of this guideline in solid waste management (Nyawira 2017).

Population Growth on Solid Waste Management

As noted by Adebuason, R (2024), waste can be loosely defined as any material that is considered to be of no further use to the owner and is, hence, discarded. However, most discarded waste can be reused or recycled. What may be of no further use to one person and regarded as waste to be dumped, may be of use to the next person, and is the basis of the rag picking trade, the sifting through refuse at landfills for recovery and resale. Ecaat (2003) maintains that, whereas it is true that the problem of urban waste manifests itself as an environmental concern requiring putting in place sound environmental practices, it is also true that, the waste problem to an extent is a function of irresponsible behavioral tendencies associated with an urban population. Mugenyi (2007) puts the blame on traditional feeding habits of the local communities that emphasize eating of food stuffs such as bananas, cassava, groundnuts with high potential to generate wastes (peelings) which are partly responsible for the high volume of organic wastes generate Population growth, rapid urbanization, booming economy, and the increase in standards of living in a community have substantially enhanced the rate of municipal solid waste generation in developing countries (Minghua et al., 2009). Municipalities, usually responsible for waste management in the cities, have the challenge to provide an effective and efficient system to the inhabitants. However, they often face problems beyond the ability of the municipal authority to tackle (Sujauddin et al., 2008) mainly due to lack of organization, financial resources, complexity and system multi dimensionality (Burntley, 2007).

In countries around the world, one major environmental problem that confronts municipal authorities is solid waste disposal. The high increase in human population, its associated increase in urbanization and increase in economic activities has made the negative impact of solid waste management very noticeable in towns and cities around the world. In developing countries in particular, the waste produced by burgeoning cities is overwhelming local authorities and national governments alike as accumulations of waste outstrip its control (Nang et al 2017)

Several studies indicate that much of the municipal solid waste from developing countries is generated from households (55% - 80%), market areas (10% - 30%), and institutions among others Research has further indicated that wastes from these sources are highly heterogeneous in nature and have variable physical characteristics depending on their sources(Nang et al 2017)

Despite the present concern of governments, organizations and individuals about solid waste management in Africa, it is still faced with more serious solid waste management problems with its accompanying negative health and environmental consequences (Freduah 2004). Thus, the priority of a waste management system must always be the provision of a cleansing service which helps to maintain the health and safety of citizens and their environment. . It is therefore an undeniable fact that for humans to safeguard, control and promote the environment there must be some appropriate facilities for solid waste management. For in the absence of such facilities solid waste management will pose significant health problem (Nang, Samuel, Steve, Senyo, 2017).

Poor Policy Implementation

The purpose of the policy in solid waste management is to enhance the way of solid waste embraces the sustainable development concept. Sustainable development has emphasized the developments that meet the needs of the present without compromising the ability of the future generation to meet their own needs. Hence, the failure of policy implementation on the ground has brought massive impact on environment, economy and social development. Solid waste pollution is very harmful to human life, degrade the quality of environment and become a constraint towards stability of the economy development. Hence associated problems to solid waste management (UNEP, 2006).

Lack of Education and Awareness

Another major constraint seen throughout the developing world is the lack of education and awareness of effective waste-management practices (Singh et al, 1998). One study in Gaborone, Botswana, found that even though citizens were aware of recycling and other sustainable waste-management techniques, this did not necessarily translate into participation in pro-environmental activities such as recycling initiatives. They appeared to have not embraced waste management reforms amid their limited knowledge of such activities (Bolaane, 2006). The lack of interest in the environment creates a culture of non-participation of communities in decision-making processes. That stance enhances lack of responsibility for pollution and waste issues. Ultimately this produces communities that have little knowledge of, or concern for, their impact on the environment (Poswa, 2001). What it may come down to is the difference between information and knowledge. Being presented with the information without prior knowledge may be ineffective in creating change. However, if prior knowledge of waste management was met with new information, these communities would be more willing to accept it and implement these changes. The need to improve public awareness of, and community participation in, waste management has been widely recognized by researchers as necessary to create sustainable waste systems and to promote environmental citizenship amongst community members (Lumbreras Martín and Fernández García, 2014). Typically, people are more likely to participate in waste management activities, for example recycling, when they observe others in their vicinity recycling.

Effects on environment

The decomposition of waste into constituent chemicals is a common source of local environmental pollution. This problem is especially acute in developing nations. Very few existing landfills in the world's poorest countries would meet environmental standards accepted in industrialized nations, and with limited budgets there are likely to be few sites rigorously evaluated prior to use in the future. The problem is again compounded by the issues associated with rapid urbanization. A major environmental concern is gas release by decomposing garbage. Methane is a by-product of the anaerobic respiration of bacteria, and these bacteria thrive in landfills with high amounts of moisture (Cointreau-Levine, 1997). A second problem with these gasses is their contribution to the enhanced greenhouse gas effect and climate change. Liquid leachate management varies throughout the landfills of the developing world. Leachate poses a threat to local surface and ground water systems (Poswa, 2001).

Effects on health

Progress of modernization and industrialization has had its share of disadvantages and one of the main aspects of concern is the pollution it is causing to the earth be it land, air, and water. With increase in the global population and the rising demand for food and other essentials, there has been a rise in the amount of waste being generated daily by each household. This waste is ultimately thrown into municipal waste collection centers from where it is collected by the area municipalities to be further thrown into the landfills and dumps. However, either due to resource crunch or inefficient infrastructure, not all of this waste gets collected and transported to the final dumpsites. If at this stage the management and disposal is improperly done, it can cause serious impacts on health and environment (Levine, 1997).

Chronic respiratory diseases, incineration operators are at risk of chronic respiratory diseases. Organic waste poses a serious threat, since they ferment creating conditions favorable to the survival and growth of microbial pathogens. Direct handling of solid waste can result in various types of infectious and chronic diseases including cancers and respiratory infections resulting from exposure to dust and hazardous compounds (Muggaga, 2006). Cancer, several geographical comparison studies have investigated cancer mortality and incidence around waste sites. Increased frequency of cancers in divisions containing hazardous waste sites was found in most studies, particularly for gastrointestinal, esophageal, stomach, colon and rectal cancer. (UNEP, 2000). So it must be noted that Methane is a by-product of the anaerobic respiration of bacteria, and these bacteria thrive in landfills with high amounts of moisture. Methane concentrations can reach up to 50% of the composition of landfill gas at maximum anaerobic decomposition (UNEP, 2006). Although less well established, results from large US cohort studies suggest that long-term exposure to low concentrations is associated with chronic health effects such as increased rates of bronchitis and reduced lung function, shortened life span, elevated rates of respiratory symptoms and lung cancer.

Methodology

A sample size of 200 was selected. These included; 30 Heads of Households,25 Business operators, 25 Elected Leaders, 20 Heads of directorates, 50 Garbage Collectors and 40 common citizens. Purposive sampling was used to identify subjects among elected leaders, heads of directorates from the Ministry of environment, Solid waste Collectors and common citizens. The above categories of respondents were expected to be more knowledgeable on issues on solid waste management and therefore major source of information. The Technical team from heads of directorates included City council Clerk, Senior Assistant Town Clerks, Town Health Inspector, Environment Officer, Engineer, Chief Finance Officer, Health Educator, Education Officer and Community Development Officer. Qualitative research methodology was used through face to face interviews, focused group discussion and telephone interviews. Interviews provided in-depth data, were more flexible and yielded more information by using probing questions. They also provided opportunity to observe non-verbal behaviour and to record spontaneous answers. The data was collected, analyzed by arranging the data into different themes and by source of information. Data was then coded to generate a description of the setting as well as categories of themes for analysis. An interpretation of the data was made in accordance with the study variables and study objectives.

Findings

i) Urban population growth significantly affects solid waste management. Population growth poses the challenges of solid waste segregation since the waste is indiscriminately disposed off
ii) Funding has a significant positive effect on solid waste management. Insufficient funding leads to inadequate provision of facilities and equipment for solid waste management.
iii) Urban population behavior significantly affects solid waste management. This was as a result of inadequate enforcement of public health legislations and solid waste management by-laws

Discussion of the findings

i) Effects of urban population on solid management in Juba city council

From the data collected, 50% of the respondents attributed urban population growth to problems facing solid waste management in Juba city in South Sudan, 30 % said it was corruption in the city council that has led non collection of waste from the streets and estates and 20% attributed it to poor implementation of policies on waste management in the city council. These findings were in line with Ecaat (2003) who maintained that, whereas it was true that the problem of urban waste manifests itself as an environmental concern requiring putting in place sound environmental practices, it was also true that, the waste problem to an extent was a function of irresponsible behavioral tendencies associated with an urban population. Matovu (2002) further revealed that it was with great concern that solid waste management was one of the pressing problems facing municipal areas, arising from rapid

urbanization due to the growing number of unplanned settlements (Matovu, 2002). Polythene bags and plastic waste have become a serious health and environmental hazard in residential and commercial areas because in addition to their traditional use as food containers, some residents use polythene bags as 'toilets' which are dumped in trenches, on the streets, garbage heaps, around homes and water sources leading to constant outbreaks of cholera, malaria, and typhoid. The allusion that many cities were increasingly facing solid waste management challenges due to rapid urbanization, lack of technical and financial capacity or low policy priority and urbanization and population growth will continue to double solid waste generation by 2025 according to UN HABITAT (2018), is a reality today.

Effects of urban population behavior on Solid waste management

The respondents were asked whether there were effects on urban population behavior on solid waste management in Juba city. 80% of the respondents were affirmative that the behavior of the residents of Juba City council on solid waste management were wanting. Many cited occasions when it was about to rain, many residents carry their waste in sacks and throw in waterways so that the running water could carry the waste. 20% still insisted that it was the laxity of the waste management officials of the city council. This concurred with behavioural finance theory by Jung (2003) that the focus was on relevance to service providers of investment management in that Service providers learning from behavioral finance ought to learn to make out their own mistakes and those of others, comprehend those mistakes, and take mitigation strategies where necessary and applicable. Uncollected solid waste can end up in drains leading to the blockage of drainage systems and cause unsanitary conditions that have a direct health impact on residents. In Juba city and other urban centres in question, if service providers lack effective behavioral mannerisms in their service provisions then solid waste management lacks effective managerial control hence poor services in the Cities and related municipalities.

Effectiveness of Juba City Council on Solid waste management

The respondents were asked on how effective Juba city council was as far as solid waste management was concerned. Majority 75% of the respondents averred that the solid waste management by Juba city council was below expected standards. A paltry 25% of the respondents in particular from the Ministry of environment and Juba city council defended their position that the city council was trying its best but hindered by poor funding and civic education to the residents. The question of garbage collection or solid waste management by cities, municipalities and urban centres was and is still a challenge in most developing countries, Juba not being exceptional. According to Levine (1997), modernization through urbanization and industrialization has had its share of disadvantages and one of the main aspects of concern was the pollution it was causing to the earth be it land, air, and water. With increase in the global population and the rising demand for food and other essentials, there has been a rise in the amount of waste being generated daily by each household. This waste is ultimately thrown into municipal waste collection centers from where it is collected by the area municipalities to be further thrown into the landfills and dumps.

However, either due to resource crunch or inefficient infrastructure, not all of this waste gets collected and transported to the final dumpsites. If at this stage the management and disposal is improperly done, it can cause serious impacts on health and environment (Levine, 1997). In addition, direct handling of solid waste can result in various types of infectious and chronic diseases including cancers and respiratory infections resulting from exposure to dust and hazardous compounds (Muggaga, 2006). Cancer and several geographical comparison studies have investigated cancer mortality and incidence around waste sites. Increased frequency of cancers in divisions containing hazardous waste sites was found in most studies, particularly for gastrointestinal, esophageal, stomach, colon and rectal cancer (UNEP, 2000). So it must be noted that Methane is a by-product of the anaerobic respiration of bacteria, and these bacteria thrive in landfills with high amounts of moisture.

The current practices of collecting, processing and disposing of solid wastes are also considered to be insufficient in the developing countries, South Sudan included. The typical problems are poor management practices, low collection coverage, irregular collection services, crude open dumping and burning without air and water pollution control (Remigios, 2010). According to Okot-Okumu (2012), only less than 30% of the urban population has access to proper and regular garbage removal. That poor waste management in the developing countries is a major threat to public health and environmental quality and reduces the quality of life, particularly for the poorer residents in both urban and rural areas (Wagner et al., 2011).

Challenges

The respondents had various views and opinions on the challenges facing solid waste management in Juba city council. 40 % said funding, 30% said lack of policy implementation, 15% said corruption and 15% attributed it to lack of awareness of the residents on effects of waste management. According to Akuei, (2017) handling of wastes in south Sudan is becoming more and more challenging day by day, as most of the municipalities do not have the institutional capacities and necessary financial resources to deal with these problems (Akuei, 2017). Collection, transportation, and disposal of MSW demonstrates a huge expense for developing nations. Akuei further avers that management of waste generally accounts 30 to 50 percent of municipal operational budgets. Despite these high expenditures, cities collect just below 50 percent of the refuse produced. On the issue of policy implementation, this concurs with institutional theory that public policy is indomitable by government institutions, enforcement bodies which provide services and provide policy legitimacy (Nyawira, 2017). The policy enforcer applies guidelines to all people of society and monopolizes the strength of the applying policy; for instance, the legislature, executive and judicial branches of government are examples of institutions that enact, amend and enforce policies both that govern assets and provision of services. Anderson (2002) considers policy as an institutional yield. Government institutions have long been an epicenter focus on service provision.

Recommendations

Based on the findings of the study, the following measures were recommended for efficient and effective management for urban centres in South Sudan.

Provision of adequate Skips and Dustbins

Adequate dustbins and skips should be provided by the municipalities. This should be provided particularly for the low class residential and middle class residential areas to avoid dumping of waste in open spaces, gutters, boilers and roadside. These should be placed at least within 30 metres radius and at most 50 metres radius in the low class residential areas. With this, residents in the low class residential areas will spend less time to dispose of their domestic waste at the skip site. In order to alleviate the problem of insufficient and inadequate solid waste management facilities and equipment, it is recommended that, the use of other collection systems and storage facilities be effected. In order to achieve the above, Juba city and urban centres management should commit more funds to solid waste management. The study has shown that, there is need to put more funds to purchase more equipment and to facilitate collection and disposal of wastes. Funds could be raised levying of waste taxes, and fines imposed on residents caught dumping wastes illegally or by attracting donor agencies to come to their aid and finance solid waste management.

Regular Collection of Wastes

There should be regularity of waste collection by the municipalities and city councils particularly in highly populated areas like Shirkhat, Gudele, and Konyokonyo to avoid heaping of wastes and over flowing of skips with solid waste. At least, waste should be collected four times a week in these areas and thrice in the Middle and high class residential areas. There should be regular monitoring of waste collection by various municipalities. This will keep the place constantly clean and prevent any possible outbreak of communicable diseases such as cholera and typhoid.

Use of Integrated Solid Waste Management

A large proportion of the wastes generated in Juba city is biodegradable and can be re-used hence an effort should be channeled towards putting these wastes to more productive use. It is therefore recommended that, segregation of waste be embarked upon in order to add value on the waste. Waste segregation should take place at the point of its generation such as at the residential and commercial premises levels. The sorting should be between bio-degradable and non-biodegradable waste. Biodegradable materials can be used to make compost to improve soil fertility or as animal feed especially the peelings of food stuff. The non-biodegradable wastes although less in composition than biodegradable wastes. Could also be re-used to reduce the quantity of wastes to be disposed for example, tins and bottles can be re-used as storage containers in homes for storing food or wastes. The integrated Solid Waste Management (ISWM) should be adopted to ensure effective solid wastes management in the area. Residents should be encouraged by the city to separate the waste generated into their

various components before final disposal. For example, waste can be disaggregated into plastic, metals, wood, cans, bottles and food waste. In this case rubber cans, bottles, metals can be reused; plastics like polythene bags and empty water sachets can also be recycled. The rest like food waste can be composted for manure, incinerate those that are combustible and land filled those that cannot be subjected to any of the above mentioned methods.

Proper Management of Landfill

The landfill site should be properly managed to avoid heaping of waste and burning. The following should be revived for the landfill to work effectively. These include the gas recovery system and leachates collection system. With the proper leachates system put in place the possibility of waste polluting groundwater the area will be prevented. Also, waste dumped in the landfill should be spread, compacted and cover with soil. This will prevent heaping of waste in the landfill. Furthermore, the landfill management should ensure that waste that is carried to the landfill does not contain fire. Any container that contains fire should be isolated and fire quenched before dumping is done. Waste collection sources should be checked to ensure that waste does not contain any drop of fire. This will go a long way to prevent the burning of waste in the landfill.

Adequate Resourcing and Technical capacity building

The waste management institutions should be adequately resourced by the state through local government to ensure efficient and effective waste management in the area. The state should liaise with other corporate bodies like the United Nations Development Program (UNDP) as well as UNEP to pull financial resources to support the institutions in charge of managing waste. With the support, adequate dustbins, skips and core waste management equipment such as compaction trucks would be purchased to ensure effective waste collection and disposal. People particularly in the low class residential areas should be made to pay for disposing their waste. This is because they are the very people who generate the waste. That is the 'pay as you throw principle' should be introduced. All these should be done through education by letting residents know the importance of environmental cleanliness and how they can contribute to it. This will go to support the financial base of the waste management institutions. In order to improve technical and managerial capacity for solid waste management in Juba city, there is need to develop capacity to prepare action plans for waste management and monitoring, and to develop the ability to monitor, understand and adequately manage the solid waste production and disposal cycle. It is hoped that, once the capacity is built, it will set the basis upon which Juba City Council will mainstream planning and resource allocation for waste management. It is also important that, capacity building for improved waste management should focus on assisting other Urban centres to put in place deliberate policies and environment management action plans that integrate waste management as a component.

Law Enforcement

Whereas it is true that laws related to waste management do exist, more needs to be done in strengthening the enforcement capacity of Juba city council. Strict law enforcement is needed

in the area of indiscriminate open dumping of waste on streets. The law enforcement personnel need to be availed with the necessary knowledge and skills and management support to enforce the law. In order for this to work effectively, the city Council should be in position to enforce the laws as the situation demands.

Legislations:

In order for any plan to work, it must be backed by legislative measures which will help to enforce the decisions that have been made. Bye-laws against littering should be enacted and enforced as the situation demands, for instance, culprits who litter the area with solid waste should be apprehended and fined. Juba city and other urban areas should also advocate for a bye-law for privatization of solid waste management such that, private collection firms can come up to relieve the pressure on the local authorities who have failed to adequately manage the solid waste.

Evaluation Criteria

The evaluation criteria of waste should be carried by the city or municipalities for effective data survey for planning and management of waste. For example, the total city or municipality solid waste generated by the city can be estimated by multiplying the city or municipal solid waste generation per capita by the population of the city. When the municipal solid waste generation per capita is not available, household surveys for daily waste generation in households and other premises for example, restaurants, hotels, hospitals, schools should be conducted. Since the waste generation can differ according to the seasons, the survey should be conducted at least two times a year to estimate the municipal solid waste generation per capita. Municipal solid waste regularly collected with adequate final treatment and disposal is estimated through qualitative judgment of the degree of environmental control of facilities where the city's municipal waste is collected and transported. The judgment of environmental control can be conducted in line with the criteria set. It is also important to deduct residue amount from treatment facilities to avoid double count.

Conclusion

The involvement of people and private sector through NGOs could improve the efficiency of solid waste management (SWM). Public awareness should be created among masses to inculcate the health hazards of the wastes. Littering of MSW should be prohibited in cities, towns and urban areas notified by the state government through a policy formulation. House-to house collection of MSW should be organized through methods like collection on regular pre-informed timing and scheduling (Speise, 2010). The collection bins must be appropriately designed with features like metallic containers with lids, and to have a large enough capacity to accommodate more than the expected waste generation in the area, with a design for mechanical loading and un-loading, placement at appropriate locations. The city Council authorities should maintain the storage facilities in such a manner that they do not create unhygienic and unsanitary conditions. Proper maintenance of the MSW transportation vehicles must be conducted. Currently, at the level of waste generation and collection, there is no source

segregation of compostable waste from the other non-biodegradable and recyclable waste. Proper segregation would lead to better options and opportunities for scientific disposal of waste. Recyclables could be straightway transported to recycling units. This would help in formalizing the existing informal set up of recycling units. It could lead to several advantages such as enabling technology up gradation, better quality products, saving of valuable raw material resources of country, reducing the need for landfill space, a less energy-intensive way to produce some products and employing labor in recycling industries. Organizing the informal sector and promoting micro-enterprises are an effective way of extending affordable services. Promotion and development of recycling is a means of upgrading living and working conditions of rag pickers and other marginalized groups. Finally, the study concluded that the lack of resources such as financing, infrastructure, planning and poor policy implementation and leadership, are the main barriers in effective solid waste management (SWM). The increase of service demands combined with the lack of resources for City councils and municipalities are putting a huge strain on the existing SWM systems.

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