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DETERMINANTS OF SOLID WASTE MANAGEMENT SYSTEM IN UYO METROPOLIS, AKWA IBOM STATE, NIGERIA

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Abstract
Solid waste is one of the major challenges facing Nigerian cities. Waste management problem is complex because it involves a multitude of scientific, technical, economic and social factors. However, this essential service is not effectively and properly performed by the concerned bodies in Uyo Metropolis of Akwa Ibom State. Data were collected from both secondary and primary sources. Data on the existing solid waste management system in Uyo Metropolis were collected from primary source through the use of questionnaire and the sample size was determine using Taro Yamane formula. Four hundred copies of questionnaire were administered in the five zones that were demarcated for this study of which 40 questionnaires were administered to Town Planners and 16 questionnaires to Waste Management Expert respectively. Simple random and systematic sampling techniques were employed to select the respondents. Principal Component Analysis was used to test the hypotheses. Out of the 30 factors that influenced solid waste management system which were identified in this study, 6 influence partly the solid waste management system in Uyo metropolis. These were; adequate policy framework, public education and awareness, strong institutional framework, proper management, transparency, and adequate staffing. The study recommends among others, the adoption/integration of the 6 identified factors of efficient solid waste management system in Uyo Metropolis, as this will go a long way in the improvement of solid waste master plan preparation/implementation in Nigeria and globally.

Key Words: *Determinants, Solid Waste, Management, System*

Introduction

Solid waste is any byproduct of human activities which tends to increase with rapid urbanization, improved living standards and changing consumption patterns. Management of increasing amounts of solid waste has become a major challenge in many cities of developing countries. Solid waste management is therefore a critical component within urban sanitation, thus, it is considered by governments as an essential social service whose budgetary provision is made in line with population projections.

Municipal wastes in developing countries have a higher proportion of organic matter and ash, higher moisture

content and lower paper content, although refuse from the wealthier suburbs is similar in composition to West European wastes. Organic matter and ash may account for between 60-85% of all wastes in low income settlements (UNEP 2004). However, most urban residents consider solid waste management as the most important environmental problem faced by humans. In Nepal, urbanization is increasing at an alarming rate putting immense pressure on municipal services, particularly in managing the ever increasing amounts of waste. Thus, management of solid waste is a growing concern in Nepal as urban population densities increase and usable land is in short supply.

In Nigeria, most of the wastes generated in municipalities are not being adequately managed thereby creating a serious health and environmental hazard, particularly in the slum and squatter areas, where the residents have less capacity to pay for better services and are often ignored by the official agencies. Therefore, poor urban settlements are most affected because of indiscriminate dumping of waste and lack of open spaces (UN-Habitat 2008).

The mountainous heaps of solid wastes that deface Nigerian cities and the continuous discharges of industrial contaminants into streams and rivers without treatment motivated the Federal Government of Nigeria to promulgate Decree 58 for the establishment of a Federal Environmental Protection Agency (FEPA) on 30 December 1988, and the NESREA Act. In spite of the formulation of NESREA Act in 2007, the environment has not been adequately protected. The poor state of waste management in Nigeria is attributable to an inadequately formulated and poorly implemented environmental policy, among other factors. Besides, waste management is a multidimensional problem that has been aggravated in Nigeria by rapid urbanization and population growth rate. Therefore, the state environmental agencies are continuously faced with an increasing amount of solid wastes to handle.

Uyo Metropolis in Akwa Ibom State is not spared the menace of un-evacuated solid waste. The creation of Akwa Ibom State in 1987 led to the upgrading of Uyo from a provincial and local government headquarters to a state capital. Since then, the city has experienced a great influx of people accompanied by a high demand for both residential and commercial accommodation (Imoh et al 2011). These have resulted in urban environmental problems of which the management of solid waste is the most outstanding. A close examination of municipal solid waste management in Uyo Metropolis shows that, the present strategies are deficient and need to be re-addressed because if ignored, can pose a serious threat to health, the environment and urban productivity. However, to curb the challenges posed by deficient solid waste management in Uyo Metropolis, there are some determinants that can boost efficiency in solid waste management system, hence, the need for this study.

Literature Review

Solid Waste Management in Nigeria

Nwachukwu (2009) reported that, Nigerian cities and towns are currently facing serious environmental problem arising from poor solid waste management. In spite of the efforts (such as, involvement of the private sector,

enactment of various environmental sanitation and protection laws, establishment of solid waste disposal agencies, etc) made by the government to curb the menace, the problem still persists. According to him, in Onitsha, this problem is worsening by two factors: first, the rapid socio-economic development of Onitsha which pulls migrants from different parts of Nigeria, and secondly, the increasing population of the city. In view of this, he empirically analyzed the solid waste generation and disposal in Onitsha metropolis in order to propose an efficient and effective solid waste management system for the city. Using simple linear regression to test two postulated hypotheses, he found that, the volume of solid waste generated in Onitsha metropolis increases as the population increases, and, the rate of solid waste disposal in Onitsha is out-paced by the rate of its generation. Based on this, he recommended that, Anambra State government should call for privatization of solid waste management as well as providing adequate funding for agencies responsible for refuse collection and disposal in Onitsha metropolis. In addition, the State Government should prohibit street trading in Onitsha metropolis, and provide adequate alternative trading sites at the periphery of the city for street traders so as to retain the aesthetic value of the city.

Solid Waste Characteristics and Management in Nigeria

Ogwueleka (2009) in assessing the municipal pointed out that, municipal solid waste management has emerged as one of the greatest challenges facing environmental protection agencies in developing countries. According to him, solid waste management in Nigeria is characterized by inefficient collection methods, insufficient coverage of the collection system and improper disposal. The waste density ranged from 280 to 370 kg/m^3 and the waste generation rates ranged from 0.44 to 0.66 kg/capita/day, the waste generation rate is typical of low income towns. The rate of waste generation is highly influenced by the population income. The density of solid waste in Nigeria ranges from 250 kg/m3 to 370 kg/m3 higher than solid waste densities found in developed countries. Stressing further, he revealed that, in Nigeria, 25 million tones of municipal solid wastes are generated annually. Against this backdrop, he recommended that, in order to achieve sustainable and effective waste management system in Nigeria, there is a great need to consider the political, institutional, social, financial, economic and technical aspects of municipal solid waste management.

Eja *et al.* (2010) studied the environmental and public health-related assessment of solid waste management in Uyo, Akwa Ibom State. They opined that, the open waste dumped at dumpsites could constitute sources of microbial and toxic chemical contamination of the dumpsite soil and streams through run-off input, which could pose serious health risk and destruction of biodiversity in both terrestrial and aquatic ecosystems. Health risk assessment was determined by a survey of existing facilities for solid waste management, which included waste bins, types of depots, mode of transportation of wastes to disposal sites and the methods of disposal. Microbiological and physiochemical analyses of decomposing waste, soil and

air at dumpsite, leachate and nearby Akpayak stream water were carried out using standard procedures. Findings indicated that, prevalent bacteria besides fungi isolated from solid waste, soil, leachate and Akpayak stream were *Staphylococcus* 38(25.85%), *Escherichia* 51(19.61%), *Pseudomonas* 44(34.11%) and each of *Shigella/Salmonella* 36(21.82%), respectively. Furthermore, the total bacterial counts showed no significant difference (P>0.05), unlike fungal counts which showed highly significant difference (P<0.01) between sources of samples and months of sampling. Solid waste followed by soil, had the highest count at 5% level of probability. These findings, coupled with the high aerial bacterial counts, indicated a high risk of microbial infection from the waste dump and the improperly stored waste in homes. They therefore concluded that, there is a high risk of diseases and potential destruction of biodiversity from toxic chemicals contained in the waste. In view of this, they recommended that, both governments and private sectors should review the present waste management practice in relation to traditional methods in Uyo Metropolis.

Study Area

Uyo Metropolis is located between latitude 4º59' and 5º04' north of the Equator and between longitudes 7º53' and 8º00' east. Also, the area is located on an elevation of about 60.96 meters (2090ft), above sea level. It is located between 112,000m S – 118,000mN) and 604,000m – 610,000m W in the UTM Zone 32.

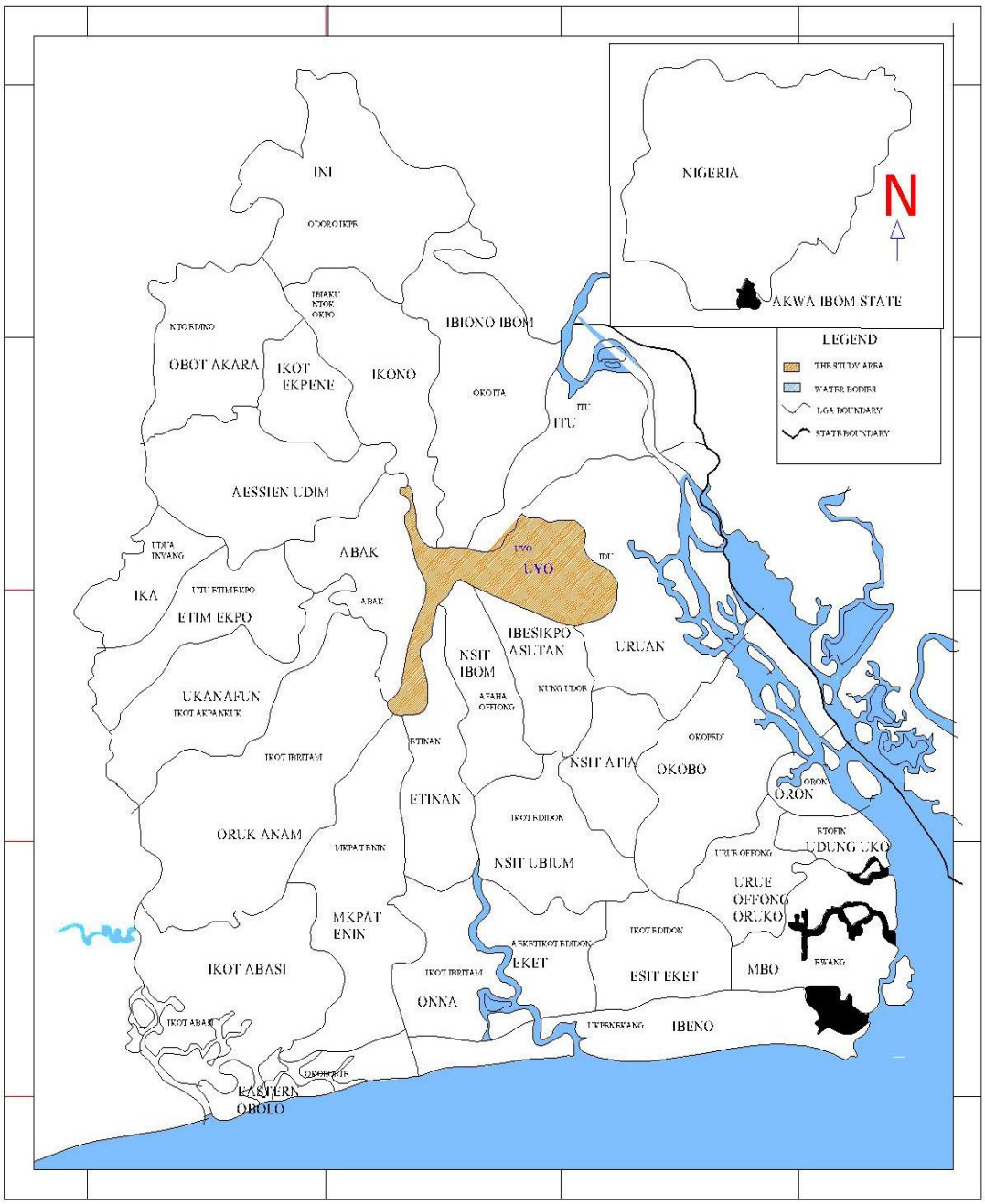

Fig 1: Map of Akwa Ibom State Showing Uyo Local Government
Source: Ministry of Lands, Surveys and Town Planning 2007

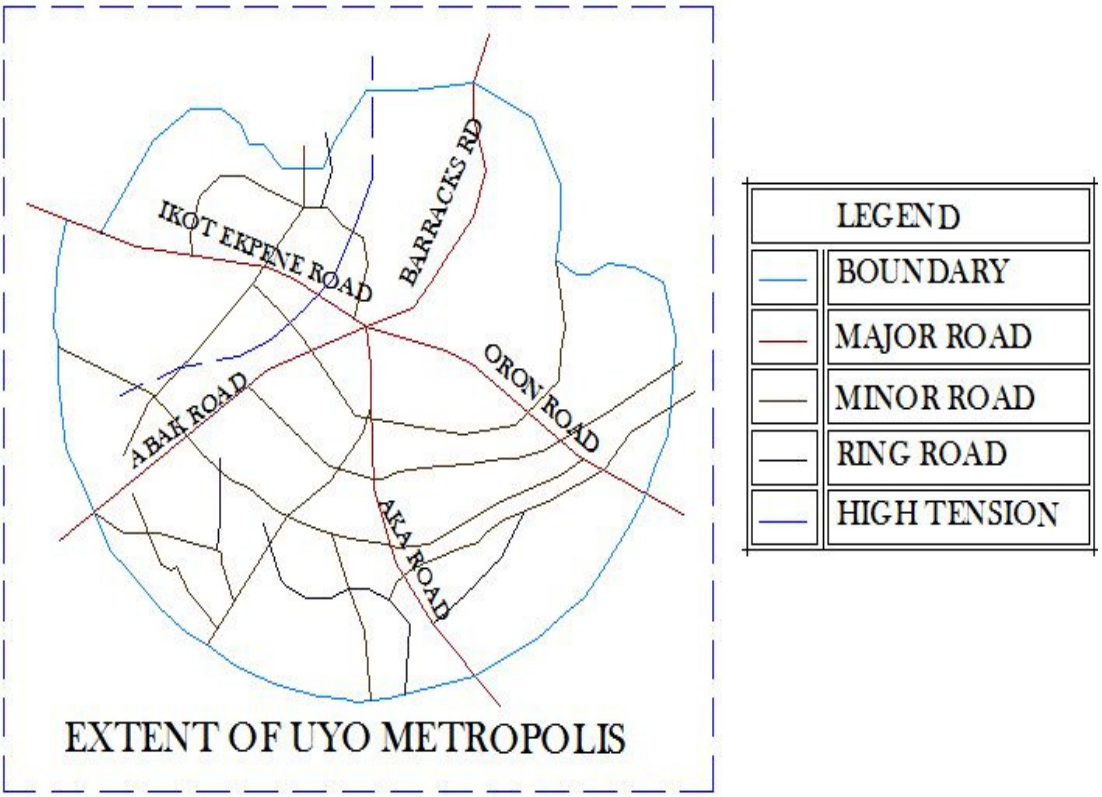

Fig. 2: Map Showing Extent of Uyo Metropolis

Research Hypotheses

Ho: Factors that determine efficient solid waste management system in Uyo Metropolis cannot be significantly identified and classified.

Ho: The extents to which factors that determine efficient solid waste management system in Uyo Metropolis cannot be significantly measured.

Methodology

The study adopted a survey design approach. Data were collected from both secondary and primary sources. Data on the existing solid waste management system in Uyo Metropolis were collected from primary source through the use of questionnaire. These data were used in the test of two hypotheses formulated in this study. Four hundred copies of questionnaire were administered in the five zones that were demarcated for this study. The sample size of 400 respondents was determined from the sample population of 309,573 resident population of Uyo metropolis using Taro Yamane Formula. See Table1 which justify the selection of the sample size of 400. However, three hundred and eighty three (383) were returned representing 96% questionnaire utilization. Simple random and systematic sampling techniques were employed to select the respondents. A Principal Component Analysis was used to test the hypotheses.

Table 1: Guideline for Sample Size Selection

Population	Sample Size
Small Population	Survey the entire population
500	50%
1500	20%
2000-3000	15%
3000- < 5000	10%
About 5000 or more	400 sample size should be adequate

Source: Adapted from Leedy and Ormrod, 2005; Olatunji, 2010, Usman, 2015

No	Roads/ Zones	Number of Buildings	Questionnaire Distributed	%	Rate of Return	%
1.	A-Abak Road	210	69	17	66	16
2.	B-Aka Road	219	72	18	70	18
3.	C-Barracks Road	184	60	15	58	15
4.	D-Ikot Ekpene Rd	230	75	19	72	18
5.	E-Oron Road	208	68	17	65	16
6.	Town Planners	121	40	10	40	10
7.	WME	50	16	4	12	3
	Total	1,222	400	100	383	96

Results

Inadequate equipment (34%) was the most prominent factor responsible for inefficient solid waste management system. This was followed in descending order by lack of citizen's participation (26%), lack of funding (21%) and inadequate staffing (15%). Of the 30 factors that influenced solid waste management system which were identified in this study, 6 influence partly the solid waste management system in Uyo metropolis. These were; adequate policy framework (.96), public education and awareness (.96), strong institutional framework (.94), proper management (.95), transparency (.98), and adequate staffing (.62). The 6 identified factors accounted for 100% of the factors of solid waste management in Uyo metropolis. The contributions of each of the factors in descending order are as follows: adequate policy framework (21.157%), public education and awareness (20.522%), strong institutional framework (20.253%), proper management (16.387%), transparency (16.233%), and adequate staffing (5.449%). Factors of solid waste management system in Uyo metropolis do not differ significantly among the various neighborhoods in Uyo metropolis ($p > .05$).

Table 2: Percentage of Variance Explained by the Five Factors

Component	Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %
1.	6.347	21.157	21.157
2.	6.157	20.522	41.679
3.	6.076	20.253	61.932
4.	4.916	16.387	78.319
5.	4.870	16.233	94.551
6.	1.635	5.449	100.000

Extraction Method: Principal Component Analysis

Discussion

Solid waste management in Uyo Metropolis as evident in this study indicates some major problems. The waste management agency can only boast of eight administrative staff and eleven ad-hoc staff that are inexperienced with very little or no formal training whatsoever in waste management issues. There were only six (6) compactors in the waste management agency, five (5) roll-on that was donated by Niger Delta Development Commission (NDDC), fifteen (15) trucks but out of the fifteen, two (2) is owned by the agency while thirteen (13) is placed on contract. There are about three thousand, two hundred and eighty (3,280) receptacle bins in the agency. Findings had it that the dumpsite platform collapsed some months ago, and the recycling unit is under construction, and as such there is no waste sorting, separation or recycling.

Furthermore, there is a general paucity of data on key waste variables such as waste composition, densities, storage and transportation. The above snag does not only make waste collection and disposal very inefficient but goes a long way to betray the complete apathy on the part of the twelve (12) board members in charge of waste management system in the agency. This is because the availability of accurate information on these attributes is a prerequisite for efficient waste management in any environment. On investigation, disposal of solid waste is on a daily basis and the workers are also paid on a daily basis. The implementation of environmental standards and the persecution of defaulters are made difficult because of the non-enforcement of the existing comprehensive legal framework provided in Akwa Ibom State (2000) for dealing with the problem. Many residents, for instance, dump their waste directly into the urban drainage system and walk away unpunished. Also, the complete lack of waste recycling and reuse arrangements either by government or private agencies indicates clearly that a greater part of useful materials like paper, plastic and polythene, bottles and metals are being thrown away. The State waste management unit has since inception suffered from poor funding, lack of motivation and incentives in the form of allowances to staff that face all sorts of hazards in the collection, transportation, as well as disposal of waste generated in the city.

Despite the laudable achievements of the Akwa Ibom State Agency for Waste Management, the findings in this study have revealed that the nature of the existing solid waste management is not efficient. The spatial spread of receptacle

bins is not evenly done with respect to the population density of a particular area.

Determinant of efficient solid waste management system in Uyo Metropolis

The thirty (30) factors that influence efficient solid waste management system in uyo metropolis were identified in this study through extensive literature review. The result of the first hypothesis showed that six (6) out of the thirty (30) identified factors are the determinants of efficient solid waste management system in Uyo Metropolis. These variables are: adequate policy framework, public education and awareness, strong institutional framework, proper management, transparency, and adequate staffing. The implications of these results with respect to each of the factors are as follows:

Adequate Policy Framework

Adequate policy framework is a major determinant of efficient solid waste management system in Uyo Metropolis. This is because there must be a development of integrated policies on waste minimization, reuse, recycling, and disposal. One of the essential aspects of these policies is the framework for adequate provision of waste collection, transportation, and disposal facilities. The elaboration of an appropriate legal and regulatory framework and body of instruments which enable responsible authorities to achieve and sustain their defined goals is a prerequisite for solid waste management. Adequate policy framework hinges on the implementation of roles, rights, and responsibilities of service users so as to achieve an organized structure of solid waste management services.

Public Education and Awareness

Public education and awareness is an outstanding factor that determines efficient solid waste management system in Uyo Metropolis. Solid waste management system revolves around public enlightenment and public participation because the public remains a recurrent decimal in solid waste management. The orientation of the populace on the importance of proper solid waste management towards real service needs and demands and also on solid waste management problems and priorities is unavoidable because it gives them the sense of belonging as they are carried along from plan preparation to plan implementation.

Strong Institutional Framework

Availability of strong institutional framework helps to achieve a clear definition of jurisdictional arrangements for waste management tasks in Uyo Metropolis. Strong institutional framework includes the devolution of solid waste management responsibility to local government so as to ensure decentralization of power. It also provides a basis for planning and improvement of operational efficiency in waste management. Appropriate regulatory framework helps responsible authorities to achieve and sustain their defined goals.

Proper Management

Proper solid waste management is a major factor that brings about efficiency. The six factors of efficient solid waste management are encapsulated in proper management because it involves the implementation of adequate policies, the orientation of the populace, transparency and adequate staffing. Proper solid waste management also includes the improvement of effectiveness through the

participation of communities and service users in local waste management, inculcating the culture of the people into solid waste management system.

Transparency

Transparency in solid waste management could be attributed to the issue of finance through the establishment of practical systems of budgeting and cost accounting for solid waste, the mobilization of the resources required for investment in waste management services and equipment. The achievement of cost-oriented revenues for waste management operations which are based on user charges, and ensuring that the collected revenues are applied to the intended purpose of waste management.

Adequate Staffing

Adequate staffing is one of the determinants of efficient solid waste management system in Uyo Metropolis. It is obvious that the number of staff at their disposal is not adequate as most of the staff do work till about 7pm. Efficiency in solid waste management involves the stimulation of the interest of workers through provision of adequate financial remuneration, and proper incentives, protection of the health of the waste workers.

Conclusion

Waste management has emerged as one of the greatest challenges facing municipal governments in Nigeria and other developing countries. The volume of waste being generated continues to increase at a faster rate than the ability of the authorities to improve on the financial and technical resources needed to respond to this growth. Municipal waste management is the collection, keeping, transportation, treatment and disposal of waste materials in such a way as to render them harmless to human and animal life, the ecology and environment as well as local aesthetics. In every cities, there should be an organized and systematic channeling of waste through practically, economically and technically appropriate recovery and disposal route which is in accordance with acceptable public safeguards.

The study identified factors that determine efficient solid waste management system in Uyo Metropolis. The results of the test suggest that out of 30 variables, 6 are the determinants of efficient solid waste management system in Uyo Metropolis. The identified factors are: adequate policy framework, public education and awareness, strong institutional framework, proper management, transparency, and adequate staffing. Furthermore, the results showed that the 6 identified factors accounted for 100% in determining efficient solid waste management system in Uyo Metropolis.

Recommendations

Generally, successful waste management is hampered by several problems including lack of financial and technical support, inadequate human resources, absence of enabling legislations and un-integrated policies. Sequel to the rapid urbanization in Uyo Metropolis, solid waste management has become a delicate problem that needs an undivided attention, even as some unguided development and un-integrated solid waste management policies had resulted in environmental degradation, with serious health implications.

The interrelationship between the different aspects of solid waste

management and the societal characteristics have not been adequately analyzed and integrated. An environmental management plan with clearly defined objectives needs to be articulated into an ideal approach aimed to achieve a cleaner urban area. Against this background, a greater investment should be made in the area of refuse storage, sorting, collection and disposal. Solid waste management problems should be considered form a more holistic point of view since they are interrelated with no fixed boundary, and revolve around crucial issues far beyond the waste profession. Against this backdrop, the following recommendations are made.

Developing a Plan for Integrated Solid Waste Management

Planning is the first step in designing or improving a waste management system. Waste management planners should take into consideration political, institutional, social, financial, economical, and technical factors. These factors vary from place to place; each community may have the challenge of selecting the combination of waste management activities that best suits its needs. Because integrated solid waste management involves both short and long-term choices, it is critical to set achievable goals. While developing an Integrated Solid Waste Management (ISWM) plan, one should identify goals or objectives e.g. protect human health, protect water supplies, eliminate open dumping, increase recycling or composting. The ISWM plan will help in the implementation process. There is a greater need to ask for the community's input in developing the ISWM plan so as to gain the public acceptance. Government should help in developing and enforcing waste management standards, providing funds, and managing day-to-day operations of solid waste management activities. Each level of government may have responsibility in your ISWM plan: national governments typically set standards for solid waste management; the state, provincial or regional governments may help monitor and enforce these standards; and local governments often play the primary role of managing solid waste activities on a daily basis. All levels may also provide funding for solid waste management activities. Two primary costs must be considered in any waste management system: initial capital costs (to purchase equipment or construct new facilities) and ongoing operations and maintenance costs. These costs can be funded in a number of ways including private equity, government loans, local taxes, or user fees.

Implementing an Integrated Solid Waste Management (ISWM) Plan

Implementing an ISWM plan is an ongoing process, so one is expected to make adjustments to the plan along the way. The system inefficiencies should always be evaluated and adjustments made to improve or expand solid waste management services. To implement an ISWM plan, some of the necessary steps must have been taken in the development process such as identifying the roles and responsibilities of each level of government, encourage citizen participation in all phases of waste management planning to help gain community awareness, input, and acceptance. Identify sources that can provide funding for solid waste management, including general revenues

or user fees, the private sector, and government or international agency grants and loans. This is important because one has to assess how they fit into the comprehensive implementation process. Equally important is the need to be flexible and creative when implementing your plan. If one is not making progress in a certain area, be prepared to reevaluate the components of your plan. It is helpful to keep in mind the ultimate goal of ISWM: to improve human health and protect the environment.

Provision of Sanitary Landfill Facilities

Controlled waste disposal can help improve and protect the health of local populations and preserve valuable environmental resources, such as groundwater and drinking water. There are two options for waste disposal: operate a properly designed, constructed, and managed landfill or burn the waste in a controlled facility that converts waste to energy. To achieve effective disposition of solid waste in a rapidly growing city such as Uyo Metropolis, a sanitary landfill is eminent. This is consequent upon the fact that it reduces pests, diseases, air pollution, ground and surface water pollution in addition to promoting aesthetic values. Unlike incineration which results in residue and fly ash, which must eventually be disposed of, sanitary landfill is preferable for efficient solid waste management system to be achieved.

However, to protect human health and the environment, Akwa Ibom State Environmental Protection and Waste Management Agency should discourage the use of existing open dumps and establish a managed site for solid waste disposal. Safe, well-controlled waste placement distinguishes a landfill from an open dump. To provide a properly designed, constructed, and managed landfill in Uyo Metropolis, the agency can convert an existing uncontrolled dump to sanitary land fill or construct a new landfill.

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