



Application of Integrated Sustainable Solid Waste Management (ISSWM) Approach in Waste Management for Economic Transformation of Port Harcourt

¹Deeyah Christopher L., ²Baadam Livinus E., ³Uebari, Sunday L. and ⁴West Tamunomiete

¹Department of Estate Management, School of Environmental Sciences, Ken Saro-Wiwa Polytechnic, Bori

^{2,4}Department of Urban and Regional Planning, School of Environmental Sciences, Ken Saro-Wiwa Polytechnic, Bori

³Department of Mechanical Engineering, School of Engineering, Ken Saro-Wiwa Polytechnic, Bori

Correspondence emails: chrisdeeyah@yahoo.com and livybas@yahoo.com

Abstract: Waste disposal remains a major problem for many low income countries. The application of integrated sustainable waste management for waste management has been accepted by decision-makers to address waste management. It refers to a waste management system that best suits the society, economy and environment in a given location, a city in most cases. This study aims to demonstrate the need to encourage the adoption of Integrated Sustainable Solid Waste Management in management of urban waste. After reviewing relevant literatures, a face to face interview was conducted with stakeholders including waste contractors, NGO's, and academia using snowball and purposive sampling technique. The study examines the concept of Integrated Sustainable Waste Management (ISWM), and assesses waste management practices in the city of Port Harcourt within the three dimensions of sustainability of ISWM. Findings reveal that there are no NGOs or any international or national donor agency involvement, non-recognition of waste minimization, re-use and recycling, gross inadequacy of facilities for waste separation system, including waste containers and waste collection points in waste management in Port Harcourt. This study recommends that an integrated approach to waste management which calls for a multi stakeholder involvement in every stage of the waste stream be adopted.

Keywords: Waste Management, Sustainability, Stakeholders participation, Economic Transformation

1.0 Introduction

Solid waste management is considered to be one of the most serious environmental issues confronting urban areas in developing countries (UN-HABITAT ,2010).The generation of Solid Waste (SW) is inevitable. It was not important in ancient times but became an issue as soon as people started to settle in communities. Manoharochary & Jayarama, (2009) documented that billions of tons of waste are generated globally and cities in developed countries produce more solid waste per capita than those in developing countries. For example, a typical American generates an average of 2kg of solid waste each day, whereas an Indian generates one-fourth

of it. The daily waste generation in urban areas of Asia was about 0.7 million tonnes in 1999 and it is expected to reach about 1.8 million tonnes per day by 2025 (World Bank, 1999). In developing countries, Nigeria inclusive, municipal solid waste management has emerged as one of the greatest challenges facing environmental protection agencies. In Port Harcourt of Nigeria, it is found that an average of 900 to 1350 metric tons of waste is generated on daily basis (Rivers State Environmental Agency, RSESA, 2005). According to Wokekoro and Uruesheyi (2014), open and indiscriminate dumping of waste which includes human waste, animal waste and other waste components have become one of the main problems and an intractable nuisance in the city of Port Harcourt. To address these issues, many cities in developing countries focus on establishing an integrated solid waste management system based on the Reduce, Recycle and Reuse (3Rs) and trying to reduce the amount of waste generation at source rather than later at the end-of-pipe. However, these efforts are still very limited with a mix of results and relatively few efforts have been made to regulate organic materials that usually comprise over 50% of the total waste generation in the cities (Dulac, 2001). There is current thinking that land fill and incinerations have significant environmental impacts, and not adequate to deal with the large volumes of solid waste generated in the cities. Due to these issues and the emergence of the sustainable development concept, it has resulted to the idea of sustainable solid waste management.

In the city of Port Harcourt, solid waste collection is inadequate and poor, leaving waste uncollected in streets, dumped in vacant lands, drains and surface water, posing threats to public health. The waste management practices are costly services, partly due to inefficiencies. The legitimate question arises how we can deal with solid wastes in an efficient, effective and sustainable manner.

Waste management is sustainable only if the relation between reutilised substances and amount of waste generated is significantly increasing, over a period of time. The concept of Integrated Sustainable Solid Sustainable Waste Management (ISWM) means the selection and application of suitable techniques, technologies, and management programmes to achieve specific waste management objectives and goals. Integrated Sustainable Waste management looks at the physical component (collection, disposal and recycling) and the governance aspects (inclusivity of users and service providers: financial sustainability; coherent and sound institutions underpinned by proactive policies).

The concept of Integrated Sustainable Waste Management (ISWM) is an approach to be adopted to attain sustainable solutions to solid waste problems, especially in Port Harcourt. This paper explains the ISWM concept and its impacts as an assessment tool to trigger economic transformation. It also examines solid waste management practices in Port Harcourt especially within the three dimensions of ISWM and creates awareness on the need to assimilate integrated sustainable waste management approach for economic benefits.

2.0 Literature Review

2.1 The Concept of Integrated Sustainable Solid Waste Management

Integrated Sustainable Waste Management refers to a waste management system that best suits the society, economy and environment in a given location, a city in most cases. The

concept of ISWM not only takes technical or financial-economic sustainability into account as in conventionally done, but it also includes socio-cultural, environmental, institutional and political aspects that influence overall sustainability of waste management (Van De Kluendert, 1999). ISWM also stands for a strategic and long-term approach. Waste management is seen in the ISWM approach as an equity and public health issue, which means that everybody has a right to a regular waste collection and proper sanitation.

Sustainability aims at providing the best outcomes for the human and natural environments both now and in the future. It is a concept relating to the continuity of economic, social, institutional and environmental aspects of human society. The word “Sustainability” and “sustainable development” are often used interchangeably in the literature. The Brundtland Report of 1987 defines sustainable development as development that “meets the needs of the present generation without compromising the ability of future generations to meet their own needs.” One of the important milestones of the development of the concept of sustainability is the 1992 Rio Conference, informally known as the “Earth Summit”. In 2002, the World Summit on Sustainable Development expanded this definition by identifying the “three overarching objectives of sustainable development” to be (1) eradicating poverty, (2) protecting natural resources, and (3) changing unsustainable production and consumption patterns.

The Earth Summit produced the Agenda 21 which stated that environmentally sound waste management should prioritise the recovery of waste and waste treatment and finally waste disposal (UNEP, 2009). This is referred thereafter to the hierarchy principle. It further stated that a preventive waste management approach focused on lifestyle changes, and ones in production and consumption patterns, offered the best chance for reversing current trends. Though, Agenda 21 is not legally binding, its implementation has been left more to the different countries for action. According to UNEP (2009), only few countries have been consistent in their Agenda 21-related policies so far.

ISSWM differs from conventional approaches towards solid waste management by seeking stakeholder participation, by including waste prevention and resource recovery explicitly, by encouraging the analysis of interactions with other urban systems and by promoting an integration of different habitat scales (city, neighbourhood, household) (Klunder and Anschütz, 2000). In this context “Integrated” means that the system uses a range of interrelated collection and treatment options, at different habitat scales (household, neighbourhood, and city). In addition, it involves all stakeholders, be they governmental or nongovernmental, formal or informal, profit- or non-profit oriented. Finally, “Integrated” takes into account interactions between the waste management system and other urban systems. For more than ten years, the ISSWM concept has also evolved and is slowly becoming accepted by decision-makers. Although this process is successful in most industrial countries, it is rather slow in developing countries like Nigeria.

2.2 Waste Generation and Solid Waste Management Practice in Port Harcourt

In Port Harcourt, average daily waste generation is between 900 to 1350 metric tons (RSESA, 2005). Composition of wastes generated includes, garbage 41%, paper and plastics 35%, scrap metal and glass 15%, construction waste 4%, sludge 3%, and expired chemical waste and drugs

2% (RSESA, 2005). Indeed, indiscriminate refuse dumping has become a common feature of most African town and cities since the recent past.

Waste management in Port Harcourt is still at the rudimentary level like so many other cities in the developing world, thus, the city is faced with the dilemma of eradicating mounting heaps of solid waste from its environment as it is being overtaken by the unsightly views of overflowing dumps, unattended heaps of solid wastes emanating from domestic or commercial sources (Agwu, 2012). The RSESA now RIWAMA charged with the responsibility of waste generation in Port Harcourt created refuse collection centres/points within the city and evacuated it to designated approved dump sites. Studies by Tamunobereton-ari, Omubo-Pepple, & Igbani, (2012) cited in Visigah and Kakulu, (2015) revealed that about 75% of the storage facilities for waste in the city are substandard and insanitary; and there is an absence of colour coded containers for different waste types, therefore resulting in a situation where all types of waste are lumped together, making sorting and treatment of waste extremely difficult. The results also revealed the fact that collection of solid waste at open space transfer stations account for about 70%, thereby exposing the soil at these locations and surrounding surface and ground water retainers to contamination by leachate and runoff during precipitation. According to the World Health Organisation (WHO) (1992), over 10% of preventable illness is due partly to inadequate SWM. The latter also poses a serious threat to the national economy in general and in particular to the tourism-driven economy.

2.3 Need for Integrated Sustainable Waste Management (ISWM)

Cities are facing an increasing growth in population, and shares in GDP growth, resulting in – among other things – increasing quantities of waste being generated and due to changing lifestyles and consumption patterns, the quantity of waste generated has increased with quality and composition of waste becoming more varied and changing. Also, industrialization and economic growth has produced more amounts of waste, including hazardous and toxic wastes. According to the World Bank (1999) an approximate of 590 to 880 million tons of methane (CH₄) are released into the atmosphere every year. About 90 % of the gases generated are due to the decomposition of biomass as a result of indiscriminate waste management, among other causes and that between one third and two-third of the solid waste generated goes uncollected, piling up on streets and in drains, contributing to flooding and spread of disease.

There is a growing realization of the negative impacts that wastes have had on the local environment (air, water, land, human health etc.). Complexity, costs and coordination of waste management has necessitated multi stakeholder involvement in every stage of the waste stream. This calls for an integrated approach to waste management.

Today, Local communities are now looking at waste as a *business opportunity*, (a) to extract valuable resources contained within it that can still be used and (b) to safely process and dispose wastes with a minimum impact on the environment Indiscriminate solid waste management leads not only to the destruction of the ecosystem, but also to lower economic productivity, and thus to poverty (Louigueur, 2007). In order to achieve sustainable development, policy makers in developing Countries have to cope with the above-mentioned issues.

2.4 Case Studies where Locally Appropriate Solutions Work

Research has showed that where there is strong political commitment and leadership, and where the local community is actively involved, solutions that are locally appropriate and affordable can be found. The case studies shown here were clearly documented by Wilson, Velis and Rodic (2013).

Moshi is a small municipality at the foot of Kilimanjaro in north east Tanzania with a clear focus on the cleanliness of the city, driven by concerns over public health. Stakeholder platform on solid waste has been active since 1999, making strategic and action plans that are subsequently implemented. Pilot projects have been used to test new models of service delivery, involving both the local private sector and community-based organisations (CBOs) that provide primary collection in unplanned settlements. These joint efforts by multiple stakeholders, has made Moshi won the official title of the cleanest city in Tanzania for several years in a row. This is a result of a broader commitment of the council and citizens to urban infrastructure and governance issues, as demonstrated by their active participation in various countrywide initiatives such as the Sustainable Cities Programme and the Urban Sector Rehabilitation Programme (Ishengoma, 2010).

Ghorahi is a small and relatively remote city in south western Nepal. The city has very limited financial resources but, due to a clear vision, strong commitment by the authorities and active participation of key stakeholders, it managed to develop a well-managed state-of-the-art waste processing and disposal facility (one of only three in the country) without any form of foreign involvement. The facility includes waste sorting and recycling, sanitary landfilling, leachate collection and treatment, and a buffer zone with forests, gardens and a bee farm that shields the site from the surrounding area. A small initial investment from the municipality budget was used to commission geological studies from the national Department of Mines and Geology and identify a very suitable site that was accepted by the general public. In turn, this convinced the Ministry of Local Development to mobilise national financial support for the construction. The site was brought into operation within 5 years, in 2005. A strong landfill management committee involving local people and key stakeholders ensures that the site is properly managed and monitored, and also giving a sense of ownership – and even pride – regarding the landfill (Tuladhar, 2010). Activities are ongoing to expand waste collection and strengthen recycling in the municipality.

3.0 Research Methodology

This research involves an element of investigation into solid waste management in Port Harcourt within the three dimensions of sustainability of ISWM namely stakeholders, system elements, and aspects as shown in the diagram. Hence, there would be need to use literature and semi-structured interview to illicit information. Qualitative research uses various techniques to explore and interpret the way in which a social actor experience or perceive the world and make meaning of the experience. Saunders *et al* (2007) note that “the adoption of a semi-structured interview will be helpful in finding out what is happening in order to seek out new insight in an exploratory study (like this)”. The researcher therefore tries to investigate the subjective reality of the stakeholders (of waste management in Port Harcourt) in order to be

able to make sense of and understand their motive and actions in the way that is meaningful (Sunder, *et al* 2009). To ensure credibility of the research, the snowball and Purposive sampling was the main technique used to identify participants for the structured and non-structured interview Babbie,(2013). Snowball sampling was used to select 12 respondents each from stakeholders, including waste contractors, and NGO's. In an attempt to get stakeholders, the researcher tried to get one stakeholder who led the researcher to get the next for interview. These trends continued uniformly for the rest of the respondent stakeholders, while the purposive sampling was used to select 12 academia. In all a total of 36 respondents were selected purposively and interviewed. Direct quotation from the Interviewers and Simple percentages were used to assess the issues canvassed within the three dimensions of ISWM. The ISWM concept consists of three dimensions of sustainability, which needs to be integrated:

- A. Stakeholders
- B. System elements
- C. Aspects

These three dimensions are worked out in more detail in Figure 1 below. The ISWM, as shown in Figure 1 , is a framework that was first developed by WASTE, a Dutch non-governmental organisation (NGO), and its partners in developing countries in the 1980s, and further developed by the Collaborative Working Group on Solid Waste Management in Low and Middle Income Countries (CWG) in the mid 1990s (Van de Klundert, Anschütz,& Scheinberg, 2001). Since then, it has become popular as an approach to reach better, more sustainable solutions to municipal waste management in developing countries (Van de Klundert, Anschütz, & Scheinberg, 2001).

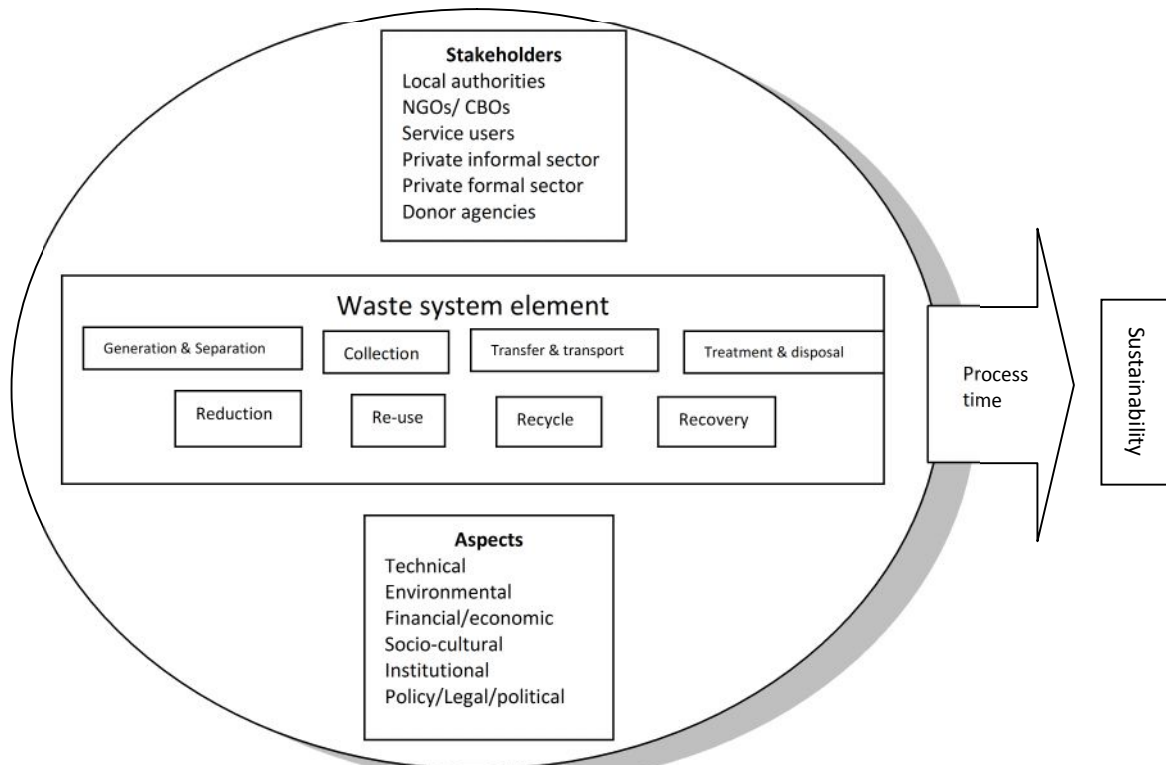


Figure 1: Integrated sustainable waste management (ISWM) framework (Van de Klundert, 1999)

4.0 Results and Discussions

The results for this study are presented below using tables, charts and direct quotation from the Interviewers to supplement quantitative data.

4.1 Characteristics of Respondents

Table 1: Categories of Respondents

Options	Frequency	Percentage %
Categories of Respondents		
Academia	12	33.3
Waste contractors	12	33.3
NGO'S	12	33.3
Age Distribution		
20-30years	3	08.3
31-40 years	11	30.6
41-50 years	12	33.3
Above 50 years	10	27.3
Educational Qualification		
SSCE	4	11.1
NCE/ND	10	27.8
B.Sc/B.Tect/HND	8	22.2
M.Sc/Ph.D	12	33.3
TOTAL	36	100.0

Source: Field Survey, 2018

Table 1 above shows the background information gathered on respondents. Majority of the respondents are mature and educated. This may have implication on the overall research findings. The age distribution of majority (33.3%) of respondents' ranged from 41 to 50years, 30.6% falling between 31 and 40 years, 27.3% are more than 50 years old, while the remaining 8.3% of the respondents are between the age of 20 and 30years. It is also observed that 33.3% of the respondent stakeholders had M.Sc/PhD, 27.8% had NCE/ND, while 22.2% had B.Sc/B.Tech/HND, and 11.1% have below SSCE. This shows that an average respondent's stakeholder is educated and the information provided by them is reliable and dependable.

4.2 Stakeholders, the First ISWM Dimension

ISWM utmost concern is the participation of stakeholders. A stakeholder is a person or organisation that has a stake, an interest in - in this case- waste management. A number of key stakeholders are listed in Figure 1. The municipality, with its general responsibility for urban cleanliness and the citizens or households who use the system, are always stakeholders in waste management. Stakeholders by definition have different roles and interests in relation to waste management; the challenge of the ISWM process is to get them to agree to co-operate for a common purpose, that of improving the waste system.

In an effort to find out the involvement of stakeholders, 30 of the respondent stakeholders representing 83.3% indicated that they were not consulted nor involved in any role pertaining to waste management in Port Harcourt; only 6 representing 16.7% said they have participated. The results are shown in the figure 2 below:

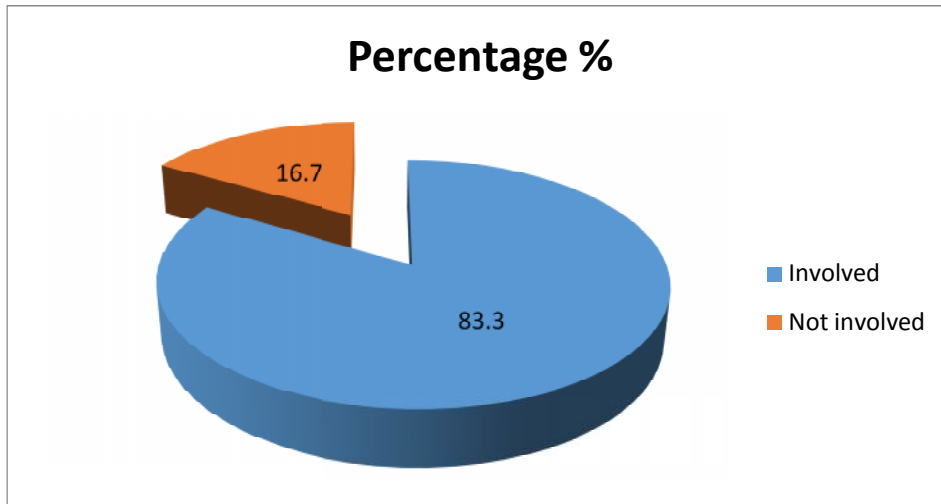


Figure 2 :Involvement of Stakeholders

Source : Field Survey, 2018.

The result of the interview conducted above implies that there are no NGOs or any international or national donor agency involvement in waste management in Port Harcourt. As stated by an interviewee NGO corroborated this when he said:

“ I have made several proposals to RIWAMA on the need to reposition waste management approach in the state but all to no avail. I have not seen any reply to my proposal. I have not been invited for any meeting”

Another interviewee also said:

“I have not participated in the design of waste services, recruitment of workers and setting of rates for user charges”

When the respondents were asked whether waste contractors are regulated, 8 of the respondent waste contractors interviewed representing 66.7% said they are not, 3 of them representing 25.0% said they are not sure, only 1 respondent representing 8.3% said they are regulated. This results of the interview with waste contractor’s shows that private waste contractors are not regulated. The reason was attributed to the fact there are no articulated SWM policy in the state (Field Survey, 2018).

On the incorporation of scavengers’ operators into the system, waste contractors were contacted and interviewed. All the respondents (100%) said scavengers were not incorporated into the system. Rather, they operate on their own.

4.3 Waste System Elements, the second ISWM dimension

Waste system elements refer to how solid waste is handled and where it ends up. Particularly this second dimension has important environmental implications and for this reason a number of national environmental ministries have taken the idea of a waste management hierarchy as an operational policy guideline. The hierarchy is also a basis of the ISWM approach and gives priority to waste prevention, minimisation, recycling and other forms of recovery of materials. Only when this is not possible is 'pure' disposal allowed. Unfortunately, this idea is not always put into practice.

When the respondents were asked questions on the level of practice of waste prevention, minimisation, recycling and other forms of recovery of material, about 78.5% of the respondents indicated they were not satisfied with the level of practice while 21.5% claimed to be satisfied with the level of practice. The results are shown in figure 3 below

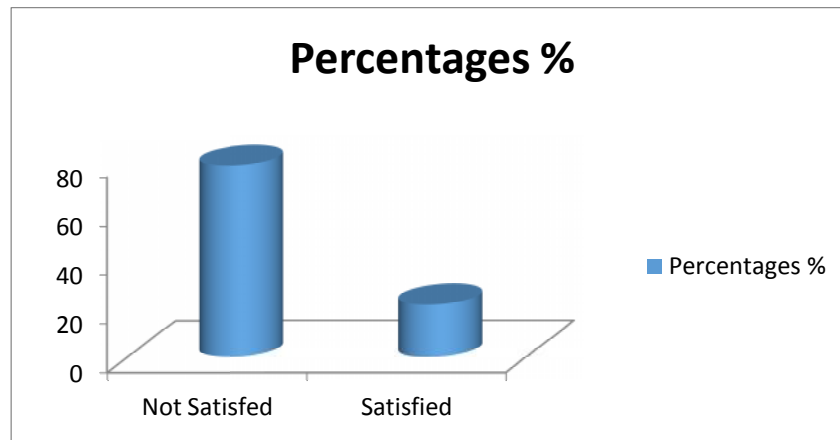


Figure 3: Respondents Satisfaction with the Level of Practice of Waste
Source : Field Survey, 2018.

This shows that Waste minimization; waste re-use and recycling are not recognized, no motivated or practiced in Port Harcourt. This was confirmed by an interviewee when he said: *“Waste minimization, re-use and recycling were only practiced at individual level and there were no policy or any public enlightenment to show government commitment”*.

In an attempt to answer question on same issue, another interviewee stated: *“The Rivers State government built a recycling plant but this plant is as good as none existing”*. The findings and the literature reviewed indicated that

4.4 The Third Dimension: ISWM Aspects

Within ISWM the third dimension consists of six sustainability aspects, or lenses, through which the existing waste system can be assessed and with which a new or expanded system can be planned. The sustainability aspects, ranging from political-legal, to social-cultural, institutional-organisational, technical performance, environmental-health and financial-economic, cover the range of factors influencing solid waste activities and, taken together, predict or influence the

sustainability of the entire system.

On the adequacy of the facilities for waste separation system, including waste containers and waste collection points all the 36 respondent stakeholders representing 100% said they are grossly inadequate. Furthermore, opinions of the 36 respondent stakeholders interviewed were sought on the need to encourage the design and fabrication of waste treatment facilities using available local materials as envisaged by ISSWM. Out of the total number interviewed, 34 respondents representing 94.4% of them said Yes, while 2 of them representing 5.6% said No. The results are shown in figure 4 below:

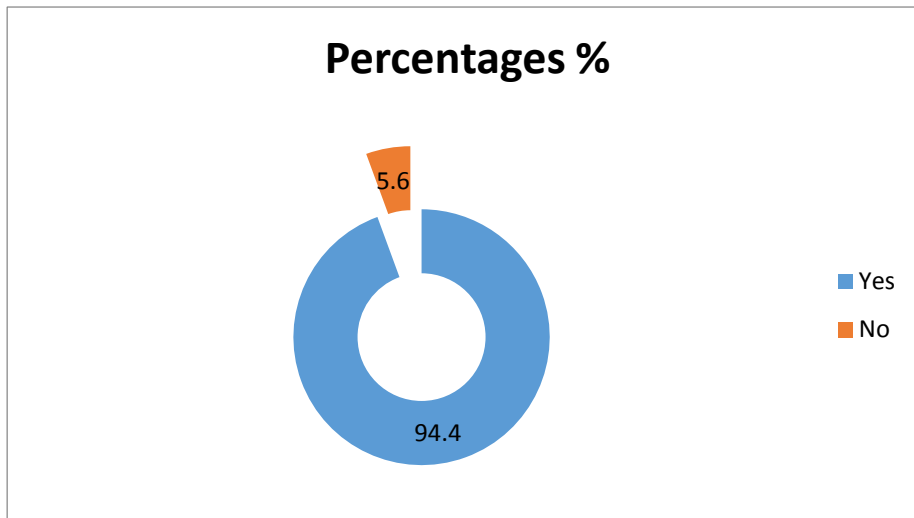


Figure 4: Opinion on Design and Fabrication of Waste Treatment Facilities using available Local Materials

Source: Field Survey, 2018.

The reason for their objection according to one of the respondents is that adequate funds are not allocated to waste collection and there is no plan for cost recovery (Field Survey, 2018). Thus an interviewee respondent stakeholder said:

“There is the absence of the political will to implement an environmental health assessment and monitoring system on a longer term.”

The search further indicated that 85% of the respondents from the stakeholders recommended the Adoption of ISWM to ensure the sustainable aspect of waste. A number of ideas were sought on how to advance waste management practice in the city. On this an interviewee respondent said:

“government should encourage a transparent procedures for competitive bidding and contracting out of waste management services to ensure sustainability”.

Similarly another respondent interviewee particularly said:

“if Institutions in charge of waste management should prepare and disseminate Technical guidelines for waste reduction and prevention, sustainability will be achieved”.

5.0 Waste Management and the Millennium Development Goal

In line with the world's governments commitment to achieving the Millennium Development Goals (MDG) , solid waste services are widely acknowledged as the principal means through which these goals can be achieved. The MDG emphasise poverty alleviation and access to sanitation and health services for all. The MDG have been adopted to ensure environmental sustainability. Within that goal, targets 9 and 11 of the MDG are "to integrate the principles of sustainable development into a country's policies and programmes and reverse the loss of environmental resources." Although there are no direct references to solid waste in the specific targets, the MDG call for appropriate environmental considerations as well as social awareness of the problems of waste pickers and other poor people in cities. Moreover, the issue of urban poverty is inextricably linked to waste management in Low and Medium Income Countries (LMIC). In India, for instance, nearly 1 million people find livelihood opportunities by engaging in waste collection and recycling through well-organised but informal systems. If the MDG of poverty alleviation and access to adequate solid waste services are to be achieved in Nigeria, waste management must become one of the chief focus areas, particularly in haphazardly growing urban and metropolitan areas like Port Harcourt where it remains a low priority for municipalities but high on the agenda of the citizens

6.0 ISSWM and Economic Transformation

An examination of the content of Integrated sustainable solid waste management (ISSWM) framework has shown that it is a meaningful tool for solid waste management because it involves carefully evaluating local needs and conditions to determine the most suitable options for all aspects of waste management, including generation, segregation, collection, transportation, sorting, recovery, treatment, and disposal. Because it is based on local needs and conditions, ISWM can be an effective policy tool in all cities, regardless of their level of development and existing waste management practices (UNEP,2004).Cities are the drivers of economic growth. As countries develop, more national income is produced in urban areas, accounting for 55% of Gross National Product (GNP) in low income countries, 73% in middle-income countries and 85% in those of high income (World Bank 1999).

Visigah and Kakulu (2015) in their study assessed cases where the ISWM approach has been successfully established as a policy tool for guiding the management of solid waste in medium income countries, with the view of imbibing practices that would be achievable, considering the available technology and financing options argued that ISWM can serve as a meaningful planning policy tool for solid waste management and environmental protection and concludes that ISWM can be used as a tool to trigger job creation, source raw materials for industry and generate energy to support the current unsustainable energy generation sector. Within the framework of ISWM, the first dimensions of ISWM as had shown in Figure 1 shows the range of stakeholders. An ideal ISWM takes into account all relevant stakeholders within a waste stream, and allows for sustainable principles to be implemented throughout. Involvement of stakeholders can take several forms. For example the involvement of local communities in planning and implementation does not mean that residents are used as cheap

labour. They can play a range of roles, such as those identified by Moreno, Rios & Lardinois, (1999). They are:

- I. residents - placing waste outside for collection, separating it at source
- II. community managers - participating in the design of a waste service, recruitment of workers, setting rates for user charges
- III. citizens - pressuring municipal authorities so that services are being offered
- IV. community members - participating in clean-ups
- V. clients - paying for waste management services
- VI. watchdogs - monitoring and supervising the operation of services

Lardinois, (1996), asserts that Stakeholder involvement is imperative, because it can lead to more responsible conduct, increased environmental responsiveness, and a higher willingness to pay among users of a waste management system. It can also lead to empowerment of groups of stakeholders that have had limited access to decision-making power and resources, for example local residents or informal micro-enterprises involved in collection and recycling of waste. According to Lardinois, (1996), the participation of communities and micro- and small-scale enterprises can generate income and employment in low-income urban areas and thus contribute to the alleviation of urban poverty.

7.0 Conclusion

This paper has shown that Waste minimization; waste re-use and recycling are not recognized, not motivated or practiced in Port Harcourt as advocated in the ISWM framework. The paper has established that the way forward for a successful solid waste management is to consider all of the three aspects of ISWM. The success of the ISWM system based on the 3Rs depends on the partnerships among all stakeholders. The ISWM framework recognizes the importance of evaluating local conditions and needs and creating place-appropriate solutions (Nachalida, Beverley & Kirstin,2018). This paper concludes that a clear vision with political commitment by government and adoption of a multi stakeholder involvement in every stage of the waste stream based on ISWM approach to waste management can help reduce costly inefficiencies, encourage the development of new markets, and lead to job creation in Port Harcourt.

8.0 Recommendations

This study recommends that the following ISWM measures be adopted to make waste management more sustainable and integrated.

- I. A training programme to promote the concepts of ISWM be encouraged and taught at all level of education
- II. A transparent system of rewards and penalties should be installed.
- III. Transparent procedures for competitive bidding and contracting out of waste management services should be established.
- IV. Social privatisation and community participation, expectedly resulting in efficiency gains and cost savings should be encouraged.

- V. Institutions in charge of waste management should prepare and disseminate Technical guidelines for waste reduction and prevention.
- VI. Waste separation at source through education and economic incentives should be encouraged.
- VII. Waste management bodies should assess technical performance of treatment facilities (energy recovery, incineration), if any
- VIII. Linkages and trust between different groups of actors involved in waste management (local government, formal and informal private sector, NGOs, CBOs) through joint management committees, co-ordinating platforms, etc. be developed.
- IX. Stakeholders and their interests in waste management (stakeholder analysis) be identified and encouraged.
- X. Design and fabrication of waste treatment facilities using available local materials be encouraged.

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