Towards Sustainable Waste Management in Lagos State, Nigeria.
Possible Adoptions From Finland.

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The main objective of this thesis is to identify and stress the value of sustainable waste management in Lagos State Nigeria with "an approach from household to the refuse managers". In contrast with what is obtainable in Finland (Lassila & tikanoja). This thesis enlightens on the immediate and future effects of proper waste disposal, recycling and sorting. A well organized sorting system helps to save numerous natural resources and abates possible problems that might be caused by implementing landfills.

This thesis attempts to answer questions on how value can be created from proper waste management, and it also emphasizes the importance of mass sensitization and awareness of households of the hazards of unmanaged waste refuse and ultimately what the benefits of proper waste sorting are. It is most times believed that the ultimate aim of waste management is waste minimization, however proper processing and recycling of waste play crucial roles in dealing with waste in a way that it becomes more environmentally and economically friendly.

The theoretical framework of this thesis is solely based on literatures and previous research papers on topics relating to waste management. The theory section will introduce solid waste management in relation to household activities through proper handling by the refuse collectors. It enumerates the types of wastes generated in households, the sorting processes, advantages and disadvantages of waste to the environment and as a better alternative means of energy generation.

The results of sustainable solid waste management of a Finnish household opposed to non sustainable solid waste management in Lagos State of Nigeria show a significant impact on the environment. Improper solid waste management has a tendency of producing green house gases (GHGS) which has an enormous contribution to the current experiences in climate change. A properly managed waste system prevents or at most minimizes environmental and health impacts. Therefore, it is recommended for every household and refuse collectors to sort and dispose waste accordingly so as to make the world a better place.

Keywords: Household waste, Sustainability, Waste management.

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1   Introduction

Sustainability has proven to be one of the most important issues facing the entire world. As the needs for sustainability arise, there is an emergence of turning waste to wealth, which in turn benefits the environment at large. This thesis highlights the proper disposal of solid waste in Finland in contrast with what is obtainable in Lagos, Nigeria. With an increasing population and an increase in domestic activities, waste generation has doubled compared to previous decades. This has brought about the need for sustainable management of waste from its source to the final reusable stage.

With the level of development that comes with increase in the volume of waste produced, there is a need for a change and overhaul of how solid waste is being managed in Lagos State. Due to the level of illiteracy and nonchalant attitude of waste producers, waste is thrown in drains and street roads. Such attitudes cause rodents and flies to feast on waste, thereby causing numerous health issues in communities. In order for all aims and objectives to be met, necessary actions and steps have to be taken to understand the current situation and adapt to the current and best practice available for sustainable solid waste management.

The objective of this thesis is to present some of the conclusions reached at a workshop organized by Connect project on 7th March 2014. The Connect project was formed by the Federation of Universities of Applied Sciences (FUAS), an alliance of HAMK University of Applied Sciences (HAMK), Laurea University of Applied Sciences (Laurea) and Lahti University of Applied Sciences (Lahti UAS), and it was funded by Tekes, a Finnish innovation funding agency (Virtanen. 2014, 9-10). The Connect project helps to bridge the gap between developing countries and the international development of Finnish small and medium scale enterprises.

The project combines research carried out by international student members and other stakeholders to create new ways of creating networks needed in entering target markets. The main goal the Connect project is to develop international skills of Finnish small and medium enterprises (SME) whereby increasing its understanding and making use of value potentials of experts and international student members, to access new possibilities and co- create an effective model for a network for Finnish SMEs and their counterparts in the developing countries.

1.1 Background

In most developing countries like Nigeria, environmental issues and their management have proven to be a great challenge. While the volume of waste generated increases by the day, the management techniques used has become obsolete to handle the collection, disposal and recycling process. Unlike Finland with good and well co-ordinate waste management scheme, most cities in Nigeria most especially Lagos state is faced with both problems of rapid expansion and population increase. The human mechanics is that it consumes all that nature has to offer and in turn waste is created which depletes natural earth reserve (Sloan, Legrand & Chen 2013, 1).

The management of solid waste is an integral part of making sure the environment is sanitary safe. Going by the world health organization, health is defined as "The complete physical and mental state and well-being of an individual and not the absence of infirmity or diseases" (UNEP 2005). Proper waste management initiative programs are relevant to Finland which is the developed country and the Nigeria which is the developing. Unlike in Nigeria, the focus of Finland is improving and upgrading of present facilities to meet a standard in environmental quality criteria, while in Nigeria considerable amount of investment is needed to build new facilities where financial technological resources are scarce (UNEP 2005).

The most effective way to reducing waste is not producing the waste in the first place; therefore a situation where effective communication and sensitization is put in place will reduce waste generation. The choice of making use of reusable materials for packaging also reduces waste. Most solid waste contains 20% – 30% materials that can be recycled in them (UNEP 2005). Paper can be reprocessed, broken glass crushed, plastic re-melted and food waste decomposed to make fertilizer. All of those imply that new things can be created out of used items which help the reduction of waste.

1.2 Research limitations, boundaries and questions

This thesis primarily focused on the studies done on the Finnish system of waste management and the system of waste management available in Lagos Nigeria. The work shop was organized by the Federation of applied sciences in partnership with HAMK, Lahti and Laurea university of Applied sciences. Lagos state remains one of the most populous cities in the Africa which makes it the commercial nerve of Nigeria. The amount of waste generated can never be under estimated due to the increase in population and expansion. One of the major setbacks while putting together this thesis is the inadequate data available on waste management in Nigeria as a whole.

Emphasis will be made on solid waste management and its best practices for the sole purpose of effective management. The outcome of the waste management workshop organized by Connect project in Lagos Nigeria in March 2014 will be analyzed serving as a possible adaption from the Finnish system. The Finnish system of waste management will be used as a model in the establishment of a new path for Lagos state waste management agency (LAWMA). The implementation of a sustainable waste management system is a real challenge for a developing country like Nigeria due to the level of urbanization and low awareness to the public.

Any sustainable waste management system to be adopted in such areas should be environmentally friendly, involve the active participation of the general public and most of all cost effective. This thesis seeks to buttress on outcomes from the workshop and further suggest possible solutions. Solid waste management is referred to the disposal, collection and transfer of solid waste. However, for the purpose of this thesis, solid waste management is essentially the wastes generated in municipals, its institutional structure and its efficient disposal and management.

With the consideration of the formulated research areas, the following are the problems that will be analyzed in this thesis:

What are the benefits of proper waste differentiation?
How sensitized are waste generators to the hazards of unmanaged waste to the environment?
What are the benefits of proper waste differentiation?

Above all, the emphasis of this thesis will be Lagos State waste management system, the lapses in the system and how it can be effectively curtailed. English language will be the language employed in this thesis because English is the official and widely spoken language in Lagos State and Nigeria at large.

1.3   Methods

The means of data collection was in a systematic form through primary and secondary means. These means were adopted to ensure that the best and right facts and figures are obtained. This research will focus on organizations and government agencies through private sector participation (PSP) of Lagos state. This thesis will adopt the legislations of waste management in Finland and show the positive result attained through the implementation. The Finnish waste management system will be used as a benchmarking process and standard to the Lagos state waste management system.

Qualitative research means will be employed as a means of data gathering. The qualitative approach will be through interviews seeking the respondent's knowledge and roles in waste management chain in the case company Lassila & tikanoja Oy Finland. This interviews help to explain more based on the respondent practical experience which will be used to complement the other methods used.

Observations were made during the interview at L & T recycling plant in Kerava Vantaa. Collection vans were seen bringing waste to the site, waste feed to the sorting machines and the various sorting processes was observed. Being a member of the Connect project, I was opportune to be part of the planning processes prior to the workshop in Lagos State.

The workshop had in attendance representatives of all stake holders, government officials of the Lagos state waste management agency (LAWMA) and students. The aim of the workshop was to discuss impending problems of the Lagos state waste management authority systems (LAWMA) and in the process recommend lasting solutions that support sustainable waste management in Lagos state and Nigeria as a whole.

2   Knowlege of waste

Articles and literatures relating to solid waste management will be reviewed to buttress how a successful sustainable waste management system achieved in Finland can be replicated in Lagos state, Nigeria. The literatures will serve as foundation to emphasis the effect and importance of an effective waste management system in an environment. In addition, tools to achieve, establish and overview the analysis of an integrated solid waste management system will also be reviewed.

Furthermore, topics covered in this chapter includes the meaning of waste management, types of waste, waste management practices in Finland and Lagos state, Nigeria, types of generated waste in households, translational phases in waste management, sustainable waste management, impact of unmanaged waste and finally household waste management in Finland.

2.1 Solid waste

Solid waste can be defined as the inevitable remain or value of a product generated in households. Solid wastes may come in solid or liquid state (sludge). Wastes as a byproduct of everyday human activity physically contain same materials as found in the original product. The only difference from the useful product is the lack of value. Calling waste lack of value can be attributed to the mixed and most times the unspecified composition of the garbage. Separating the useful materials in the mixed waste increases the value of the waste (McDougall et al. 2008, 1).

Waste can be seen as a left over or redundant value of a product depending on the value for the owner who is discarding the waste. One of an important characteristic of waste is the value or the situation in which the item appears and defined by the owner (Thomas 2010, 1). There are suggestions that waste to one person may be a treasure to another depending on if there are potentials of the waste being traded and the cost of transferring does not exceed the value of the item. Hence the quantity, quality and purity is always the issue when it comes to solid waste (Thomas 2010, 3).While considering an item to be a waste, they are couple of factors comes into effect, some of those factors include time, state or statues of the item, the level of income, location and preferences.

The time a waste is discarded depends immensely on the outcome of the waste. In a situation where there is scarcity, embargo or war owners tend to put more efforts in repairing or recycling because alternative might be hard to find or costly to get. The state of status of item which can be the price, level of damage or age also influences the possibility of repairs to avoid being discarded (Adebola 2006, 2). The level of income cautions the way items are discarded. Items might be thrown away either because it is outdated or out of vogue. The location of the said waste also affects the value of the waste. Wastes generated in the rural household can simply be utilized as animal food.

2.2 Sustainable waste management

Humankind in nature consumes whatever comes its way and in turn it generates waste which the deplete earths reserve. Earths depletion is further heightened by rapid growth in population and change in consumption pattern. All human actions have an equal reaction on the earths ecosystem which is only able to renew it self at a low consumption level (Sloan, Legrand & Chen 2013, 1). Over the years, man's actions on earth were negligible; however things changed at the down of the industrial revolution. Human starts to consume faster than the earth can regenerate.

Sustainability can be defined as development which meets the demands of the present with-out compromising the future generations to meet their needs (WCED 1987). This includes the preservation of natural resources in such a way that it can still be found sufficient for the present and preferred future life style. Sustainability obviously show that present goals trans-cends the current dominating decision making (Spangenberg 2000, 2).

The level of destruction caused by human activity on earth cannot be reversed but we can learn to utilize and make use of available resources. The government should encourage a more sustainable consumerism and also tax incentives for recycling companies (Sloan et al 2013. 1). though the modern day public seems more aware of the good impact of a greener society, evidence still shows that attitudes towards man's willingness to act still remain ten-tative at most (Sloan et al 2013. 1).

2.3   Sustainable waste management concepts

The main priority of achieving an effective and sustainable waste management is to ensure the highest human safety and health. Whatever strategy should be able to protect the general public from diseases and other related health hazards. Additionally, a more sustainable waste system should be environment friendly, socially accommodating and economically affordable (Oluwaleye 2012, 52). A sustainable waste system must be able to reduce emissions to air land and water. Affordability is another concern when it comes to sustainability.

The price that comes with waste management should commensurate with the standard of liv-ing in the community's Social acceptability and public co-operation (Oluwaleye 2012, 54). Public sensitization through education, proper information dissemination and trust should be earned from the community. Environmental effectiveness, economic affordability and social acceptance obviously cannot be achieved without tradeoffs. It is therefore better to firstly reduce all environmental burdens with acceptable cost systems.

2.4   Waste to Energy

Energy recovery through waste incineration in Europe has dramatically increased over the years due to the increase in wastes generated. Energy recovered from waste incineration is used for heating, cooling and electricity. Heating is produced by pumping heated water through the installed district pipes to end users. Cooling for homes and other premises is also based on the same principles at the heating but in this case cooled water is passed through

the pipes. As for electricity, water is heated into steam under high pressure and temperature. This process makes it possible to produce heat and electricity to power premises and also heating (Swedish waste management 2009, 20).

Waste to energy initiative is a method that is initiated to provide for major energy needs. In Europe, the 50 million of wastes incinerated corresponds with the heat requirements of Norway, Sweden, Finland, Denmark, Latvia, Lithuania and Estonia all together (Swedish waste management 2009, 4). Energy recovery from waste is an exploit of a resource that is otherwise assumed to be wasted. The European rule or the hierarchy as it been called states that waste creation should be initially avoided, followed by material re use and recycling (Swedish waste management 2009, 4).

The most recent ways of sustainable waste management has gone past landfills to energy recovery and material recycling. Even though landfills are the most common methods of waste management in developing countries, incinerators are the most dominant in Europe and have been tipped to most efficient way of waste management (Swedish waste management 2009, 24). In most cases, wastes sent for incineration in Europe is usually combustible source separated waste which is a set requirement for waste supplied to plants. Wastes for instance should have low moisture content and other material that makes it suitable for incineration (Swedish waste management 2009, 10).

3   Impact of un-managed waste

Indiscriminate disposal of waste causes all forms of pollutions from air to sea and water. In Lagos state, un-managed waste clogs drain channels creating flooding and water stagnation which then serves as breeding ground for insects and rodents. Burning of waste significantly contributes to air pollution in most urban areas. Organic waste decomposition generates greenhouse gases in land fill while un-managed leachates contaminates waters and soil.

Effective waste management contributes to sound social and economic development. Despite the wide spread sensitization on the hazards of unmanaged waste, a higher proportion of municipal waste are disposed of in road side, waste dumps and nonfunctional landfill with a little fraction being recycled. The disposal of waste in landfills is deemed unsustainable given the impacts it will eventually have on the environment.

3.1   Environmental and health impact of solid waste

Poor waste management has always been a threat to health and environmental well being of most developing countries. Waste disposed in water and on land causes infectious diseases that are dangerous to human health. In most cases, this infection causes respiratory, skin, blood infections and other diseases that emanate as a result of poor hygiene. The most affected groups are the waste generators that live around the heap of waste and workers that lack proper education about proper waste handling.

Improper collection, storage, transportation and disposal of waste possess a great risk to water, land and the air which then impact the quality of life. Some waste takes ages to breakdown and in the process generates methane gas or smell; this contributes to greenhouse gases. Plastics burnt in incinerators produces toxins and gases that causes air pollution and acid rain. Human exposure to hazardous waste especially after being burnt stands at risk of developing diseases such as cancer or lungs related disease. Waste reduction means less human consumption, less use of resources which then leads to less environmental and health impact (Sloan et al. 2013, 76- 77).

Hence an efficient waste management strategy is of utmost importance in either developed or developing country. Most of the affected groups are either un-trained workers or poor people that are forced to live near landfills or un-managed waste. All items thrown away, such as packed food past its sell date, plastic containers or paper bags if not properly disposed is a shear waste of resources and leads to dare environmental consequence. All energy and raw materials used in the process of making the product is lost and can never be regained.

3.2   Environmental and Health management plans

A waste management strategy that aims to utilize and reduce the generation of waste is critical before a sustainable waste management system. Enhancement of workable recycling policies and investment in current recycling technologies should be a key policy in the implementation of an environmental health plan. Awareness and continuous education of the need and effects of uncollected waste on the environment and health. Private investment in waste recycling has to be encouraged and made cheaper than landfills (Syeda & Bhupatthi 2013, 117).
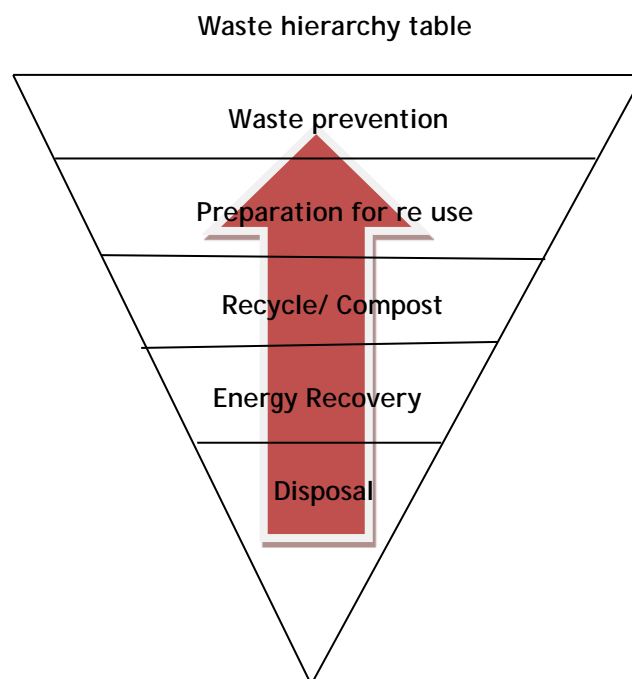
Waste hierarchy table

Table 1. The waste hierarchy table (European Commission 2012, A).

The above table shows waste management hierarchy. The hierarchy tends to give priority to prevention of waste, followed by re-use, recycle and recovery then disposal.

3.3   Waste legislaations and polices

In April 2008 as part of the finish government initiatives approved a "Towards a recycling society" which is the National waste plan for 2016" (Finland, 2009). The document contained measures for the future and targets. This document precedes the first plan which covered a period of 1998 through 2005.One of the main targets of the National waste target plan for 2016 was to maintain a 2000 level of municipal solid waste and ultimately a decrease by 2016, recycle at least 50% of all municipal wastes, energy generation form 30% and ensure that 20% of all waste if disposed of in Landfills (EEA, 2010).

Waste management challenges have to be considered while framing waste policies. These policies should include proper waste segregation, waste generation, collection, transportation, proper disposal and management in landfills. Other issues should include handling of toxic materials, recycling, incineration maintenance, continuous monitoring and frequent evaluation of improved methods. In further addition to these issues, enacted policies have to be able to address both long and short term environmental, economic and social benefits with the roles of concerned stakeholder's participation.

4   Waste Management practices in Lagos State

Lagos state is located in the southwest region and one of the 36 states in Nigeria. With over 21 million inhabitants Lagos state is one of the 12 states created on the 27th of May 1967 and former capital territory of Nigeria before Abuja. According to United Nations statistics, the state is presently densely populated with an estimated growth rate of 6% by 2015. With a population of 18million and 4000 square kilometer per person, it is the 3rd largest mega city in the world (Adebola 2006, 2).

Lagos state is arguably the most developed and the most viable commercial nerve in Nigeria. The viability of the state is due to its strategic location. The state is bounded in the west with the Republic of Benin and in the North with Ogun state. Stretching over 180 kilometers north of Guinea Coast off the Atlantic Ocean helps to place the state as an export and import hub of the country. The state is surrounded by water; this makes it an aquatic state and a tourist attraction (Adebola 2006). The state is divided into 57 local governments which is called municipalities in Finland.

Under the 1999 constitution of the Federal Republic of Nigeria, the local government is responsible for the management of all wastes generated in its locality. However, due to the peculiarity and metropolitan nature of the state, Lagos state have not been able to function within its constitutional framework. The local government which is the third tier of government has been able to handle waste management through an environmental monitoring unit headed by a chief environmental health officer. The head is responsible for all policy formulations, monitoring and implementations, inspections and prosecution of offenders.
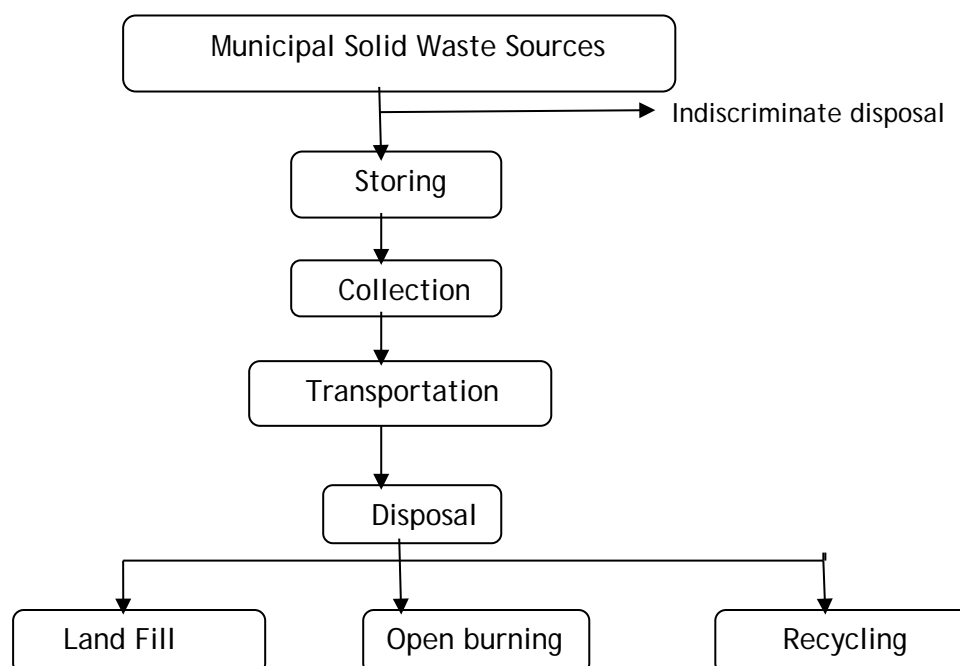
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┌─────────────────────────────────────┐
│     Municipal Solid Waste Sources    │
└─────────────────────────────────────┘
                  │           ──────────────→  Indiscriminate disposal
                  ▼
            ┌──────────┐
            │ Storing  │
            └──────────┘
                  │
                  ▼
            ┌──────────┐
            │Collection│
            └──────────┘
                  │
                  ▼
          ┌──────────────┐
          │Transportation│
          └──────────────┘
                  │
                  ▼
            ┌──────────┐
            │ Disposal │
            └──────────┘
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┌──────────────┐   ┌──────────────┐   ┌──────────────┐
│ Land Fill   │   │ Open burning │   │ Recycling   │
└──────────────┘   └──────────────┘   └──────────────┘

Table 2: Current Municipal Waste Management flow chart of Lagos State (Abila & Kantola 2013, 173).

4.1 Role of private sector participation in waste management in Lagos State

Following the pace of urbanization in a metropolitan Lagos and the level of unimpressive attitude in the public sector in the provision of infrastructural amenities, the search of alternative and sustainable strategies for the development of urban environment has become inevitable. One of the consequences of rapid urbanization is solid waste generation; many public authorities encounter unprecedented challenges collection, disposal and management. Despite the over stressed effect of untreated solid waste on the environment, the reaction of most city authorities leaves much to be desired.

Successive state government inherited huge un-cleared solid waste around cities, this is a clear indication that there is yet to be a functional solution to waste management in the state (Adeniji & Kunle, 1996). Since waste generation is part of human existence, the issue to be addressed should be proper management so that it would not cause health hazards. Lagos state sought to bring in private partnership in the collection and disposal of solid waste in various local government areas. The private operators engaged in house to house collection of refuse.

With the rise in population and housing, most residents are forced to dispose of household refuse outside of their homes. Such attitudes still persists due to the fact that they are yet to come to terms with paying for waste disposal. Most residents feel the responsibility of waste collection lies with the government and should be free of charge.

4.2   Current situation in Lagos State Nigeria (LAWMA)

All environmental issue is centrally administered by the Ministry of Environment both at the Federal and state levels while the Environmental health department handles at the local levels. Relevant environmental legislations are established to guide proper management of waste. Such legislation includes the harmful waste Act 1988 with special criminal provisions, the national environmental standards and regulations enforcement agency ACT 2007 (NESREA) which repealed the Federal environmental protection ACT 1988.

Other regulations such as national environmental sanitation and waste control regulations 2009 and the national environmental protection are also in place. It is suggested that the quantity and quality of waste generated in an area or in this case a state is directly proportional to the population size and quality of life. As the population increases so is the quantity of waste generated.

Lagos state which happens to the biggest business hub in West Africa is faced with numerous problems among which are electricity, roads, water and prominently waste management which is associated with human wellbeing. Just like unplanned cities with rapid expansion and drastic population, Lagos state has been overwhelmed by its sudden expansion and population increase. With a population of over 21 million, Lagos state generates 10,000 tons of waste per day (Lagos waste management Authority, LAWMA).

Lagos state waste management authority which manages wastes in Lagos state operates three major landfills and two backup sites to serve Lagos environ. The Abule- Egba land fill site occupies almost 10.2 hectares of land in Alomosho local government areas; the site has been active since 1992. The residual life span is predicted to last approximately 8 years (LAWMA). The Olushosun landfill site situated within the Ikeja Local Government area occupies 42.7 hectares of land and receives about 40% of waste deposits in Lagos state.

The Solous I and II sites is situated along Iba Road by Lagos State University occupies 7.8 hectares and 5 hectares respectively and receives an average of 2,250 m3 of refuse per day. Other satellite sites include the Owutu in Ikorodu, Sangotedo in Eti-Osa and Temu dumpsites in Epe (LAWMA).

Figure 1: Scavengers in refuse land fill in Olususon (Akoni 2013).

Figure 2: Scavengers pick trash for recycling at Olusosun dump site (Akinleye 2013)

Figure 3: Waste dumping site (Akinsanmi 2013).

Figure 4: Waste collection in drainages on the street of Lagos (Nairaland 2008).

Waste disposal habits, ignorance coupled with poverty can be attributed to the way waste is handled. Many industries in an industries Lagos discharge their waste into seas and streams which often times cause diseases. This act has disastrous consequence such as polluted water

for irrigation which in turn leads to the reduction in the quality and quantity of agricultural produce.

The private sector participation (PSP) schemes initiated by the government to ease it burden on waste management have had problems with efficient collection. Due to bad roads, traffic congestions, poor maintenance of vehicles and long queue at dump sites, collections fall behind schedule. Most households lack awareness and basic education about the benefits of waste sorting.

In most parts of Lagos state, waste collection is done mainly with four wheeled carts with cart pushers that are small enough to access small and bad roads. Scavengers do most of the sorting and recycling. Valuable and recyclable materials such as metals and plastics are sold buyers that eventually sale to export merchants.

5   Household waste management practices in Finland

Finland which is officially called the Republic of Finland situated in the northern most part of Europe. With a population less than 6million, Finland has the eight largest lands mass in Europe. Just as many other European counties, Municipalities in Finland are responsible for the treatment and collection of all generated waste from households. The municipalities are has been organized into 39 inter municipal associations (Fischer 20013, 13). This mode of organization has helped to improve each municipal waste infrastructure over the last 15 – 20 years. Finland has been able to achieve a good feet based on the organizational model.
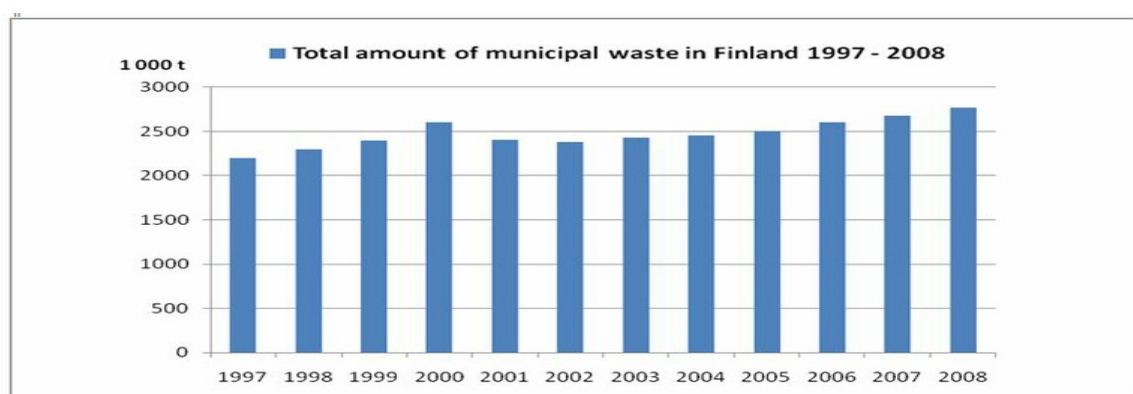

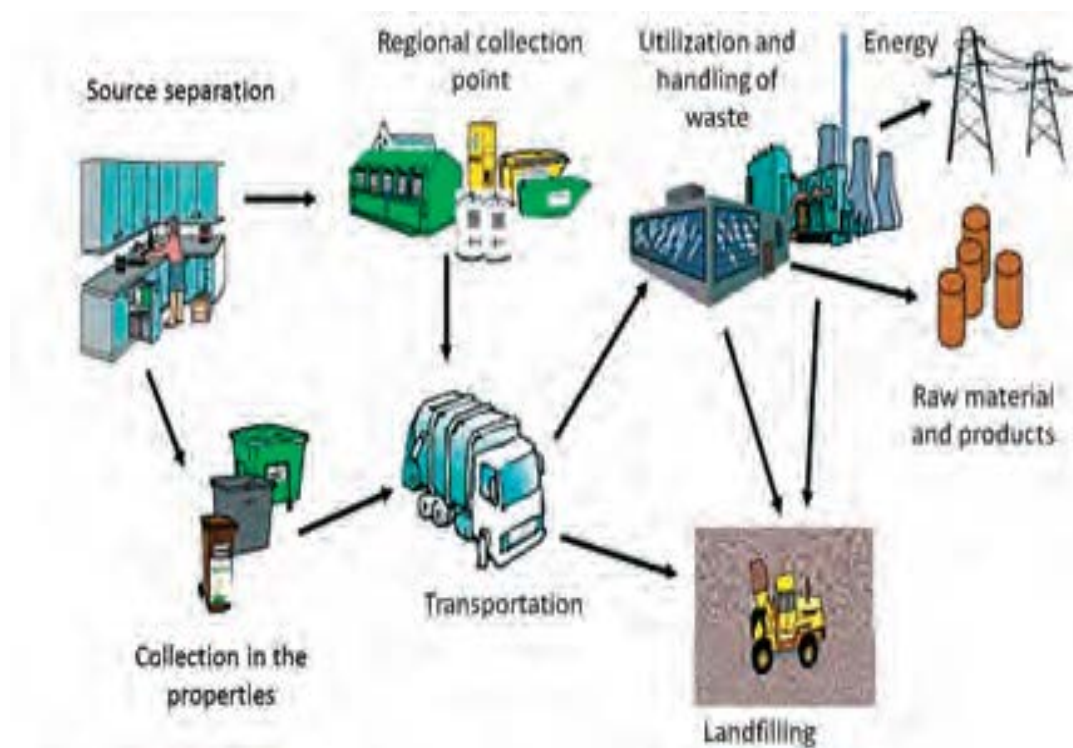Figure 5: Total amount of municipal wastes generated in Finland 1997- 2008 (EEA 2008, Figure 1).

Figure 6: Showing waste management processes in Finland (Piippo 2013, 21).

Waste Produced in households	(Figures in tones)
Bio Waste	156 000
Paper and cardboards	258 000
Mixed waste	1 199 000
Plastics waste	24 000
Wood waste	3 000
Other wastes	215 000
Total	1 854 000

Table 3: Showing the amount of waste produced in Finnish households (Mazengo 2013, 9).

In a Finnish family, an individual averagely generates 340kilos of waste per year. Approximately a third of it is organic compostable waste, One fifth which is paper, another fifth is made up of plastics while the rest consist mainly of textiles, packaging's, glass and metals. A typical waste management system in Finland involves Selection of sorted wastes, transportation and treatment all of which is organized by the municipality or companies assigned to such responsibilities. Presently there are 40 regional solid waste management firms in conjunction with 350 municipalities with over 5million inhabitants in Finland (Mazengo 2013, 9).

Each municipalities has a choice of either organizing a waste management system on its own or can make a co-operation with another municipality.

Each municipality is responsible for the treatment of its domestic wastes. In practice, most of the municipalities have reassigned such responsibilities to local companies who on request purchase the services by tenders amongst the interested companies. In pursuant to the Finnish waste act, producer of waste is responsible for the cost of management organized by the municipality. The charge covers the cost of setting up plants, transportation and after care processes of the treatment facilities. Some of the cost determinants include quantity and quality of waste, household size, transport distance and the collection frequency (ymparisto 2013).

Translational phase of solid waste management is a vital process towards achieving an affective waste management system. Solid waste management in Finland is considered to be a basic service that affects the immediate environment. The management phases consist of sorting, collection, transportation and waste treatment in most cases organized by various municipalities. Various municipals are obliged to organize its solid waste management or together with other municipalities.

With 40 regional waste management companies providing management services to 350 municipalities, the creation of a joint stock regional and federal waste stations have been able to effectively to the environmental demands.

An efficient sorting collects suitable materials for recovery. Most houses with blocks of flats or individual houses have several containers either underground pits bins or surface bins in their back or front yards. All containers have name labels boldly written most times in Finish and translations in English. Contacts are made with a local waste transport a company who empties the containers regularly. In single household, sorting of waste is voluntary. This is due to the realization that most of the wastes generated in a single household thrown in landfills are suitable for energy waste unlike row of houses or block of flats (The City of Pori Environmental Agency).

Households also produce hazardous wastes that pose greater risk to human health and the environment. Hazardous wastes are wastes such as chemicals which have to be collected separately from other wastes. Household hazardous waste should always be kept in its original package and instructions on disposals must be adhered to. Hazardous waste in households includes strong cleaning detergents, fertilizers, glues, waste oils, break or gear fluids to mention a few. Such wastes should not be stored at home but taken to the municipal waste dis-

posal collection centers which is collected free of charge (The City of Pori Environmental Agency).

Figure 7: Waste management lessons from Norway and Finland (Hans India 2014)

Figure 8: picture showing an underground household sorting bin (Piippo 2013, 1).

Housing companies and individual house owners are obliged to organize waste containers for their use and all producers / inhabitants take their waste to the collection containers at a designated point. Wastes are separately collected in containers or bins which are boldly labeled to facilitate easy handling. Containers come in sizes of 14o liters for bio and 240 or 600 liters for other types of waste. Color codes are used to differentiate bin use.

 While apartment house have different containers for metals, glass, paper and card boards, single family use houses usually have collection containers just for wet (bio) and dry wastes which are emptied every week (Piippo 2013, 22). A collection container comes in deep containers as shown in Figure 5 and the surface containers in Figure 6. Surface containers are the more traditionally used for collection in individual households. Deep containers are usually larger than the surface containers and are mostly used in rows of house or block of flats.

 For the deep collection containers, the sizes of the containers are 1300 liters for bio-waste, 3000 liters for paper wastes and cardboards while 5000 liters for dry wastes. All containers have 12c disposable bags laced in the container which is emptied by lifting the bag out of the container with the help of a truck. The cost of empting and maintaining a deep collection container is always cheaper since it is not emptied as often as the surface collection containers (Piippo 2013, 22).

Figure 9: Showing containers with deep collection capacity (Piippo 2013, 22)

Figure 10: Showing movable surface containers (Piippo 2013, 22)

Each municipality with agreements with private waste firms is saddled with the responsibility of organizing waste transportation in Finland since the municipalities do not have the collection vehicles. Waste collection time is based on the household and an agreement reached between the household and the service provider which in this case is the collection company. Each vehicle is manned with collection crew which comprise of the driver and two other personnel whose job is to position the collection container to the rear end of the vehicle for empting by the lifting mechanism attached to the vehicle (Byrne 2013).

Figure 11: A typical waste collection truck and surface bins (Byrne 2013).

 Waste treatment is the process of disposal or recovery operations. This involves sorting into more useful form or converting into more harmless form. As part of an effective waste management system in Finland, municipalities are obliged treat wastes that they are responsible for. With contractual agreements made between households and private waste management companies, waste collected needs to be transported to the appropriate places designated by municipalities for treatments and utilization of waste (Piippo 2013, 23).

In Finland, waste treatment is carried out in large centralized regional centers where treatments are done. All regional centers have different process stages for different waste types and final disposal grounds for unrecoverable waste (Piippo 2013, 23-24). Waste can be treated through mechanical, biological or thermal means depending on the composition of the waste. In mechanical treatment, the waste is crushed and screened to separate waste fractions to be used. This method is often used to process waste for fuel recovery (Piippo 2013, 23).

Bio-waste is decomposing during biological treatment process by composting to a safer form that can be used for improving the soil. As a source of energy, the biogas produced during composting or anaerobic digestion can be used as a source of energy.
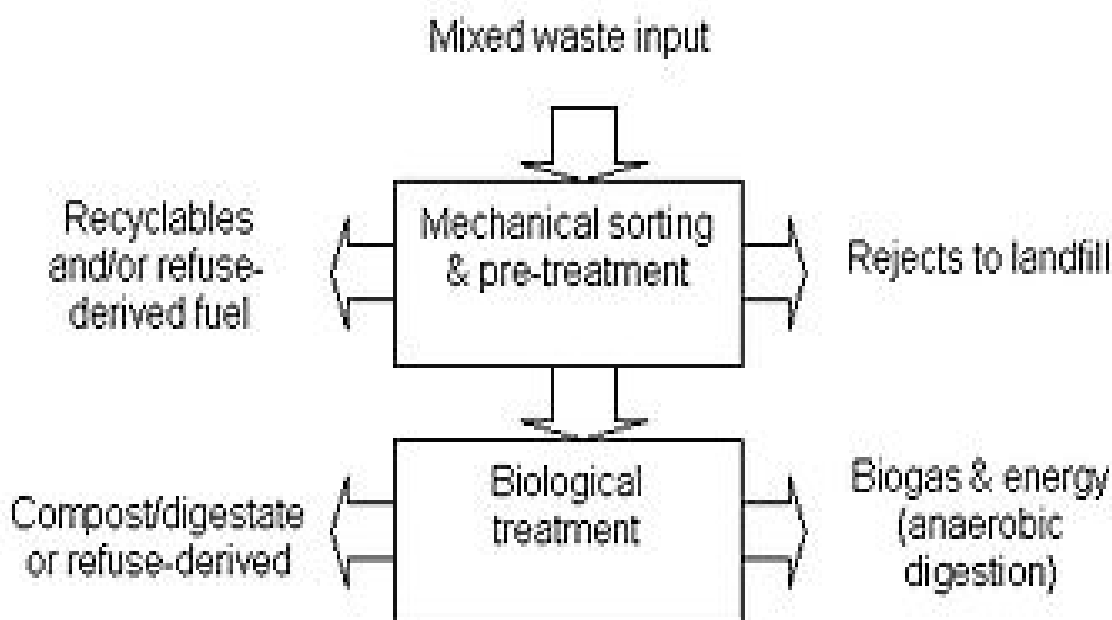

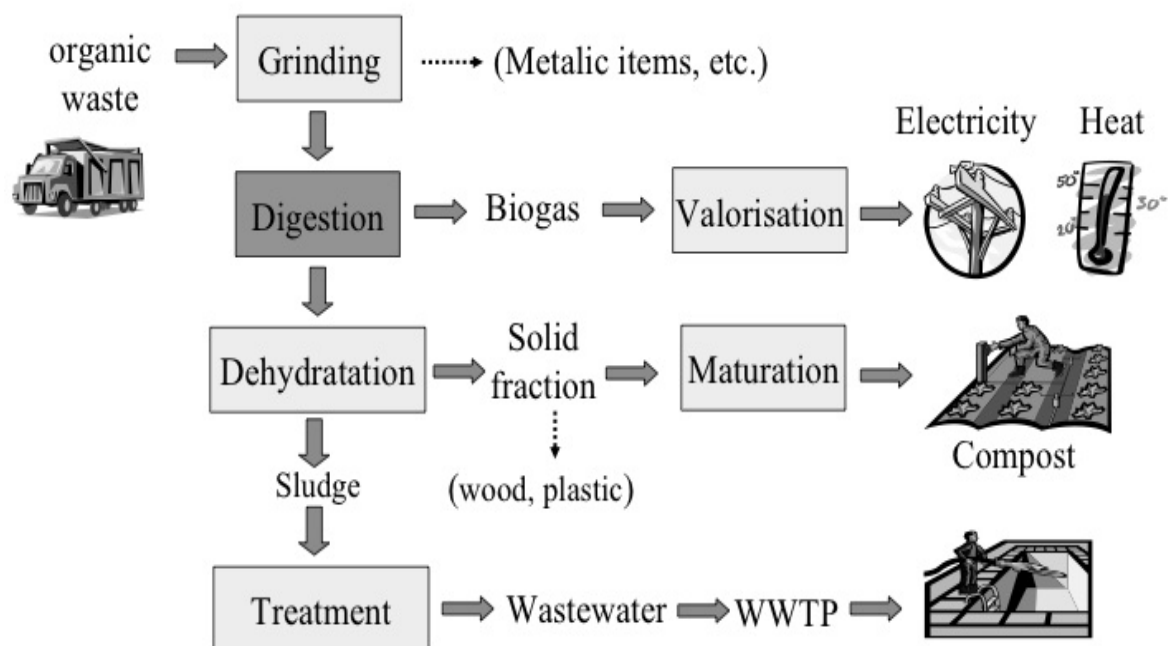Table 4: Mechanical biological waste treatment (Spuhler 2010, 3).

Figure 12: Anaerobic digestion of solid waste (Spuhler 2010, 2).

6   Present practice in Finland (Lassila & Tikanoja OY)

Lassila & tikanoja started as a whole sale company was founded in 1905. Over time and through numerous phases, L&T has developed into a corporation with international reputation in environmental management and property support services. During these times, L&T business operations had expended from Vaasa in Finland to Sweden, Russia and Latvia. Established in Vassa, Finland, the enterprise started with the whole sale of fabrics and heavy products such as soaps and confectionaries growing into one of the biggest private owned wholesale company years after.

In 1923 through the 80's, L &T diversified through the acquisition of non-woven fabric company, a plastic flexi packaging company and a paper bag company. The company began the manufacturing of clothing and soon became the biggest in Finland with locations in 20 cities all over Finland. In 1961 with exports accounting for 50% of its net sale, L &T became listed on Helsinki stock exchange. Lassila & Tikanoja in 1989 bought 74% shares into Sakkivaline Oy which was established by the Finnish paper manufacturers to promote the use of waste bags.

This prompted the establishment of a separate company in 1967 which towards the service rendering such as cleaning, waste collection, maintenance, industrial cleaning and property maintenance. In year 2000 Sakkivaline Oy acquired another environmental management firm called WM Ymparistopalvelut OY. This made Sakkivaline Oy become the leading environmental management firm in Finland. On September 30th 2001 Lassila & Tikanoja was established to serve as the parent company for Sakkivaline Oy .Subsequently Sakkivaline Oy was merged with its parent company to become Lassila & Tikanoja with the head office located in Satanrikuja 3 Helsinki.

6.1   Company sector

Lassila & Tikanoja facility management Service Company specializes in the waste management and property maintenance. In conjunction with customers, L&T strives to create an efficient tailored service package to meet the individual needs of its numerous customers. The company's services includes waste management and recycling, process cleaning, support and cleaning services, environmental construction, technical systems and property maintenance services, provision of waste bins and loading containers.

L&T offers commercial and retail collection and transportation of municipality solid waste. Such services are solely based on agreements wherein payment is determined by the amount waste collected which is always measured cubic meters under each area approved tariff. Waste collection routes are efficiently optimized for the convenience of customers and to ease traffic congestion. With net sales of 668.2 million Euros in 2013 and over 8,000 employees, L&T has been able to establish its presence in Finland, Sweden and Russia. Listed in the Helsinki stock exchange NASDAQ OMX, L&T has been able to cut a niche in its line of business.

6.2   Lassila & Tikanoja waste journey

Waste journey can be described as the translational phase of waste from various households. L&T is a leader in the Finnish waste management market having cutting edge infrastructural assets in waste collection, transportation and processing. L & T aims at turning waste into raw materials to save energy and raw materials. With over 200,000 customer base, 10% in households, 20% in the public sector and 70% with the company which comprise of industries, retail & logistics, property owners and managers.

According to the interview conducted on the 3rd of June 2014 with Mirva Vaisanen a training consultant, waste recycling and management specialist with Lassila & tikanoja. L & T in

agreements with municipalities is responsible for collection and transportation of wastes from apartments and households. Lassila & tikanoja provides waste containers and organizes waste transportation for customers since the municipalities do not have the facilities to provide such to households. L & T mostly offers open top waste collecting containers with inscription of use written boldly on it.

Different waste color bins serves as instructions for different waste fractions for users most especially in big apartment houses. The most common wastes fractions collected in house-holds are bio waste, paper, recyclable papers, glass, small metals and then mixed waste.

600 trucks   **24 plants and Terminals**

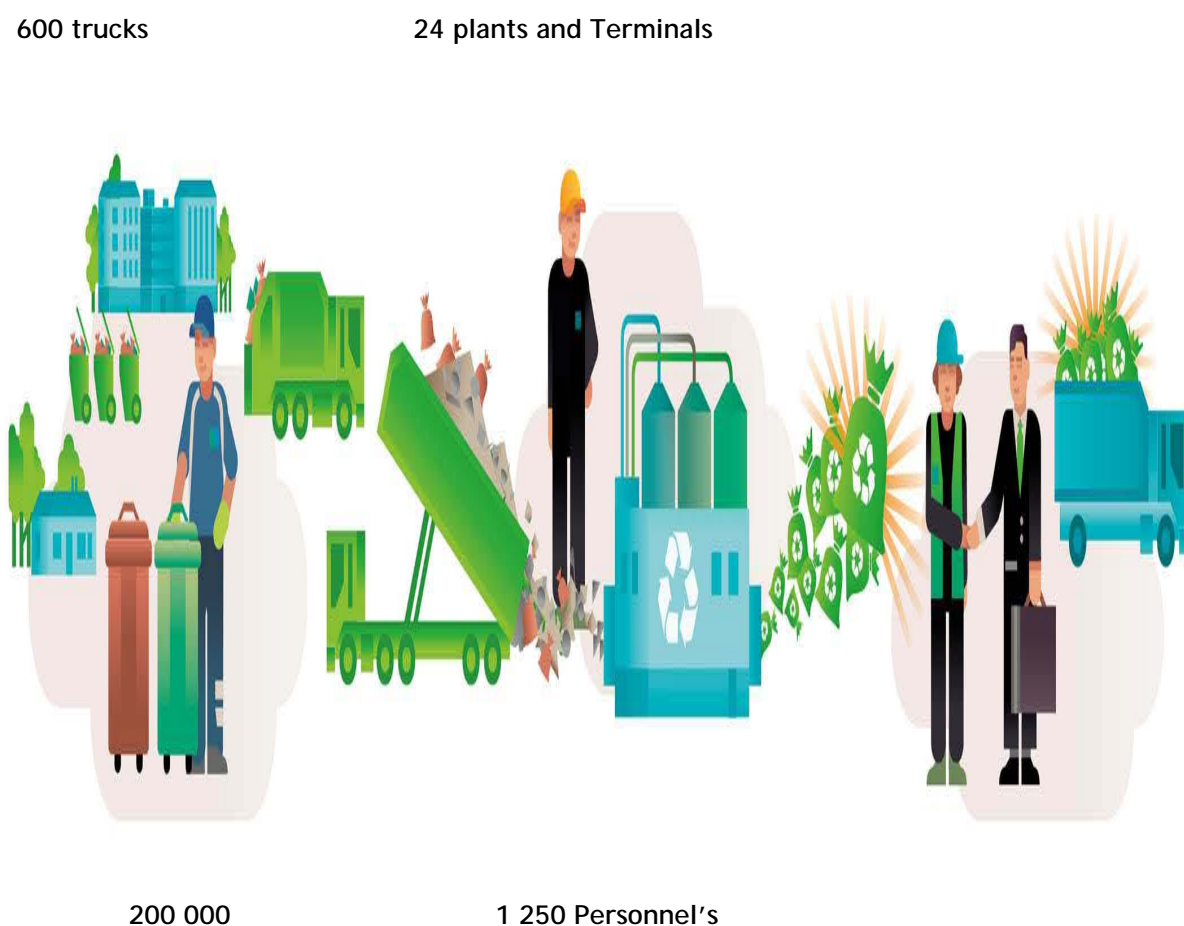**200 000**   **1 250 Personnel's**

Figure 13: Lassila Tikanoja Value chain (Lassila Tikanoja OY).

In Finland, every city has its own local waste act which governs the way waste are collected and disposed. In Helsinki, it is believed that buildings with more than 20 apartments will have to sort its waste individually according to fractions. In Porovo, buildings with more than 10 apartments will have to sort its waste. This shows that each city has different rules attached to waste disposals. Waste collection times are based on contractual agreements reached with households. L&T provides different waste trucks for each fraction of waste. In some cases, there are waste trucks that are partitioned to accommodate two different waste fractions mostly metal and glass. Each truck manned with collection crews which comprise of a driver and two other personnel whose job is to position the collection container to the rear end of the truck for empting by the lifting mechanism attached to the truck.

Lassila & Tikanoja runs its own recycling plants in locations around Finland one of which is located in Karhuntassuntie Kerava. To facilitate quick and prompt service, L & T have partner waste management companies that helps to execute some of its duties to achieve a wider reach. Lassila & tikanoja does not manage bio waste, all it does is collect and drive while other partner companies do the handling and decomposing. Recyclable paper, small metals, recyclable plastics and cardboards which eventually serve as raw material for the paper, metal and plastic industries respectively are wastes that L & T makes profits in on like the bio waste. Customers with bio waste pay for the disposal on like other wastes that L & T have to pay for.

Wastes are transported to various plants where they are further sorted into fractions for onward processing. The fractions are processed for further usage by other partner companies. Mixed waste are dried and chopped into bits for energy companies, plastics washed and chopped into flaks for the production of new plastics, metals are passed to companies that can melt for reuse and wood chopped into dust also for energy firms. All the processed wastes are further passed to other partner companies in the chain of production.

7   Analysis and adaptations from The Connect Project

The waste to energy workshop organized in Lagos State Nigeria in 2014 was aimed at creating an open understanding on the current situation of waste management and waste to energy in the state, identify the mutual interests and future potentials for developments and collaborations. This workshop was facilitated by Connect project and represented by Maarit Virtanen, Ritva Jaattela and Eija Laitinen.

The workshop was attended by 36 participants drawn from the Federal Ministry of Environment, Lagos State Waste Management Authority, Ministry of Works and Infrastructure, Ministry of Energy and Mineral resources, Ministry of Rural development, Nigerian Conservation

Foundation (NFC),Bank of Industry (BOI),University of Ibadan, Babcock University to mention a few (Connect project, Lagos 2014).

The current situation of the state was analyzed and conclusion was drawn on possible developmental areas. Such areas will be further explained with subsequent headings.

7.1   Need for awareness and capacity building on waste management processes

Insufficient capacity building is one of the most fundamental impediments to an effective solid waste management in Africa in which Lagos State is inclusive. An efficient and environmentally viable solid waste management plan involves co operations between government and private sector equipped with sound technical capacity for maintaining, monitoring and operating the process (Mungure 2008, 20). Often times, a large number of employees both in the private, non-governmental and governmental organizations working in the sector have none or insufficient technical skills to perform efficiently (Mungure 2008, 20-23).

Capacity building entails the investment in people, institutions and its practice which in turn helps to achieve developmental objectives (World Bank 1997). Capacity building can be developed through training and sensitization of personnel. Most African States like Lagos State invest most times in physical resource which is a part of capacity building but not the whole (Mungure 2008, 21-22). Therefore it involves the collective co-operation of organizations, governmental institutions, local communities, societies, individuals and concerned stakeholders to develop means to solve problems and achieve set objectives (Mungure 2008, 21).

Public awareness is also one of the key factors that influence the level of environmental protection and management in any society. The level of awareness in most cases can be attributed to personal values and cultural traditions. These values and traditions reflect in the solid waste handing pattern and general attitude which is conditioned by people's cultural and social context (Mungure 2008, 23).Some of the steps towards improvement are awareness and benefits of environmental sanitation and its impact on human wellbeing. The central objective of capacity building as to the protection of the environment is not to change cultural values or tradition but to improve information and communicative capacities (Mungure 2008, 23).

7.2   Solutions to suit localized environment

The idea of localized approach is centered on individuals and stakeholders that fall in between the waste management chains. These individuals and stakeholders include waste management firms, waste generators and packaging companies while technology can be used in storing and information dissemination. People should be knowledgably oriented to see the environmental and health consequence of dumping wastes in streams, drainage channels and road paths (Abila & Kantola 2013, 4).

The present challenges facing the waste management in Lagos state can only be solved through localized interventions. Cultural beliefs still strive in the way people dispose and handle household waste. In Lagos State, centralized storage containers are not seen as solutions to recycling and recovery. Packaging producers should be considered as major stakeholders. As opposed to waste management in developed countries, packaging producers are more interested in contents rather than the packages (Abila & Kantola 2013, 2).

In most suburbs of Lagos State, waste is seen as useless materials rather than wealth. A change in people's perception about the value of waste can enhance the eventual actualization of processes involved in the proper management of solid waste. The general conception of solid wastes as worthless and useless can be linked with a disorganized societal system where all waste belong to the land fill.

7.3   Introduction of small scale solutions

According to Ernst & Young 2014, Nigeria is anticipated to remain an economic investment hub in the future and could most likely be one of the most attractive market and investment destination in the world. Poor waste management in recent time has been one of the major causes of concern, this pose various safety and health risk to the people. There is a high risk of water pollution from poorly stored waste as well as uninvited vectors such as flies, birds and rodents that can transmute diseases to human being (khennas 2003).

Public and private participation (PPP) in solid waste management in Lagos State has provided communities and other entities with the avenue to fulfill social responsibilities but an opportunity to be entrepreneurs. If such initiative is more developed, the synergy among the state and local stakeholders can further create a stronger economy thereby offering residents with a better quality of life. This synergy will create more jobs and a higher spending power to the communities (Gonzales, Lauder & Melles 2000).Part of the entrepreneurs that have emerged to benefit from small scale solutions includes the cart pushers, scavengers, recyclers and the merchants.

To further encourage these entrepreneurs, continuous trainings have to the organized on how to enhance and improve productivity. Training on effective management of income re-investment into other enterprises. The facilitation of cooperatives among groups local stake-holders (Gonzales, Lauder & Melles 2000). The promotion of awareness programs on the need for more safety and protective tools and for the government to formalize and recognize the activities of these locals with legislations at both levels of government.

7.4   Need for baseline Information on collection, storing and retrieval

In Lagos state, data on composition of waste in residential, industrial and commercial areas is readily available on the Ministry of environment website but the reliability has been ques-tioned. Information shearing between waste producers, waste generators and waste manage-ment authority is vital in bridging the present knowledge gaps in the sector. The flow of In-formation facilitates the exchange of knowledge between stakeholders.

Although the active participation of the informal private sector in waste management in La-gos state has made it a more livable environment, there is still a lot of work to be done. In order to be able to gather a more accurate data on the quantity of waste being generated in the state, an extensive survey needs to be done. A robust data base on waste will not only enhance integration within the sector but also give interested investors needed information on waste management system in the state (LAWMA 2009).

7.5   Ensuring open access to existing information

To achieve a robust and efficient waste management in Lagos State, there is need for an open access to current and exiting information to individuals, stakeholders and investors. The in-teraction and information shearing between the local waste authorities and its international counterpart if required to close the ever exiting gap between developing and developed countries.

Corruption and poor infrastructural investment is often a constraint in information dissemina-tion to ensure open access to information on waste management in Lagos state and Nigeria as a whole. The emergence of a well developed policy on information gathering will further be a benefit to the sector. Over the years, large scale projects like the World Bank projects that would have benefited the sector

8   CONCLUSION

The comparison of the best practices in waste management in municipalities around Finland against what is obtainable in Lagos state Nigeria will further locate the lapses in the present adopted waste management system in Lagos State. The analysis and recommendations will help to enact new policies that favor recycling and ultimately enlighten its citizen on the adverse effect of untreated waste and the value that lies in it. All of the outlined feet achieved in the Finnish waste management system are made possible due to legislations that regulate the amount of wastes that goes the landfill.

It is pertinent to conclude that all highlighted stakeholders from the informal private to the government are meant to be sources of employment, wealth creation and poverty alleviation but the reverse is the case. All of the benefits of public private participation are yet to be achieved due to the effect of incessant political interference, nonchalant attitude on the part of the government and staffs, inadequate equipments and funds, inadequate technical know-how in the maintenance of equipment and the lackadaisical attitude of the waste generators (the public) in paying for the services rendered.

 More frequent interaction with the stakeholders and international agencies should be encouraged so as to bridge the wide gap that existed between the developed and developing countries. This interaction will open more strategies for knowledge shearing and the efficient management of waste. With scarce resources and global warming, waste can no longer be treated as worthless; rather it should be treated as a present or available resource that has to be put in further use. When considering sustainable waste managements, different recovery and treatment options should always be considered based on available technology.

One of the most prominent problems mitigating the smooth running of an efficient solid waste management in Nigeria is corruption. Corruption is a menace that has eaten deep into all government agencies in Lagos State and Nigeria at large. All the problems identified and its interventions can only be fruitful if agencies are given adequate funds to perform its duty. All funds allocated should be monitored and judiciously used in executing what it is meant for.

Recommendations and observations made by the Connect project workshop in Lagos state Nigeria has contributed a lot in highlighting the prevailing problems associated to waste management in Lagos state. Some of the findings have been able to serve as modelling network for developing countries. The network and modelling strategy formed by Connect project with NGOs, government agencies, ministries and target countries have been able to serve as a bridge for Finnish companies that have solutions and knowhow in entering new markets.

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Figures

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Appendices 1

INTERVIEW WITH MIRVA VAISANEN OF LASSILA & TIKANOJA OY (RECYCLING PLANT KERAVA, VANTA)

The interview was conducted on the 3rd of July 2014 at Lassila & tikanoja's recycling plant in Kerava Vantaa with Mirva Vaisanen. Mirva Vaisanen works with L &T as a training consultant and waste recycling and management specialist. Having a broad knowledge in the waste recycling, sorting and how waste is handed in Finland, i decided to grant the interview based on her broad knowledge.