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**ANALYSIS OF PROJECTS PROGRAMS AND PORTFOLIO MANAGEMENT METHODOLOGIES USED IN MUNICIPAL ENGINEERING MANAGEMENT SECTOR IN FREETOWN CITY COUNCIL**

The article summarizes how project, programs and portfolios are defined by the study area; presents project management classification based on methodological, method and methodic using the 3 pyramid model, which can be applicable to the study area; shows the framework of wastes management system developed for the study area for sustainable solid waste management system using the system model showing inter-connections between systems. Fig. 2, tabl. 3, ref. 13.

Key words: solid waste, project, program, practices, waste, waste management, disposal, collection, methodology, methods, methodic, tons.

**Problem statement.** Wastes management throughout the World is a global concern especially in developing countries based on many factors but not limited to limited funding, civil war, natural disasters, corruption, weak institutions to manage the daily waste management challenges [1]. The weak economic growth of low income countries faces the worse of these challenges because of high rural-urban migration of people with little opportunities to keep the cities going. Also, looking at the different projects, programs and portfolio operating within these institutions are also key for solving the long decade challenges of managing wastes. The International Organization for Standardization provide the necessary guide lines, methods, strategies in the area of ISO 140001, the Environmental management system which means the role of organizations in addressing environmental issues during their daily project activities [2]. The application of this standard and its related other standards in the waste management sector will help determine each country waste management status.

**Goal of the article.** Analyze projects, programs and portfolio management and the type of standards used. within the Municipal Engineering sector of Freetown City council.

Introduction of the basic findings. Different entities from state and private sectors are engaged in the waste management projects in Sierra Leone but the Freetown city council is responsible to ensure that the municipality meets its developmental goal. It has key strategic areas of intervention which includes municipal engineering, internal audit, Administration, Finance, development planning and educational departments [3]. The municipal engineering department within FCC is responsible for the management of the environment, civil works, development and maintenance of public parks, cemetery, and open parks within the city. The Freetown Waste management company which was established in 2008 based on the recommendation made by world bank a project which was to improve the waste management sector in Freetown [4]. The Freetown waste management company(FWMC) under the supervision of Freetown City Council Municipality (FCC) as the key state actor responsible for ensuring that appropriate body or contractor is hire for keeping the city clean. One of the responsibilities of FWMC is to ensure that daily wastes are transfer from temporary deposit points to permanent open dumpsites within the city. Due to the incapacity of FWMC to work effectively for so many reasons such as limited budget allocation by government, corruption, lack of required methods/approach, the limited

availability of waste collection, transportation with no reduction of waste generation, reuse and recycling strategy faced by the company. Waste generation is increasing especially in the urban areas in the world and African countries have urban population of 260 million generating wastes of 69,119 tons/day with 0.65 per capita. Projected population for 2025 for African urban population is 518 million with per capita of 0.85 and waste generated 441,840 tons/day [1,5]. More burden is expected in the waste management sector in the world especially the developing countries that still lack the appropriate project management methodologies/strategies and equipment. The poor performance of FWMC led to hiring a private company, MASADA Waste management company responsible for the collection, transportation and minimum recycling of waste in some zones within Freetown in order to compliment FWMC. African countries need to revamp the waste management in a different forms by trying the 3Rs meaning Reduce, Reuse and Recycling of wastes because waste collected and transported in African countries remain in the final dumpsite/landfill without converting it to other product [1,6] In the regional areas and district level, the city and district councils are responsible for the collection and transportation of waste in their respective districts and cities partly funded by central government of Sierra Leone and partners. Wastes categorization is one step by which every city or country could be able to address the issues surrounding wastes management sector. Therefore, the definition of wastes and how it is categorized is crucial especially for the study area. Waste is any solid, liquid, or contained gaseous material that is being discarded by disposal, recycling, burning or incineration. It can be byproduct of a manufacturing process or an obsolete commercial product that can no longer be used for intended purpose and requires disposal. Clearly understanding the different types of wastes help organizations to take the necessary decisions. Examples of such wastes include domestic trash and garbage; inert construction / demolition materials; refuse, such as metal scrap and empty containers. But what do we really understand waste management is a crucial phase for research like this. Therefore, Waste management refers to the practice of collecting, transporting, processing or disposing of, managing and monitoring various waste materials. It is important to observe sustainability in this aspect so that every bit of waste can be managed in an efficient manner rather than just dumping it all in landfills [4,6].

Most of the wastes generated in Africa fall under the following category into key areas namely organic, paper, plastic, glass, metals and others. the income level of countries around the world determines waste generation and types of wastes normally generated

Sierra Leone is among the low income countries and most of the wastes generated in this country is from organic (64%) based on the income level of the people. The organic wastes comprised of food wastes generated at households and commercial areas, wastes generated from agricultural activities etc. but these organic wastes are not utilized to produce energy, gas, or even well planned composting. This is evidence to show how the country is still faced with the necessary challenges which are limiting the operations such as limited wastes storage and transfer equipment, funding constraint, required expertise and developing a waste management community culture oriented so that citizens can take responsibilities in handling wastes. Other components of wastes as indicated include papers mostly waste generated from factories, offices etc., plastics and glass wastes are also generated in this country with poor recycling operation at the moment. However, the future of the small nation with regards to creating sustainable waste management especially solid wastes can contribute by reducing health related diseases caused by water and air borne diseases. It also contributes energy to waste which is more sustainable in converting the waste to energy that will produce electricity [5]. Considering

methods/strategies/techniques in implementing any project is a way forward to be able to manage such project. Therefore, it is important to look at specific ways wastes are categorized in Sierra Leone (tabl. 1).

Table 1

**Category of wastes and type of generators in freetown**

Source	Typical waste generators	Types of solid wastes generated
Residential	Households wastes	Food wastes, paper, cardboard, plastics, textiles, leather, wood, glass, bulky items and household hazardous wastes.
Industrial	Light and heavy manufacturing	Housekeeping wastes, e-waste, packaging food wastes, demolition materials, waste generated from mining companies.
Commercial	Stores, hotels, restaurants, market places, public places	Paper, cardboard, plastics, wood, food wastes, hazardous wastes, e-waste
Institutional	Schools, hospitals, prisons, etc.	Same wastes like the commercial such as ministries, departments and agencies, new construction sites, road maintenance repair, concrete wastes etc.
Municipal services	Street cleaning	Street sweeping done by youth and women, land scraping, tree trimmings, general cleaning Saturdays as it used to be, waste generated from vehicle parks
Process wastes	Heavy and light manufacturing	Slag, mineral tailings etc.
Agriculture	Crops, orchards, vineyards, dairies	Spoiled food wastes, agricultural wastes.

Sources: Developed from [3] and adopted for the case study.

The municipality wastes generated are mostly household wastes that are highly organic comprised of food wastes, paper, plastics etc. including hazardous wastes. Wastes are also generated in commercial business areas such as market places, public parks, restaurants, while for institutional wastes generated from schools, offices etc. The point we want to establish here is that for effective waste management system, it is important to considered all the above which can expand based on the key areas more relevant.

*Waste collection and transportation within freetown.* Every day, the municipality produces more than 745 tons of solid waste which means a system should be in place to manage the daily solid wastes generated. But how are wastes collected in the municipality? As wastes volumes increases every day in the world, there is increasing demand to provide the necessary strategies that will tackle it [5]. The city has two main permanent landfills located in Kingtom, west of Freetown and Kissy Dockyard in the east end. The industry is faced with huge challenge in the collection and separation of solid wastes from household/community/ or city levels. The solid wastes are normally categorized by their sources, types of waste generated, quantity, and composition [6]. This means accurate information availability enhances effective waste collection which is limited in Sierra Leone. The collection frequency of solid wastes, strategies, expertise and many more are limited. Also, community knowledge on waste collection, separation and following the required environmental policies are not fully implemented or practice both at community disposal sites and permanent landfills. One of the waste collection strategy is the youth empowerment scheme project which is responsible for the cleaning of public places by youth and women as

part of the waste collection and separation strategy. These wastes collected are deposited inside the skips at zonal level.

Therefore, we first want to know the wastes generated in Sierra Leone daily per person. The country daily data on wastes produced is limited and because of this, as we initially mentioned that at global level, wastes generated per person per day is 0.5kg as against the population which will be able to project the future wastes production in the study area. We will present this information in a tabular form looking at the key indicators such as population of the study, wastes produce daily and future wastes generation. The first table is summary of waste generation per person per year against the population in the four regional head quarters

Table 2

**Waste generation in the four regional head quarters of sierra leone**

District	Populati on 2015	Waste generati on per Person/ year (0.5kg)	Populat ion 2017	Waste generatio n per Person/y ear (0.5kg)	Populat ion 2020	Waste generati on per Person/y ear (0.5kg)
Bo	574,201	787	591718	810	612008	838.4
Kenema	609,873	835.4	635465	870	657255	900.3
Makeni	606,183	830. 4	625183	856.4	645183	884
Western Area Rural	442,951	606	462951	634.2	482951	662
Western Area Urban	1,050,30 1	1351.1	107030 1	1466.2	109030 1	1494

Sources: Developed by authors from [3] and adopted for the study area.

There are four key areas within the country that have the highest population than other places because of their strategic position as regional headquarters where wastes are highly generated. Looking at the various total population and calculations of three years and the population against the wastes generation. In 2015 for instance, the Western Area Urban population of 1,050,30 produced 1,351.1 kg of wastes per year per person. The projection of wastes generation will increase to 1,494kg per person per year in the study area in 2020. Similarly, wastes are produced in the other cities base on the inhabitants especially due to high economic activities and migration from rural to urban areas within the country. Kenema and Makeni produce the second and third highest wastes in the country. As we early stated that migration has a direct link with municipal city population in the world is no surprise that the study area faced similar challenges like any other low income countries in the world.

*Waste storage facilities around freetown city.* Freetown city has many temporary deposit sites around the city and two main landfills but how many zones, number of skips, collection frequency and the estimated population generating wastes every day[6,7] This is important because it help us understand the capacity of wastes generated and transported daily The city is divided by the number of zones with skips where wastes are collected on frequency meaning how many times the waste collection teams collect and transport solid wastes from community temporary sites/bins. The population producing wastes are also indicated in order to determine

how much solid wastes are generated. Therefore, the temporary waste storage facilities known as Skips and the frequency of waste collection from these points to the permanent landfills in the study area is analyzed below.

The city has four zones with specified temporary wastes deposit sites. Zone one comprised of total projected population of 185,000-200,000 and eleven skips points which has a total frequency collection of 30 times in the week from Calaba town to Ferry Junction in the east end part. Also areas found within zone two are from Ferry Junction, East end Police station and mountain cut communities having nine skips and total frequency of twenty times wastes are transported to permanent dumpsites. The zone has a total population of 185,000-210,000. Similarly, the third zone starts from East end police station, St John and Brookfields communities with 8 skips and 35 frequency of wastes collection points and periods of collection with a population ranging from 250,000-285,000. Lastly, the final zone starts from St John to Juba Bridge around Lumley community with a total waste collection points of fifty and frequency of twenty-four times in the month. The zone also has a projected total population of 275,000- 410,000. Based on this, it is simple to understand how the waste management system has been developed though there are still challenges. Human beings and animals especially dogs, pigs etc. every day enter these landfills in search of wastes food, plastics, metal, and many more. This has a direct link to health implication as a consequence of poor waste management practices since the dumpsites are not secured. one common way wastes are collected in Freetown is through the street sweeping/cleaning project that was established to ensure that effective cleaning is done in public places especially the major roads, streets, parks and other public places. The project provided jobs for community members as part of the cleaning teams every day. They help to collect solid wastes and place them to the temporary sites. The households also collect wastes and store them to the skips. Sierra Leone is among the low income countries in the world which clearly shows the country huge challenge to tackle solid wastes or convert it to energy a process called waste –energy. The country has many priorities but the strategy to Reduce, Reuse and Recycle wastes due to the fact that this will help to minimize the daily solid wastes produce everyday [7]. More is needed now in the area of converting waste to energy to help improve the economy. What is the current plan for the waste management industry in Freetown? FWMC and MASADA company will work together to ensure that the two years' project meet its intended goal and expectations of stakeholders, direct and indirect beneficiaries for sustainable waste management system. MASADA company will be more focus in the area of sorting and recycling of wastes in order to produce electricity and methane gas for household and commercial utilization. [7,8]. Therefore, we will look at project management methodologies used in waste management especially taking into considerations the definitions of project, program and portfolio management which may vary at organizational levels and the project and program managers' responsibilities may change [6]. Been that the aim of any project manager is to produce the expected result through using the project management methodologies. This is also similar with the program managers in some organizations who preferred managing different projects and portfolios within the organization. Therefore, it is necessary for us to find out and apply the project management methodologies and how are they classify in Sierra Leone.

*Project management methodologies used in waste management.* Project management methodologies are key ways we look at an object in different ways, the approach taken to solve a problem is important and it has to be in line with the international standard which is ISO 140001 environmental management system and also considering the current situation of this sector because ISO 40001 addresses the application of environmental management system in place at all levels of project

activities [9]. Therefore, classification of these methodologies depend on the country strategy to address this which should be in line with ISO 140001. We will present this using 3M pyramid model [10] to explain how Freetown waste management company and MASADA company are delivery different methods in the waste management sector (fig. 1).

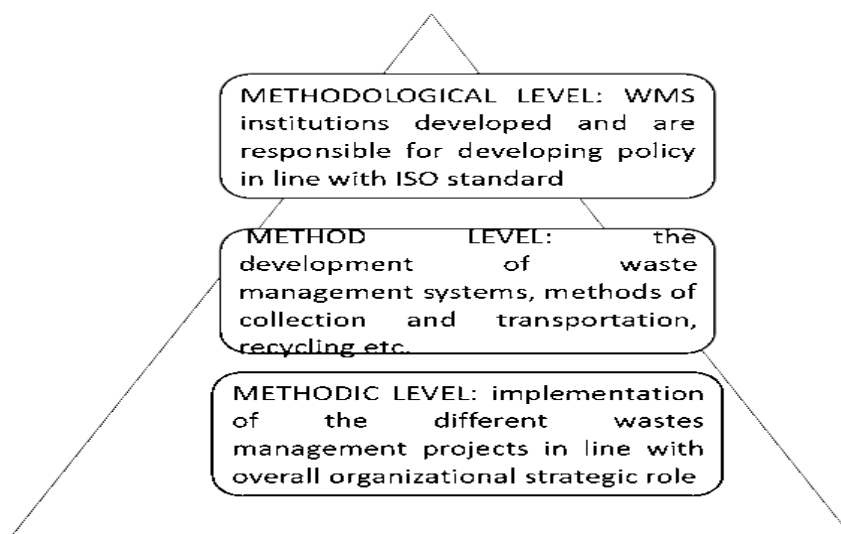


Fig. 1. Project management methodologies used in waste management sector based on their level of importance

There are three layers of this model, at methodological level, waste management perception at national level shows the development of institutions responsible for developing policy frame work and strengthening other institutions to implement the policy. Such institutions are the establishment of Environmental Protection Agency as the main agency responsible for addressing environmental and climate change issues in the country. The ministry of Health and Sanitation has been responsible for developing policy relating to wastes management in the country since independence. But institutions at city level council like FCC municipal engineering sector apply EPA national policy guidelines in line with ISO 140001 especially in the waste management sector and the national health management policy developed by ministry of Health and Sanitation in the country. These institutions also conduct monitory and evaluations of projects implemented in this sector. But implementing appropriate standards will help this sector which is still faced with the challenges. At the method level, explains methods used in the waste management sector in sierra Leone and we made a comparative analysis with the developed world waste management system. At methodic level, waste management is more less the development of processes which can enhance effective waste management system [9]. At the method level, waste collection, little, separation, transfer of wastes are ongoing but effective methods are required such as the development of modern municipal waste plant or other alternatives. In summary the strategic level plays a pivotal role regarding the development of national policies, implementation of these policies, monitoring to ensure that they meet their required goals. are considerable plans for the construction of modern processing plant which facilitate and enhance effective waste management system through the participation of public –private partnership.

*Analyses of FCC institutional project management framework.* If we are to consider the project management framework of FCC for the waste management sector, there are key areas we have to take into consideration based on the current situation, namely, the organizational processes, structure, the human resource (people) and the type of system they have at the moment. The institution is how ever faced with huge challenges which we can categorize under equipment meaning the necessary logistics, personnel (expertise to delivered the required services). The waste collection and transfer is key in municipal wastes management but for the study area, the limited equipment to tackle the huge pack of wastes generated every day coupled with the weak environmental practices such as open burning, indiscriminate waste disposal, little or low knowledge of communities regarding community sustainable waste management culture [11]. A sustainable waste management system is require considering the following areas such as waste collection and transfer system, environment management system, law enforcement and the equipment systems. We can present this using the system model as showing in the diagram below (fig. 2).

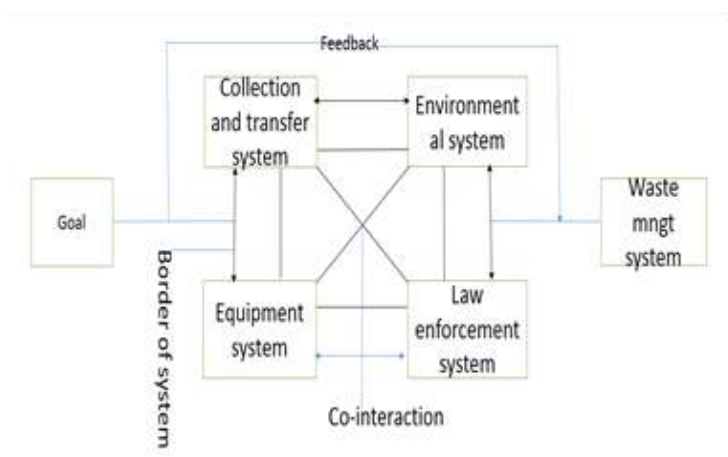


Fig. 2. Framework of waste management system  
Sources :developed by author methodologically based on [12].

The framework developed is based on the main solid waste management system which can enhance effective services if these systems are improved. It is by all indication that the waste management sectors in low income countries have weak waste management system which has led to the dilapidating condition as in the case of Sierra Leone but development is a gradual process and it takes time. Considering the system model, much is needed to address the waste management sector by creating a sustainable waste management system instead of just waste management. Providing the expected equipment and capacity building to company's employees could bring more improvement in the sector. Also, the law enforcement unit for dealing with defaulters of breaking the EMS law is weak because of poor community engagement in this. Also, the sustainable management of the environment has to be considered using ISO 140001 as international standard for environmental management system. Further improvement in the area of waste collection, separation, transfers to follow the standard procedures and creating community waste management culture will help to reduce worse practices such as open burning of wastes, poor composting, little or no RRRs strategy used at the moment by FCCM. Coming to the law enforcement and penalty for disobeying waste management best

practices. The city council police are charged with the responsibility of arresting alleged individuals but the local lack the judiciary system and fines normally create room for continuously violation of law. It is a system model where in all the different systems are interlink/interrelated. Each system has a closed border with another system [2]. Other primitive practices are still being in some places within Freetown such as disposal of wastes in the drainage, burning and burying wastes at household level and community levels.

*Waste management policies or by-laws.* Institutions such as Environmental Protection Agency (EPA), Ministry of Health and Sanitation, Freetown city council and the parliament of Sierra Leone have more work in the area of policy design, approval by parliament and implementation of waste management policies or by laws for sustainable solid waste management. This is evidence of the current weak by laws, policies, penalties or weak judiciary system in the country to ensure that appropriate measures are taking to remedy the city wastes management challenges. Municipal waste management success also lies on the educational activities in order to inform people the need for sustainable solid waste management because it will help reduce health related diseases cause by improper wastes management. This can will be enhanced through effective community engagement structures such as school health clubs, community youth health clubs. Taking responsibility for wastes generation and transfer to temporary dumpsite sites from household level has helped in other developing countries with the creation of school and community health programs can contribute in this direction [9]

*Analysis of project, program and portfolio management methodologies used in the waste management sector in Freetown.* There are two main players in this industry at the moment to facilitate waste collection, transfer, and many other processes. We want to look at the different projects, program, and portfolios within the Freetown city council as a parent body in charge of Freetown city municipality. All these actors in the solid wastes management sector may be engage in one project, under a portfolio, or programs. Our focus is to identify the current projects, programs and portfolio in the waste management sector in Freetown. The definition of projects, programs and portfolio by waste management sector is also important because this can help us to really understand how do they classify projects, programs and portfolio management and also the type(s) of international standard currently in use. Therefore, can present this using a tabl. 3.

Looking at the definition of project, program and portfolio management with regards to the study area, there is direct relationship among these three areas The government of Sierra Leone and its development partners have established institutions responsible for developing national institutional framework as in line with the international standards and methods for national policy development. Even though more is needed but certain bench mark has been made such as the establishment of Environmental Protection Agency (EPA) in 2012 shows a strong commitment at national level to address environment and climate change issues and is the only agency responsible for formulating policy and building institutions that can deliver the policy on environment and climate change. Why is EPA role important to sustainable solid waste management methodology or standards? The ISO 140001 and its related standards addresses the organizational structure of the FCC, the municipal engineering unit is responsible for civil works, environment and public parks within the city. There are different projects previously or are currently ongoing which meet the definition of project, such as the street cleaning project, waste transportation project carried out by FWMC etc. all these projects are grouped under programs and portfolios in this sector. But before the establishment of EPA, the MoHS has been



Table 3

**Relationship among project, program and portfolio management  
in the study area**

	<b>Sustainable solid waste management (object), how is the metrics related and examples of such metrics for waste management sector</b>
<b>Program Management</b>	The method of managing related group of projects in a coordinated manner which can enhance benefits and control in managing two or more projects as compared to separating them individually. Programs may include elements of related work outside scope of the discrete projects in the program. Looking at the waste management sector in Freetown, the government of Sierra Leone through municipal councils set up the waste management program within which different projects are operating. The sustainable waste management as a program set by government to handle the different project areas under waste management. National Protection Agency are responsible for developing policies in line with ISO 40001. ISO 40001 and MoHS policy on waste management help organizations adapt the environmental management system as part of their strategic key areas and must pass through the certification process in meeting the international standards. The environmental protection agency was established to address environment and climate change issues and is only agency responsible for formulating policy and building institutions that can deliver the policy on environment and climate change. The FCC developed the FWMC as a program to address the waste management issues them.
<b>Project management</b>	A project can be defined as temporary activities carry out to provide services or produce product within a limited timeframe and budget constraints. In essence, every project must be unique and clear definition of project scope, planning, implementation, monitoring and control and closure of projects. We believe that every project must have a specific duration based on the outlined activities and resources. In the area of sustainable waste management project/waste management project in Sierra Leone, the youth and women employment scheme created by government of sierra Leone was aimed at collecting solid waste from the streets and public places (street cleaning project) and transfer wastes to skips within the zone they are working. Project management is the use of skills, techniques, knowledge to project activities in order to meet the definition of "done" by the customer. There are different related waste management projects under the waste management program in the FCC
<b>Portfolio management (PMI)</b>	Project portfolio management can be defined as the "centralized management of one or more portfolios that enable executive management to meet organizational goals and objectives through efficient decision making on portfolios, projects, programs and operations. There are different organizations may define portfolio management based on the number of projects like the Freetown city council has the waste management program run by Freetown waste management company. FWMC has different projects on waste management such as hospital waste management, industrial waste, residential and commercial wastes etc. collections and transportation of wastes. In summary, for sustainable or solid waste management projects in Africa especially in Sierra Leone, the project management methodologies used is the waterfall model using PMI method or ISO standard but hence our focus is waste management, ISO 140001 which describes the environmental management system since waste has high link with the environment. Using methodology during project feasibility, planning, implementations and closure of projects. Different projects, programs, sub portfolio within the environmental management system in the country.
<b>PMO</b>	An organizational body or entity assigned various responsibilities related to the centralized and coordinated management of those projects under its domain. The responsibilities of a PMO can range from providing project management support functions to actually being responsible for the direct management of a project. In the case of FCC, the waste management division within the Freetown city council is charge with the oversight responsibility to ensure that all public and private sectors in the waste management sector adheres to the policies, procedures, guidelines according to the law of Sierra Leone, the Ministry of Health and Sanitation (MoHS) waste management policy.

Sources: created by Authors from references.

providing technical role in the area of policy design and monitoring but not excluding evaluation and reporting on wastes management within the country. The waste management division also play active role together with development partners for institutional support through improvement/development of required organizational structure which outlined different structures including projects, program, portfolio management within the organizations. But with all these, low income countries are still faced challenges we have earlier mentioned and more is expected regardless of institutions which have been established especially in the area of developing the required standards and implementing them is key for the success of most projects in the world. Using the current standards such as ISO guides to project management at national level is low and this will help improve on the institutional project management oriented [11].

**Conclusions and prospects of further researches.** The waste management sector was established since 1960s in sierra Leone and subsequent changes have been seeing as evidenced in the formation of Environmental Protection Agency, EPA, the key agency responsible for dealing with environment and climate change issues in Sierra Leone. Formulating policies, monitoring how these policies are implemented at organizational level and measure the climate change indicators. The FCC, the waste management division are using the EPA policy on EMS as in line with ISO 140001. The waste management division within FCC act as the project office for all programs, portfolio and projects within the waste management division. The Environmental officers are part of the waste management sector whose responsibility is to ensure that all projects, programs, and portfolio within the organization meets the EMS standards. The waste management municipal engineering sector are also developing new strategies towards zero wastes drive by currently working on reduction, reuse and recycle of wastes in the country. At the organizational structure of the FCC, the municipal engineering sector which waste management is key. The FCC and MoHS are responsible for developing different Projects, programs, and portfolios defined based on the organizational strategic goal in line with international standards or methods. In overall, the country is still among the low income generating country which means more wastes are generated due to the huge migration rate in urban areas especially Freetown where most of the government functions are operating with little or no reduction, reuse or recycle methodology working at the moment. This has high health related implication such as the normal rampant reported malaria, Diarrhea, Cholera cases in the country. The poor institutional response to addressing wastes challenges show that the study area need better best practice and implementation of international standards as in line with local policy.

The future of the waste management division is great based on the current strategic plan which is more focusing on rapid waste collection, transportation, conversion of waste to energy which will contribute immensely to the current waste management system.

Further research in the area of benefit of energy to waste project currently in the implementation stage will be necessary in order to know how far this case study has benefited from waste to energy.

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