

Solid Waste Management Options for Sustainable Development in Enugu Urban

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ABSTRACT: The study examined the solid waste management options for sustainable development in Enugu urban. The aim is to develop a solution strategies for solid waste management in Enugu urban with the objectives to review the existing municipal solid waste management practices and develop solid wastes management options for sustainable development of Enugu urban. The methodology is the collection capacity disposal chart of Enugu State Waste Management Authority (ESWAMA) in some parts of Enugu, estimate the quantity of waste based on previous records and data collected from refuse dump sites to estimated the total tons of solid waste generated in the area. The results show that 2400 tons of solid waste were generated and collected in Enugu urban. The non-segregation of the waste makes the job of collection more cumbersome and some wastes are left behind intentionally. The paper recommends a reverse pyramid of waste management options, collective participation for integrated solid waste management and developed a sustainability framework for solid wastes management and proposed a solid waste recycling plant for Enugu.

Key words: solid waste management, sustainable development, waste generation, waste segregation and recycling.

I. INTRODUCTION

Solid wastes are unwanted or discarded materials that emanate from natural or artificial sources. Natural sources may result from dead wild animal, leaves from trees arising from transpiration effects. Artificial sources include, house refuse, garbage, rubbish, street refuse, ashes, demolition debris, construction refuse, junk automobile, old furniture, and wastes from slaughter houses, schools, manufacturing plants, hospitals, agricultural, markets, etc. The planning and

management of solid waste in Enugu the capital city of Enugu state has been an issue of concern to successive government in Enugu both at state and local government areas. Various strategies to tackling the problem enunciated by successive governments are inconsistent with the global standard. Solid waste problem in Enugu contributes to the contamination of the streams, river, land and the atmosphere. Waste disposal operations are becoming increasingly sophisticated with specialist companies and facilities, leaving the developing countries to rise up to the challenges. The under estimation of the amount of solid wastes generated is one basic problem that has hampered most planning and management of solid wastes in most cities. This has led to poor design calculation which has resulted into incorrect capacity of waste management systems. The possession of corrected and adequate information on the rate of generation and composition of wastes generated will make it easy to propose and implement an effective method of management (Aramabi, 1998). Management of solid wastes and associated wastes is paramount to achieve a healthy and sustainable environment.

Nwofe (2017) opined that management of waste requires careful approach and planning through the method of collection, storage, transportation, processing, treatment and its final disposal so that it will not lead to negative consequences like environmental degradation, health issues and emission of harmful gases into the atmosphere. It is difficult to achieve in practice sustainable waste management systems in most developing countries either as a result of poverty, illiteracy, lack of awareness, government insensitivity, lack of waste management data, lack of credible policy on sustainable waste management, lack of advanced technological skills, lack of trained manpower in waste management,

and other associated issues. People are not aware of the need to preserve their environment through careful management of waste or by utilizing more civilized approaches to other human activities that could lead to a safe and sustainable environment. The management of the quantity of Municipal Solid Waste (MSW), which is an indicator of an urban lifestyle, has been a nagging problem all over the Enugu community as a result of increase in population, rise in the living standard, etc. These have increased Solid waste generation rate in Enugu and have made solid waste composition more complex and heterogeneous. This problem is worse in public places such as Schools, Markets, Mechanics sites etc. in which Municipal Solid Waste Management is highly neglected.

The population distribution for Enugu Urban consists of seventy (70) percent for high density area, twenty eight (28) percent for medium density and two (2) percent for low density areas (Enugu Master Plan, 1992). Spontaneous increase in volume and composition of solid waste as a result of urbanization and industrialization is growing problem in many urban centres. Solid waste survey and characterization are special tools in bringing to light the generation rate and composition of solid waste (Sincero and Sincere, 2006). Management methods such as recovery, recycling, and reuse are very important tools for creating wealth from waste. Oyinlola (1999) stated that it is not essentially every composition of solid waste that can be further utilized as resources for wealth creation. Therefore, solid waste components in Enugu must be well classified to make the compositions readily differentiable to intended stakeholders.

It is essential for adequate attention to be paid to all components of solid waste management so as to ensure cost-effectiveness and sustainability of the management system. There are ten components of effective solid waste management which include: (i) Waste Generation, (ii) Waste storage, (iii) Waste collection, (iv) Waste reduction, (v) Waste transfer, (vi) Waste recycling, (vii) Waste re-use, (viii) Waste resources recovery (ix) Waste treatment/processing and (x) Waste disposal.

Waste can be categorized also based on material, such as plastic, paper, glass, metal and organic wastes. Waste categorization may also be based on hazard potential, including radioactive, flammable, infectious, toxic or non-toxic wastes. Categories may also pertain to the origin of the waste, whether industrial, domestic, commercial or construction and demolition. Regardless of the origin, content or

hazard potential of solid waste must be managed systematically to ensure environmental best practices. As solid waste management is a critical aspect of environmental hygiene, it must be incorporated into environmental planning

II. AIM AND OBJECTIVES OF THE STUDY

The aim of this study is to develop optimization solution strategies for solid waste management in Enugu urban.

The objectives of this study include the following:

- i. To review the existing municipal solid wastes management (MSWM) practices in Enugu urban.
- ii. To quantify solid wastes volumes in Enugu urban.
- iii. To determine the characteristics of solid wastes generated in Enugu urban
- iv. Develop solid waste management options for sustainable development of Enugu Urban.

III. LITERATURE REVIEW

Solid waste management is referred to as the discipline associated with control of generation, storage, collection, transport or transfer, processing and disposal of solid waste materials in a way that best addresses the range of public health, conservation, economic, aesthetic, engineering, and other environmental considerations (Omuta, 1988). The scope of solid waste management includes planning, administrative, financial, engineering, and legal functions. Solutions might include complex inter-disciplinary relations among fields, such as public health, city and regional planning, political science, geography, sociology, economics, communication and conservation, demography, engineering, and material sciences (Atuegbu, 2007).

There is a distinction in Solid waste management practices for residential and industrial producers, for urban and rural areas, and for developed and developing nations. The job of Local government authorities is administration of non-hazardous waste in metropolitan areas. However, the management of hazardous waste materials is typically the responsibility of those who generate it, as subject to local, national, and even international authorities (Pichtel, 2005). The main goal of solid waste management is reducing and eliminating adverse impacts of waste materials on human health and the environment to support economic development and superior quality of life. This is to be done in the most efficient manner possible, to keep costs low and prevent waste buildup. The functional activities that comprise a solid waste management system : waste generation, waste handling and separation, storage and

processing of the source, collection, separation, processing and transformation of solid waste, transfer and transport and disposal.

3.1 Integrated Solid Waste Management (ISWM)

The advancement in the field of solid waste management made it possible for solutions to be looked at more systematically and holistically. ISWM, for example, is an increasingly important term in the field of waste management. It is referred to as the selection and use of appropriate management programs, technologies, and techniques to achieve particular waste management goals and objectives. The U.S. Environmental Protection Agency (EPA) (2013a) states that ISWM is composed of waste source reduction, recycling, waste combustion, and landfills. These activities can be done in either an interactive or hierarchical way.

It is important to stress that better solid waste management programs are urgently needed in some countries. Only about half of the waste generated in cities and one-quarter of what is produced in rural areas is collected. Internationally, the World Bank warns that global waste could increase by 70% by 2050 in a business-as-usual scenario. Ongoing efforts to improve the waste management system are an important part of preserving a healthy human and ecological future (World Bank, 1994).

3.2 Solid Waste Management in Enugu

The city of Enugu in Nigeria is confronted with urban solid waste management which is considered to be one of the most serious environmental problems. The economic recession in Nigeria which has resulted in high levels of unemployment is estimated at 80 percent of the population (NBS, 2020). This has led to the growth of home industries in Enugu and around the city centre and high density suburbs such as Abakpa, Emene, Amaechi Awkunanaw, Enugu Ngwo etc. Solid waste generation in these suburbs is very high given their spatial extent and population. This is putting much pressure on the waste disposal system in place and as a result a lot of waste is left uncollected creating a health hazard.

The "Waste management" refers to the collection, transport, recovery, and disposal of waste, including the supervision of such operations and after-care of disposal sites. It concerns itself with the existing amount of waste, trying to minimize the human-waste or environment-waste interface and to minimize potential impact. Waste management should concern itself not only with final disposal of waste but also with the whole

cycle of waste creation, transport, storage, treatment, and recovery and does so to minimize pollution (Chukwuemeka, Ugwu and Igwegbe, 2012). According to the waste management pyramid, the waste management strategies need to be based on prevention measures and measures such as recovery and disposal are secondary (Chime, 2009). Waste minimization measures include waste prevention, internal recycling of production waste, and source-oriented improvement of waste quality and reuse of products for the same purpose. Also external recycling, sorting of waste, reuse for another purpose, and energy recovery are included as waste management measures. Waste management is also viewed as the control of waste-related activities with the aim of protecting human health and the environment and resources conservation. Waste related activities include waste-creating processes, waste handling processes, and waste utilization.

The cost of collection has been estimated to represent about 50 to 70% of the total cost of solid waste management, depending on the disposal method (Tchobanoglous, Theisen and Vigil, 1993). Refuse collection is a difficult and expensive aspect of solid waste management in developing country and accounts for 70% to 90% of costs in developing countries. However, in most developing country, cities such as Addis Ababa (Ethiopia) and Ibadan (Nigeria), efficient refuse collection is complicated by poor roads and perennial access problems which make house-to-house collection difficult and expensive. Even in those areas where house-to-house collection is practicable, lack of collection vehicles makes the process irregular and unreliable. Refuse character and availability of trucks affect frequency of collection.

3.3 Key Factors for Success

Tchobanoglous (2008) stated that arriving at successful solid waste management solutions requires more than just good planning. The best technical solution may fail if politicians and government officials do not consider a series of other important points. This section attempts to identify some of these points.

(i) **Credibility for Decision Makers:** It is absolutely crucial to work to protect the credibility of those individuals who must ultimately make the difficult siting and permitting decisions. Proper environmental standards for all types of facilities, including recycling, can help give decision makers necessary support.

- (ii) **Efficient Implementation Mechanisms Including Market Incentives:** A number of things can be done to help facilitate program implementation. Expedited permitting approaches for new facilities and expedited permit modification approaches for existing facilities can be helpful.
- (iii) **Market Incentives:** Market approaches can significantly cut the cost of achieving a fixed amount of environmental protection, energy conservation, or resource conservation when compared with a traditional command-and-control approach.
- (iv) **Significant Attention on Recycling Markets:** Recycling will not be sustainable in the long term unless it is market-driven, so that there is a market demand for secondary materials. The market incentive discussion provides some ideas as to how market incentives can be utilized broadly to drive desirable integrated waste strategies by influencing the behavior of affected entities. Some of these behaviors may lead to the creation of market demand for specific secondary materials. However, it is also important to examine secondary material markets on a commodity-specific basis, particularly in the subset of materials that compose a large fraction of the MSW stream.
- (v) **Public Involvement:** The best technical solution is unlikely to work unless the public is active in helping to reach the final choice of options. Public involvement must be just that-it cannot be a one-way street; rather, the public must be involved in two-way discussions.
- (vi) **Continuous Commitment to High-Quality Operations for All Facilities:** Today's solid waste solutions require a commitment to high-quality operations. In the past, solid waste management, as with many other government services, was often awarded to the lowest bidder. This approach needs to be seriously reconsidered, given the environmental liabilities associated with poorly managed solid waste.
- (vii) **Evaluation of the Effectiveness of the Chosen Strategy:** In developing specific legislation and regulations, it is important that the full impact of individual legislative or regulatory provisions be monitored after the program has been implemented. MSW planning is a process, not a project. That process must continually ensure that the plan mirrors reality and that implementation obstacles are addressed expeditiously.

IV. RESULTS AND DISCUSSION

4.1 Waste collection and disposal in Enugu State

Information available from Enugu State Waste Management Authority (ESWAMA) revealed that currently the disposal vehicles in Enugu urban are over sixty (60) both public and private owned. These vehicles have average capacity of 20 tons and expected to dump refuse at landfill which situates at Agu-owor Ogui Nike. If they make 2 trips in a day with a capacity of 20 tons, a total of 2400 tons of solid wastes are generated and collected in Enugu urban. The non-segregation of waste makes the job of collection more cumbersome and some wastes are left behind intentionally. The slums like Obiagu, Abakpa, Ikirike village, Gariki, Ugbo-Odogwu, Ugbo-Okonkwo, Coal Camp and some other satellite areas in Enugu urban constitute the greatest nuisance. Poor infrastructures like lack of access road, insufficient dustbins at dumpsites, and pressure of over-growing population clearly overwhelms the little services provided by the government waste management agency. Some disgruntled people also dump waste indiscriminately thereby making the work of waste collection more cumbersome for the agency. The agency (i.e. ESWAMA) on their part has not done so well in areas of waste collection and collection of tolls. The body is alleged to charge arbitrary fees and uses thugs to intimidate people into paying these arbitrary fees or their properties will be impounded by the thugs. These allegations, to some extent, unfounded, have earned the agency some notoriety in the eyes of the public. Recently, the government has put some measures in place to curb this menace by not allowing any resident to pay cash to anybody. ESWAMA sanitation fees are now paid directly into ESWAMA designated banks account.

It is obvious that the agency lacked the human resources needed to prosecute an effective war against waste in the state. The scenario has not changed in 2019 following the result of my investigation in terms of capacity. Some disposal vehicles bought by the previous government of Sullivan Chime's regime has been packed due to lack of maintenance. Recently, the Authority (ESWAMA) resorted to the use of hired vehicle to collect & transport solid wastes to landfill sites within the city on contract basis. They engage private contractor in the guise of public private partnership and distribute them to strategic locations to collect solid waste at cost of twenty five thousand naira (₦25, 000) per day. Information from waste management office revealed that out of about 400 workforces, only 50

are core staff while the rest are people called upon on ad-hoc basis. Apart from the integrity issues involved in using ad-hoc staff, the loyalty of these classes of workers is seriously in doubt. The lack-lustre performance of the agency and the aggressive and coercive method employed in fees collection which has given the agency the bad image may be the handy-work of these elements.

Moreover, these ad-hoc staff have been known to work at cross-purposes and for their selfish ends. More than 50 percent of the workforces were laid off to pave way for private contractors to be involved in lifting of solid wastes in the city. Table 1 to 3: shows the available official record available at ESWAMA last updated in 2014.

Table 1: Enugu Eastcapacity disposal chart of ESWAMA

S/N	Location	Morning	Evening	Intermittent	Total
1	Abakpa main	3	2	1	6
2	Ogwuagor	2	—	1	3
3	Trans-Ekulu	4	2	2	8
4	City Layout	-	2	2	4
5	Thinkers comer	2	1	1	4
6	Nkpologwu	-	1	1	2
7	Emene	2	1	1	4
8	Ugbodogwu	2	1	1	4
Total		15	10	10	35

Source: Field Work Jan.2020.Data from Head Effluent and Special Waste Unit ESWAMA last updated 2014

Table 2: Enugu North, Quantity measurement is in Ten of tons

S/N	Location	Morning	Evening	Intermittent	Total
1	Ogui Nike	3	1	-	4
2	Asata	2	2	-	4
3	New Haven	2	1	-	3
4	Ind. Layout	2	3	1	6
5	GRA	2	2	.	4
6	Ogui N/L	1	1	-	2
7	Ogbete Market	7	3	2	12
TOTAL		= 35 (Ten tons of Waste)			

Source: Field work Jan.2019. Data from Head Effluent and Special waste unit ESWAMA last updated 2014.

Table 3: Enugu South Quantity measurement is in Tens of tons

S/N	Location	Morning	Evening	Intermittent	
1	Garki	3	2	1	6
2	Uwani	4	3	2	9
3	Achara Layout	3	2	1	6
4	Mary Land	3	2	1	6
5	Ikiriki	1	1	2	4
6	Idaw River	2	1	1	4
TOTAL = 35 (Ten tons of Waste)					

Source: Field work Jan.2019. Data from Head Effluent and Special waste unit ESWAMA last updated 2014.

The source above which estimates 1050 metric tons per day were based on the capacity of ESWAMA vehicle and equipment to lift Solid Waste as at 2014 and represents the only official available data. However, substantial quantity of wastes are generated through domestic, industrial, commercial and agricultural activities especially in areas like coal camp, Nkpologwu and suburbs. Many new estates have been developed within the period where the inhabitants generate large volume of Solid waste which are not captured in the data above. The current sanitation is the contracting of individual disposal vehicles to assist in collection and disposal of solid wastes from dumpsites to landfill sites. In the course of this research work, I visited the landfill sites and the staff recording the deliveries of solid waste disposal vehicles revealed that an average of 2400 tons of Solid wastes is deposited daily. This amount represents about seventy (70) percent of the waste generated in one day within the Enugu urban. The remaining thirty (30) percent are unaccounted for or disposed, through other means like littering drainage channels / street, burning, composting, etc. The quantity of waste generated and disposed varies depending on whether it is rainy or dry season. Some areas like Garki and Abakpa Nike generate more waste during raining season because of the Agricultural waste like maize, vegetable etc.

V. CONCLUSION AND RECOMMENDATION

The philosophy behind this research article is to evolve a system in Enugu **where no**

waste exists. Waste should be reused and reduced to a minimum, then collected, recycled and treated properly. The waste management should aim to remove the waste that has been produced by the management system and reduce the influence of the waste on the environment and economy. The shortest way to reach that goal is to naturally reduce the amount of waste and the residual matter should be handled in a safely engineered way, ensuring a clean and healthy environment as illustrated in the reversed pyramid option in Figure 1. Integrated waste management should encompass choosing and using the correct method, technology, and management programs for a specific waste management objective while making sure that the legal procedures are fully applied. This is explained in Figure 2. This collective participation for integrated solid waste management will lead to a sustainable framework for municipal solid waste management as explained in Figure 3. There should be a synergy to achieve this, so that people should have the right to enjoy an environment with clean air, earth, seas and soils.

To this end, a layout plan is proposed on **Integrated sustainable solid waste recycling plant** in Enugu to be located at Enugu East along Idodo-Owo area

The layout consists of three major sections

- a) Administrative section
- b) Processing/Production area
- c) Auxiliary facilities

(a). Administrative Section includes the provision building block, facilities for staff, research and control area.

(b). Processing area include reception yard, hopper, silo with existing metal belt conveyor, picking and sorting belt conveyor in place, sorting recyclable belt conveyor, output materials for recycling, and other output materials for composting organic fertilizer etc.

(c) The auxiliary facilities may include factory buildings, the maintenance garage, parking lots, restaurant, toiletry facilities, first aid room, security posts etc.

The main aim of the overall design is rooted in the “zero waste concepts” which involves the recycling of all materials back into nature in a manner that protects human health and the environment. All waste materials brought into the facility will go through processes from which

recyclable and non recyclable materials are recovered and organic recyclables are utilized by extracting from them useful products (gas and compost) after altering their characteristics. The facility is expected to sort out metals, plastics, ceramics, e-waste and other wastes which can be converted and used for agricultural purposes. This will invariably eliminate landfills and its associated dangers while affording maximum utilization of the inbuilt potentials of the waste materials.

Production/Processing area will involve reception yard, storage/waste sorting plant, factory buildings for e waste, ceramics, plastics and metals and other wastes that are not in this category.

Figure 4 is a proposed layout plan of solid waste recycling plant at Enugu.

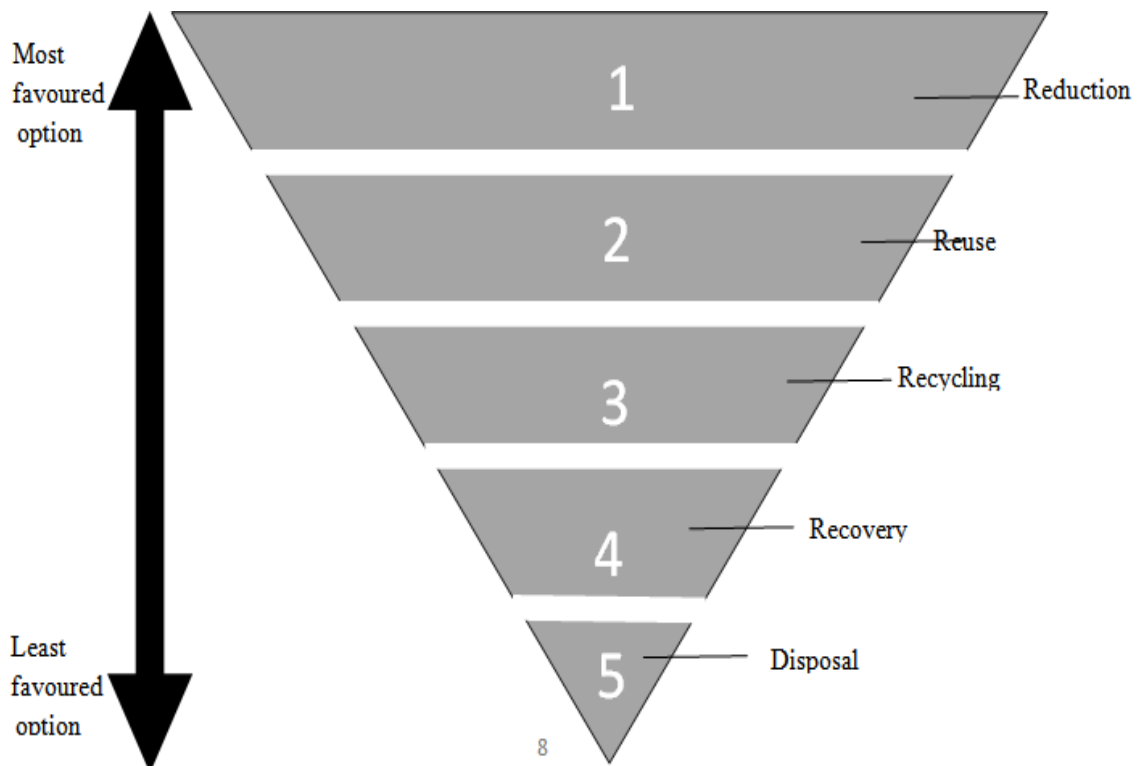


Figure 1: Reversed pyramid of waste management

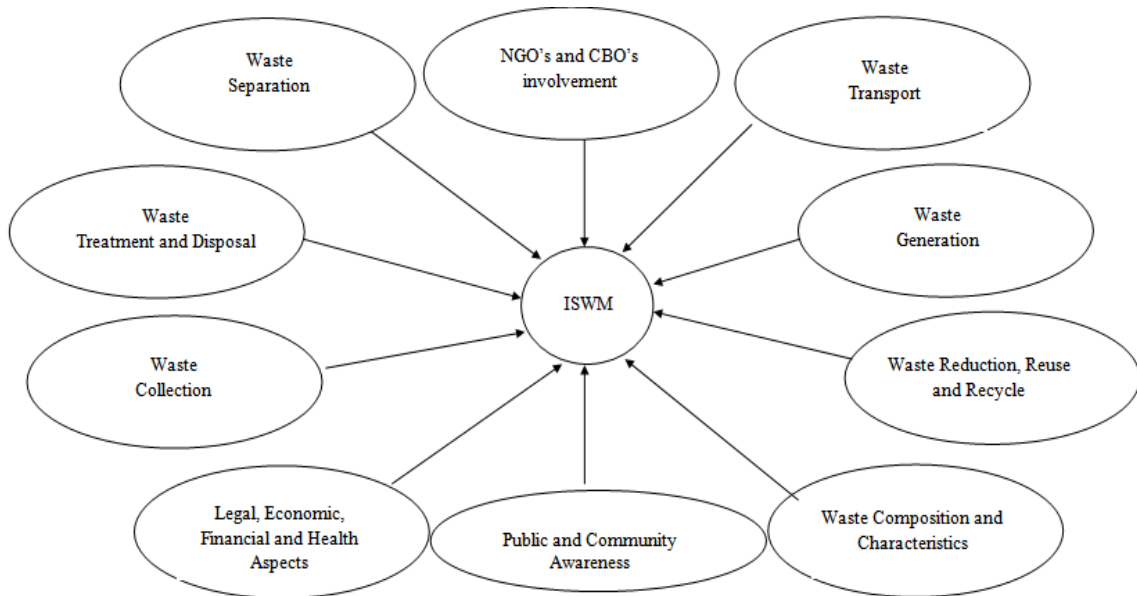


Figure 2: The collective participation for integrated solid waste management

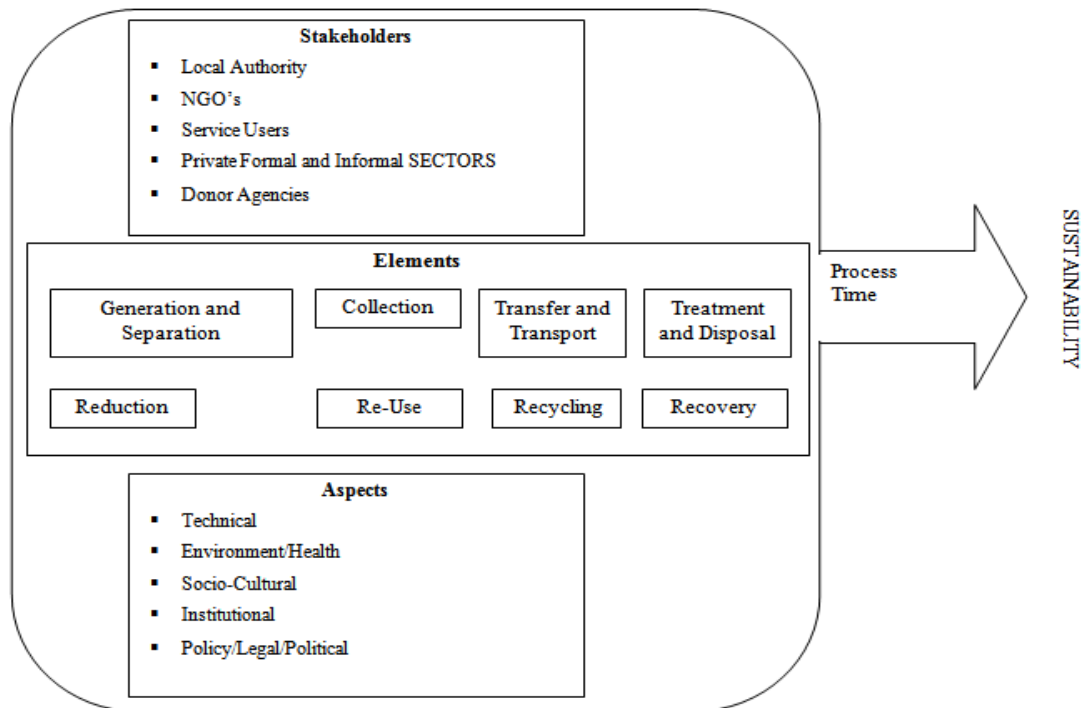


Figure 3: Proposed sustainability framework for solid wastes management in Enugu

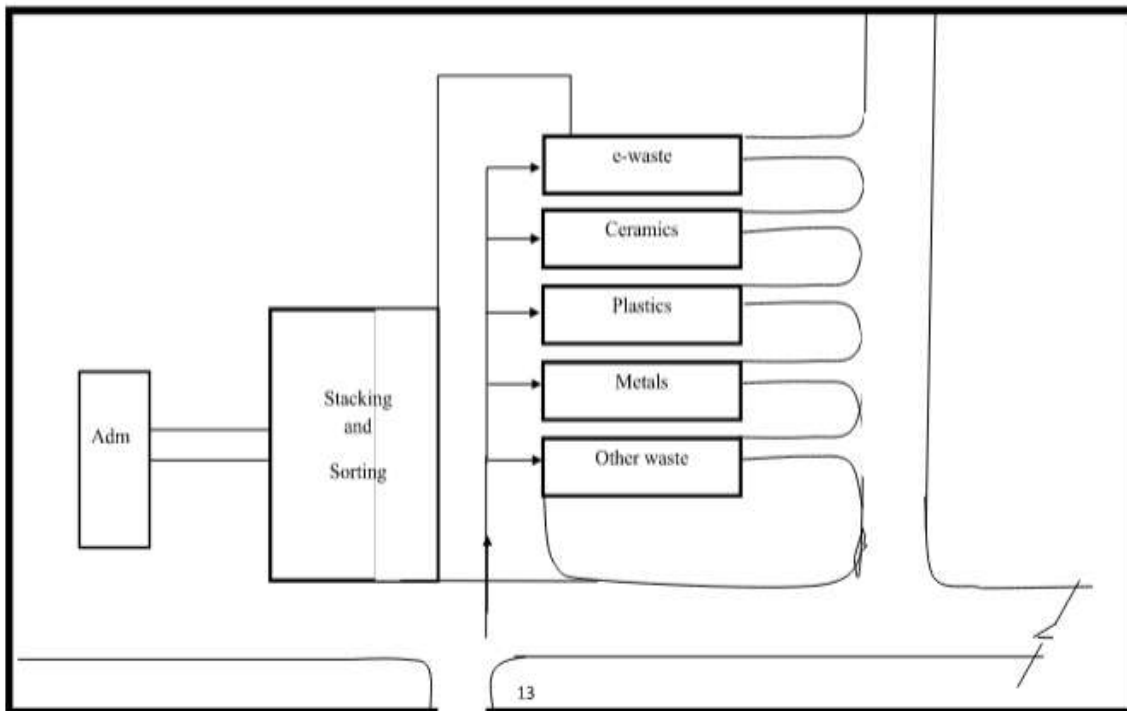


Figure 4: Proposed Layout Plan of Solid Waste Recycling Plant at Enugu

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