New Approaches to Solid Waste Management

C. N. Ezugwu

Abstract: Not much attention is paid to management of solid wastes in most parts of the world, particularly in the context of developing countries. Solid waste management (SWM) has become an issue of increasing global concern as urban populations continue to rise and consumption patterns change. Solid wastes scattered in most parts of the world pose environmental and public health problems in most cities of the world. Even where there is SWM programme in place, it is executed poorly. This paper presents new approaches to solid waste management to make it cost-effective and to ensure wealth creation from wastes.

Index Terms: cost-effective, global concern, public health, wealth creation.

I. INTRODUCTION

It is a known fact that as urbanization continues to take place, the management of solid waste becomes a major public health and environmental concern in urban areas and towns throughout Nigeria and other developing countries of the world. The primary purposes of solid waste management (SWM) strategies are to address the health, environmental, aesthetic, land-use, resource, and economic concerns associated with the improper disposal of waste[1], [2], [3]. These issues are ongoing concern for nations, municipalities, corporations, and individuals around the world [2], and the global community at large [3]. The concern is serious, particularly in the capital cities, which are often gateways to our country for foreign diplomats, businessmen, and tourists. Moreover, poor visual appearance of these cities will have negative impacts on official and tourists visits and foreign investments.

A typical solid waste management (SWM) programme in any Nigerian town displays an array of problems, including: (i) waste generation, (ii) waste storage, (iii) low collection coverage, (iv) irregular collection services, (v) crude open dumping, (vi) burning without air and water pollution control, (viii) breeding of flies and vermin, (viii) handling and control of informal waste picking or scavenging activities.

Solid waste presents environmental, public health and management problems as presented above. A visit to most towns in this country makes someone discover that there is unorganized, ineffective and incomprehensive solid waste management in these towns. Solid wastes include organic (decomposing) matter like decayed vegetables, human faeces, refuse, etc. and inorganic (non-decomposing) matter or materials such as ubiquitous ‘pure water’ sachets, lastics, nylon bags, papers, metals, special wastes, and so on.

A few decades ago, wastes were defined as useless, unwanted, unused, or discarded materials resulting from the normal community activities. Presently, because of development in recycling and resource recovery technologies, the above definition is no longer completely correct. Some of what are known previously to be useless and unwanted are now processed into different valuable products. The types, composition and sources of solid wastes are shown in Table I.

TABLE I

COMPOSITION AND SOURCES OF SOLID WASTES

Kind	Composition	Sources
Garbages	The waste from preparation, cooking and serving of foods; market waste, waste from handling, storage and sell of produce.	Restaurants, households, institutions, stores
Rubbish	Combustible, non-combustible, paper, carton, boxes, barrels, tree branches, wood furniture.	Markets, commercial activities
Ashes	Residuals from fire used for cooking and heating	Households, incinerators.
Refuse	Street refuse, sweeping, dirts, dead animals	Street side
Industrial waste	Food processing waste, scraps	Factories, power plants
Demolition	Pluming parts, bricks, blocks	Demolition sites
Construction	Scraps	Construction sites
Special wastes	Hazardous solids and liquids, explosives, radioactive materials, Hospital wastes	Household, Hospital, Institutions
Sewage treatment residue	Solid from coarse screens, grits, sludge	Treatment plants, septic tanks

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A Historical Background of SWM

From ancient times, people have been mass-producing solid waste. Most communities manage to burry solid waste just outside their settlements or dispose of it in nearby rivers or water bodies, but as population densities increased, these practices no longer prevented the spread of foul odours or disease [4]. As waste accumulated in these growing communities, people simply lived amongst the filth. There were exceptions: organized SWM processes were implemented in ancient city of Mahenjo-Daro in the Indus Valley by 2000 BC [5]; the Greeks had both issued a decree banning waste disposal in the streets and organized the Western world's first acknowledged "municipal dumps" by 500 BC [6]; the Chinese cities had "disposal police" responsible for enforcing disposal laws by 200 BC. In both Athens and Rome, waste was only relocated well outside city boundaries when defenses were threatened because opponents could scale up the refuse piles and over the city walls [5].

City streets in the Middle Ages were plastered in an odourous mud composed of soil, stagnant water, household waste, and animal and human excreatment [7]. This situation created very favourable conditions for vectors of disease. Indeed, the Black Death, which struck Europe in the early 1300s, may have been partially caused by the littering of organic wastes in the streets [7]; [8]; [5]. In colonian America, the urban population lived in similar putrid conditions [6]. However, scarcity of resources ensured many items were repaired and reused, and the waste stream was thoroughly scavenged [9].

SWM contex in a developing country is presented in Fig 1.

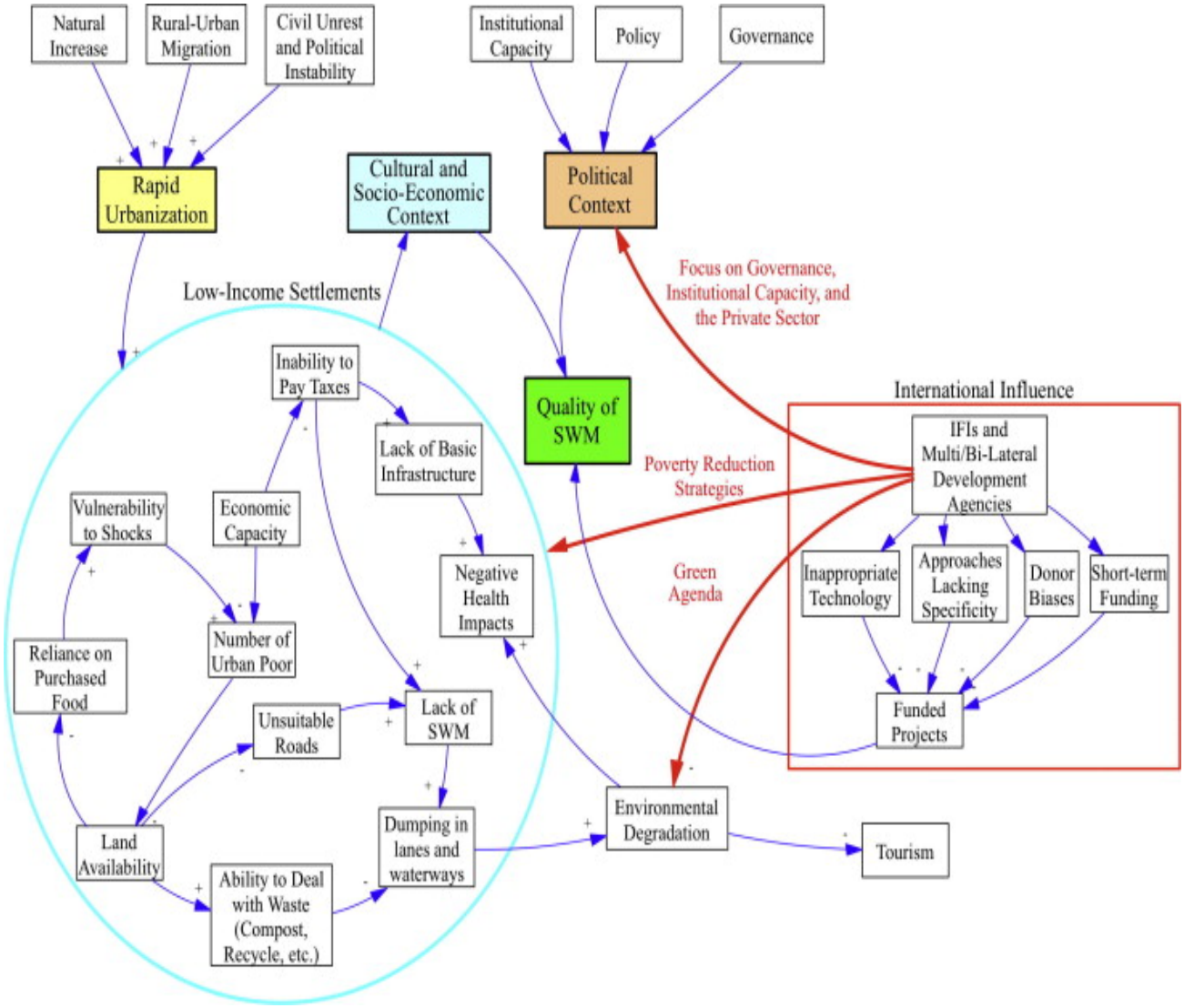

Fig. 1: Developing country SWM context

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II. NEW APPROACHES TO SWM

New approaches in SWM are adopted to ensure that it is comprehensive, organized, cost-effective, creates wealth, environment friendly and protects public health.

Employment of 4Rs

The 4Rs in waste management are Reduction, Recycling, Reuse and Recovery.

A. Reduction

This is a process by which the size of waste is reduced as much as possible. This makes the landfill sites and transfer stations last longer. So, size-reduction of refuse is necessary. Machines used to achieve this are called shredders. It could be achieved manually. Moreover, reduction could be achieved from source by controlling wastes generated. For instance, in office, paper wastes could be reduced by typing on both sides of the sheet and using single line spacing method as against typing on one side of the sheet and using double line spacing method. By doing this, waste is reduced four folds, if compared to the later. Also, waste reduction could be achieved by cutting wastes in small bits (shredding), e.g. paper wastes, etc. Waste minimization is achieved by reducing the waste either by not generating waste at all, by changing the form of the waste (like shredding paper wastes) or by extracting useful materials from it.

There is need for individuals to minimize their own waste production, particularly of packaging materials.The idea of reducing personal waste is carried out by rejecting goods that are unnecessarily packaged, buying on the basis of re-using either the goods themselves or the associated packaging, and re-cycling as much as is practical [10].

B. Recycling

It is interesting to learn that what is termed waste can still be used if due attention is applied to identify how they can be so used. For instance, lead from used batteries could be recycled and used in production of new batteries. Also, pure water sachets littering everywhere could be shredded, put in large basin, melted and cast in a mould to produce objects of different shapes, eg. hollow tubes used by matriculating students. So, this implies that there are resources in waste. In waste recycling, a waste component is extracted and used again in another manufacturing process. This helps to minimize what ends up in the sanitary landfill for ultimate disposal, thereby making the landfill last longer. It is particularly applicable to materials like plastics and steel which are not biodegradable.

The extent to which recycling methods are used depends very much on the cost-benefit analysis of the process. If the cost of manufacturing an item from its raw materials is less than what it takes to induce recycled components, then there is no economic incentive to recycle. For the mass of junk the process will remove from our waste mountains, it is worth the while to explore how optimally waste can be recycled [11].

C. Reuse

Some of the wastes generated and collected could be put into use. Wastes that could be re-used include: off-cut iron in construction sites, re-useable bottles, etc. Also used tyres could be shredded and used as aggregates for concrete works to repair worn-out roads. These reuseable wastes are sorted out at source (i.e. at generation points or at transfer stations by scavengers).

D. Recovery

Any waste or discard material is technically worthless if it cannot, in its current form, be used. The value of a waste is therefore potential rather than real and depends entirely on its ability to be re-utilized [12].

Resources recovery is the systematic diversion of waste, which was intended for disposal, for a specific next use [13]. It is the processing of recyclables to extract or recover materials and resources, or convert to energy [14]. These activities are performed at a resource recovery facility [14]. Resource recovery is not only environmentally important, but it is also cost effective [15]. It decreases the amount of waste for disposal, saves space in landfills, and conserves natural resources [15].

Wherever any resource can be obtained in the waste management process through a cost-effective method, that recovery must be encouraged [11]. For instance, there is a large landfill site near the city of Los Angeles, Califonia, USA and it was discovered that the network of pipes had been laid beneath the landfill that gathered methane gas. This gas was a product of the natural fermentation of the waste. The gas collected was channeled to near by power generating station where the gas provided the steam that drove the turbines in steam turbines.

Also, in another popular landfill at station Island, New York, USA, massive compacts from the dump site, after natural fermentation of the organic waste, had been turned into fertilizer. These are good examples of how resources that would otherwise have escaped into the biosphere were converted into something useful. Every resource recovery move will be steered, with such extra-utility-derivation-at-economic cost consideration in mind [16].

In other to ensure effective employment of these wealth creation measures, it is proposed that the proportions of solid wastes generation for different wealth creation activities and landfilling for a typical community in a

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developing country should be as presented in Fig 2. This leads to minimization of wastes that finally go to landfills.

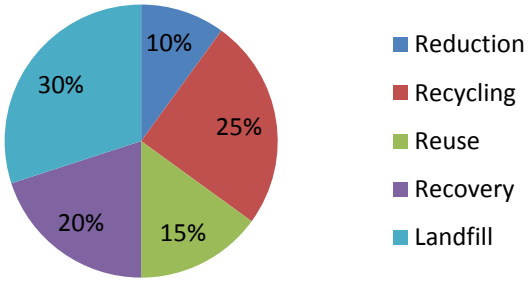

Fig 2: Proportion of wastes generation for wealth creation activities and landfilling.

III. PUBLIC PRIVATE PARTNERSHIP (PPP) IN SWM

The management of solid wastes is expensive and calls for a well-co-ordinated arrangement to ensure its effectiveness and sustainability [16]. There should be a public-private partnership to achieve this objective. Public enlightenment programme should be carried out in mass and print media to create awareness. Since the financial resources required runs into millions of naira, there is need for public-private partnership to source for funding the project. Moreover, they should organize its enforcement and monitoring to ensure its implementation. By partnering, the wealth created from recycling, re-use and wealth-to-energy measure should be shared by the partners.

High capital costs for solid waste projects such as constructing landfills and purchasing equipment along with operating and maintenance costs present serious obstacles for many towns and communities, as well as insufficient access to training ad technical support programme hider the efforts of many communities to tackle SWM issues. To overcome above barriers, there is need for public private sector participation to raise resource to overcome these solid waste management problems. The public and private sectors should partner by way of providing both human and financial resources to enhance effectiveness and sustainability of the project. State owned industries should partner with private companies to put in place municipal SWM projects that might otherwise be difficult or unaffordable for a single individual or company. For instance, the public and private companies within an area or town can purchase SWM equipment, such as collection trucks/vehicles to be used by the town. Partnerships can also provide local communities environmental personnel with wider access to technical assistance, training programmes and financial support mechanisms. By working together, local government with limited resources can expand their waste management options to establish effective waste prevention and recycling programmes, state-of-the-art landfills and waste-to-energy facilities.

IV. SANITARY LANDFILLING AS A WASTE DISPOSAL METHOD

Sanitary landfill is to bury refuse containing biodegradable and non-biodegradable material, in a systematic and hygienic way without exerting any nuisance or hazard to public health or safety [17]. Based on past experience in cities throughout the world, the waste disposal in the form of a sanitary landfill has proved to be most economical and acceptable method for the disposal of solid wastes. Land filling is a complete and final means of disposal. In incineration, perhaps more termed a waste volume reduction technique, for regardless of the operational efficiency of any incinerator, total combustion can never be achieved and some residue will remain requiring disposal. The classical definition of a sanitary landfill is an engineered facility for the disposal of municipal solid waste (MSW) designed and operated to minimize public health hazards and environmental impacts [18]. This is preferred to other methods because of the daily soil cover of the waste with attendant minimization of environmental impacts and public health hazards. The typical landfill consists of several cells in which the waste is systematically placed.

SWM progress finally began and was driven by five principal factors: public health, the environment, resource scarcity and the value of waste, climate change, and public awareness and participation. The driving forces and the progress they instigated are depicted in Fig 3.

IV. DISCUSSION AND CONCLUSION

In most cities of the world especially in developing countries, adequate attention is not paid to proper waste disposal systems. The practice is mostly disposal of waste in open dumps, incineration, composting etc. These practices degrade the environment and increase public health hazards which can lead to outbreak of diseases. This work discussed new approach to SWM that will be comprehensive, cost-effective environment-friendly and sustainable. These new approaches to SMM lead to wealth creation from wastes.

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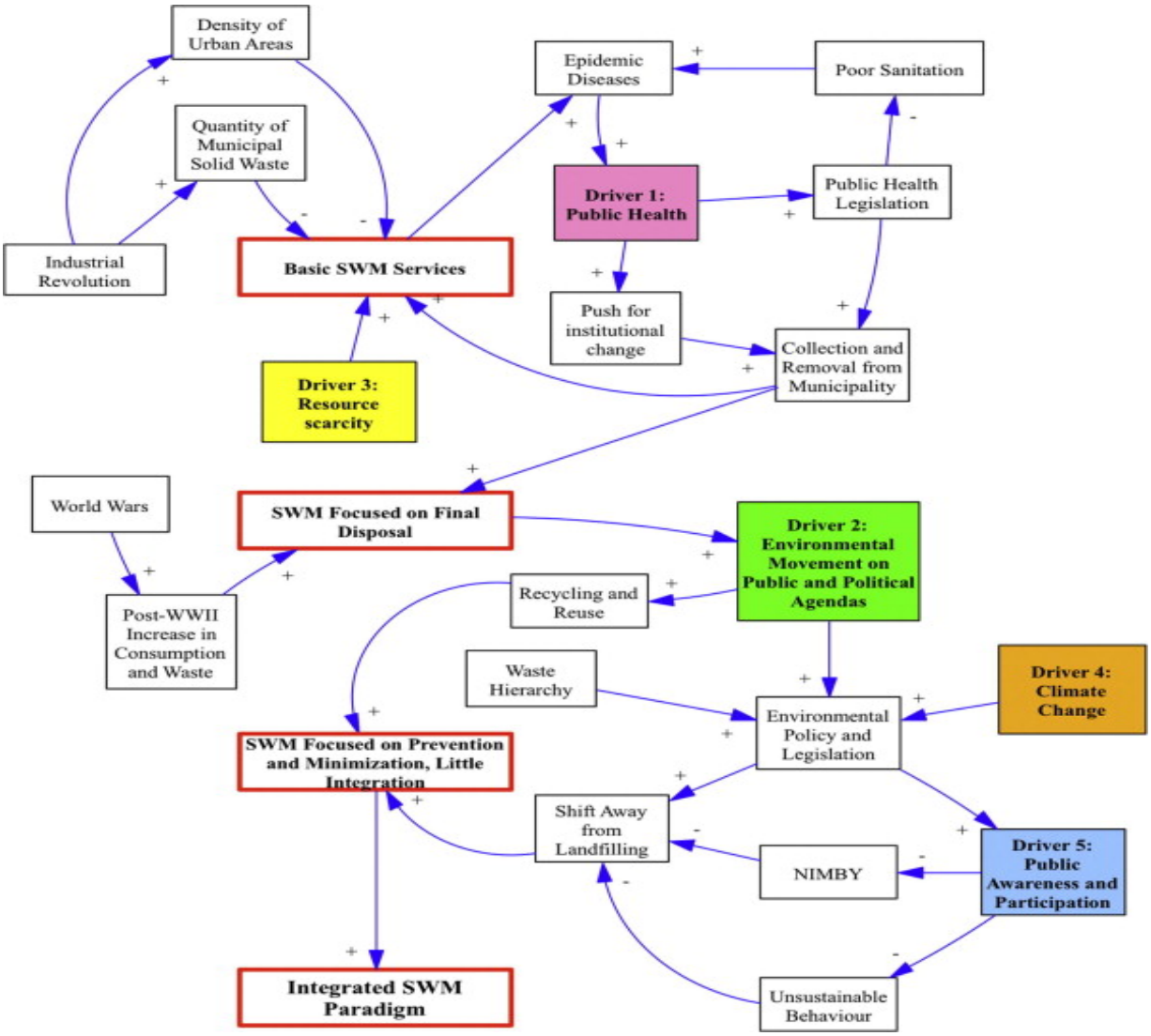

Fig. 3: SWM drivers and progress

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VII. RECOMMENDATIONS

- These new approaches to SWM should be adopted by all cities to achieve cost-effective SWM system. There should be focus on the $4R^s$ to create wealth from these wastes and to reduce the final wastes going into the landfills.
- Government should sponsor public enlightenment programmes to educate the public on ill-effects of improper handling of wastes.
- Those handling wastes according to laid down rules should be remunerated by appropriate authorities to encourage them.
- Sanitary landfilling should be adopted as final destination of these wastes to save our environment from further degradation and to protect public health.

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