

## Solid Wastes Management (SWM) in Nigeria and their Utilization in the Environmental Geotechnics as an Entrepreneurial Service Innovation (ESI) for Sustainable Development

Onyelowe KC\*

Department of Civil Engineering, Michael Okpara University of Agriculture, Umudike, P. M. B. 7267, Umuahia 440109, Abia State, Nigeria

### Abstract

Entrepreneurial space has been created for sustainable development through the ideas made available in the present work. It exposed the extent of waste generation in Nigeria cities and poor management program by government and the relevant ministries. The unemployed youths and individuals have been given a clue to try out their entrepreneurial prowess so as to harness the indiscriminate disposal of solid waste on our streets to their advantage by creating jobs. At the same, this would have opened up a business chain between the innovative entrepreneurial waste managers and the experts in the area of Environmental Geotechnics. Finally, soil improvement and stabilization for use as construction materials through the use of waste will encourage green and sustainable engineering.

**Keywords:** Solid waste management; Utilization; Environmental geotechnics; Entrepreneurial service; Innovation; Sustainable development

### Introduction

Solid waste management constitutes one of the major environmental problems facing Nigeria as a third world country [1,2]. This ranges between indiscriminate disposal and management of same by the relevant agencies [3,4]. These are classified as domestic wastes, agricultural wastes, industrial and agro industrial wastes, e-waste, wood wastes, etc. These classes of wastes are generated from human activities [5,6]. But, the country lacks the technologies needed to manage these solid waste materials disposed on the streets, roadsides, drainage channels, farmlands, rail tracks, etc. [7-9]. In advanced countries, waste management is a serious business because these materials are seen as not entirely useless [10,11]. Mostly, they are recycled for different purposes. These may include industrial purposes, agricultural purposes and more importantly, energy or renewable energy use. Researchers have identified cassava peel, plantain peel, yam peel, palm bunch, palm kernel shell, palm kernel sludge, palm fruit sludge, rubber latex, coconut shell, snail shell, oyster shell, animal bone, etc. as agricultural solid wastes; carton/papers, nylon/cellophane bags, plastic containers, beverage cans, animal bones, snail shells, palm fruit sludge, e-waste, broken glass bottles, broken ceramic plates, etc. As domestic wastes; computer hardware, television hardware, radio hardware, cable coats, jugs, etc. as E-waste; sawdust as wood waste; broken glasses, paper sludge, chemical wastes, cement kiln dust, palm kernel sludge, fly ash, blast furnace slag, etc. as industrial and agro industrial wastes. In a country like Nigeria with a population of over 200 million people, where unemployment has affected a lot of young graduates and youths, an entrepreneurial innovation, which explores the management and harnessing of solid waste for use in environmental Geotechnics will be considered the novelty of the century. Solid waste disposal affects every urban center and suburb in Nigeria and deserves undivided attention [12,13]. The Ministry of Environment and government has also failed in this area because solid waste hunts our lives like a housefly. Environmental Geotechnics is the discipline of applied science that deals with the management of the Geotechnical aspect of the environment. It is a broad area of technology because every civil infrastructure is founded on soil. For these facilities to be sustained and maintained, the soil upon which they are founded is managed

for sustainability. The objectives of this work were; (i) to evaluate the process through which solid waste management in Nigeria could be an entrepreneurial innovation to service environmental Geotechnics for sustainable development and (ii) to evaluate the effect of these wastes on the Geotechnical properties of soil.

### Generation and composition of solid waste

Solid waste is generated at all levels of our lives in Nigeria; both locally as household solid waste and in the corporate front as industrial wastes and management practices are very poor [14,15]. Waste characteristics vary with respect to seasonal movements, population changes, climatic factors, and industrial development, the size of markets for waste materials generated and the extent of urbanization, effectiveness of recycling and work reduction [2]. Other factors affecting increased waste generation among residents in Nigeria cities are changes in social economic and educational circumstance.

### Management practices in Nigeria

Ogwueleka [2] had argued that in Nigeria, the abundance of cheap labor, the use of a low capital cost and labor intensive solution due to unemployment, that reduces poverty will be preferred. It should include low technology like handcarts and pick-up trucks for collection, informal sector involvement (waste pickers), training, local waste recycling and transfer stations to reduce operating cost, community participation and involvement [16]. These are all laudable, but entrepreneurial consciousness is dead in Nigeria that no one thinks of such an adventure, hence this research work.

\*Corresponding author: Onyelowe KC, Department of Civil Engineering, Michael Okpara University of Agriculture, Umudike, P. M. B. 7267, Umuahia 440109, Abia State, Nigeria, Tel: +234-803-954-7350; Fax: +234-803-954-7350; E-mail: [konyelowe@mouau.edu.ng](mailto:konyelowe@mouau.edu.ng)

Received March 14, 2017; Accepted May 30, 2017; Published June 06, 2017

Citation: Onyelowe KC (2017) Solid Wastes Management (SWM) in Nigeria and their Utilization in the Environmental Geotechnics as an Entrepreneurial Service Innovation (ESI) for Sustainable Development. Int J Waste Resour 7: 282. doi: 10.4172/2252-5211.1000282

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## The contribution of the institutions

In June 1988, the Federal Environmental Protection Agency (FEPA) was created which consequently sprang up counterpart ministries at the state level. The landmark Federal legislation on environmental protection in Nigeria was the decree Number 58 of 1988, which established the Federal Environmental Protection Agency (FEPA). The specific roles of FEPA with respect to solid waste management were to [2,17]: (i) Study the most reliable systems that are appropriate for local, domestic and industrial wastes management, (ii) Specify waste disposal and treatment methods that take into consideration the geological and environmental setting and encourage recycling, (iii) Specify waste disposal sites that guarantee the safety of surface and underground water systems, (iv) Set up and enforce standards for adequate sanitary facilities for the disposal of human and other solid wastes in dwellings, housing estates and public facilities in both urban and rural areas, (v) Establish monitoring programmes, including periodic surveillance of approved waste disposal sites and their surroundings and waste water systems, and (vi) Establish monitoring stations for the control of the disposal of leachate from dumpsites into surface water and groundwater systems. Under this Act, all states and local government set up their own environmental protection body for the protection and improvement of the environment within its jurisdiction. In 1999 [1,2], FEPA was taken over by the Federal Ministry of Environment to combat some of the challenges faced which include the absence of pollution, waste management laws, lack of environmental enforcement, funding, role conflicts power play between FEPA workers and some powerful individuals whose companies not ready to pay for services. It still conformed to all the regulation stated above, but even with this change of hands, there was still inadequate provision of solid waste services in Nigeria. According to Ogwueleka [2]; Gaidajis et al. [18]; solid waste management in Nigeria is characterized by inefficient collection methods, insufficient coverage of the collection system and improper disposal. Lack of institutional arrangement, insufficient funds, the absence of standards and bylaws, insufficient information on waste composition and quantity, inflexible work schedule and inappropriate technology transfer are the common constraints faced by environmental agencies in solid waste management. 75-95% of the revenue of solid waste is spent on collection and disposal and only 40-70% is collected from the urban areas [19,20]. Most of the rural areas have no management facility.

## Source separation and local contributions

There is no formal practice in place for source separation at present, although the Federal Ministry of Environment (2000) specified in the Blue print for municipal solid waste management (MSWM) in Nigeria that separation at source is one of the viable alternatives to an integrated solid waste management program. And from the point of view of solid waste reduction through local contributions, the traditional practices of repair and reuse and the sale, barter, or gift-giving of used goods and surplus materials is an advantage to the poorer countries like Nigeria. Quantities of inorganic post-consumer wastes entering the municipal solid waste (MSW) stream would be higher if these forms of waste reduction did not exist [6,21-24]. Where are our entrepreneurs? Are there specific areas that are bound not to venture into? Innovation is ground breaking and when merged with entrepreneurial skills, the combination becomes the Eldorado that would save our environment and save its facilities from poor waste management.

## Solid Waste Manager as an Entrepreneur

The methods adopted in this research include observation and

reconnaissance fieldwork to really study the mode and frequency with which waste is generated and disposed on our streets. This was to ensure the viability of the study by taking an entrepreneurial adventure and close any loops that may have arisen. Research in the developing countries with an absence of adequate solid waste management system has focused more on adequate collection and disposal options than on the waste generators, storage or even an avenue for waste reduction which aids in the reuse and recycling, hence creating major gaps [25-27]. These gaps are areas that need to be addressed to ensure that there is a sustainable management of solid waste generated, to prevent environmental hazards. Figures 1-6 show unofficial solid waste dumpsites that have not only defaced our environment, but destroyed the transport facilities by impairing the Geotechnical functions of the soil upon which the facilities are founded [28-30]. An entrepreneur explores every available opportunity to make businesses out of anything, including solid waste management and disposal. Tonnes of solid wastes are discharged daily and disposed on our streets as shown in Table 1 and the present research is building a business chain between individuals and Geoenvironmental experts that have achieved positive results using solid waste in the stabilization of soil for construction



Figure 1: Refuse dump site on upstairs line road, Umuahia.



Figure 2: Refuse dump site on health center road, Umuahia.



Figure 3: Refuse dump site on Aba road, Umuahia.



Figure 6: E-waste dumpsite 2.



Figure 4: Refuse dump site on Amuzukwu gully site, Umuahia.



Figure 5: E-waste dumpsite 1.

Type of Waste	Volume (%)
Plastics	6.25
Papers	9.90
Glass	4.69
Aluminium scraps	9.90
Metal scraps	10.41
Food and wood	47.39
Water sachets and cellophane Packages	11.45

Table 1: Types of the solid waste generated in Aba.

purposes. Plastics; containers and electronic scraps, paper cartons, cellophane bags, rubber and leather wears, etc. are materials that can be converted to ash and applied in the stabilization of soil. It is the entrepreneur's task to develop a business plan on how to manage these waste materials so that he becomes the link between the waste generator and the waste user.

The biochemical hazards associated with these dumpsites cannot be overemphasized. Ammonia gas, lead, chlorides, hydroxides and many other organic compounds that are dangerous to health are examples of what the environment is exposed to through the indiscriminate disposal of solid waste.

## Results and Discussion

Previous research results have shown that the palm bunch ash, coconut shell ash, palm kernel shell ash, paper ash, cellophane ash, tyre ash, etc. [31] improved the strength properties of soil used as construction soil material in the formation of pavement sub-grade and sub-base layers hence meeting the standard requirements [32]. These ash materials were products of the solid wastes under study, burnt and completely pulverized and stored for stabilization purposes. That means that Environmental Geotechnics have opened up an atmosphere for the solid waste manager to expand his business horizon. The entrepreneur's task will now be the separation of the solid waste materials and making the same available to the relevant professionals who are the end users. So long as there will be pavement construction, maintenance, rehabilitation, soil improvement, etc. the entrepreneur stays in business and manages the solid wastes which the relevant Ministry of Environment has failed to manage [33].

## Conclusion

There exists a viable business chain between the solid waste Generator, the solid waste management entrepreneur and the Geotechnical engineering expert. It is innovative and offers business opportunities for the unemployed youths of this country.

## Acknowledgement

The Abia State Ministry of Environment made information available for this research work.

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