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# Waste Management and Sustainable Chemical Model Solutions for Nigeria's Underdevelopment

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**ABSTRACT**

Waste management and sustainable chemical model play an important role in addressing Nigeria's underdevelopment. It does this by ensuring the provision of environmental, social and economic advantages. In Nigeria and in other developing countries, poor waste handling practices with its attendant urbanization have caused environmental degradation, economic loss and public health issues. On the other hand, sustainable chemical model provides innovative solutions to these problems through the promotion of the design of products and processes that reduce waste and harmful materials and in turn conserve resources. This study investigates waste management and sustainable chemical model solutions for Nigeria's underdevelopment. The study uses a review approach to examine this subject matter. The review is based on existing literature to discuss waste management. The study reveals that about 50% of generated solid waste in many Nigerian cities has remained unattended to, thus, giving rise to unhealthy conditions especially in crowded regions. More so, this study reveals that paucity of funds and unhealthy implementation of waste management policies and programs are among the factors that have hindered waste management in Nigeria. This study concluded that illnesses and deaths can be prevented if both the citizens and local authorities jointly ensure that waste and chemicals usage do not pollute the environment nor contaminate water, air and soil, thus, helping to solve the problem of underdevelopment in Nigeria.

## 1. INTRODUCTION

Many African countries including Nigeria are facing significant challenges that are related to waste management. These challenges include poor waste disposal practices, inadequate infrastructure and rising urbanization, thus, leading to environmental degradation, economic loss, health issues, among others [8].

Nevertheless, sustainable chemistry offers innovatory answers that can change waste management practices, nurturing economic growth

and development and environmental sustainability.

Wastes arise through the uncontrolled activities of human beings. The geometric rise in human population coupled with urbanization and large communities' growth have triggered waste generation. Many negative effects have emanated from the lackadaisical management of waste and these include, among others, the contamination of the atmosphere, soil and water, thus, causing a major impact on public health [11].

This paper seeks to address waste management and sustainable chemical model solutions for Nigeria's underdevelopment.

## 2. STATEMENT OF THE PROBLEM

Transforming waste into energy through sustainable chemical process can help resolve both waste disposal and energy shortages in Nigeria. Making use of organic waste for composting and the production of biogas can enhance the fertility of the soil and make available renewable energy sources. This will enhance food security and decrease reliance on fossil fuels [24].

Through the integration of sustainable chemistry into educational curricula, the awareness about waste management issues can be raised, thus, fostering sustainability culture and for future generations.

In virtually all the activities of man (agricultural, chemicals, water purifiers, medicines, among others), chemicals play a key role. More so, the chemical industry contributes significantly to the gross domestic product (GDP) and job creation of national economies. However, any mismanagement of chemical poses a big risk to poor communities in developing economies (including Nigeria). This is due to their conditions of living, occupations and lack of access to hygienic food and water [1].

A good use and application of pesticides and fertilizers can make fertile agricultural lands on which poor and rural communities depend for survival. On the contrary, when agricultural chemicals are poorly managed and handled, they can pose big risks to the health of humans and can also lead to land degradation, impacting livelihoods in agricultural sector, fisheries and other sub-sectors [1].

## 3. LITERATURE REVIEW

Many researchers have identified some stakeholders, persons, organizations or institutions that may have interests in sufficient waste management. These include the government (both local and national), municipal authorities, non-governmental organizations (NGOs), city corporations, private contractors, households, recycling companies and Ministries of Finance, Health and Environment [2].

Furthermore, some writers and scholars have identified some important factors that affect the elements of the waste management systems. These factors include family size, education level and monthly salary, among others [3]. Also, households' attitudes, which are related to the separation of waste are influenced by the active investment and support of a real estate company, community residential committees' inclusion for public participation and collection service fee based on the weight and volume of the waste [4]. In addition to the above factors are land size, peer influence, gender, household location and membership of environmental organization [5].

According to [6], it has been discovered that the collection, transfer and transport or movement practices are being affected by insufficient information on collection schedule, poor route planning and improper bin collection systems, inadequate infrastructure and bad roads. Notwithstanding the organization of the informal sector and the promotion of micro-enterprises are some of the effective ways to extend affordable waste collection services [7].

### 3.1 GENERATION OF WASTE

The incessant migration of people from rural to urban cities and towns in Nigeria has been trending over the years. This uncontrolled growth of urban cities has left many cities in Nigeria deficient in infrastructural services like pipe-borne water, sewage disposal and solid waste management [8]. About 50% of generated solid waste in many Nigerian cities has remained unattended to. This has given rise to unhealthy conditions especially in crowded regions, thus, resulting in a rising morbidness especially due to microbial and parasitic infections across the population with the urban dwellers and waste controllers being worst hit [3]. Waste management is part and parcel of public health and sanitation

.

### 3.2 WASTE GENERATION, DISPOSAL AND HEALTH

Associated with the handling, disposal and treatment of waste either directly or indirectly are health issues. Directly by recovering and recycling activities in the waste management industry through exposure to poisonous substances in the waste or to emissions from landfill site, incinerators, odors, noise and indirectly through ingestion of contaminated food, soil and water [9].

As remarked by [10], despite the advancements in technology, improved legislation coupled with regulatory systems in waste management field and health surveillance, the acceptance of the public on the new waste disposal and treatments facilities is still insignificant. This is due to lack of concern about adverse effects on the environment and human health. Studies have shown that incinerator's emissions are linked to respiratory illnesses. Serious and chronic symptoms of respiratory failure are also connected to incinerator emissions, likewise the association between the development of certain cancers' symptoms in person who are living very close to incinerator sites.

Reference [11] identified the following specific cancers: laryngeal cancer, excess of bladder, liver cancer, soft-tissue sarcoma and cancer of the lung, stomach cancer and leukemia. More so, there is a gradual rise in risk of negative health effects close to landfill sites and real risks linked to residence close to certain landfill sites.

### 3.3 THE INCINERATION OF WASTE

Waste incineration can help decrease the quantity of disposed waste by up to 90% [8]. These significant quantity reductions can be found only in waste streams that have high amounts of packaging materials, paper, horticultural waste and plastics. Because of costs and pollution, incineration without energy recovery is not a chosen option.

Waste incineration is a very costly and it poses problems of air and ash pollution. Incineration needs wastes kept outside for gathering to be put in containers in order to stay dry and much of the waste stream is not inflammable. However, it can be used to bring down the original volume of combustibles by 80-95% [12].

### 3.4 WASTE DISPOSAL, RECYCLING AND MANAGEMENT

On factors influencing household waste disposal decision-making, [13] listed the supply of waste facilities, insufficient supply of containers and longer distance to these containers, inadequate funds, lack of legislation, among others. As regards waste recycling, [14] discovered some factors as being the reasons why some communities build and develop strong recycling habits. These factors include among others, social influences, beneficent and regulatory factors.

These authors also reported that persons who go to the bins frequently to dispose of general refuse are more likely to recycle some products in their homes. Again, in most cases, the shorter the

distance to the recycling, the bigger the number of fractions that citizens separate and take at home. According to [15] and [16] respectively, factors that affect the management of environmental aspect of solid waste in developing countries (including Nigeria) are lack of environmental control systems and real impacts evaluation, among others.

Municipalities have not been able to handle solid waste as a result of financial factors. The delivery of proper waste management services has been hindered by the following factors: big expenditure required to provide the service, lack of zeal on the part of the users to pay for the service and inadequacy of proper use of economic instruments [17].

The management of waste has been regarded generally as the sole responsibility and duty of local authorities and the public is not supposed to participate. Meanwhile, the operational effectiveness and efficiency of the management of solid waste lies upon the active participation of both the citizens and the municipal agency, therefore, societal dislike for contributing in solutions, people's participation in decision-making and community awareness are some of the socio-cultural aspects enlisted by some scholars including [8]. More so, waste management workers are always associated with low social status. This situation is as a result of low motivation among the employees of solid waste. Even some politicians do not give high priority to solid waste compared to other municipal activities. These lead to limited trained and skilled personnel in the municipalities [16].

On the contrary, support from municipal authorities and strategic plans for the management of waste that create room for the annual monitoring and evaluation of the system are among the positive factors that improve the system. Some researchers like [16] have gone further to point out that adequate and strong legal framework positively contribute to the growth and development of the integrated waste management system. This notwithstanding, the absence of lack of satisfactory policies coupled with weak regulations are hindrances to the development of the integrated waste management system [18].

### 3.5 SUSTAINABLE CHEMISTRY

The subject of sustainable chemistry gives a holistic view with the inclusion of relevant tasks of waste management. Sustainable chemistry guides and approaches can be very useful for waste management if and only if more outputs are recycled and more products regained for further use on a high level.

Reference [19] identifies the following as the benefits of sustainable chemistry in waste management:

- Lower hazardous waste and lower risks for operational health.
- Better use of secondary raw-materials.
- Better quality of resources arising from necessary waste.
- Better use of renewable resources based on separated chemicals from industrial waste.
- Waste reduction as a result of better process in the chemical industry.

### 3.6 GOALS AND IDEAS BEHIND THE SUSTAINABLE CHEMISTRY

Reference [3] identified the following as the goals and ideas behind the sustainable chemistry:

1. Making available value-creating products and services through new products and technologies.
2. Raising the use of substances, products and processes with minimal adverse effects.
3. Ensuring recycling concepts.
4. Natural resources conservation.

5. Evading damage and destruction to the ecosystems, resources and human beings.

### 3.7 UNDERDEVELOPMENT

According to [20] in [21], development means a process of transformation that is usually seen or felt in the occurrence of some desirable changes in different aspects of life of the society. At any point in time these changes are absent in a society, that society can be said to be underdeveloped. Such changes, according to [20], include:

1. Fall in the level of absolute poverty.
2. Rise in the level of employment.
3. Decrease in the extent of personal and regional inequalities.
4. Increase in real output of goods and services plus improvements in production techniques.
5. Improvements in government services, housing conditions, health services and literacy.
6. Improvements in the level of political and social consciousness of the people.
7. Higher ability to draw on local resources (material and human) in order to meet local needs.

For [22], the main goals of development are economic, political and social empowerments. Development must entail building the capacity of a nation technologically in order to exploit its environment to attain its existential needs [23].

### 3.8 CONTRIBUTIONS OF WASTE MANAGEMENT AND SUSTAINABLE CHEMICAL MODEL TO NIGERIA'S DEVELOPMENT.

Waste management and sustainable chemical model can contribute immensely to Nigeria's development in so many ways. [8] identified the following ways:

a. **The Creation of Jobs**: The development of a robust waste management sector will help create jobs in waste collection, recycling and processing, thus, contributing to economic growth and development.
b. **Green Technologies Investment:** By encouraging investment in sustainable chemistry and innovations in waste management, funding can be attracted, thus, local economies can be boosted.
c. **Public-Private Partnerships**: Through the engagement of private enterprises in waste management solutions, resources and expertise can be leveraged on, thus, fostering effectiveness, efficiency and innovations.
d. **Waste-Energy Technologies**: The conversion of waste into energy can provide solutions to both waste disposal and shortages of energy. Technologies like anaerobic digestion can ensure the provision of renewable energy and at the same time reduce waste.
e. **Biogas Production and Composting:** Organic waste can be changed to biogas and compost. This leads to the improvement of soil health and the provision of sustainable energy sources. This does not only lead to the reduction of waste but also the enhancement of agricultural productivity, thus, causing development.
f. **Waste Reduction and Recycling:** In many Nigerian cities, reasonable quantity of waste ends up in landfills and illegal dumps. Proper waste management reduces these wastes, thus, leading to the reduction of air, water and soil pollution and minimization of health hazards such as water borne infections, respiratory diseases, among others.

[11] added the following to the contributions waste management and sustainable chemical model to Nigeria's development process:

g. **Sustainable Chemistry for Clean and Pure Production:** The implementation of green chemistry in industries can lead to a reduction in the manufacturing of harmful by-products and pollutants. This will ensure cleaner water and air and also lead to the reduction of toxic wastes that often emanate from industrial processes.
h. **Climate Change Mitigation:** Waste handling particularly via waste-to-energy technologies and sustainable chemistry can help alleviate greenhouse gas emissions. Through anaerobic digestion or composting, good management of organic waste can lower methane emissions.
i. **Recovery and Recycling Resource:** Effective and efficient management of waste can promote resource recovery where valuable materials such as metals and plastics are recycled. This ensures the creation of a circular economy, lowers the demand for virgin materials and fosters local industries. Avenues for entrepreneurship are opened in recycling industries, thus, reducing poverty.
j. **Urban Waste Management Systems:** Many urban areas in Nigeria (Lagos inclusive) face significant challenges with waste management. This is as a result of poor infrastructure and population growth. Sustainable waste management systems (like effective and efficient collection, sorting and treatment) can help improve the living conditions in the urban areas, thus, making cities attractive for investors.
k. **Construction and Material Innovation:** Innovations in building materials like recycled materials for construction and low carbon cement can be attained through sustainable chemistry. These innovations are crucial for Nigeria's infrastructural development needs, thus, reducing the environmental impact of construction ana contributing to the building of r

## 4. FINDINGS FROM THE STUDY

The following findings were made from the study:

1. The application of hazardous chemicals in products and in productive sectors and sub-sectors, their usage and the dumping of commodities or products that contain them, can lead to the release of poisonous chemicals causing pollution that affects the quality of water and makes it unsafe for drinking.
2. Surface waters released from sectors like industry, agriculture, mining, among others, can pollute the seas, oceans, waterways, nutrients and oceans' food chain.
3. The wastes which end up in rivers, oceans or other waterways can cause the yearly death of hundred thousand of sea turtles, fishes and other water animals and sea birds.
4. The use, production and management of chemicals and wastes, if not handled properly can lead to serious environmental degradation, water, air and soil contamination and the disruption of the ecosystem [1].
5. The management of wastes involves a significant number of different stakeholders, who have different fields of interest. These people are key players in shaping the system of a city or town. However, it is wrongly to be the sole responsibility of the local authorities.
6. There is a cost attached to solid waste services as any other services that are provided but the expenditures are not recovered in general.

## 5. RECOMMENDATIONS

Based on the findings of this study, the following recommendations are made:

1. There should be a production of reliable data and the creation of proper information

channels between and within municipalities.

2. Decision makers who are saddled with the responsibility of planning and policy making should be well-informed on the cities' situation so as to make positive and rewarding changes, develop good integrated waste management instruments that will be congruent with the needs of the citizens bearing in mind their ability and willingness to pay for the services.
3. Our universities and other research centers have a significant role to play in preparing and equipping professionals and technicians in the field of environment.
4. We must ensure that wastes and chemicals usage do not pollute the environment nor contaminate water, air and soil, but rather protect the health of humans, thereby preventing illnesses and deaths.
5. Improving and rehabilitating the management and disposal of wastes and the reduction in the release of harmful chemicals is a bold step in the protection of world's seas, oceans and marine raw-materials.

## 6. CONCLUSION

Addressing waste management through sustainable chemical model solution offers a viable path to check Nigeria's underdevelopment challenges. Through innovatory practices and sustainability promotion, Nigeria can increase its economic prowess, improve public health and protect the environments.

Waste management and sustainable chemical model are vital in solving Nigeria's underdevelopment challenges. Through resource recovery, effective and efficient waste management and the application of the principles of green chemistry, Nigeria can foster sustainable economic growth and development, create jobs, protect and promote public health and protect its environment.

By investing in these salient areas, infrastructural development can be supported, food security enhanced and energy access boosted, thus, positioning Nigeria firmly on a path to sustainable growth and development.

The management of waste has been wrongly seen as the singular duty of the local authorities. Meanwhile, the efficacy of the vibrant participation of the agencies responsible for managing waste and the citizens involved.

This paper diagnosed waste management and sustainable chemical model as a panacea to Nigeria's underdevelopment by looking closely at waste generation, disposal, incineration, recycling, management and the health of humans. It went further to highlight the benefits of sustainable chemistry in waste management.

Following the findings of the study, some recommendations (solutions) were proffered of which if taken seriously will help solve Nigeria's underdevelopment problems.

### Contribution to Knowledge

The major contribution to knowledge is that the study has established that Sustainable Chemical Model offers innovatory solutions that can transmogrify waste management practices, thus, nurturing economic development and sustaining the environment.

Another contribution to knowledge is that the results of this research will be used by Scientists, Economists and policy makers to make clear decisions about the challenges related to the management of wastes including insufficient infrastructure, unhealthy waste disposal practices and rising urbanization in developing countries, particularly in Nigeria. This situation adds to environmental degradation, health-related issues and economic ineffectiveness.

This study has succeeded in making

popular waste management and sustainable chemical model and their effectiveness in curbing underdevelopment. Before now, there has been non-popularity of waste management and sustainable chemical model.

In addition, this study has established that while sustainable chemical model stresses the design of chemical products and outcomes that reduce to the barest minimum dangerous substances and waste, putting into practice these principles can lead to cleaner and safer production methods in Nigerian industries, thus, decreasing waste generation.

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**CONFLICT OF INTEREST:** There is no conflict of interest.