

# Waste Resources and Climate Change: Implications and Mitigation

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**Abstract:** Waste occurs both from human and natural activities on daily basis. Sustainable waste management is paramount to reducing the effect of global climate change due to increased greenhouse gases (GHG) arising from unsustainable waste management. In most developing countries, management of waste is mostly done through very primitive methods with the consequences that the environment is made more unsafe for human survival. Increase in the global temperatures will surely lead to an intensification of the hydrological cycle, resulting in changing seasons and subsequently increased risks of more extreme and frequent floods, drought, and costly growing health impacts. Unsustainable waste management results not only in climate change but also impose serious negative consequences on the environment. This paper investigates the impact of waste resources on the environment and implications for climate change, and other necessary mitigation responses towards the possible impacts of climate change with particular emphasis on the Nigeria environment.

**Keywords:** Climate change, sustainable, waste management, greenhouse gases, developing countries.

## 1. Introduction

Wastes are inevitable product of human and/or natural activities. They can be seen as constant inexhaustible and locally produced but untaxed materials whose volume, nature, and composition depend upon the standard of living and the characteristics of domestic, industrial and commercial activities of the population producing such waste. Waste resources includes but not limited to: household 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. Waste management requires prudent approach in the mode of collection, storage, transportation, processing, treatment and its final disposal so that it will not result in environmental degradation, health issues and emission of harmful gases into the atmosphere. Accordingly, Clark defined solid waste management as the branch of solid waste engineering associated with waste control of generation, storage, collection and transfer, transportation, processing and disposal of solid waste in a manner that is in accordance with the best principle of Public Health Economics, Engineering Conservation, aesthetics and other environmental consideration [1].

Climate change is due to natural and artificial factors. Climate change from natural factors is mostly caused by layer of greenhouse gases because these greenhouse gases allow solar radiation to pass through the atmosphere but stops the reflected heat from escaping back into space thereby causing an increase in the earth's temperature. It has been shown that these layer of greenhouse gases (water vapour and traces of carbon (iv) oxide, methane and nitrous oxide) behave as a thermal blanket for the earth by absorbing heat and warming the surface to an average of 15°C [2]-[3]. Another major contributor of climate change is human activities. It has been reported that there is an exponential increase in GHG emissions dating back from the industrialization era due to increased burning of fossil fuels

and other crude oil related products. As the energy demand increases due to increase in population and/or increased urbanization, the level of greenhouse gases emission will also rise due to increased consumption of fossil fuel related products. This is particularly the case for most developing countries like Nigeria, Ghana, Cameroon to mention but few, and some emerging economies such as China, India, Thailand etc. Another human factor that contributes immensely to climate change is animal husbandry. Based on the literature, it has been reported in 2006 by the United Nations that animal production for food also contribute to global warming more than the burning of fossil fuels [4]-[6]. The implication is that the animal waste which emits nitrous oxide (NO<sub>2</sub>) is increased, thereby increasing global warming and subsequently climate change. Also methane and ammonia concentration in the atmosphere can be increased by humans through meat consumption and its subsequent excretion. This is more significant in developing countries where open defecation is almost a common culture. It has been reported that the effect of methane on global warming is about 25 times greater than that of carbon (iv) oxide, while large concentration of ammonia is known to cause acid rain [7]. Another source of concern is deforestation. Deforestation is the process of removing/cutting down trees without replanting them. It is generally known that trees convert CO<sub>2</sub> to oxygen during photosynthesis. Since deforestation will lead to a reduction in the number of trees available to convert carbon (iv) oxide to oxygen, there will be an increase in the concentration of carbon (iv) oxide in the atmosphere thereby causing an increase in global warming, and consequently climate change.

## 2. Literature Review

### Sources of Waste in Nigeria

The sources of wastes in Nigeria include but are not limited to; household, municipal, agricultural, industrial, hospital, construction sites, public sites, and e-wastes.

## Waste Management in Nigeria

Waste management in Nigeria, just like other third world countries is still largely dominated by primitive and unsustainable methods. These methods include; open dumping, open burning, incineration, burial and stream/river/sea dumping. This has been discussed by various authors [8]-[10]. Some authors argued that waste management in Nigeria is saddled with the problems of inefficient collection methods, insufficient coverage of the collection system and improper disposal [11]. It has been reported that some of the common challenges faced by the environmental agencies include; lack of institutional arrangement, insufficient financial resources, lack of by-laws and standards, inflexible work schedules, insufficient information on quantity and composition of waste, inappropriate technology, and insufficient manpower in the sector [12]- [14]. Improper waste management in Nigeria has led to land pollution, water pollution (ground and surface), and air pollution. Open burning methods contribute immensely not only to air pollution but also to increase in greenhouse gases within the vicinity.

### 2.1. Water pollution

Most water bodies in Nigeria especially local streams are largely polluted with solid wastes. A typical example of such scenario is shown on Figure 1. Ahianba et al reported that about 40.1% of Nigerians derive their sources of water from groundwater sources in which 28.27% use water from hand-dug wells and 11.83 % got their water from boreholes [15].



**Figure 1:** Typical solid waste polluted stream, Ohugbudu in Abakaliki, Ebonyi State, Nigeria.

There is no doubt that the health status of people who depend on these sources of water for their domestic needs is in jeopardy. Also this will make such stream a strong breeding ground for water and air borne diseases. This has been highlighted by other authors [16]-[17].

### 2.2. Land and Air Pollution

As indicated earlier, one of the commonest methods of waste disposal in Nigeria is by open dumping. Several authors have reported on this ugly scenario [8], [18]-[22]. This is mostly

caused by; illiteracy, poverty, lack of awareness, poor sanitation policies, inadequate attention by sanitation authorities, unchecked urbanization, lack of the proper technology and skills to address such issues amongst others. In every States in Nigeria, it is very common to find solid waste littered indiscriminately on the streets or heaped at strategic corners. Figure 2 gives a picture of an open dumping site in one of the most popular street in Abakaliki metropolis, Ebonyi State, Nigeria. The volume of waste generated from households, industries, and commercial establishments in Nigeria are increasing at an alarming rate and these wastes are not being collected and disposed in a sustainable manner. This has been reported in the literature [11], [23] – [26]. The nonchalant attitude of the staff of environmental protection agencies in Nigeria on waste collection is not helping matters either. A typical abandoned industrial waste from Abakaliki Rice Mill Industry is shown on Figure 3. These abandoned wastes pollute the land that could have been used for agriculture, residence, or for other good purpose. They also pollute the air within that neighborhood and as well constitute serious nausea, eyesores and serves as a potential breeding ground for germs and bacteria. Also most abattoirs in developing nations use waste tyres for open roasting method and this generate serious greenhouse gases into the atmosphere. A typical example is shown on Figure 4.



**Figure 2:** Open dumping site at Goddy Ogbaga Avenue, Abakaliki, Ebonyi State



**Figure 3:** Rice husk hill in Abakaliki Rice Mill Industry, Ebonyi State, Nigeria.

### 3. Research Methodology

This research work was carried out using a literature based conceptual approach; hence the author reviewed literature on waste resources in Nigeria. The work then discussed the impact of waste resources on the environment, and consequently on climate change. The study further discussed on the implications and mitigation with particular reference to Nigeria.



**Figure 4:** Typical roasting ground at Kpiri-Kpiri market, Ebonyi State, Nigeria.

## 4. Results and Discussion

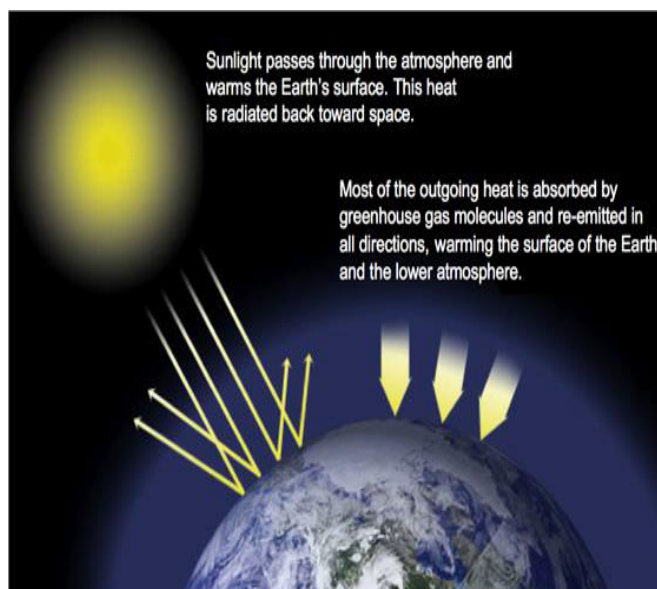
### 4.1 Waste Management and Climate Change

Waste management is one of the fundamental steps that will enhance a significant reduction on climate change. It is a common knowledge that any activity that will lead to increase in greenhouse gases will subsequently lead to climate change. Waste management has the capacity to do that since it has been established that major disposal of waste in some third world countries is by open dumping and burning [8], [14] - [18], which generally contributes some

greenhouse gases to the atmosphere and subsequently climate change. Figure 5 shows the effect of greenhouse gases on solar radiation and how they end up increasing the earth's temperature.

#### 4.1.1 Sustainable Waste Management

Sustainable waste management refers to management of waste such that maximum benefits will be derived from the waste and in such a manner that it will neither affect the present nor the future negatively. This can be achieved through use of new technologies in waste management. In most developing countries, people are not aware of the need to preserve their environment through careful management of waste or by adopting more civilized approaches to other human activities that could enhance such. Recycling - the act of changing waste materials to new products is another option with the benefits of; less raw materials needs, less energy usage, reduced air and water pollution, and reduced greenhouse gas emission. Awareness programme to ensure that people understands the immense benefits of recycling will play a large role towards achieving sustainable waste management in Nigeria.



**Figure 5:** Greenhouse effects in the atmosphere [27].

### 4.2 Implications

The implications of poor waste management are that the changes in the form and quality of our environment will have serious significant consequences for human populations, through impacts to health, agriculture, economic activity, and on increased GHGs and subsequently climate change.

#### 4.2.1 Impact on the Health sector

Waste becomes a serious threat if managed in an unsustainable manner. Wastes generally serve as reservoir or breeding grounds for harmful microbes, bacteria and viruses. These then constitutes serious nuisance and health hazards. Several authors have reported on the negative effects of unsustainable waste management on the health of citizenry [28] - [30]. Anytime an epidemic occurs in a country, be it air-borne or water-borne disease, huge amount

of money is spent by Government and individuals with many lives being lost in most cases especially in third world countries. In Africa and some other developing countries, it is a common knowledge that malaria is one of the commonest scourge, and stagnant waste water are potential breeding grounds.

#### 4.2.2 Impact on Agriculture

Agriculture requires favourable and stable weather conditions amongst other factors for maximum yield to be achieved. Warmer temperatures due to climate change will lead to increased water evaporation, thereby increasing the need for irrigation especially as water becomes even less available. An increase in the supply of irrigation will not be possible in some regions especially where irrigation capacity is not sufficiently developed to accommodate changing precipitation patterns, coupled with the additional cost of procuring irrigation equipments. It has been reported that the International Rice Research Institute, estimates that for every degree Celsius of night time temperature increase, there is at least a 10% decrease in rice production for the African region [31]. Changing season pattern strongly affect food production and may lead to famine. Increased rainfall in Nigeria in 2012 resulted in large scale loss of cassava farms, leading to serious shortage of cassava related products [32]-[33].

#### 4.2.3 Impact on Economy

The impact of unsustainable waste management on the economy cannot be over-stressed. Since wastes must be produced in any place that life exists, there is an urgent need to ensure that these wastes are managed sustainably. Polluted environment creates a lot of negative impacts which brings untold hardships to the populace thereby imposing serious strain on the economy in a bid to tackle such issues.

#### 4.3. Mitigation

Mitigation refers to any form of human intervention/policy implementation with the intent to; remove the greenhouse gases (GHG) released into the atmosphere, reduce their magnitude, or to reduce any risk and hazards of climate change to human life and the environment. This could be done through the development of appropriate technology for reducing emissions and/ or capturing the greenhouse gases

from their point of emission. Measures that will enhance mitigation include; sustainable waste management, energy efficiency, energy sustainability, increased awareness on the negative consequences of global warming and climate change, eco-city designs, and increased utilization of renewable energy sources compared to fossil fuels.

##### 4.3.1. Carbon (IV) oxide Capture and Sequestration

Carbon (iv) oxide (CO<sub>2</sub>) capture and storage/sequestration is simply the process of capturing carbon (iv) oxide from energy-related sources; industrial, waste etc, and transport and storage of the gases through underground injection and geological sequestration. Carbon (iv) oxide capture and sequestration (CCS) could play a significant role in reducing

greenhouse gas emissions and simultaneously enabling low-carbon electricity generation. Carbon (iv) oxide capture and sequestration is one of the fundamental steps in minimizing greenhouse gas emissions from large stationary sources of CO<sub>2</sub> such as fossil-fuel products related industries.

#### 5. Conclusion

Climate change is occurring and will continue to occur due to natural and artificial factors. It is anticipated that the rate and intensity of climate change is increasing globally, and especially in third world countries due to rapid urbanization, unsustainable waste management, and over-dependence on fossil fuel products amongst other factors. This has been highlighted on the Fourth Assessment Report by the Intergovernmental Panel on Climate Change [34]. Effects of climate change such as; accelerated sea-level rising and coastal flooding, changes in temperature and seasons, heavier precipitation patterns and severe drought in some areas have impacted negatively on agriculture, food security, health and on the economy. These adverse consequences can be avoided if proper cleaner technologies are developed to reduce/eliminate climate change along with unsustainable waste management practices on a global scale. In Nigeria, sustainable waste management can be made more effective by raising local awareness, increased funding of the waste management sector, and increased waste to energy policies/implementation across the 36 States, and extensive research/information dissemination to reduce the knowledge gap regarding the negative impact of unsustainable waste management on the environment and subsequently climate change.

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### Author Profile



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