

## Green Entrepreneurial Opportunities in Food Waste Management for Climate Resilience in Nigeria

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### ABSTRACT

Climate change, global warming and other related environmental challenges which constitute a threat to sustainable economic growth have also created green entrepreneurial opportunities in food waste management in Nigeria. The issue of food waste represents a squandering of limited natural resources, which has the potential to worsen poverty and contribute to food insecurity in Nigeria. Through literature review, participant observation and data collection from relevant agencies in Nigeria, this study identifies the green entrepreneurial opportunities in food waste management for climate resilience in Nigeria. It also identifies the adaptation and mitigation strategies to the impacts of food waste on climate and health in Nigeria. This study identifies the role of environmental education in mitigating the impacts of food waste on climate and health in Nigeria. This study recommends more advocacy projects and in-depth research on green entrepreneurial opportunities in food waste management in Nigeria. This study concludes that there is a great need for individuals, institutions and communities to work together towards adaptation and mitigation of the impacts of food waste for climate resilience in Nigeria.

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### Introduction

Food waste refers to food that is discarded, even though it's still edible. This can happen at any point in the food supply chain, from farms and factories to restaurants, grocery stores, and households. It includes things like food that spoils in the fridge, over-portioned meals, or produce that doesn't meet aesthetic standards [1]. Food waste is when edible food is thrown away, lost, or left uneaten while it is still valid for consumption. It includes many forms of waste such as food that is intentionally thrown away, expired food, kitchen trimmings, etc [2]. Food waste is also defined as the disposal of edible food at any stage of the supply chain from production to consumption, illustrates its complex nature [3]. Food waste is generally defined as consumable food but may be discarded due to spoilage along with the associated inedible parts removed from the food supply chain in various sectors such as retail, food service, and households. Different types of food waste (solid, liquid, etc.) call for different ways of managing them [4]. Food waste is a significant global issue, a quiet crisis that affects economies, environments, and societies, leading to serious repercussions. Significant amounts of food waste are generated at different stages including the primary production, distribution, and sale of food products, and the preparation and serving of food in commercial and domestic environments [2]. The Food and Agriculture Organization (FAO) estimates that

roughly one-third of the food produced globally, around 1.3 billion tons annually, is either lost or wasted, highlighting the magnitude of this problem [5]. Every year, approximately 1.3 billion tons of food, which accounts for around one-third of global food production, is lost or wasted. Among this high amount, one-third occurs during the production phase. This wasted food is valued at around U.S. \$1 trillion [2]. Food losses can occur during farming due to pest infestation or excessive planting, in processing due to inefficiencies or rejections based on quality standards, during distribution because of logistical failures, and at retail and consumer levels from overstocking or waste disposal [6]. Every point in this chain signifies a lost chance to feed people, making food waste a wasted opportunity to tackle global hunger; a contradiction that becomes more apparent as populations grow and cultivable land declines [6]. The UN reported in 2024 that roughly 828 million people, nearly 10% of the world's population, suffer from chronic hunger, highlighting a significant failure in resource allocation and distribution. This represents a serious global crisis, demanding immediate attention and systemic solutions to address the underlying causes of hunger and food insecurity [7]. The household sector plays a critical role in food waste generation in developed and developing nations, with notable levels of waste observed at the household level in the European Union [8]. In developed countries, supermarkets often discard perfectly edible fruits and vegetables that are merely cosmetically imperfect, while households frequently waste leftovers or foods past their expiration dates. These habits are influenced by a sense of abundance and

convenience. Conversely, in developing countries, food is lost due to insufficient technology and infrastructure, including a lack of refrigeration in humid areas or inadequate road systems that hinder market access. This difference in causes does not lessen the common result: a weakened global economy burdened by inefficiency [8]. In developing nations, food losses are significantly higher than in developed countries due to issues like inadequate storage, transportation, and processing technologies. This includes a lack of refrigeration in humid areas, hindering the preservation of perishable goods, and poorly developed road systems that limit farmers' access to markets. These infrastructure gaps, coupled with inadequate handling and storage practices, contribute to substantial food spoilage along the supply chain. The FAO also estimates an annual loss of \$940 billion, which includes direct costs such as unsold goods and indirect costs like wasted labor and infrastructure investments. To put this in perspective, this figure is comparable to the GDP of medium-sized nations, highlighting how food waste threatens global economic stability [5]. This WHO 2024 report theme "Financing to end hunger, food insecurity and all forms of malnutrition", emphasizes that achieving SDG 2 Zero Hunger requires a multi-faceted approach, including transforming and strengthening agrifood systems, addressing inequalities, and ensuring affordable and accessible healthy diets for all. It calls for increased and more cost-effective financing, with a clear and standardized definition of financing for food security and nutrition [7]. It is therefore important to understand proper food waste management strategies for tackling the menace of food waste, enhancing food security and climate resilience in Nigeria. Green entrepreneurship has been identified as a valuable tool for enhancing food security and climate resilience in Nigeria [9]. This study therefore explores the green entrepreneurial opportunities in food waste management for climate resilience in Nigeria.

### Methodology

Materials used for this study were derived from online academic journals, magazines, articles, conference papers, textbooks, and educational materials from libraries. The researchers gathered a lot of materials for the research but summarized the characteristics of the papers that centred more on "Green entrepreneurial opportunities in food waste management for climate resilience in Nigeria". This enabled the researchers to generate the synthesis of various views of other researchers on the subject matter.

### Understanding Food Waste Management

Food waste management is a systematic approach that aims to handle and redirect food and agricultural products that are no longer fit for human consumption, with the goal of finding better uses for them, such as animal feed, industrial applications, or to prevent environmental harm. It involves reducing food waste at all stages of the food supply chain, from production to consumption, and finding ways to repurpose food that is otherwise destined for landfill [2]. From an environmental standpoint, food waste significantly exacerbates climate change with alarming accuracy. The 4.4 gigatons of greenhouse gases it emits each year, accounting for 8% of total human-caused emissions, is among the leading contributors to global warming, second only to major industrial sectors [10]. Decomposing food in landfills releases methane, a greenhouse gas thereby accelerating global warming and disrupting weather patterns. In addition to emissions, the resources wasted in producing food that is never eaten, such as water for irrigation, land for farming, energy for processing, and labor for harvesting; add to the environmental impact. For example, the water wasted on uneaten food could satisfy the domestic water needs of millions of people each year [11]. This depletion of limited resources intensifies the pressure on a planet

already struggling with deforestation, soil degradation, and the loss of biodiversity. Public health also deteriorates under the burden of food waste. Decomposing organic matter in unmanaged landfills encourages the growth of pathogens and pests, heightening the risk of diseases like cholera and malaria [11]. These problems are particularly severe in areas with inadequate sanitation. At the same time, the nutrients lost due to food waste could help alleviate malnutrition, a persistent global health issue [12]. This relationship between economic losses, environmental damage, and health risks positions food waste as a pressing challenge that calls for innovative solutions, laying the groundwork for exploring green entrepreneurial opportunities in places like Nigeria, where these effects are profoundly felt and immediate action is crucial. With Nigeria in focus, the growing population and swift urban development have led to a complicated array of environmental and socio-economic challenges [13]. Among these challenges, the increasing problem of food waste emerges as a critical issue that necessitates immediate and creative solutions. In a country where achieving food security is a vital goal, the contradiction of significant food loss and waste is economically illogical and environmentally harmful. The enormous quantity of food that is discarded, encompassing everything from farm produce to household leftovers, significantly contributes to greenhouse gas emissions, public health hazards, and the exhaustion of crucial resources [14]. The need to tackle this issue is emphasized by the Sustainable Development Goals (SDGs), particularly SDG 12 (Responsible Consumption and Production) and SDG 13 (Climate Action), which advocate for effective waste management and climate change mitigation [15]. With a population exceeding 220 million, Nigeria faces a complicated food system rife with inefficiencies at multiple levels, from production and distribution to consumption [16]. The agricultural sector, which is fundamental to Nigeria's economy, encounters difficulties in post-harvest management, storage, and transportation, resulting in considerable losses even before food reaches consumers. Additionally, urban areas, characterized by their dense populations and changing consumption habits, produce significant amounts of food waste from both households and businesses [17]. The conventional waste management methods, primarily based on open dumpsites and ineffective collection systems, worsen the situation. Food waste decomposing in such conditions emits methane, a powerful greenhouse gas, which contributes to climate change and its related consequences, including irregular weather patterns, flooding, and drought [18]. One of the main causes of food waste in Nigeria has been inadequate storage facilities. Proper storage conditions must be in place to curtail the deterioration of agricultural products [8]. Innovative strategies in food waste management need to be engaged to enhance climate resilience and sustainable economic growth in Nigeria. This study identifies the green entrepreneurial opportunities in food waste management in Nigeria.

### Understanding Green Entrepreneurship

Green entrepreneurship can be defined as the activity of consciously addressing an environmental/social problem/need through the realization of entrepreneurial ideas with a high level of risk, which has a net positive effect on the natural environment and at the same time is financially sustainable [19]. A green entrepreneur is someone who starts and runs an entrepreneurial venture that is designed to be green in its products and processes from the very moment it is set up [20]. Green entrepreneurs are valuable assets across various communities in Nigeria today. The Green entrepreneur sees the problems caused by climate change, food waste, environmental pollution and global warming; He/she also perceives the green entrepreneurial opportunities in food waste management and takes on the risk of engaging the process of food

waste management to ensure climate resilience and sustainable economic growth in his community and nation [20]. The green business environment in Nigeria is moving at a very rapid rate. This can be seen in the number of green entrepreneurship businesses springing up. When green entrepreneurship thrives in Nigeria, the rate of unemployment amongst the youths will be drastically reduced and this will go a long way to help to achieve the sustainable development goals [21]. The idea of green entrepreneurship presents a promising avenue for turning the food waste dilemma into a potential opportunity in Nigeria. Green entrepreneurship, which centres on environmental sustainability and social impact, provides innovative solutions that are in harmony with the principles of a circular economy [22]. By implementing waste-to-resource strategies, entrepreneurs can create value from food waste, producing economic gains while reducing environmental damage. This research identifies and investigates potential green entrepreneurial ventures within Nigeria's food waste management sector for enhancing climate resilience and sustainable economic growth.

### Green Entrepreneurial Opportunities in Food Waste Management in Nigeria

Nigeria has a significant amount of food waste, which can lead to environmental damage, health issues, and economic losses. This high waste rate presents an opportunity for entrepreneurs to develop innovative solutions to reduce waste, improve food preservation, and develop sustainable food processing practices [9]. Investigating the landscape of green entrepreneurial possibilities within Nigeria's food waste management industry and examining how sustainable business models can tackle these intricate challenges of food waste while promoting economic development and community welfare is crucial [23, 24]. Green entrepreneurial opportunities in food waste management in Nigeria present a promising avenue for sustainable development and economic growth. Nigeria faces significant food waste, estimated at 40% of food produced, creating challenges for food security, the environment, and the economy. However, this waste also presents an opportunity for entrepreneurs to develop innovative solutions that address these challenges while building profitable businesses [9].

### The following are green entrepreneurial opportunities in food waste management in Nigeria:

- a) **Food Waste Recycling:** Entrepreneurs can leverage food waste for composting, anaerobic digestion (biodigestion) for biogas production, or utilize it as feedstock for other industries.
- b) **Sustainable Food Preservation:** Developing and marketing sustainable food preservation technologies and practices, such as innovative packaging solutions or cold storage facilities, can reduce post-harvest losses.
- c) **Food Waste Reduction Education:** Creating awareness campaigns and educational programs to promote responsible food consumption and waste management can help reduce food waste at the household level.
- d) **Community Food Redistribution:** Establishing or supporting community food redistribution programs, such as food banks or food recovery initiatives, can reduce food waste and provide access to food for those in need.
- e) **Waste-to-Wealth:** Transforming food waste into valuable products or resources can create new economic opportunities for entrepreneurs, such as producing animal feed, fertilizer, or other byproducts.

### The Benefits of Green Entrepreneurship in Food Waste Management include:

- a) **Environmental Protection:** Reducing food waste through composting, anaerobic digestion, and other sustainable practices can minimize the environmental impact of food production and disposal.
- b) **Economic Growth:** Green entrepreneurship in food waste management can create new jobs, generate revenue, and contribute to a more sustainable and resilient economy.
- c) **Social Impact:** Reducing food waste can improve food security, address hunger, provide employment and promote social equity by ensuring access to food for all.

### Recommendations

1. Supportive policies and regulations should be enacted by the Nigerian government to help create a conducive environment for green entrepreneurs in the food waste management sector.
2. Multilateral organizations such as the World Bank Group should provide access to funding, technology, and expertise which are crucial for the success of green ventures in food waste management in Nigeria.
3. Green entrepreneurs should go the extra mile to understand consumer preferences and market trends for green products and services which is essential for developing successful businesses in food waste management in Nigeria.
4. Nigerian government should develop adequate infrastructure, such as waste collection and processing facilities which are necessary for managing food waste effectively.
5. Seminars and workshops on food waste management targeted at green entrepreneurs, youths, women and the vulnerable individuals should be organized regularly by the Nigerian government in collaboration with educational institutions and multilateral organizations.
6. Awareness creation, sensitizations and campaigns towards enhancing food waste management in Nigeria should be undertaken by professionals, passionate individuals and non-governmental organizations in Nigeria.

### Conclusion

Harnessing the green entrepreneurial opportunities in food waste management in Nigeria will bring economic growth, environmental protection and positive social impact. There is therefore a great need for individuals, institutions and communities to work together towards adaptation and mitigation of the impacts of food waste for climate resilience in Nigeria. Deeper research on the green entrepreneurial opportunities in food waste management is timely and of great importance.

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