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Sustainable Cassava Waste Management and Its Implications for Food Security in Oke-Ogun, Nigeria

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Abstract

Cassava is a vital staple crop in Nigeria, particularly in Oke-Ogun, Oyo State, where both small- and medium-scale processing industries dominate. While cassava processing ensures food availability and income, it simultaneously generates enormous quantities of solid (peels, sievates) and liquid wastes (effluents), which pose environmental and food security risks. The central problem is that waste management practices in Nigeria are largely unsustainable, leading to land degradation, water pollution, and reduced agricultural productivity. This study investigates the volume of cassava processed, waste generated, management strategies adopted, and implications for food security in Oke-Ogun. Concept of sustainability anchors this study. Using a mixed-method approach, a multi-stage random sampling technique was used to obtain data on volume of cassava tubers processed, volume of waste (solid and liquid) generated, and the effect of cassava wastes on food security from 300 cassava processors across five local government areas through questionnaires. Focus group discussions, and field observations were carried out for qualitative data. Analysis of quantitative data shows that the region processed over 16 million metric tonnes of cassava (2008–2020), generating more than 1.6 million kg of solid waste and 1,660 MT of liquid effluents. Qualitative findings reveal poor waste handling practices, including indiscriminate dumping, with adverse impacts on farmlands, water quality, and livelihoods. The findings highlight the urgent need for environmentally sustainable cassava waste management policies to enhance food security and environmental protection.

Keywords

Cassava waste, Food security, Sustainable management, Nigeria, Environmental planning

1. Introduction

Food security remains one of the major global challenges, particularly in sub-Saharan Africa, where the growing population depends heavily on staple crops such as cassava (Kiaya, 2014). Nigeria is the world's largest producer of cassava, accounting for about 20% of global output (FAO, 2004). Its processing industries provide food, income, and employment opportunities, making cassava central to rural livelihoods. However, the growing volume of cassava production results in significant waste generation. Solid wastes such as peels and sievates, and liquid effluents from processing, threaten environmental quality, degrade farmland, and pollute water bodies (Olukanni & Olatunji, 2018). The statement of the problem is that despite cassava's importance, inadequate waste management practices undermine its contribution to sustainable food security. In regions like Oke-Ogun in Oyo State, cassava is central to livelihoods and food systems, yet poor waste management practices have resulted in soil infertility, water contamination, and loss of arable land (Eze & Onyilide, 2015; Omilani, Abass & Okoruwa, 2015). This paper examines the nexus between cassava waste management and food security in Oke-Ogun, Nigeria, with an emphasis on sustainable environmental planning.

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2.0 Conceptual framework and Literature Review

2.1 The Concept of Sustainability

The concept of sustainability is a core principle of the attached document, serving as the link between environmental conservation and economic development to ensure the well-being of future generations. It is a multi-dimensional framework that recognizes the finite nature of natural resources and advocates for their responsible use to meet present needs without compromising the ability of future generations to meet their own (Brundtland Commission, 1987). This framework is often understood through three interconnected pillars: environmental, economic, and social sustainability (Sphera, 2020).

Environmental Sustainability focuses on maintaining the integrity of ecological systems and ensuring the responsible use of natural resources like water, air, and soil. In the context of the attached document, this pillar is challenged by the indiscriminate dumping of cassava waste, which leads to soil degradation, water pollution, and a loss of productive farmland. The study's focus on sustainable waste management, such as converting waste into organic fertilizer or biogas, directly addresses this pillar.

Economic Sustainability is concerned with maintaining economic growth and productivity over the long term without causing irreversible environmental harm. The document highlights that mismanaged cassava waste is not just an environmental problem but also an economic one, as it reduces agricultural productivity. The proposed solutions—turning waste into valuable by-products like livestock feed—transform a liability into a new economic opportunity, thereby contributing to a more sustainable economic system.

Social Sustainability ensures that the benefits and burdens of development are equitably distributed and that communities can thrive. The paper links poor waste management to health risks, which, in turn, affect the community's productivity and well-being. By proposing solutions that improve environmental health and restore farmlands, the study implicitly supports social sustainability by creating a healthier, more resilient community that can better achieve food security.

The central argument of this paper is that the quest for food security in Nigeria is inextricably linked to the practice of sustainable development. It demonstrates that by adopting sustainable waste management, the Oke-Ogun region can overcome environmental degradation, enhance agricultural productivity, and ultimately achieve long-term food security for its population.

2.2 Literature Review

Existing research highlights cassava's role as both a food security crop and a source of environmental pollution. According to Ubalua (2007) and Adejumo & Adebiyi (2021), cassava processing generates enormous solid and liquid wastes, which if mismanaged, cause soil infertility, water contamination, and health hazards. Comparative studies such as Piyachomkwan & Tanticharoen (2011) illustrate how Thailand has turned cassava waste into economic resources through biogas production and zero-discharge processing systems. In contrast, Nigerian cassava processors often dump wastes indiscriminately, with limited regulation or recycling (Olukanni, Agunwamba & Abalogu, 2013). Research by Oyewole & Eforuoku (2019) and Popoola et al. (2015) shows the potential for value addition to cassava wastes, such as their conversion to livestock feed or organic fertilizers, but adoption remains limited. Furthermore, studies like Zhang et al. (2016) emphasize that cassava waste biorefinery could transform environmental risks into economic opportunities. Few studies explicitly examine the food security implications

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of these practices, particularly in rural regions like Oke-Ogun. This study addresses that gap by integrating environmental planning perspectives with food security analysis.

3. Study Area

The Oke-Ogun region (the study area for this study, figure 1) is located in northern Oyo State, Nigeria. It is primarily agrarian, with fertile land for cassava, yam, maize, and livestock farming. The region comprises ten Local Government Areas (LGAs), but this study focuses on five (Atisbo, Iseyin, Itesiwaju, Iwajowa, Kajola), selected for their high cassava production. According to the 2006 census, the population of the region was 1.48 million, with cassava as a dominant crop. Processing industries in the region are mostly small-scale, often located close to rivers or streams, which raises environmental concerns due to waste discharge.

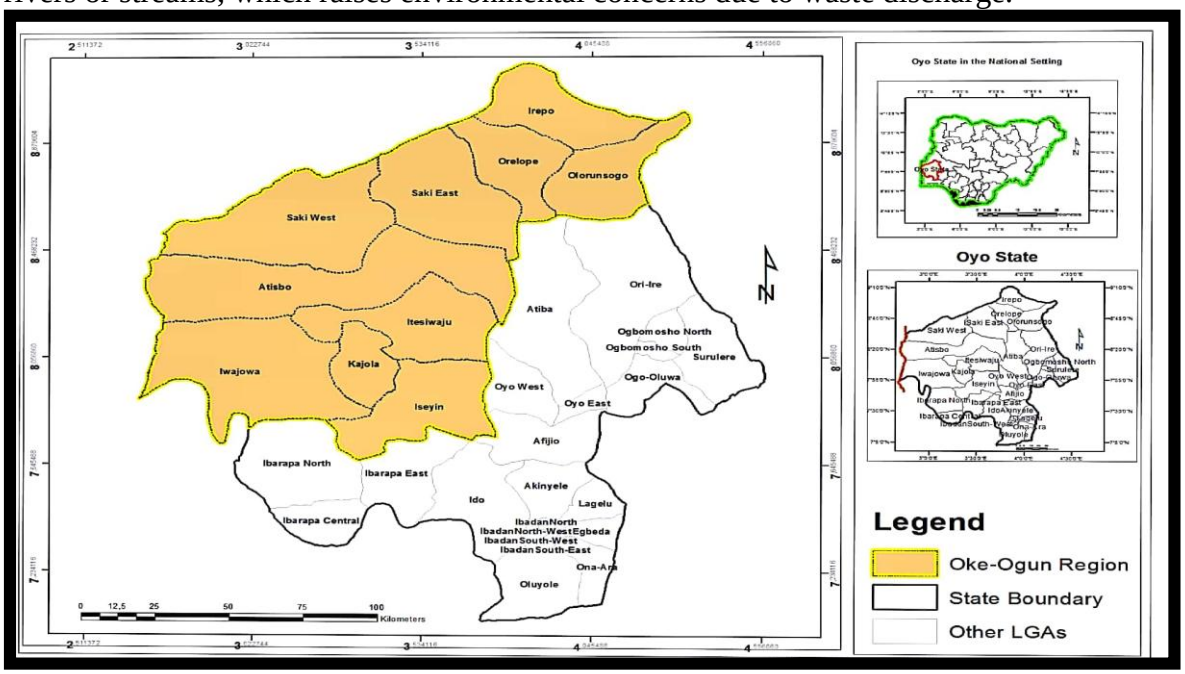

Figure 1: Oke-Ogun region in the Oyo state context
Source: Iseyin Zonal Town Planning Office, 2018.

4. Methodology

This study adopted a mixed-methods approach. A multi-stage random sampling technique was used to select 300 cassava processors from five LGAs (Atisbo, Iseyin, Itesiwaju, Iwajowa, Kajola). Quantitative data were collected on the volume of cassava tubers processed, volume of waste (solid and liquid) generated, and the effect of cassava wastes on food security in the region. Qualitative data were also collected using focus group discussions and field observations. Quantitative data were analyzed using descriptive statistics, samples of water collected from all the locations were analyzed using Standard methods for the examination of water and wastewater (APHA, 23rd edition) and HACH methods of analysis of water (12th edition) – (APHA, AWWA, & WEF. (2017), while qualitative data from FGDs were thematically coded. The various locations where water samples were collected for analysis include Elekan Village (Iwajowa LGA), Agunrege (Atisbo LGA), Ipapo (Itesiwaju LGA), Oja Agbe and Barracks areas, Iseyin (Iseyin LGA) and Okeho (Kajola LGA) (see Figure 4). Laboratory analysis followed APHA standard methods to assess pH, heavy metals, nitrates, cyanide, and microbial content of cassava effluents.

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5. Results of Findings

5.1 Volume of Cassava Processed

Between 2008 and 2020, the Oke-Ogun region produced and processed approximately 16,172,898 MT of cassava (Oyo State Ministry of Agriculture, 2021). Among the LGAs, Iseyin recorded the highest production with over 2.4 million MT, while Olorunsogo produced the least at 601,954 MT. The high volume of cassava processing demonstrates the region's role as a food basket but also underscores the growing magnitude of waste generation. The study revealed that 1,617,289.8 kg of solid waste and 1,660.46 MT of liquid waste were generated within the period. This trend highlights the dual role of cassava processing: a source of food and income, and simultaneously, a major source of environmental concern.

5.2 Types of Waste Generated

Both solid (cassava peels, sievates) and liquid wastes were generated, as shown in Table 1.

Table 1. Types of Waste Generated

Response	Frequency	Percentage
Solid and liquid wastes	185	61.7
Liquid waste	95	31.7
Solid wastes	20	6.6
Total	**300**	**100.0**

Source: Field work, 2021

5.3 Chemical Contents of the Wastes

In Table 2, Laboratory analysis revealed acidic effluents with high cyanide and heavy metal concentrations. It shows that the pH had a mean of 4.25, standard deviation was 0.53, minimum value of 3.50 and maximum of 4.84. The colour had a mean of 486Pt-Co, standard deviation of 37.42Pt-Co, minimum and maximum values of 401.00Pt-Co and 500.00Pt-Co; total acidity had minimum and maximum values of 35.00mg/L and 9900.00mg/L; Nitrate had minimum and maximum values of 0.01mg/L and 75.00mg/L; Lead had a mean of 0.02mg/L, standard deviation of 0.03mg/L; minimum and maximum values of 0.01mg/L and 0.08mg/L respectively. Also in Table 6.4, Cadmium had a value of 0.05mg/L, standard deviation of 0.05mg/L, minimum value of 0.01mg/L and maximum value of 0.13mg/L; total Cyanide with a mean of 35.9mg/L, standard deviation of 23.24mg/L, minimum value of 0.01mg/L and maximum value of 56.80mg/L; and Faecal coliform (E. coli) with a minimum value of 0.00CFU/mL and maximum value of 120.00CFU/mL.

Table 2: Descriptive Statistics of Waste Water Samples from all the Locations

PARAMETER/UNIT	Mean	SD	Min	Max
pH @ 25.0oC	4.25	0.53	3.50	4.84
Colour, Pt-Co	486	37.42	401.00	500.00
Total acidity, mg/L	6689	4288.37	35.00	9900.00
Nitrate, mg/L	14.0	27.18	0.01	75.00
Lead, mg/L	0.02	0.03	0.01	0.08
Cadmium, mg/L	0.05	0.05	0.01	0.13
Total cyanide, mg/L	35.9	23.24	0.01	56.80
Faecal coliform (E.coli), CFU/mL	29	45.12	0.00	120.00

Source: Field work, 2021

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5.4 Waste Management Strategies

Cassava processors employed various strategies, including selling peels and discharging liquid waste into pits. From the analysis in Figure 2, the 6 cassava wastes management strategies employed by the cassava processors in the Oke-Ogun region were revealed.33.7% of the respondents submitted that they sold their solid wastes in dry forms; this was followed by those (27.3%) who trapped their liquid waste in a pit and only 1.7% of the respondents gave their solid wastes as gifts. It could be inferred from this analysis how valuable the solid and liquid wastes were to the respondents. The finding was in line with Olukanni and Olatunji' (2018) submission that solid waste management is the most pressing environmental challenge faced by urban and rural areas of Nigeria.

5.5 Environmental Effects

Observations at the various cassava processing industry sites in the 5 selected LGAs revealed that the colour, taste and odour of the water changed after cassava effluent had been discharged into or diffused with it. This is an indication of pollution. In addition, the creation of eye-sore by the cassava peeling dumps affected the environmental quality. Findings revealed that as cassava processing industries in the region were meeting the food demand of residents, so are the number of processors increasing daily. Therefore, an increase in the number of cassava processing industries in the region implies a definite increase in the liquid and solid wastes expected to be generated. Thus, findings revealed pollution of water bodies and loss of fertile farmland.

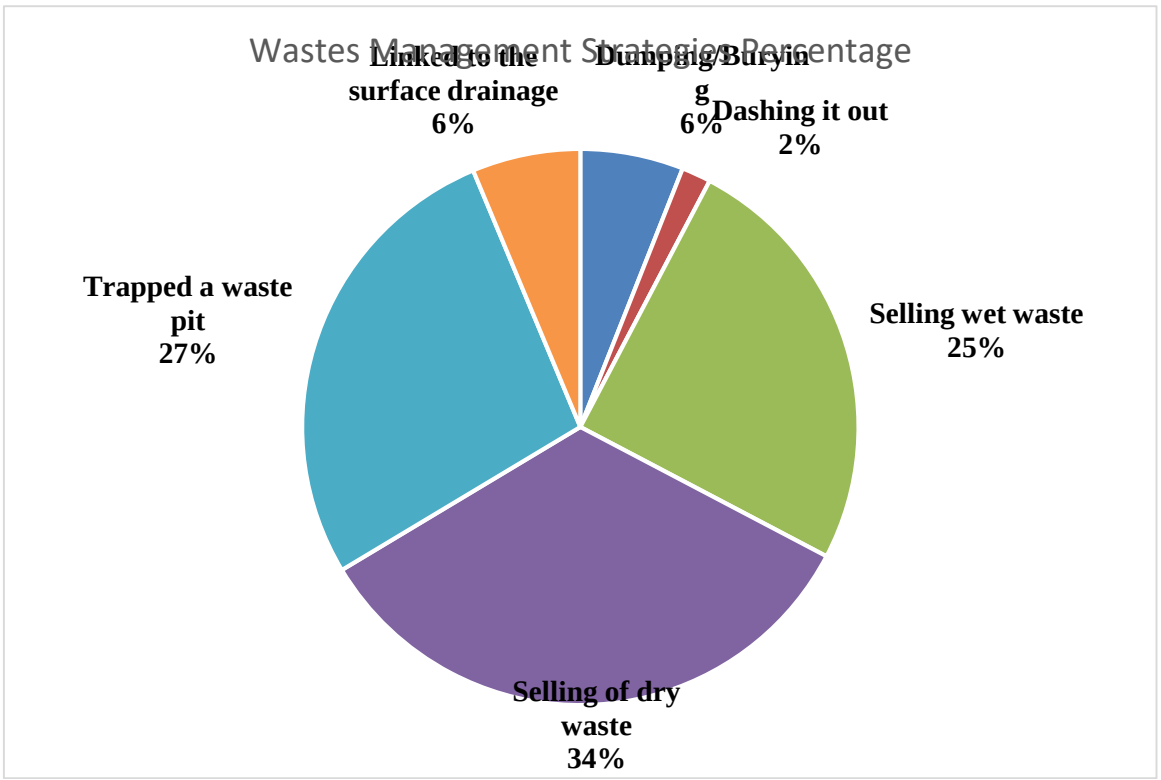

Figure 2: Pie Chart showing Wastes Management Strategies

Source: Field work, 2021

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5.6 Implications for Food Security

As depicted in Table 5, 19.7% of the respondents claimed that poor management of the cassava processing wastes, had led to loss of fertile farmland. Similarly, the discussion with FGD participants established that "Any plant that is in contact with the cassava liquid waste (effluent) will no more be healthy". Therefore, fertile lands that are supposed to be used for farming were lost to this activity thereby challenging food security in the region. Other respondents (11.1%) submitted that that cassava wastes (liquid or solid) had negative effects on the environment. Some of the negative effects revealed by observation and respondents include: foul smell, promotes breeding of mosquitoes, attracts rodents and contaminated streams/wells that were nearby the processing sites. Therefore, it could be inferred from the various findings on the effect of cassava processing industrial wastes (solid and liquid) on the environment in Oke-Ogun region that the magnitude of the environmental effect is determined by many factors such as: scales of cassava processing; processing method; type of products; knowledge about the waste; and size of land occupied by the industry.

Table 5: The Effect of Cassava Wastes on Food Security in the Region

Use	**Frequency**	**Percentage**
Source of income	123	41.0
Feeding of livestock	85	28.2
Loss of fertile farmland	59	19.7
Other effects	33	11.1
Total	300	100.0

Source: Field work, 2021

6. Discussion

Findings demonstrate that while cassava processing contributes to food availability and income generation, waste mismanagement undermines environmental quality and long-term food security. Solid wastes such as peels are often discarded or left to rot, while liquid effluents are discharged untreated into streams and farmlands. These practices result in soil acidification, reduced crop yields, and contamination of surface water (Eze & Onyilide, 2015). Compared to Thailand, where waste-to-resource technologies such as biogas plants and feed conversion systems are widely adopted (Piyachomkwan & Tanticharoen, 2011), Nigeria lags significantly in implementing sustainable models. The discussion also reveals that food security is

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compromised in four dimensions: availability, access, utilization, and stability. Although cassava peels provide cheap feed for over 22,000 livestock in the study area, indiscriminate waste disposal has led to the loss of fertile farmland, which reduces long-term food production capacity. Furthermore, untreated effluents promote mosquito breeding and health risks, which indirectly affect community productivity and food access.

These findings corroborate earlier studies by Olukanni & Olatunji (2018), who identified cassava effluents as a significant source of groundwater pollution in Ogun State, and by Omilani, Abass & Okoruwa (2015), who demonstrated the economic losses associated with poor waste management among cassava processors in Nigeria. Similarly, Oyewole & Eforuoku (2019) emphasize that despite opportunities for value addition, most rural processors lack the technical knowledge and resources to harness cassava wastes productively. Zhang et al. (2016) also show that a biorefinery approach to cassava waste in Asia transforms risks into opportunities, underscoring that Nigeria's situation is not unique but a missed opportunity. Collectively, these corroborations highlight the urgent need for context-specific interventions that align local practices with global sustainability standards. Addressing these issues requires not only technical interventions but also robust policy frameworks, stronger environmental enforcement, and grassroots awareness. Ultimately, sustainable cassava waste management represents both an environmental necessity and an opportunity for rural economic transformation in Nigeria.

7. Conclusion

Cassava waste management in Oke-Ogun remains unsustainable, with direct consequences for food security. Solid and liquid wastes, if properly managed, could serve as inputs for animal feed, biogas, and organic fertilizer. Failure to implement sustainable strategies risks worsening soil infertility, water pollution, and food insecurity.

8. Recommendations

1. Enforce environmental regulations requiring cassava industries to treat effluents before disposal.
2. Promote value addition through biogas and animal feed industries.
3. Establish designated industrial layouts with waste treatment facilities.
4. Provide capacity building and awareness campaigns for processors.
5. Encourage inter-sectoral collaboration among ministries, NGOs, and local governments.

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