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Shifting Cultivation and Mixed Cropping: Implications for Sustainable Forest Resource Management in Boki Local Government Area, Cross River State, Nigeria.

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Abstract
This study examined the impact of shifting cultivation and mixed cropping on sustainable forest resource management in Boki Local Government Area, Cross River State, Nigeria. To achieve this objective, two research hypotheses were formulated. The study adopted a survey research design, involving 291 registered farmers. Data were collected using a structured questionnaire titled Shifting Cultivation, Mixed Cropping, and Sustainable Forest Resource Management Questionnaire. The instrument's face and content validity were assessed by an expert, and its reliability was established using the Cronbach Alpha method, yielding coefficients ranging from 0.75 to 0.89. Regression analysis was employed to test the hypotheses at a 0.05 level of significance. Findings revealed that shifting cultivation and mixed cropping significantly influence sustainable forest resource management. Based on these findings, it was recommended that both micro- and macro-level government efforts focus on enhancing climate change mitigation and adaptation strategies. This includes making such strategies more affordable, accessible, and user-friendly through extension education on the sustainable application of relevant technologies.

Keywords: Shifting Cultivation, Mixed Cropping, Sustainable Forest Management, Land Use Practices, Agricultural Sustainability, Deforestation, Soil Fertility, Biodiversity Conservation, Community Participation.

Introduction and Background
Sustainable forest resource management balances agricultural needs with environmental conservation by minimizing deforestation, enhancing soil fertility, and maintaining biodiversity. In Boki Local Government Area, Cross River State, forests provide critical ecosystem services such as carbon sequestration, watershed protection, and wildlife habitat. However, shifting cultivation and mixed cropping, the dominant farming practices in the region, pose both opportunities and challenges for forest sustainability.

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Shifting cultivation involves clearing forested land, cultivating it briefly, and allowing natural regeneration, while mixed cropping enhances land productivity by growing multiple crops on the same plot. Although these methods support food security and livelihoods, their expansion has raised concerns about deforestation, biodiversity loss, and soil degradation. However, when properly managed, they can promote environmental sustainability by reducing land pressure and improving soil fertility.

Boki's economy heavily relies on agriculture, with generations of farmers practicing these traditional methods. However, increasing population pressure, climate change, and economic demands have intensified land use, threatening forest resources. Eneji, Mubi, Husain & Ogar, (2015) report that forest resources in Cross River State are exploited unsustainably, often without conservation efforts. Historically, local institutions such as kinship networks and town unions helped regulate forest use, but modern pressures have weakened these traditional controls.

Participatory resource management is now recognized as a viable solution to balancing conservation and agricultural needs. Engaging local communities in forest management ensures long-term sustainability and equitable resource use Akalibey, Hlaváčková, Schneider, Fialová, Darkwah & Ahenkan, 2024). This study explores the implications of shifting cultivation and mixed cropping for sustainable forest resource management in Boki, providing insights for policymakers and stakeholders.

Intercropping, the practice of growing multiple crops on the same land in a single season, enhances soil faunal activity, improves soil fertility, and promotes sustainable agriculture. Shifting cultivation, a traditional farming method still widely practiced in Cross River State, involves clearing a plot of land, cultivating it for a few years, and allowing it to regenerate while farmers move to a new plot. This method has been deeply rooted in the customs and beliefs of the people of Boki.

Historically, shifting cultivation was practiced with primitive tools and relied on the natural restorative properties of vegetation. Farmers would partially clear the land, slash and burn vegetation to release nutrients, and practice short-term intercropping. According to Marambanyika, (2022), this system allowed land to regain fertility naturally before being reused. However, modern pressures such as population growth and increased agricultural demand have led to excessive land clearing, reducing fallow periods and negatively impacting soil quality. Veste, Sheppard, Abdulai, Ayisi, Borrass, Chirwa... and Kahle, (2024) note that

when shifting cultivation is practiced with adequate fallow periods, soil nutrients are replenished, making it an environmentally sustainable practice.

Despite its benefits, shifting cultivation has been criticized for contributing to deforestation. Cairns (2015) report that shifting cultivation accounts for 50-75% of the 17 million hectares of forest destroyed annually. Ogar, (2023) found that 70% of rainforest resources in Cross River State are lost yearly due to logging, fuelwood demand, and unsustainable farming practices. Over time, land degradation has forced farmers to adopt irrigation, which, when mismanaged, leads to soil salinization and nutrient depletion (Gomiero, 2016).

A shift towards sustainable forest management is crucial. Cairns (2015) emphasizes the importance of conservation-oriented farming, including composting instead of burning biomass. Sinclair, Wezel, Mbow, Chomba, Robiglio and Harrison (2019) argue that shifting cultivation is sustainable when fallow periods are adequate, but shortened cycles lead to soil depletion and forest loss. Dawson, Coolsaet, Sterling, Loveridge, Gross-Camp, Wongbusarakum, and Rosado-May (2021) highlights the role of traditional conservation practices in promoting environmental sustainability, emphasizing the need for policies that integrate indigenous knowledge with modern strategies.

To ensure long-term forest resource sustainability in Boki, policymakers must promote adaptive agricultural practices, conservation efforts, and community engagement in forest management.

Mixed cropping and sustainability forest resources management

Mixed cropping involves cultivating multiple crops on the same land during the growing season without a specific planting sequence. This practice mimics natural biodiversity and is commonly used by small-scale farmers in Nigeria, who grow crops like cassava, maize, okra, cocoyam, beans, yam, and sorghum. According to the Ezeaku, Mbah, Baiyeri and Okechukwu, (2015), mixed cropping integrates crop farming with livestock rearing, increasing income and yield while optimizing land and labor use throughout the year.

Kassam, Kueneman, Lott, Friedrich, Lutaladio, Norman and Mkomwa (2019) note that mixed cropping provides economic stability by ensuring year-round farming. It allows farmers to feed their livestock with farm products, reducing reliance on market prices. Additionally, farmyard manure enriches the soil, while crop residues, such as groundnut haulms and cowpea tops, serve as livestock feed (Babubhai, (2020). Asante, Villano, Patrick, Battese (2018) adds that livestock in mixed farming systems provide manure, transportation, and labor for plowing.

Gulwa, Mgujulwa and Beyene (2018) acknowledges that farms combining livestock and crops benefit from nitrogen-fixing forage grasses, improving soil fertility. Bhattacharyya, Ros, Furtak, Iqbal and Parra-Saldívar (2022) highlight the role of soil organisms in breaking down organic matter, leading to higher crop yields. Sileshi, Mafongoya and Nath (2020) emphasizes that mixed cropping maintains soil fertility by recycling nutrients and rotating crops with legumes and trees.

This system also supports biodiversity and minimizes soil erosion. Ijaz, Nawaz, Ul-Allah, Rizwan, Ullah, Hussain and Ahmad (2019) argue that mixed cropping reduces climate and market risks compared to monoculture. Adegbeye, Salem, Reddy, Elghandour and Oyebamiji (2020) highlights its role in waste recycling, as animal dung is used as fertilizer. Additionally, mixed farming can include integrated systems, such as fish farming with chicken manure or swamp rice-fish production, where fish contribute to pest control (Nayak, Nayak & Panda, 2021).

Overall, mixed cropping is a sustainable agricultural practice that enhances soil health, optimizes resources, and reduces environmental risks.
Eneji, Ogundu and Ojelade, (2019) examined the impact of rural and urban dwellers' wildlife consumption on biodiversity conservation in Calabar (urban) and Bekwarra (rural). Using a questionnaire survey of 530 respondents, data were analyzed with chi-square, correlation, t-test, and ANOVA. Results showed that rural dwellers' consumption patterns significantly affect biodiversity conservation due to factors like taste, cost, accessibility, and alternatives. The study proposed recommendations to manage wildlife consumption for conservation.

Statement of the Problem

Shifting cultivation and mixed cropping are traditional agricultural practices widely used in Boki Local Government Area, Cross River State, Nigeria. While these methods have historically supported food security and rural livelihoods, their impact on sustainable forest resource management remains a concern. Shifting cultivation, which involves periodic land clearing and fallowing, contributes to deforestation, soil degradation, and biodiversity loss. Similarly, mixed cropping, although beneficial for soil fertility and crop diversification, can exert pressure on forest resources when poorly managed.

Despite conservation efforts and government policies aimed at promoting sustainable land-use practices, forest degradation continues to threaten ecological stability in the region. The tension between agricultural expansion and forest conservation raises critical questions about the long-term viability of these traditional farming practices. This study seeks to examine the

implications of shifting cultivation and mixed cropping on sustainable forest resource management in Boki, providing insights into how these practices can be adapted to balance agricultural productivity with environmental conservation.

Purpose of the study

1. To examine the extent to which shifting cultivation contribute to sustainable forest resources management.
2. To find out the extent to which mixed cropping contribute to sustainable forest resources management.

Research Hypotheses

1. Shifting cultivation does not significantly contribute to sustainable forest resources management.
2. Mixed cropping does not significantly contribute to sustainable forest resources management.

Methodology

This study employed a survey research design to examine conservation practices and sustainable forest resource management in Boki Local Government Area (LGA), Cross River State, Nigeria. Boki LGA, a landlocked region bordering Cameroon, is known for its agricultural trade and rugged terrain, largely covered by the Cross River rainforest and Afi Mountain Ranch. Its fertile soil supports extensive farming, making it a key agricultural hub in the state.

The study targeted 2,907 registered farmers, as recorded by the Ministry of Agriculture, Planning, Research, and Statistics (2021). A sample of 291 farmers (10%) was selected through purposive and accidental sampling. A structured questionnaire, Conservation Practices and Sustainable Forest Resources Management (CPSRM), was used for data collection. It comprised three sections: demographic data, conservation practices (20 items), and sustainable forest resource management (10 items), with responses measured on a modified Likert scale.

Face validity was ensured through expert review, while reliability was assessed using Cronbach's Alpha, yielding coefficients between 0.79 and 0.80. The researcher and assistants personally administered the questionnaires, and data were analyzed using simple regression analysis.

Presentation of result

Ho_1

Shifting cultivation does not significantly influence sustainable forest resources management.

The independent variable in this hypothesis is shifting cultivation; while the dependent variable is sustainable resources management. Simple regression analysis was the statistical tool employed to test this hypothesis. The result of the analysis is presented in Table 1.

Table 1: Simple regression result of the influence of shifting cultivation on sustainable resources management

Model	Sum of Square	df	Mean square	F-ratio	p-level	R	R^2
Regression	262.639	1	262.639	89.618	.000	.372	.138
Residual	1635.297	289	2.931				
Total	1897.936	290					

* Significant at .05 level

The simple regression analysis of the influence of shifting cultivation on the sustainable resources management produced an adjusted R^2 of .137. This indicate that the Shifting cultivations account for 13.7% of the determinant sustainable resources management in the study area. This finding is a critical indication that Shifting cultivations are relatively high in the area of the study. The F-value of the Analysis of Variance (ANOVA) obtained from the regression table was F = 89.618 and the sig. value of .000 (or $p<.05$) at the degree of freedom (df) 1 and 289. The implication of this result is that shifting cultivation is a significant predictor of sustainable resources management.

Ho_2

Mixed farming does not significantly influence sustainable resources management. The independent variable in this hypothesis is mixed farming; while the dependent variable is sustainable resources management. Simple regression analysis was employed to test this hypothesis. The result of the analysis is presented in Table 2.

Table 2: Summary of Simple regression analysis of mixed farming and sustainable resources management

Model	Sum of Square	df	Mean square	F-ratio	p-level	R	R^2
Regression	1197.609	1	1197.609	954.221	.000	.794	.631
Residual	700.326	289	1.255				
Total	1897.936	290					

* Significant at .05 level

The simple regression analysis of the influence of Mixed farming on the sustainable forest resources management produced an adjusted R^2 of .630. This indicated that the Mixed farming accounted for 63.0% of the determinant sustainable resources management in the study area. This finding is a critical indication that Mixed farming is relatively high in the area of the study. The F-value of the Analysis of Variance (ANOVA) obtained from the regression table was F = 954.221 and the sig. value of .000 (or $p<.05$) at the degree of freedom (df) 1 and 289. The implication of this result is that Mixed farming is significant predictor of sustainable resources management.

Shifting Cultivation and Sustainable Resource Management

The results of the study indicate that shifting cultivation significantly influences sustainable resource management. This finding aligns with Kustermann, Christian, and Hulsberge (2010), who noted that farmers practicing shifting cultivation move to new plots when soil fertility declines, allowing the previous land to regenerate naturally. The study also agrees with Marambanyika, (2022) who highlighted that extended fallow periods enable deeper plant roots to recover lost nutrients, promoting soil rejuvenation. This finding also supports the view of Sinclair et al (2019) who stated that shifting cultivation can be environmentally friendly by facilitating soil recovery.

The extensive clearing of forests for agriculture accelerates deforestation, leading to biodiversity loss, desertification, and increased carbon emissions. Uncontrolled bushfires, often associated with shifting cultivation, further degrade forest ecosystems. When fallow periods are too short, soil fertility depletes rapidly, making land unsuitable for continuous cropping.

Mixed Farming and Sustainable Forest Resource Management

The study also found that mixed farming significantly influences sustainable resource management. This finding aligns with Akalibey et al (2024) who noted that integrating crop and livestock farming enhances economic sustainability. Farmers can use crop residues as livestock feed while manure enriches soil fertility. The findings agree with Bhattacharyya et

al (2022) who observed that farmyard manure improves soil health and supports sustainable agriculture. In some communities, livestock also provide labor and transportation.

The findings of this hypothesis align with Gulwa, Mgujulwa and Beyene (2018) who emphasized that farms with both livestock and crops maintain soil fertility by incorporating nitrogen-fixing plants, benefiting future yields. Kassam et al., (2019) affirmed that mixed farming preserves soil biodiversity, reduces erosion, and ensures sustainable land use through crop rotation and fallowing. Helga, Julia, and Robert (2013) highlighted how mixed farming maximizes resource efficiency, with crop residues enriching soil and livestock waste reducing chemical dependency.

Mixed farming supports sustainability by optimizing available space and resources. Grain-legume associations improve soil nitrogen levels, while intercropping maximizes light, moisture, and nutrient use. Integrated systems, such as fish-chicken or fish-rice farming, create synergies that enhance productivity while reducing environmental degradation. However, improper management of mixed cropping can negatively impact resource sustainability. Thus, careful implementation is necessary to balance productivity with environmental conservation.

Conclusion

Based on the results of the study it was concluded that conservation practices use in this study vis-a-vis shifting cultivation, mixed farming, impact considerably on sustainable resources management.

Recommendations

On the basis of the findings of this study, the following recommendations were made:

1. Men and women should continue to participate in the shifting conservation practices that are carried out in the locality.
2. Mixed cropping should be carefully practices in order not to interfere with sustainability resources management.

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