Transdisciplianry Journal of Education and Sustainable Development Studies, *Vol. 1, No. 1, April 2025*
A publication of the Department of Education Geography & Sustainable Development Studies, ISSN: 1595-8051
University of Calabar, Nigeria.

Agroforestry and Afforestation: Enhancing Sustainable Forest Resource Management in Boki Local Government Area, Cross River State, Nigeria.

By
Agomobi, Magdalene Dikpen
Email:magdaleneodu794@gmail.com
Department of Education Geography & sustainable Development studies, University of Calabar, Nigeria

Ambe, B. A., PhD.
Email: benjamin.a.ambe@unical.edu.ng
Department of Environmental education, University of Calabar, Nigeria

Abstract
This study examined the role of agroforestry and afforestation in enhancing 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 *agroforestry,* afforestation and Sustainable Forest Resource Management Questionnaire (CEPSFRMQ). The instrument's face and content validity were assessed by experts, 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 agroforestry and afforestation practices 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: Agroforestry, Afforestation, Sustainable Forest Management, Conservation Practices, Land Use.

Introduction and background
The utilization of forest resources has become a global issue, sparking discussions on sustainable management practices. Human activities, such as over-exploitation, ecosystem destruction, and pollution, have significantly impacted forests. In Cross River State, unsustainable exploitation of forest resources threatens both biodiversity and human

existence. The challenge lies in ensuring sustainable resource use while balancing economic and social development (Mezentseva, Baysaeva & Fayzullaev, 2024).

Despite Nigeria's vast land and vegetation, forest resources are not managed sustainably. Government bodies, NGOs, and policymakers are concerned about the high rate of deforestation. Forests provide essential resources, including food, raw materials, habitat for wildlife, and climate regulation. However, deforestation and poor conservation efforts have led to biodiversity loss and environmental degradation in Nigeria, particularly in Cross River State.

Tropical rainforests are among the most biologically diverse ecosystems, hosting 50% of global biodiversity and storing significant carbon reserves (Gallery, 2014). These forests contribute to ecological stability, medicinal discoveries, and economic resources through non-timber products, logging, and ecotourism, valued at over $500 billion annually. Despite their importance, tropical forests worldwide, including those in Africa, face deforestation, with only 25 million hectares managed sustainably (Goodman & Herold, 2014).

Historically, Cross River State had 17 forest reserves at Nigeria’s independence, covering significant land areas. These include Afi River Forest Reserve (383.32 km2), Okwangwo Forest Reserve (468.79 km2), and Ukpon River Forest Reserve (313.39 km2) (Enuoh & Bisong, 2014). However, ongoing degradation threatens these reserves, leading to erosion, biodiversity loss, and unfavorable hydrological changes (Wassie, 2020). Neglect, underinvestment, and inadequate management have further exacerbated the situation.

Traditional farming practices, often blamed for deforestation, include bush burning, shifting cultivation, intercropping, and crop rotation (Arunrat, Kongsurakan, Solomon & Sereenonchai, 2024). These techniques, though sustainable in some contexts, contribute to forest loss when improperly managed. Bush fallowing, where land is left to regenerate before reuse, plays a crucial role in maintaining soil fertility and providing resources such as timber and medicinal plants. However, the length of the fallow period determines its effectiveness in resource regeneration.

The Nigerian government has implemented conservation measures, including forest reservations and participation in international environmental agreements such as the Convention on Biological Diversity and the UN Framework Convention on Climate Change (CCSENET, 1992) Fajemirokun, 2021). Additionally, the National Conservation Education Strategy (NCES) was adopted in 1990 to integrate environmental awareness into the

education system. Cross River State also enacted laws in 1981 to protect endangered species and regulate harmful practices such as using chemicals for fishing.

Despite these efforts, conservation remains a challenge due to weak law enforcement, institutional failures, poverty, and lack of awareness. Many rural communities rely on forest resources for survival, often overlooking sustainable practices. Scholars debate whether the issue stems from governance failures or socio-economic factors. This research aims to explore the influence of traditional farming practices on sustainable resource management in Cross River State, Nigeria.

This study is anchored on Abraham Maslow's Theory of Needs (1968), Clarkson's Anthropocentric Theory (1967), and Ajzen's Theory of Planned Behavior (1985). Its findings will benefit students, lecturers, farmers, policymakers, NGOs, and researchers by providing insights into improving forest conservation efforts in Cross River State.

Agroforestry Practice and Sustainable Forest Resource Management

Agroforestry, the integration of trees and agriculture, has been practiced for centuries, though the term was first coined in 1977. It is often described as growing trees on farms but encompasses a broader concept involving the deliberate management of trees and non-tree components to maximize ecological and economic benefits. Agroforestry plays a critical role in environmental protection, offering ecosystem services that support soil conservation, climate mitigation, and biodiversity.

The impact of agroforestry on the environment occurs at multiple levels, ranging from soil structure enhancement to broader regional and global benefits. In both tropical and temperate climates, agroforestry systems are designed to counteract soil erosion and degradation while improving soil quality and health. This approach is widely advocated for its ability to enhance agricultural sustainability, offering a viable alternative to conventional farming systems. Scholars such as Udawatta, Rankoth and Jose (2019) argue that agroforestry improves agricultural productivity, increases biodiversity, and mitigates environmental degradation. It diversifies agricultural production systems, reduces pollution, and enhances rural development by integrating sustainable land management practices.

Agroforestry contributes significantly to sustainable resource management through its environmental, economic, and social functions. It enhances soil productivity while conserving natural resources, making it a key strategy for sustainable agricultural development. However, rapid population growth has increased pressure on forestlands and agricultural land, leading to unsustainable resource exploitation. As a sustainable land management system,

agroforestry has the potential to address these challenges by improving ecological stability and promoting long-term agricultural productivity (Wilson & Lovell, 2016).

Empirical studies have examined the impact of agroforestry on sustainable agriculture. Okoro, Etuk, and Akpan (2016) studied sustainable agricultural practices in Ibesikpo Asutan Local Government Area of Akwa Ibom State, Nigeria. Their study, based on a sample of 120 farmers, found that mixed cropping and organic manure application were the most widely used sustainable agricultural practices. However, overall utilization of sustainable agricultural methods was low. The study also revealed significant relationships between household size, educational status, and knowledge levels in the adoption of sustainable practices. It recommended targeted policies and extension services to improve awareness and adoption of sustainable agriculture.

Akinwalere (2017) examined the benefits of agroforestry in South West Nigeria, finding that agroforestry adoption was growing, with significant environmental and economic benefits. The study, which surveyed 200 agroforestry farmers, found that farmers' income increased from $1462.89 to $2131.82 after adopting agroforestry practices. Factors such as education, social networks, and environmental awareness influenced the adoption and sustainability of agroforestry systems. The study emphasized the need for enhanced extension services to further promote agroforestry.

Similarly, Okonkwo (2010) investigated agroforestry practices in Katsina State, assessing initiatives by international organizations, the Nigerian government, and local farmers. The study revealed that only 23% of sampled farmers practiced agroforestry, with predominant systems including windbreaks, woodlots, and multipurpose trees on croplands. The study underscored the need for increased education and incentives to promote agroforestry adoption.

Overall, agroforestry represents a sustainable approach to land management, enhancing agricultural productivity while preserving environmental integrity. Increased awareness, supportive policies, and investment in research are crucial to expanding its adoption and ensuring long-term sustainability.

Afforestation Practice and Sustainable Forest Resource Management

Afforestation plays a critical role in controlling erosion and maintaining soil stability. Tree roots help bind the soil, reducing surface runoff and preventing landslides. According to Montalvo, Riordan and Beyers, (2018), up to 85% of a plant's weight is in its roots, which

anchor the soil effectively. Certain tree species, such as California live oak (*Quercus agrifolia*) and California holly (*Heteromeles arbutifolia*), are particularly effective for erosion control.

A study by Chikwue, Richard-Ehiri, Nwakuba and Okafor, (2023) on erosion management in Owerri, Nigeria, highlights the importance of preventive measures over post-disaster responses. Using remote sensing and Geographic Information System (GIS) technology, the study identified improper waste disposal, unplanned structural development, and high rainfall as key contributors to erosion and flooding. The findings suggest that geo-information technology can aid in better urban planning and disaster management.

Erosion remains a serious threat in Nigeria, displacing communities and damaging infrastructure. The 2012 floods submerged farmlands and displaced 1.3 million people, claiming 431 lives. Afforestation has been widely adopted in highland regions to mitigate such disasters. However, Prescott, Frouz, Grayston, Quideau and Straker, (2019) note that while forests enhance soil infiltration and base flow, afforestation activities, such as soil disturbance by heavy machinery, may initially hinder infiltration and increase runoff. Over time, however, forest soils can regenerate, improving water retention and ecological stability. Thus, afforestation remains a sustainable strategy for erosion control and forest resource management, provided it is implemented with careful consideration of soil conservation techniques.

Statement of the Problem

The rapid exploitation of forest resources in Cross River State has raised significant concerns about sustainable resource management. With approximately 65% of the population depending on agriculture, fishing, and environmental resource marketing, deforestation, bush burning, and continuous cropping have led to severe vegetation depletion over the past five decades, contributing to environmental degradation.

Traditional farming practices such as shifting cultivation, intercropping, and soil tillage have historically supported sustainable resource management by optimizing land use and preserving endemic crop varieties. However, ongoing forest degradation highlights the conflict between conservation efforts and the livelihood needs of local communities.

In response, the Nigerian government has introduced conservation initiatives, including watershed projects, reforestation programs, and regulatory policies. Additionally, Nigeria is a signatory to international environmental agreements such as the Convention on Biodiversity and the Convention on Desertification. Despite these interventions, forest exploitation

persists, driven largely by widespread unemployment, which forces many individuals to rely on resource extraction for survival.

Given these challenges, this study seeks to examine the impact of traditional farming practices on forest resource conservation in Cross River State. By assessing the relationship between agricultural livelihoods and environmental sustainability, the research will provide empirical insights into strategies for balancing economic survival with the need for sustainable forest management.

Purpose of the study

The purpose of the study is to examine the conservation practices and Sustainable Forest Resources Management in Boki Local Government Area of Cross River State, Nigeria. The study specifically seeks to:

1. Ascertain the extent to which agro forestry practice contribute to sustainable forest resources management.
2. Investigate the extent to which afforestation practice contribute to sustainable resources management

Research hypotheses

The following hypotheses are set to guide the study:

1. There is no significant contribution of agro forestry practice on sustainable forest resources management.
2. There is no significant contribution of afforestation practice on sustainable forest resources management

Methodology

This study employed a survey research design, which was deemed suitable for examining conservation practices and sustainable forest resource management in Boki Local Government Area (LGA) of Cross River State, Nigeria. The research was conducted in Boki LGA, a region bordering the Republic of Cameroon and recognized for its thriving agricultural trade.

Boki LGA is landlocked and surrounded by five other LGAs: Obudu and Obanliku to the north, Ikom and Ogoja to the west, and Etung to the south. The area's landscape is predominantly rugged, with much of its land covered by the Cross River State rainforest, one of the last remaining rainforests in Nigeria. The Afi Mountain Ranch, occupying 60% of the

region, is largely inaccessible by road. In July 2014, mudslides led to the destruction of bridges, isolating several communities, including the local capital, Boje. The LGA consists of multiple communities such as Iso-Bendegha, Bashies, Basan-Osokom, and Nsadop. Its tropical rainforest and fertile soil make it an attractive site for agricultural investment.

As the agricultural hub of Cross River State, Boki LGA is known for producing key crops, including cassava, yam, cocoa, pineapple, oil palm, banana, and timber. The Boki people have a rich cultural heritage, evident in their distinctive traditional attire and festivals such as the New Yam Festival and Edien Festival. The region's musical traditions feature instruments like Obam, Mgbe, Ata, Obon, and Bekarim.

The study population included 2,907 registered farmers, based on records from the Ministry of Agriculture, Planning, Research, and Statistics (2021). A sample of 291 farmers (10% of the total population) was selected through purposive and accidental sampling techniques. Purposive sampling targeted registered farmers, while accidental sampling included those encountered during the research process.

A structured questionnaire, titled *Conservation Practices and Sustainable Forest Resources Management (CPSRM)*, served as the primary data collection tool. It comprised three sections: Section A gathered demographic information, Section B featured 20 items assessing conservation practices (with each sub-variable measured by five items), and Section C included 10 items evaluating sustainable forest resource management. Responses were recorded using a modified Likert scale ranging from Strongly Agree to Strongly Disagree.

To ensure face validity, the questionnaire underwent expert review, while reliability was assessed using Cronbach's Alpha, yielding coefficients between 0.79 and 0.80. The researcher, assisted by trained personnel, personally administered the questionnaires. Data analysis was performed using simple regression analysis to test the study's hypotheses.

Results and discussions

Ho_1

Agroforestry do not significantly influence sustainable forest resources management. The independent variable in this hypothesis is Agroforestry; 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 1.

Table 1: Summary of Simple regression analysis of Agroforestry and sustainable resources management

Model	Sum of Square	df	Mean square	F-ratio	p-level	R	R^2
Regression	630.443	1	630.443	277.546	.000	.576	.332
Residual	1267.492	289	2.271				
Total	1897.936	290					

* Significant at .05 level

The simple regression analysis of the influence of Agroforestry on the sustainable resources management produced an adjusted R^2 of .331. This indicated that the Agroforestry accounted for 33.1% of the determinant sustainable resources management in the study area. This finding is a critical indication that Agroforestry 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 = 277.546 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 Agroforestry is a significant predictor of sustainable resources management.

H_{O2}

Afforestation practice does not significantly influence sustainable resources management. The independent variable in this hypothesis is afforestation practice; 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 Afforestation practice and sustainable resources management

Model	Sum of Square	df	Mean square	F-ratio	p-level	R	R^2
Regression	46.683	1	46.683	277.546	.000	.157	.025
Residual	1851.253	289	.318				
Total	1897.936	290					

* Significant at .05 level

The simple regression analysis of the influence of Afforestation practice on the sustainable resources management produced an adjusted R^2 of .023. This indicated that the Afforestation practice accounted for 2.3% of the determinant sustainable resources management in the study area. This finding is a critical indication that Afforestation practice 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 =14.071 and the sig. value of .066 (or p<.05) at the degree of freedom

(df) 1 and 289. The implication of this result is that Afforestation practiceis significant predictor of sustainable resources management.

Discussion of findings

Agroforestry and Sustainable Resource Management

The findings of this study indicate that agroforestry significantly influences sustainable resource management. This aligns with the research by Udawatta et al., (2019), which observed that tree and crop/livestock interactions can be positive, negative, or neutral. Positive interactions lead to increased resource capture and higher productivity, while negative interactions result in competition and reduced yield. In cases where no direct interactions occur, the net effect remains neutral. Trees play a vital role in modifying microclimatic conditions, such as temperature regulation, water vapor content, and wind speed, which can benefit crop growth and livestock welfare. Wind speed reduction, extending up to 30 times the height of tree belts, minimizes soil erosion, enhances crop growth rates, and improves soil moisture management.

The finding also agrees with Wilson and Lovell (2016) who noted that agroforestry encompasses various land-use systems in which trees are deliberately integrated with crops and livestock. One of its key benefits is soil conservation. The presence of woody perennials in agroforestry systems enhances soil quality through erosion control, organic matter maintenance, nitrogen fixation, and improved soil structure. These factors collectively promote efficient nutrient cycling and prevent nutrient loss due to leaching. Despite Nigeria's vast land and forest resources, unsustainable land use practices have led to widespread deforestation and land degradation.

However, growing awareness of rapid deforestation and resource depletion has emphasized the need for sustainable management. The primary drivers of forest depletion in Nigeria include the demand for agricultural land, shifting cultivation, and urbanization. Agriculture, forestry, and urban development are the three dominant land uses, contributing to environmental degradation and limiting available farmland. Consequently, farmers have been confined to continuous cropping on the same land, leading to declining soil fertility and crop yields. Agroforestry has emerged as a viable solution to these challenges, offering long-term environmental and economic benefits.

Agroforestry reduces deforestation-related emissions and promotes sustainable land management. It plays a crucial role in improving soil fertility, conserving biodiversity, and stabilizing agricultural productivity. Trees provide multiple ecosystem services, including

shelter for livestock, shade, and natural windbreaks. Chickens and pigs, which naturally prefer forested habitats, benefit from agroforestry environments as they offer protection from predators and support natural behaviors. Poultry manure has also been found to enhance tree growth and nutrient content.

The environmental benefits of agroforestry extend from soil preservation at the local level to global-scale climate mitigation. Tree roots enhance water infiltration, reducing surface runoff and soil erosion while improving moisture retention. The integration of trees into agricultural systems thus strengthens environmental resilience, making agroforestry a critical strategy for sustainable land use and resource management.

Afforestation Practices and Sustainable Resource Management

The findings of the second hypothesis indicate that afforestation significantly influences sustainable resource management. This aligns with Prescott et al, (2019), who observed that inadequate drainage systems contribute to environmental degradation. Effective flood mitigation requires properly designed water drainage facilities, including culverts and detention basins. However, ecological funds are often mismanaged, limiting the government's ability to address flood-related issues. Private sector participation in environmental protection is therefore crucial.

The finding equally agrees with Chikwue et al (2023) who highlighted the role of vegetation in erosion control, noting that taller, denser plants provide greater resistance to water flow. Vegetation reduces water velocity, minimizing shear stress on riverbanks while promoting sediment deposition for soil stabilization. However, mobilized woody debris can also contribute to erosion when transported by floods. Changes in channel patterns, such as those observed along the Squamish River in British Columbia, often result from the removal of woody debris, which alters river flow and increases erosion risks.

Afforestation can reduce soil erosion, particularly in marginal lands prone to degradation. Perennial grasses and woody biomass plantations enhance soil structure, increase organic matter, and improve moisture retention, reducing runoff and sediment loss. Shelterbelts further minimize wind erosion while improving soil fertility in adjacent areas. However, improper afforestation practices, such as excessive land clearing and use of heavy machinery, can disrupt soil infiltration, leading to increased runoff. Long-term forest regeneration can restore infiltration capacity, ultimately enhancing water retention and reducing land degradation.

Conclusion

Based on the results of the study it was concluded that conservation practices use in this study agroforestry and afforestation impact considerably on sustainable resources management.

Recommendations

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

1. Agroforestry should therefore be seen as a system that addresses the declining quality of the environment, including the soil, while also increasing the variety of produce by the farmer. This will not only increase the farmers' income but also help ensure food security and balance. The retention of trees in farming systems has been recognized to increase crop output in the semi-arid region.
2. Efforts should be made at both micro and macro levels of government to improve on the mitigation and adaptive strategies of climate change available to farmers by making such more affordable, available and user friendly through extension education on the appropriate uses of such technologies in a more sustainable manner.

References

Akinwalere, B.O. (2017). Determinants of Adoption of Agroforestry Practices Among Farmers in Southwest Nigeria. *Applied Tropical Agriculture*, 22, No. 2, 67-72.

Mezentseva, E., Baysaeva, M., & Fayzullaev, N. (2024). The Impact of Sustainable Development on Economic Growth: Balancing Environmental, Social and Economic Factors. *Reliability: Theory & Applications*, *19*(Si 6 (81)), 1269-1274.

Gallery, R. E. (2014). Ecology of tropical rain forests. *Ecology and the Environment*, 1-22.

Montalvo, A. M., Riordan, E. C., & Beyers, J. (2018). Plant profile for Heteromeles arbutifolia. *Native Plant Recommendations for Southern California Ecoregions*.

Okonkwo, M. C. (2010). Analysis of agroforestry practices in Katsina State, Nigeria. *A PhD thesis (unpublished) in the Department of Geography and planning faculty of Environmental science, University of Jos*.

Goodman, R., & Herold, M. (2014). Why maintaining tropical forests is essential and urgent for a stable climate. *Center for Global Development Working Paper*, (385).

Wassie, S. B. (2020). Natural resource degradation tendencies in Ethiopia: a review. *Environmental systems research*, *9*(1), 1-29.

Arunrat, N., Kongsurakan, P., Solomon, L. W., & Sereenonchai, S. (2024). Fire impacts on soil properties and implications for sustainability in rotational shifting cultivation: a review. *Agriculture*, *14*(9), 1660.

Fajemirokun, B. (2021). Making the case for reforms of forestry policy and law: Lessons and experiences from Nigeria. *Environmental Policy and Law*, *51*(5), 317-325.

Udawatta, R. P., Rankoth, L. M., & Jose, S. (2019). Agroforestry and biodiversity. *Sustainability*, *11*(10), 2879.

Wilson, M. H., & Lovell, S. T. (2016). Agroforestry—The next step in sustainable and resilient agriculture. *Sustainability*, *8*(6), 574.

Okoro, G. I., Etuk, U. R., & Akpan, E. I. (2016). Utilization of sustainable agricultural practices among crop farmers in Ibesikpo Asutan Local Government Area of Akwa Ibom State, Nigeria. *Int J Agric Ext Rural Dev Stud*, *3*(3), 52-60.

Chikwue, M. I., Richard-Ehiri, E. N., Nwakuba, N. R., & Okafor, V. C. (2023). Design of an Open Channel for Flood and Gully Erosion Control: A Case Study of Amakohia-Uratta in Imo State, Nigeria. *J. Eng. Res. Rep*, *25*(6), 10-17.

Prescott, C. E., Frouz, J., Grayston, S. J., Quideau, S. A., & Straker, J. (2019). Rehabilitating forest soils after disturbance. In *Developments in Soil Science* (Vol. 36, pp. 309-343). Elsevier.