Agroforestry, Organic Farming, and Forest Conservation in Cross River State: Exploring the Nexus

[1]**Bassey Obeten Udumo, Ph.D**
basseyobeten9@gmail.com

Osedumme Igwebuike, Ph.D
Department of Curriculum and Teaching
University of Calabar, Calabar
osedumme83@gmail.com

[1]**Oham Sunday Bassey, Ph.D**
[1]*Department of Environmental Education*
University of Calabar, Calabar

Abstract
This study is on exploring the nexus between agroforestry, organic farming, and forest conservation in Cross River State. Two research questions and hypotheses were formulated to guide the study. The population of this study consists of all 73,755 farmers in Cross River State, Nigeria that are registered under the Agricultural Development Programme across various Local Government Areas. The stratified and systematic random sampling techniques including the proportionate sampling approach were used to select 495 registered farmers with the Agricultural Development Programme in Cross River State. Agroforestry, Organic Farming and Forest Conservation Questionnaire (AOFFCQ) was used for data collection. The data were analysed with simple linear regression. The results revealed that there is a significant prediction of agroforestry on conservation of forest resources in Cross River State, and organic farming significantly predicts conservation of forest resources. Based on the findings, it was recommended, among others, that policymakers should incorporate agroforestry and organic farming practices into forest conservation policies in Cross River State.

Keywords*:* exploring nexus, agroforestry, organic farming, forest, conservation

Introduction
Human activities over the years have continued to put pressure on existing ecosystems, which have led to endangerment and extinction of various species of plant and animal. The alteration in the activities and function of ecosystems has necessitated various

stakeholders in environment to clamour for an urgent redress of certain conducts that impinge on the quality and sustainability of various ecosystems due to climate change (Anukwa, 2021). Climate change adaptive strategies may be required so that humanity can get off this trajectory of destructive climate change.

Adaptive strategy is a programme, project or approach that has been developed to respond to anticipated climate change impacts in a specific area of concern. The adaptive strategies are intended to inform and assist communities in identifying possible ways to address current and future threats resulting from the charging climate. Climate change adaptive strategies may be necessary to cope with the increasing risk coming from climate change. Adaptive strategies are not aimed at reducing or stopping climate change but at responding to climate change and limiting its negative effects.

In other words, climate change adaptation refers to the process of adjusting to the current or predicted effects of climate change; unlike mitigation strategies, which aim to prevent or reduce climate change, adaptation focuses on coping with its impacts. For humans, this means finding ways to moderate or avoid the harms caused by climate change, while also exploiting any opportunities that may arise. In natural systems, adaptation involves making gradual or transformative changes to maintain the system's integrity and essence. Ultimately, climate change adaptation is about being proactive and resilient in the face of climate change, rather than trying to prevent it from happening.

Agroforestry can take carbon dioxide out of the atmosphere and in the process reduce global warming and help in conserving the environment (Enger, 2017). Regenerative agroforestry also has great potential as a climate change adaptation solution – that means helping farmers and landowners to prepare for the impacts of climate change. For instance, agroforestry systems contribute to the health of the soil and increase biological diversity. These benefits increase farmers’ resilience and ability to cope with extreme weather events such as extreme rainfall or extreme drought (Smith, 2016). Makini (2017) found that the potentials of agroforestry systems in adaptation to expected changes in climate by smallholder farmers in the tropical regions in general and in sub-Saharan Africa in particular is enormous. Agroforestry can improve the resilience of agricultural systems and mitigate the impacts of temperature change (Elliot, 2017). The practice of integrating trees on farms can prevent environmental degradation, increase carbon sequestration and improve agricultural productivity by generating cleaner water, and support healthy soil and healthy ecosystems while providing stable incomes and other benefits to human welfare.

ISSN: 2645-324X (Print)
ISSN: 2645-3223 (Online)

The need for adaptation varies from place to place, depending on the risk to human ecological system. Adaptation is especially important in developing countries since those countries are most vulnerable to climate change. Human adaptation capacity is evenly distributed across different regions and populations and developing countries generally have less capacity to adapt. Adaptive capacity is closely linked to social and economic development (Anabaraonye et al., 2019).

Agroforestry is an agricultural practice that is seen to promote climate change adaptive strategies. Agroforestry has been identified as an environment friendly farming practice which encourages the cultivation of crops along with planting of trees. The practice of agroforestry has contributed significantly to the restoration of lost forests as well as reclaiming of degraded ecosystems (Mikan, 2018). The planting of trees through agroforestry has potential to provide vegetation cover which serves as carbon sinks. These sinks help to sequestrate carbon emissions into the atmosphere and prevent further changes in climate conditions. This can positively contribute to climate change mitigation effort, which will ensure a safe and healthy environment for humans and other living organisms. Agroforestry serves dual purposes of increasing food production and establishing forest through tree planting. The process of planting trees on the same plot of land used for cultivation encourages reforestation and in some cases afforestation. The growing of trees provides carbon sink, absorbing emissions from various human activities. This helps to regulate temperature as well as sequestrate carbon that is present in the atmosphere (Elijah, 2016).

Organic farming is a systematic approach for sustained biological diversity and climate change adaptation through production management. Minimizing energy, randomization of non-renewable resources, and carbon sequestration is a viable alternative. Wilson (2018) identifies organic practice that has potentials to contribute to climate change mitigation. The practice of organic farming involves the use of organic manure, where crop remnants from one specie is use to boost the cultivation and nutrients required by species with longer maturity period. Organic farming does not support the use of artificial fertilizer, pesticide, herbicides and other chemicals associated with other forms of farming practices. This reduces the amount of carbon released into the environment. Soil viability is usually sustained through this farming practices, thereby reducing the rate of demand for virgin land to boost crop yield. The reduction in the rate of deforestation and improvement of soil capacity to absorb carbon gives credit to organic farming. The ability to regulate rising temperature and consequences of climate change underlines the contribution of organic farming to climate change mitigation.

Okoro et al. (2016) noted that agroforestry can occur at a variety of spatial scales (for example, field or woodlot, farm, watershed) in different ecosystems and cultures. When properly applied, agroforestry can improve livelihoods through enhanced health and nutrition, increased economic growth, and strengthened environmental resilience and ecosystem sustainability. In turn, such improvements can contribute to increased social sustainability in which human needs are satisfied in a way that fosters environmental health. Farm diversification is a growing strategy for economic competitiveness, especially throughout the industrialized temperate zone, and agroforestry offers great promise for the sustainable production of specialty nut and fruit crops, high-value medicinals, dairy and beef cattle, sheep, goats, and biomass for biofuel.

Agroforestry systems also yield proven strategies for long-term carbon sequestration, soil enrichment, biodiversity and forest conservation, and air- and water-quality improvements, benefiting both the landowners, society and forest resources. Carlos (2019) remarked that agroforestry seeks to optimize positive interactions, such as mutualism and commensalism, and to minimize predation on crops and livestock and competition within and between species; stressing that positive interactions may reduce stress to plants and animals, enhance yields, retain soil, and capture water, thereby conserving forest resources. For example, the moist shaded microclimate under certain crop trees is beneficial for shade-tolerant crops such as turmeric or pineapple. Negative interactions, by contrast, can result in resource competition, more pests, excessive shading, and allelopathy (the release of biochemicals by one plant to suppress the growth of another). Black walnut and various eucalyptus trees, for example, are known to allelopathically inhibit the growth of certain annual crops planted near them

Ogunleye et al. (2018) encourage the development of technologies and farming practices that not only increase productivity, but also arrest degradation as well as reclaim, rehabilitate, restore and enhance biological diversity and monitor adverse effects on sustainable agricultural diversity. These include, inter alia, organic farming, integrated pest management, biological control, no-till agriculture, multi-cropping, intercropping, crop rotation and agricultural forestry. While several agricultural approaches make sustainability claims, organic agriculture is the only well-defined agricultural management system, including recommended and restricted practices that aim at environmental protection and food production. The decades-long implementation of organic agriculture, including inspection and certification to ensure compliance, as well as the steady growth of organic food sales in the global market, offers a living example of a viable system that reconciles forest conservation and production needs. Organic farming is a holistic production management system which promotes and enhances agro-ecosystem health, including biodiversity, biological cycles, and soil biological activity. It emphasizes the use of management practices in preference to the use of off-farm inputs, taking into account that regional conditions require locally adapted systems

This study is anchored on the Social constructive theory by Vygotsky (1978). Lev Vygotsky propounded the social constructivist theory in 1978. The author posited that social learning (knowledge) precedes individualized cognitive development within an individual. Going further, Vygotsky (1978) noted that the root of people's knowledge is sourced from the interactions with their immediate surroundings and other persons before knowledge is internalized. According to the author, humans have an inherent desire to understand and make sense of others within their social surroundings. This drive enables individuals to construct knowledge through social interactions, which in turn helps them navigate and relate to various situations. From the theory, the circumstances are culture and context inclined. From the foregoing, an individual's knowledge and understanding is collaboratively developed in coordination with other people thus the "social constructivist concept".

Amineh and Asi (2015) pointed out that the theory is based on specific assumptions concerning reality knowledge and learning. The specific assumption are as follows:

i. Reality does not exist in advance but it is rather constructed through human activity of social interactions; this implying that it is not innate in human beings.

ii. Knowledge is a human product which is created when people interact with one another and with the environment which they live in.

iii. Learning is an active social process that occurs through interactions and collaborations with others. It is not something that happens solely within an individual, nor is it imposed by external factors. Instead, learning emerges when people engage in shared activities and work together, exchanging ideas and experiences.

The implication of this theory to the present study is based on the farmer's deduction of logical reasoning from their cognitive development experience and how their traditional environmental knowledge seemingly influences their environment-related endeavour. The influence on their environmental related endeavour is as a result of the traditional environmental knowledge creating a mental map which depicts their societal position in relationship to other communities and environments. Therefore, disparity in all of the variables, like afforestation/reforestation, use of alternative/renewable energy, land tenure system, African traditional belief, mixed cropping/agroforestry and organic farming, appears to be synonymous with variance in reality, knowledge and learning. The variance in reality, knowledge and learning in turn not only serve to challenge their capabilities and potentials but also hinders their associative interaction and collaboration with other communities who apparently appear not to be on a similar traditional environmental knowledge level with them.

Statement of the problem

The relationship between man and nature has always been dominated by economic development and man's wellbeing rather than environmental consideration, especially since the industrial revolution. The study area has been regarded as one of the major states with natural forest cover in Nigeria and beyond. But today, most of the natural vegetation has disappeared as a result of human activities like deforestation, unsustainable agricultural practices, bush burning, illegal hunting, logging activities and mining activities. As a result, most of the forest reserves are being converted to farm land, plantation farm, housing sites, quarrying sites, roads and construction sites. Despite the glaring consequences of climate change facing the people in the study area, many people do not seem convinced on the need to carry out sustainable agricultural practices as a means of controlling climate change. Residents of the study area are still indulging in farming practices that promote the emission of greenhouse gases into the atmosphere. Government and other concerned stakeholders have made efforts in creating awareness and sensitizing people on adaptation strategies and on the need to consider alternative farming practices that do not contribute to severe climatic problems. These efforts have yielded no significant results as the incident of forest destruction seem to be on the increase in the study area.

Urgent steps must be taken to tackle the problem of forest destruction in the study area by raising a citizenry that is aware of and committed to finding lasting solution to the conservation of forest resources, that will ensure ecosystem sustainability, regulate temperature and ensure continuity of the society. This emphasizes the need to consciously promote climate change adaptive strategies among the people in the study area. This informs the researchers' interest to carry out research on exploring the nexus between agroforestry, organic farming, and forest conservation in Cross River State.

Objectives of the study

Specifically, the study seeks to find out whether:

1. Agroforestry predicts conservation of forest resources in Cross River State.
2. Organic farming predicts conservation of forest resources in Cross River State.

ISSN: 2645-324X (Print)
ISSN: 2645-3223 (Online)

Research questions

The following research questions were posed to guide the study:

1. How does agroforestry predict conservation of forest resources in Cross River State?
2. To what extent does organic farming predict conservation of forest resources?

Hypotheses

The following hypotheses were formulated to guide the study:

Ho1: There is no significant prediction of agroforestry on conservation of forest resources in Cross River State.

Ho2: Organic farming does not significantly predict conservation of forest resources.

Methodology

Survey research design was used for the study. The research design studies situations as they exist at the time of a research. This research design is therefore considered appropriate for this study because it allows the researchers to make use of a representative sample of the population from where generalization of the study result will be made. The population of this study consists of all 73,755 farmers in Cross River State, Nigeria that are registered under the Agricultural Development Programme across various Local Government Areas. The sample of the study was 495 registered farmers with the Agricultural Development Programme in Cross River State.

The instrument used for data collection was 20 items researchers-made instrument titled Agroforestry, Organic Farming and Forest Conservation Questionnaire (AOFFCQ). The instrument has two sections; section "A" measures the respondent demography, while section "B" measures the variables under study. The instrument was validated by three experts from Test and Measurement unit of the University of Calabar. The reliability of the AOFFCQ was determined by administering the instrument to 20 respondents that were not part of the actual study. Thereafter, Cronbach alpha reliability coefficient analysis was used to calculate the internal consistency which ranged from .086 to .091.

The stratified and systematic random sampling techniques including the proportionate sampling approach were used for this study. The LGAs in the state were stratified into three educational zones for random selection. The researchers wrote the names of the state's 18 LGAs according to their strata on small pieces of paper, folded the pieces of paper into little ball-like shapes which were turned into three bowls, each representing an education zone in the state. They were mixed and the researchers blindly picked 50% of the paper balls from each of the bowls according to their strata. From Calabar Educational

Zone, four LGAs were picked, while Ikom and Ogoja Educational Zones provided three each, thus totalling 10 LGAs across the state. In each of the LGAs selected for the study, the proportionate sampling approach was used to select 10% of communities from each of the 10 LGAs sampled for the study. From the communities, systematic random sampling technique was then employed to select 5% of the farmers. Using the list of registered farmers in each selected community, every 10^{th} name on the list was selected for the study.

The data collected during the study were analyzed with simple linear regression using package IBM SPSS Version 27. The data were analyzed at .05 level of significance at 1 and 493 degrees of freedom.

Presentation of results

Ho1: There is no significant prediction of agroforestry on conservation of forest resources in Cross River State.

The result of the analysis is shown in Table 1.

Table 1: Simple regression analysis on the prediction of agroforestry on the conservation of forest resources in Cross River State

Model R	R Square	Adjusted R Square	Std. Error of the Estimate
.150	.023	.021	2.70805

ANOVA[b]

Model	Sum of Squares	df	Mean Square	F-ratio	Sig.
Regression	83.380	1	83.380		
Residual	3615.436	493	7.334	11.370	.001[a]
Total	3698.816	494			

a. Dependent Variable: Forest conservation

The simple regression analysis in Table 1 showed the prediction of agroforestry on conservation of forest resources in Cross River State which produced an adjusted R^2 of .021. This implies that only 2.1 percent of the variance of the dependent variable (conservation of forest resources) can be predicted from the independent variable (agroforestry). The F-value of 11.370 of the Analysis of Variance (ANOVA) obtained from the regression table with a p-value of .001 with 1 and 493 degrees of freedom at .05 level of significance showed that the null hypothesis was rejected. This result therefore signifies that agroforestry significantly predicted conservation of forest resources by 2.1 percent. The result therefore implies that there was a significant prediction of agroforestry on the conservation of forest resources in Cross River State.

Ho2: There is no significant prediction of organic farming on conservation of forest resources.

The result of the analysis is shown in Table 2.

Table 2: Simple regression analysis on the prediction of organic farming on the conservation of forest resources in Cross River State

Model R	R Square	Adjusted R Square	Std. Error of the Estimate
.177	.031	.029	2.69585

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F-ratio	Sig.
	Regression	115.896	1	115.896		
	Residual	3582.920	493	7.268	15.947	.000[a]
	Total	3698.816	494			

Dependent Variable: Forest Conservation

The simple regression analysis in Table 2 showed the prediction of organic farming on conservation of forest resources in Cross River State which produced an adjusted R^2 of .029. This implies that only 2.9 percent of the variance of the dependent variable (conservation of forest resources) can be predicted from the independent variable (organic farming). The F-value of 15.947 of the Analysis of Variance (ANOVA) obtained from the regression table with a p-value of .000 with 1 and 493 degrees of freedom at .05 level of significance showed that the null hypothesis was rejected. This result therefore signifies that organic farming significantly predicted conservation of forest resources by 2.9 percent. The result therefore implies that there was a significant prediction of organic farming on the conservation of forest resources in Cross River State.

Discussion of the findings

Results from testing of hypothesis one revealed that agroforestry significantly predicted conservation of forest resources in Cross River State. This result supports Okoro et al.

(2016) who noted that agroforestry can occur at a variety of spatial scales (for example, field or woodlot, farm, watershed) in different ecosystems and cultures. When properly applied, agroforestry can improve livelihoods through enhanced health and nutrition, increased economic growth, and strengthened environmental resilience and ecosystem sustainability. In turn, such improvements can contribute to increased social sustainability in which human needs are satisfied in a way that fosters environmental health. Farm diversification is a growing strategy for economic competitiveness, especially throughout the industrialized temperate zone, and agroforestry offers great promise for the sustainable production of specialty nut and fruit crops, high-value medicinals, dairy and beef cattle, sheep, goats, and biomass for biofuel. Agroforestry systems also yield proven strategies for long-term carbon sequestration, soil enrichment, biodiversity and forest conservation, and air- and water-quality improvements, benefiting both the landowners, society and forest resources.

This result also agrees with Carlos (2019) who remarks that agroforestry seeks to optimize positive interactions, such as mutualism and commensalism, and to minimize predation on crops and livestock and competition within and between species, stressing that positive interactions may reduce stress to plants and animals, enhance yields, retain soil, and capture water, thereby conserving forest resources. For example, the moist shaded microclimate under certain crop trees is beneficial for shade-tolerant crops such as turmeric or pineapple. Negative interactions, by contrast, can result in resource competition, more pests, excessive shading, and allelopathy (the release of biochemicals by one plant to suppress the growth of another). Black walnut and various eucalyptus trees, for example, are known to allelopathically inhibit the growth of certain annual crops planted near them.

Results from hypothesis two revealed that organic farming significantly predicted conservation of forest resources in Cross River State. This result is in tandem with Ogunleye et al. (2018) who encouraged the development of technologies and farming practices that not only increase productivity, but also arrest degradation as well as reclaim, rehabilitate, restore and enhance biological diversity and monitor adverse effects on sustainable agricultural diversity. These include, inter alia, organic farming, integrated pest management, biological control, no-till agriculture, multi-cropping, intercropping, crop rotation and agricultural forestry. While several agricultural approaches make sustainability claims, organic agriculture is the only well-defined agricultural management system, including recommended and restricted practices that aim at environmental protection and food production. The decades-long implementation of organic agriculture, including inspection and certification to ensure compliance, as well

 ISSN: 2645-324X (Print)
ISSN: 2645-3223 (Online)

as the steady growth of organic food sales in the global market, offer a living example of a viable system that reconciles forest conservation and production needs. Organic farming is a holistic production management system which promotes and enhances agro-ecosystem health, including biodiversity, biological cycles, and soil biological activity. It emphasizes the use of management practices in preference to the use of off-farm inputs, taking into account that regional conditions require locally adapted systems.

Conclusion

The findings of this study unequivocally establish that agroforestry and organic farming practices are potent predictors of forest resource conservation in Cross River State, offering sustainable solutions to mitigate deforestation and promote ecological balance. By embracing these environmentally friendly land-use strategies, policymakers and stakeholders can effectively conserve the state's fragile forest resources, ensuring the long-term health of ecosystems and local communities.

Recommendations

Based on the findings of the study, the following recommendations were given by the researchers:

1. Policymakers should incorporate agroforestry and organic farming practices into forest conservation policies in Cross River State, providing incentives for farmers and communities to adopt these sustainable land-use strategies.
2. Government agencies, NGOs, and stakeholders should invest in scaling up agroforestry and organic farming initiatives, providing training, technical support, and resources to promote widespread adoption, enhancing forest conservation and sustainability

References

Amineh, R. J., & Asi, H. D. (2015). Review of Constructivism and Social Constructivism. *Journal of Social Sciences, Literature, and Languages, 1*, 9-16.

Anabaraonye, B., Chukwuma, O. J. & Eriobu, C. M. (2019). Green entrepreneurial opportunities in climate change adaption and mitigation for sustainable development in Nigeria. *Journal of Environmental Pollution and Management,* (2), 1-6.

Anukwa, F. N. (2021). Forest Policy Regulations and Sustainable Management of Forest Resources in Cross River State: Forestry Commission. *Journal of Forestry Research and Management*, *18*(1), 1-15.

Carlos, S. E. (2019). Farming methods and sustainable forest management in Mexico. *International Journal of Ecology and Climate,* 4(1), 162-168.

Elijah, D. E. (2016). *Modern perspective in crop production: An introductory text.* Ibadan: Oluyemi Printing Press.

Elliot, F. O. (2017). Agriculture in the tropics and environmental sustainability. *Journal of Agricultural Science, 4*(3), 241-249.

Enger, C. U. (2017). Approaches to sustainable forest management and climate change mitigation in developing countries. *Journal of Agroforestry and Conservation, 3*(1), 72-79.

Makini, K. M. (2017). *Sustainable agricultural practices and soil conservation: Issues, perspectives and prospects.* Nairobi: Wanyama Printing Press Ltd.

Mikan, W. O. (2018). On the simulation of root water extraction: Examination of a minimum energy hypothesis. *Soil Science*, 165, 226-236.

Ogunleye, A. U., Adeola, A. O., Ojo, L. O. & Aduradola, A. M. (2018). Impact of farming activities on vegetation in Olokemeji Forest Reserve, Nigeria. *Global International Journal*, 6(2), 131-140.

Okoro, I. O., Etuk, M. C., & Akpan, K. A. (2016). Sustainable agricultural practices and forest conservation among farmers in Ibesikpo Asultan Local Government Area of Akwa Ibom State, Nigeria [M.Ed thesis]. University of Calabar, Calabar.

Smith, D. K. (2016). *Perspectives of man-environment interaction in contemporary Nigerian communities. Ibadan*: Adebesin publishing company Ltd.

Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Harvard University Press.

Wilson, J. R. (2018). The eleventh hypothesis shade. *Agroforestry Today*, 2, 14-15.