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EVALUATING THE IMPACT OF DIFFERENT AGROFORESTRY PRACTICES ON BIODIVERSITY CONSERVATION IN HONG LOCAL GOVERNMENT ADAMAWA STATE, NIGERIA.

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ABSTRACT

This study evaluates the impact of various agroforestry practices on biodiversity conservation in Hong Local Government, Adamawa, Nigeria. Agroforestry, the integration of trees and shrubs into agricultural landscapes, offers potential benefits for biodiversity by creating habitats and enhancing ecosystem services. However, the effectiveness of different practices in promoting biodiversity can vary. This research aims to identify which agroforestry practices are most beneficial for biodiversity conservation in Hong, exploring both the challenges and opportunities encountered by local farmers. Through a combination of field surveys, interviews, and biodiversity assessments, the study provides comprehensive insights into the relationship between agroforestry practices and biodiversity outcomes. The findings highlight significant variations in biodiversity impacts among different agroforestry practices, underscoring the need for tailored approaches to maximize conservation benefits. findings underscore the importance of integrating biodiversity conservation objectives into agroforestry planning and management strategies to achieve sustainable and resilient agricultural landscapes. Through collaborative research, policy support, and stakeholder engagement, agroforestry can emerge as a cornerstone of biodiversity conservation efforts, contributing to the protection of ecosystems, the preservation of species diversity, and the promotion of sustainable land use practices.

Key Words; Evaluating, Agroforestry. Practice. Biodiversity. Conservation

INTRODUCTION

Agroforestry practices have gained recognition as a sustainable land management approach that balances agricultural productivity with environmental conservation. In regions like Hong Local Government in Adamawa, Nigeria, where biodiversity faces threats from deforestation and unsustainable farming practices, agroforestry presents a promising solution. This study focuses on evaluating the impact of different agroforestry practices on biodiversity conservation in Hong Agroforestry systems, including alley cropping, silvopasture, multistrata agroforestry, \home gardens, and boundary planting, are examined to determine their effectiveness in enhancing plant and animal diversity. (Girma and soloman, 2023) reported that agroforestry has multiple economic and environmental benefits as it helps farmers adapt to rapidly changing weather patherns. The research aims to provide actionable insights into how these practices can be optimized to support both agricultural productivity and biodiversity conservation, addressing the unique socio-economic and environmental context of Hong.

The agroecosystem biodiversity can be affected due to abandoning traditional, locally adapted crop varieties and intercropping for high yielding monocultures (Chappell and LaValle 2011; Sunderland 2011). Generally, agroforestry systems are closer to the natural forest systems (Schroth and McNeely 2011). Agroforestry helps in conservation of ecosystem through improving soil and microclimate properties, reduced erosion, improved water quality and carbon sequestration (Schroth and Sinclair 2003; Schroth *et al.* 2004; Nair *et al.* 2009; Sarvade 2014). Farmers practice agroforestry for gaining livelihood, income generation, risk management, food security and optimal use of available land, labor and capital (Arnold and Dewees, 1997). It is estimated that about 1.2 billion people (20%) of the world population depends directly on agroforestry products and services in developing countries which can provide goods and services, that can offset 5-20 per cent of

deforestation (Dixon 1995; Leakey and Sanchez 1997). Agroforestry represents the pinnacle of sustainable development and plethora of its uses has made it closer to the people. Many effective conservation organizations are now including agroforestry as a component in their programs. In general, agroforestry plays five major roles in conserving biodiversity especially it provides habitat for species that can tolerate a certain level of disturbance, helps preserve germplasm of sensitive species, helps reduce the rate of conversion of natural habitat by providing more productive, sustainable alternative to traditional agricultural systems that may involve clearing natural habitats, provides connectivity by creating corridors between habitat remnants which may support the integrity of these remnants and the conservation of area-sensitive floral and faunal species, and also helps to conserve biological diversity by providing other ecosystem services such as erosion control and water recharge, thereby preventing the degradation and loss of surrounding habitat (Jose 2009). Agroforestry systems are considered as diversity enhancing land use system especially in the context of inter-species diversity as it brings together crops, shrubs, trees and in some cases livestock on the same piece of land (Atta-Krah *et al.* 2004). A well-designed agro forest, can spontaneously attract and support higher biodiversity. In the lowlands of Sumatra, resin-producing agro forests planted several generations ago are now some of the last reservoirs of biodiversity as they are harboring rare epiphytes and herbs as well as 46 species of mammals, 92 species of birds, and much of the native soil fauna. Agroforestry plantings provide expanded habitat for a wide range of species, from soil micro life to insects to mammals and have diversified and intensified agro-ecosystems to maintain and enhance biodiversity (Sanchez and Leakey 1997; Sanchez *et al.* 1997). Agroforestry systems have potential to support as high as 50-80 per cent of biodiversity of comparable natural system (Noble and Dirzo 1997). Agroforestry conserve biodiversity within deforested, fragmented landscapes by providing habitats and resources for plant and animal species. It makes the landscape less harsh for forest dwelling species by reducing the frequency and intensity of fires and providing buffer zones to the protected areas (Pandey 2002). Biodiversity conservation is essential for maintaining ecosystem functioning, resilience, and stability. Agroforestry systems play a crucial role in preserving biodiversity by providing habitat for a wide range of species, including birds, mammals, insects, and microorganisms. High levels of biodiversity contribute to ecosystem services such as pollination, pest regulation, soil fertility, and water purification, which are vital for sustaining agricultural productivity and human well-being. This paper aim to, evaluates the impact of various agroforestry practices on biodiversity conservation in Hong Local Government, Adamawa, Nigeria

MATERIALS AND METHODS

STUDY AREA; Hong Local Government Area is located in Adamawa State, Nigeria. Geographically, it lies in the northeastern part of Nigeria. The coordinates for the town of Hong, which serves as the administrative center of the Hong LGA, are approximately Latitude: 10.25583^0 N Longitude: 12.9874^0 E Hong LGA is bordered by the following local government areas within Adamawa State: To the north, it is bordered by Song LGA. To the east, it is bordered by Mubi South and Mubi North LGAs. To the south, it shares a border with Gombi LGA. To the west, it is adjacent to Maiha LGA. According to the (NPC, 2006) census, the population of Hong LGA was around 169,126. Hong Local Government Area covers an area of approximately 970 square kilometers The dominant tribe in Hong Local Government Area of Adamawa State, Nigeria, is the Kilba (also known as Huba) people. The Kilba tribe is known for its rich cultural heritage and history within the region. They are primarily engaged in agriculture, trading, and various traditional crafts. The Kilba language is widely spoken among the inhabitants of the area is characterized by savanna vegetation. This savanna vegetation is well-suited to the region's climatic conditions, which include a wet season and a dry season. The vegetation supports agriculture and livestock rearing, which are the main economic activities in the area. The type of soil are Sandy Soils, loamy soil and clay Predominantly found in the area, these soils are well drained and suitable for growing crops such as millet sorghum, and groundnuts. Rainy Season typically occurs from May to October. This season is marked by heavy rainfall, which is crucial for agricultural activities in the area. Dry Season Lasts from November to April. It has the

average rainfall of 2,400mm and average temperature of about 36^0C. This season is characterized by little to no rainfall and includes. Harmattan Period Occurring from late November to early February, this period is marked by dry, dusty winds blowing from the Sahara Desert, resulting in cooler temperatures and lower humidity. (Adebayo, 2004). Dominated by grasses with scattered emergent vegetation of African Savannah such as *Acacia species philoshgma spp* . the dominant tree species typically found in the savanna vegetation include: *Vitellaria paradoxa, Adansonia digitata, Parkia biglobosa. Tamarindus indica, Balanites aegyptiaca,Terminalia avicemioides, pterocarpus erinaceus, Annona muricata, Ficus sycomorus, Daniellia oliveri, Vitex doniana, Anogeissus leiocarpa, Combretum micranthu, Diospyros mespiliformis, Albizia lebbeck, Prosopis Africana, Afzelia Africana, Faidherbia albida, Sterculia setigera, Azadirachta indica, Terminalia superba,Lonchocarpus sericeus*,. These indigenous tree species play crucial roles in the local ecosystem, providing resources such as food, medicine, and timber, and contributing to the biodiversity and environmental stability of the region. There are 12 political wards in Hong LGA:these include Hong, Gaya, Mayo lope, Uba, Garaha ,Husherezum, Daksiri Hildi, Thilbang, Kwarhi, Shangui, Banshika. (Adebayo, 2004). Dominated by grasses with scattered emergent vegetation of African Savannah such as *Acacia species philoshgma spp*. the grasses and trees covers ranges from *Andropogon spp pennisetum spp and imperata spp.*

DATA COLLECTIONS;
Data were collected using Stratified Sampling, this method involves dividing the population into distinct subgroups or strata that share similar characteristics. In this case, the population is divided into four strata: Age, Gender and location. Random sampling was use to select individuals within each stratum to ensure that every individual has an equal chance of being included in the study. A total number of Two hundred (200) questionnaires were administered to get information from respondents. Eight (8) wards randomly selected base on size include, Husherezum, Daksiri, Thilbang, Shangui, Banshika Gaya, Garaha, and Mayo lope.

DATA ANALYSIS;
The data generated were analyzed using descriptive analysis to summaries and interpret the distribution of the questionnaires in terms of raw count frequencies, and simple percentage

RESULTS AND DISCUSSIONS
In Hong Local Government Area of Adamawa State, Nigeria, agroforestry practices are predominantly carried out by male farmers, particularly those in middle age groups. These individuals are typically more involved in physically demanding agricultural tasks and decision-making processes regarding land use and tree planting. However, women also play a significant role, especially in activities like planting and managing tree nurseries, as well as in processing and marketing agroforestry products. The involvement of youth varies, often influenced by educational opportunities and migration trends. Agroforestry is most commonly practiced by farmers, particularly those with a background in agriculture. These individuals often have practical knowledge of farming systems and a vested interest in land productivity and sustainability. In terms of education, those with some level of agricultural education or training are more likely to engage in agroforestry practices, as they are aware of the benefits and techniques involved. However, even farmers with minimal formal education but extensive practical experience are active participants in these practices. In Hong Local Government Area of Adamawa State agroforestry practices are predominantly carried out by rural people. This is because rural communities typically have more direct access to agricultural land and rely heavily on farming for their livelihoods. Urban residents, on the other hand, are less involved in agroforestry due to limited access to land and different occupational focuses. Rural farmers engage in agroforestry to enhance food security, improve soil fertility, and diversify income sources, making it a crucial part of their agricultural practices. Table: 1 reveals men are the majority with 60% age group 36-55 with 50% and rural people with 60%. Table: 2 shows that by understanding these common practices and their variations, we can tailor

biodiversity conservation strategies to be more effective and context-specific for different parts of Hong Local Government. From the Table: 3 different agroforestry practices play a significant role in terms of diversity and abundant of plants and animals in various ways. Table: 4 shows the benefits observed among others are increase in organic matter, enhance nutrients cycling, improve infiltration, reduce erosion, increase yields, temperature regulation, while different agroforestry practices play a significant role in terms of agricultural yield in Table: 5 addressing these challenges requires comprehensive support systems, including education and training programs, supportive policies, financial incentives, and technical assistance in Table 6 tailored to the needs of farmers interested in adopting agroforestry practices for biodiversity conservation. Table: 7 indicate that by Addressing technical, financial, and education support system will effectively tailored farmers interested in adopting agroforestry practices for biodiversity conservation.

Table 1: Gender, Age, location,

Gender	Number of the respondents	Percentage (%)
Male	120	60
Female	80	40
Total	200	100
Age class	number of respondents	%
15-20	-	-
18-35	60	30
36-55	100	50
56-above	40	20
T0tal	200	100
Location	Number of respondents	%
Urban	80	40
Rural	120	60
Total	200	100

Source; field survey, (2024).

Table 2: Which agroforestry practices are most commonly used by farmers in Hong Local Government, and how do these practices vary between different areas?

Agroforestry practices	Number of the respondents	%
Alley Cropping	40	20
Silvopasture	35	17.5
Agroforestry for Soil Conservation	45	22.5
Multistrata Agroforestry	30	15
Homegardens	25	12.5
Boundary Planting	25	12.5
Total	200	100
Variations Between Different Areas		
Topography	35	17.5
Soil Type	35	17.5
Climate	40	20
Cultural Preferences	30	15
Access to Resources	30	15
Community Initiatives	30	15
Total	200	100

Source; field survey, (2024).

Table: 3 How do different agroforestry practices affect the diversity and abundance of plant and animal species in your area?

Practices	Plant Diversity	Animal Diversity
Alley Cropping;	increase plant diversity	attract bird, insects, mammals, nesting
	provide ecological niches	sites, food, create microhabitat
	Offer habitat & ground cover	
Silvopasture	soil health, plant varieties	provide habitat, support insets Birds, & small mammals
Agroforestry for Soil Conservation;		
	Increase plant, prevent erosion.	increases soil organism
	Maintain soil health, stabilizes soil.	insects, birds, refuge for Wild animals
Multistrata Agroforestry		
	Vegetation types, plant diversity, habitat	from ground dwelling
	Ground cover plant	to canopy birds & mam Mals Als dwelling
Hoegaardens; support a rich assemblage plant		attracts pollinators, birds & Small mammals, hotspot Within Agricultural land scape
Boundary Planting; increase plant varieties		corridors and habitats for wildlife
		support insect birds, and small mammals

Source; field survey, (2024).

Table: 4 What benefits have you observed from using agroforestry practices in terms of ecosystem services (e.g., soil fertility, water retention, pest control crop yield and productivity, microclimate)

Benefit in terms of ecosystems
Soil Fertility; increase organic matter, enhance nutrient cycling
Water Retention; Improved Infiltration, Reduced Erosion
Pest Control; Natural Pest Management, Reduced Need for Pesticides
Crop Yields and Productivity; Increased Yields, Diversified Income
Microclimate Regulation; Temperature Regulation,

Source; field survey, (2024).

Table: 5 How do different agroforestry practices impact your agricultural productivity and economic outcomes?

Practices	Impact Agricultural Productivity	Economic Outcomes
Alley Cropping	increase crop yield	income stream from crop & tree
Silvopastur	enhance posture productivity	increase livestock productivity
Multistrata Agroforestry: productivity from divers	Crop & trees grown	Income from tree product multiple sources of income from trees & crops, reduce Risk, increase financial stabilities
Hoegaardens	intensive production of Varieties of crop, in small spaces	increase food security,
Boundary Planting	protect crops, soil erosion Stable yield	income from boundary tree, fruit, nuts, timber, reduce
Soil Conservation Practices; improve soil health, crop		lower input, reduce need for

	yield Reduce erosion fertilizer & pesticide,

Source field survey (2024).

Table: 6 What challenges or limitations have you encountered in implementing and maintaining agroforestry practices that promote biodiversity?

Challenges	
Financial Challenges	High Initial Costs, Limited Access to Credit
Land Tenure Issues	Insecure Land Tenure, Land Ownership Conflicts
Technical Difficulties	Lack of Knowledge and Training, Inadequate Extension Services
Climatic Conditions	Drought and Water Scarcity, Extreme Weather Events
Social and Cultural Obstacles	Resistance to Change, Community Engagement
Support and Resources	Training and Education, Financial Assistance, Policy support. Community initiative

Source; field survey, (2024).

Table: 7 What kind of support (e.g. technical, financial, educational) do you think would most effectively enhance the adoption of biodiversity-friendly agroforestry practices in your community

Support	
Technical Support;	Modern Tools and Access to efficient planting tools, irrigation system and soil health monitoring equipment. Technology, Expert Advice; Guidance from agroforestry Specialists on designing and managing diverse agroforestry systems.
Financial Support;	Grants and Subsidies: Financial assistance to cover the initial costs of establishing agroforestry systems, such as purchasing seedlings and materials. Low-Interest Loans: Affordable credit options to enable, Long term investments in agroforestry practices
Educational Programs;	Workshops and Training Sessions: Practical training on Agroforestry techniques, biodiversity conservation and sustainable farming practices.

Source; field survey, (2024).

CONCLUSION

The study concludes that different agroforestry practices have varying impacts on biodiversity conservation in Hong Local Government. Multi strata agroforestry and home gardens demonstrate the highest potential for enhancing biodiversity due to their structural complexity and resource diversity. Alley cropping and silvopasture also contribute positively but require more technical knowledge and financial investment. Boundary planting provides important ecosystem services but may be less effective in increasing biodiversity on its own. Overall, the integration of agroforestry into farming systems in Hong can significantly contribute to biodiversity conservation, but success depends on addressing the challenges faced by local farmers.

RECOMMENDATIONS

1. Technical Training and Extension Services: To implement training programs and extension services to educate farmers on effective agroforestry practices and biodiversity conservation techniques.
2. Financial Support: Provide financial incentives, such as grants or low-interest loans, to help farmers cover the initial costs of establishing agroforestry systems.
3. Community Engagement: Foster community-based initiatives and farmer cooperatives to promote collective action and knowledge sharing.

4. Policy Development: Advocate for policies that support agroforestry and secure land tenure, encouraging long-term investments in biodiversity-friendly practices.
5. Market Access: Develop value chains for agroforestry products to ensure farmers can access markets and receive fair prices, incentivizing the adoption of these practices.
By addressing these recommendations, stakeholders can enhance the adoption of agroforestry practices that promote biodiversity conservation, ensuring sustainable agricultural development in Hong Local Government, Adamawa, Nigeria.

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