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## Agro-biodiversity Conservation for Hunger and Poverty Reduction among Farmers in South-east Agro-ecological Zone, Nigeria

Tijjani AR<sup>1</sup>, Chikaire JU<sup>2</sup>

<sup>1</sup>Department of Agricultural Economics & Extension, Federal University, Dutsinma, Katsina State, Nigeria.

<sup>2</sup>Department of Agricultural Extension, Federal University of Technology, Owerri, Imo State, Nigeria

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**Abstract** Biodiversity conservation is key to poverty and hunger reduction among rural dwellers whose major occupation is farming. This study seeks to establish the veritable role agro-biodiversity play in food provisioning, thereby reducing hunger and poverty. A total of 250 respondents were randomly selected from 3 South-east States (Abia, Imo and Ebonyi) of Nigeria. Data were collected with questionnaire complimented by oral interview and analyzed using percentages and mean presented in tabular forms. The results revealed that majority (55.6%) were males, and 45.7 % were females, with a mean age of 50.2 years. On marital status, 50 percent were married, while 35.2% were widows. Again, 52 % had primary education, while 33.6 % had secondary education, with a mean farm size of 1.90 hectares, and mean household size of 8.2 persons. The respondents had a mean farming experience of 25.6 years. The prevalent agro-ecosystems included cropping systems, aquaculture systems, lakes, wetlands, forests, rice paddies, among others. The traditional agro-biodiversity practices included crop rotation/diversification with mean response of 2.50, agro-forestry (M = 2.41), reduced tillage (M=2.52), contour planting (M=2.36), drainage control (M=2.53), terracing (M=2.48) among others practices. Agro-biodiversity conservation play the following roles in reducing hunger and poverty: improve crop yield, improve income of farmers, guarantee access to markets, reduces vulnerability of crops to death and pressures, improves soil texture and fertility, reduces economic loss, provision of medicines and many more. It was recommended that to encourage and sustain conservation of biodiversity, conservation education and training be given to farmers regularly by agricultural extension personnel. The prevailing tenure systems should be reformed to make access to land easy and secure to enterprising farmers.

**Keywords** Agro-biodiversity, hunger, poverty, conservation, agro-ecology, Nigeria.

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### Introduction

Agricultural production is an integral part of everyone's life. Agriculture provides humans with food and raw materials for goods—such as cotton for clothing, wood for shelter and fuel, roots for medicines, and materials for biofuels — and with incomes and livelihoods, including those derived from subsistence farming. Biodiversity has enabled farming systems to evolve ever since agriculture was first developed some 10,000 years ago in regions across the world including Mesopotamia, New Guinea, China, Mesoamerica, and the Andes. Worldwide there is now a huge diversity of agricultural systems ranging, for example, from rice paddies of Asia, to dry-land pastoral systems of Africa, and hill farms in the mountains of South America [1].

Biodiversity is the source of the plants and animals that form the basis of agriculture and the immense variety within each crop and livestock species. Countless other species contribute to the essential ecological functions upon which agriculture depends, including soil services and water cycling [1]. As custodians of land and natural resources, including biodiversity, farmers and agricultural producers manage agricultural biodiversity and their



associated landscapes. Generally, managers of biodiversity aim to achieve sustainability to preserve resources for future generations. Where this does not occur, the root causes often lie outside their control. Farmers and producers are allies in global efforts to manage biodiversity better.

Agricultural livelihoods are based on the use of agricultural produce directly for subsistence and or, on income derived from work and produce. Agricultural livelihoods are the oldest mode of humans' subsistence and remain the principal form of livelihood in many regions today. From the earliest days of domestication of plants for human use about 12 000 years ago, agricultural biodiversity has played a pivotal role in sustaining and strengthening food, nutrition, health and livelihood security all over the world. In spite of enormous progress made in enhancing crop productivity through Mendelian and more recently molecular breeding, more than 800 million children, women and men go to bed every day under-nourished [2]. Endemic hunger caused by protein-energy malnutrition, hidden hunger caused by deficiencies of iron, iodine, zinc, Vitamin A and other micro-nutrients in the diet, and transient hunger caused by drought, floods, and other natural disasters can be overcome through an integrated strategy for the conservation and sustainable and equitable use of agricultural biodiversity. Many life-saving crops, like tubers and legumes, were cultivated in the past and we urgently need to rekindle such dying wisdom and take steps to save vanishing crops, which help to heal the wounds inflicted by natural or man-made calamities. Women, in particular, are holders of such traditional knowledge and the critical role of women in conservation and sustainable management of agricultural biodiversity needs to be strengthened and revitalized [2]. Tropical fruits, beta-carotene-rich sweet potato and other vegetable crops can help to fight Vitamin A deficiency in children. In other words, agricultural biodiversity provides uncommon opportunities for developing decentralized and locale-specific community food security systems involving field gene banks, seed banks and grain banks developed and managed by local women and men. This approach further helps to enlarge the food security basket by including nutrition-rich but under-utilized crops. This is the most sustainable and affordable pathway to achieving the MDG in relation to elimination of hunger and poverty.

Agricultural biodiversity offers the crucial raw material for improving in perpetuity the productivity and quality of crops, livestock and fish. Goals such as health for all and fish for all can be achieved only by conserving medicinal plants and genetic diversity in fish. Agricultural biodiversity also offers opportunities, especially to the landless poor, for entrepreneurial initiatives, which will generate employment and income from a range of value-added foods, medicines, bio-fuel and other products. Such opportunities are of particular value, since today inadequate income and purchasing power are the major causes of food insecurity at household level [2]. The potential of agricultural biodiversity for coping with climate change is not well appreciated. In short, the flagship role played by agricultural biodiversity in overcoming hunger in an environmentally, economically and socially sustainable manner is yet to be widely realized and integrated with national and global strategies for achieving the MDGs. Better nutrition is also vital for fighting pandemics like HIV/AIDS and tuberculosis, since a drug-based approach alone will not lead to the desired results. The health foods of tomorrow will be mostly the under-utilized crops of today.

Agricultural biodiversity and cultural diversity have feedback relationships. Local farming systems provide the feedstock for poems, songs, dance and drama. Community-led food security systems based on the conservation, cultivation and consumption of local foods thus help to preserve cultural and ethnic diversity in crop and culinary preferences. Thus, agricultural biodiversity confers multiple benefits—ecological, economic, nutritional and cultural. However, the Earth's biodiversity is being lost at an alarming rate, putting in jeopardy the sustainability of ecosystem services and agriculture, and their ability to adapt to changing conditions. The conservation and sustainable use of biodiversity is essential for the future of agriculture and humanity. At the same time, since agricultural lands extend across such a considerable proportion of the Earth's surface and harbour significant biodiversity, the conservation of biodiversity within agricultural landscapes must play an important part in global conservation strategies.

### **Status of Biodiversity in Nigeria**

Nigeria is rich in biodiversity because the country is endowed with a variety of plants and animal species found in the boundless forests and grass lands. There are about 7895 plant species identified in 338 families and 2,215 genera. There are 22, 000 vertebrates and invertebrates species. These species include about 20, 000 insects,



about 1000 birds, about 1,000 fishes, 247 mammals and 123 reptiles. Of these animals; 0.14% is threatened while 0.22% is endangered. About 1,489 species of micro-organisms have also been identified. All these animal and plant species occur in different numbers within the country's vegetation that range from the mangrove along the coast in the South to the Sahel in the North [3]. Most of the biodiversity sustains the rural economy.

At present, in Nigeria the destruction of natural habitats continues apace resulting in the depletion of the country's biodiversity [4]. For example the Nile crocodile (*Crocodilus niloticus*) which was once found in the Nigerian coastal waters right up to Lake Chad is fast disappearing due to loss of habitat and the hunting of crocodile for their meat, egg, hide and skin [4]. Also, in Southern Nigeria, the forest elephant, chimpanzee, leopard, yellow-backed duiker, the Royal python, the Nigeria quonon (*cercopithecus erythrogaster*) are among the animals on the endangered list. Nigeria present network of protected areas include a biosphere reserve, 8 national Parks, 445 forest reserves, 12 strict nature reserves and 28 game reserves. Other sanctuaries and game reserves were meant to conserve wild life and to supplement protein from domestic sources [3].

In Nigeria Forestry, about 65 of 560 species of trees are now faced with extinction while many others are at different stages of risk [4]. According to website reports, about 48 species of animals, and 431 species of plants are endangered, of which 16 species of mammals and 45 species of plant are categorized as rare, 30 species of animals and 20 species of plants are endemic ([www.onlinenigeria.com/links/bioticadv.asp?](http://www.onlinenigeria.com/links/bioticadv.asp?)). All these are of conservation concern to the country. Every year a considerable part of the nation's forest resources are destroyed through industrialization, urbanization, road construction, commercial agriculture and other activities thereby disturbing the ecological balance that nature maintains with the living and non-living resources [4]. This damage is done without recourse to the benefits accruing from use of biodiversity resources. This study therefore has the following specific objectives: (a) to describe the socioeconomic characteristics of the respondents; (b) identify agro-biodiversity ecosystems in the study zone; (c) examine traditional agro-biodiversity practices of respondents and (d) ascertain perceived roles of agro-biodiversity conservation in hunger and poverty reduction.

### Methodology

The study was conducted in South-east agricultural zone. The South-East zone of Nigeria lies between latitude  $4^{\circ}20'N$  and  $7^{\circ}25'N$  and longitudes  $5^{\circ}25'E$  and  $8^{\circ}51'E$  covering a land area of about 109,524 sq km, which represent about 11.86 % of the total area of Nigeria [5]. This area lies on mainly plains under 200m above sea level. It is bounded on the South by bight of Bonny, on the East by the Republic of Cameroun,, on the West by River Niger and on the North by Benue State. The zone has a population of 18.92 million or 21.48 % of the total population of Nigeria [6]. About 60 – 70 % of the inhabitants resides in rural areas and with a population density of about 173 person per square kilometer, making it one of the most densely populated agricultural zones in Nigeria. The climate of the South-East zone is typically equatorial. It is influenced by the East line, namely the tropical continental and tropical maritime air masses. There are two distinct climate seasons the rainy and dry seasons. The rainy seasons starts from March/April and ends in October/November and dry season lasts till March of the following year. Crop farming is the dominant activities, while fish farming is the primary occupation of the river-rine areas [7]. The target population for the study consisted of all registered farmers in the states identified above. The choice of the area was justified by the agrarian population found in urban, semi-urban and rural settlements in this region and the obvious contribution of the region to agriculture in Nigeria. A multi-stage and random sampling procedures were applied in selection of sample for this study. In the first stage of the sampling procedure, 60% of the states that constitute South-east, Nigeria were randomly selected. This process yielded selection of Abia, Ebonyi and Imo states. Thereafter, two extension zones each from 3 zonal extension districts in each of the states were again randomly picked. This resulted in six zones that have a total of 72 extension blocks. In the third stage, 25% of the total extension blocks (18 blocks) were randomly selected. In the fourth stage, all extension circles in the 18 blocks were populated and this gave 90 extension cells. In the final stage, 10% of farmers registered with the extension agents in each extension circle were randomly selected and a total of 250 farmers were selected and interviewed using the Agricultural Development Project (ADP) platform in each of these states. Farmers whose name fell within third quartile in the register were picked for randomness. Data were collected with the aid of structured questionnaire. These were analysed using descriptive statistics of



frequency table, percentage, mean and standard deviation. For the mean, a discriminating index of 2.00 was established as the cut-off mark for accepting an item statement as practiced or not on a three point likert scale of practiced always, practiced somewhat and not practiced (objective 3), while for the four point likert –type scale of strongly agree, agree, disagree and strongly disagree (objective 4) a mean index of 2.5 was used as the discriminating index. The deviation from the mean was also computed. For objective 1 and 4, frequency table and percentages were computed.

## Results and Discussion

### Socio-economic characteristics of respondents

The result in table 1 reveals that 55.6% of the respondents were males, while 45.7% were females. This shows the dominance of males as owners of land and family heads who take major decision in the family production business. It was also revealed that majority (45.7%) of the respondent were on their later sixties which makes them experienced and knowledgeable in the topic of biodiversity conservation. Table 1 shows also that 52.2% of the respondents were married, 25.2% were widows who fend for themselves and their family members having lost their husbands to death. The number of widows also revealed that women are custodians of traditional seeds used as food and sale in the market. The respondents had certain level of education as indicated by 52.% with primary education, 33.6% had secondary education, while 2.4% had tertiary education. This implies that the respondents are not illiterates. Education provides valuable knowledge on the benefits of conservation of natural resources. Majority (56.8%) of the respondents had small land holding of 0.5 – 1 hectares, 25.2% had 1.5 – 2 hectares, with a mean farm size of 1.9 hectares, mean household size of 8.2 members, and a mean farming experience of 25.6 years. The above implies that larger households engage in farm work readily as they provide the farm labour needed for conservation practices. Again, as age increases among farmers, years of farming experiences also increases making them experts in the field of conservation of nature.

Majority (64.8%) had not received extension visit, while 23.2% received such visits at 2 weeks interval and 12% received once in a while. This visit is important as it serve to educate and train farmers on the need and benefits of agro-biodiversity conservation. Finally, 70.8% belonged to social organizations, while 29.2% belonged to no organization. Membership of social group is an avenue of change and information gathering by farmers and information sharing. Farmers gather information and benefit from others when they join and belong to social organizations.

Multiple responses were recorded on occupation of the respondents. Farming had the highest response of 82.4% as the major occupation. This implies that farming activities predominates in the zone. Other supplementary occupations included trading (42.8%), craft-making (10.4%), hunting (13.6%) and 2.4% who were civil servants.

**Table 1:** Socio-economic Characteristics of Respondents

Characteristics	Frequency *	Percentage
<b>Sex</b>		
Male	136	55.6
Female	114	45.7
<b>Age</b>		
31-40	17	6.8
41-50	23	9.2
51-60	96	38.4
61 & above	114	45.7
<b>Marital status</b>		
Married	88	35.2
Widow	31	12.4
Widower		
<b>Educational level</b>		
No formal education	30	12.0
Primary	130	52.0
		33.6



Secondary	84	2.4
Tertiary	6	
<b>Farm size</b>		
0.5-1	142	56.8
2.5-2	63	25.2
2.5- above	45	18.0
<b>Household size</b>		
1-4	120	48.0
5-8	87	34.8
9 & above	43	17.2
<b>Farming experience</b>		
11-20	50	20.0
21-30	86	34.4
31-& above	114	45.7
<b>Extension visit</b>		
Not at all	162	64
2 weeks interval	58	23.2
Once in a while	30	12
<b>Membership of organization</b>		
Yes	177	70.8
No	73	29.2
<b>Occupation</b>		82.4
Farming (major)	206	
Trading	107	42.8
Craft making	26	10.4
Hunting	34	13.6
Civil servant	4	16

Field survey data, 2015

#### Agro – biodiversity Ecosystems in Study Area

Table 2 reveals also the various agro-biodiversity ecosystems in the study zone. These included forests with 84.8%, usually seen in the tropical rainforest areas of the zone, wetlands (78.4%) seen around areas with lakes and rivers for dry season farming. The dominant agro-ecosystem was the cropping system available in almost all the farming communities in the zone with 100% response. Others were aquaculture system (86.8%), rice paddies (98.4%) which is common in the Ebonyi State area where rice farming is main economic activity among the rural dwellers.

**Table 2:** Agro-biodiversity ecosystems in study area

Ecosystems	Frequency	Percentage
Forest	212	84.8
Wetland	196	78.4
Grassland	124	49.6
Coastal area	167	66.8
Lakes	193	77.2
Rice paddies	246	98.4
Aquaculture system	217	86.8
Cropping systems	250	100

Field survey data, 2015



### Traditional Agro-biodiversity Practices of Respondents

Table 3 shows the agro-biodiversity conservation practices used by respondents in the study zone. Based on a discriminating index of 2.0, the respondents identified 17 practices used always in the area. The practices were crop rotation /diversification with a mean of 2.50. Crop rotation/diversification ensures that different crops are planted on a farm following a principle that ensures nutrient availability to all crops in the farm. Agro-forestry practices had a mean of 2.40. This practice helps to tackle the triple challenge of food security, reducing the vulnerability and increasing the adaptability of agricultural systems to climate change. Other practices included crop enterprise mix (M=2.36), mixed farming (M=2.46) mulching (M=2.44) and land fallow (M=2.52). Crop mix ensures availability of variety of foods to the family. Mixed farming system enables the interaction of both livestock and crop production on the same plot. The soil retains water and moisture and reduces evapo-transpiration. Again, useful conservation practices employed by the respondents were reduced soil tillage (M=2.35), planting indigenous crops (M=2.28), green manuring (M=2.40), contour planting (M=2.60), water storage pits (M=2.49), avoidances of bush burning (M=2.60) , planting of hedge rows and living barriers (M=2.35), terrace making (M=2.48), biological pest control (M=2.46) and reduced used of chemicals (M=2.42), among others.

**Table 3:** Traditional Agro –biodiversity Practices of Respondents

Practices	Mean	SD
Crop rotation/diversification	2.50	0.647
Planting indigenous crops	2.28	0.602
Reducing soil tillage	2.52	0.500
Crop enterprise mix,	2.36	0.769
Green manure/compositing	2.40	0.566
Practice of agro forestry	2.41	0.582
Contour planting	2.36	0.671
Water storage pits/holes	2.49	0.582
Drainage/runoff control	2.53	0.595
Refraining from burning of farm residues	2.60	0.490
Hedgerows and living barriers	2.35	0.741
Biological pests/disease control	2.46	0.627
Terraces to prevent erosion	2.48	0.554
Mixed farming	2.46	0.627
Reduced use of herbicides/chemicals	2.42	0.510
Land fallow	2.52	0.512
Mulching	2.44	0.638

### Perceived Role of Agro-biodiversity Conservation in Hunger and Poverty Reduction

Agro-biodiversity conservation contributes to the well-being of individuals who depend on the services provided by the ecosystem. Table 4 shows the various ways agro-biodiversity fills the needs of mankind. The table reveals that agro-biodiversity conservation improves crop yield as indicated with the mean score of 3.22. It improves income earning opportunities of farmers (M=3.38) and provides substance support to local livelihood (M=3.07). The above implies that biodiversity contributes directly to peoples livelihood through ecosystem provisioning services. Peoples' income-earning opportunities depend on the abundance and availability of particular species such as timber and non-timber forest resources providing food, fuel and other tradable goods. Other roles for hunger and poverty reduction included provision of crop, livestock and fishery raw materials to farmers with a mean score of 3.31, reduce pest/diseases outbreak (M=3.35) ,reduced protein-energy malnutrition (M=3.26), reduces vulnerability of crops to pressure (M=3.10),building healthy soils (M=3.34), enhances soil nutrient recycling (M=3.07), makes soil nutrients available to crops (M=2.26), increasing soil permeability (M=3.24).

This means that biodiversity is essential to food provision through the facilitated access to a diverse range of locally produced agricultural and wild food stuffs, thus maintaining a balanced and satisfying diets and



enhancing adaptation and resistance of crops as an insurances against future risks and changing climatic conditions. Again, biodiversity support food production through soil formation and productivity, pests and diseases control and pollination. This happens when the soil is rich and high in nutrient for plant growth. This improves the well being of farmers who farm on such land as yield will increase and or bumper harvest achieved.

Again, biodiversity conservation reduces vulnerability of drought as indicated by a mean score of 3.13, reduction of flooding and erosion (M=3.09), reduction production losses (M=3.38), avoidances of total ecosystem failure of crops (M=3.29) , promotion, use and development of indigenou varieties (M=3.31). Biodiversity conservation guarantees the provision of medicinal plant to local resident (M=2.84), access to market (M=3.05), reduction of financial inputs (M=2.86) and delivery of higher water quality (M=3.0). Many plants, fungi and animals have provided the world with medicine, and the pharmaceutical industries base on these biological resources and knowledge to function. Water quality is enhanced through natural purification function of the ecosystem, and use of high water quality reduces farmers spending of water purchase and related excise. All of these are tied to improving the well –being of people thereby reducing hunger and poverty.

**Table 4:** Perceived Role of Agro-biodiversity in Hunger and Poverty Reduction.

Statement	Mean	Score
Agro-biodiversity conservation improves crop yield	3.22	0.508
Reduces need for use of chemicals in farm	3.27	0.849
Reduces protein-energy malnutrition	3.26	0.688
Provision of crops, livestock and fishery raw materials	3.31	0.849
Reduces seventy of pest/diseases outbreak	3.35	0.763
Enhances pest control	3.44	0.669
Reduces vulnerability of crops to pressures	3.10	0.978
Reduces vulnerability of extreme drought	3.13	0.519
Reduces vulnerability of flooding/erosion	3.09	0.875
Agro forestry provides shelter /shoves	3.16	0.917
Improves income earning opportunities of farmers	3.38	0.703
Reduces production losses	3.38	0.773
Increases resilience of agro ecology	3.24	0.728
Avoidances of total ecosystem failure of crops	3.29	0.760
Building of healthy soils	3.34	0.777
Promotes use/development of indigenou varieties	3.31	0.786
Enhances soil nutrient recycling	3.02	0.966
Makes soil nutrients available to crop	2.86	1.020
Increases soil softness and permeability	3.20	0.798
Reduces financial input	2.86	1.020
Delivery of higher water quality to crops/annual and mean	3.0	2.100
Provision of medicines to local residents	2.84	0.931
Guarantees access to market	3.05	0.860
Provision of substances support to local live hood	3.07	0.966

Field survey, 2015

### Conclusion

Nature's gifts to humans abound and if managed well, will be of immense benefits to man's survival. Agro-biodiversity conservation practices such as crop rotation/diversification, zero-tillage, mulching, land fallow among others have the ability to reduce the vulnerability of both crops and man to the unpredictable adverse weather and climatic conditions of today's environment. These practices have the potentials of reducing hunger and poverty among users of agro- biodiversity products when conserved.



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