Common Place And Towards A Common Future: The Role Of Ecoagriculture In Biodiversity Conservation And Agricultural Sustainability In Nigeria

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Abstract: This article observes agriculture and the challenges it poses to biodiversity conservation in Nigeria. The expansion of modern day agricultural system has led to a wider conversion of land alongside biodiversity loss. However, agricultural system can be modified to benefit biodiversity conservation, food production and livelihood. Ecoagriculture is a strategy that integrates farming, biodiversity and rural populace. This paper the potentials of ecoagriculture as a strategy for a successful conservation of biodiversity in agricultural landscapes in Nigeria. The strategies include developing habitat network in non-farmed areas, reducing agricultural pollution and modifying farming systems to mimic natural ecosystems. Effective ecoagriculture will require proper funding both nationally and internationally.

Keywords: Biodiversity conservation, Agricultural expansion, Agricultural sustainability, Ecoagriculture, Rural livelihood.

I. INTRODUCTION

Farming began around 12,000 years ago and approximately 7,000 plant species and thousands of animal species have been used historically by humans for food and health requirements (Toledo and Burlingame 2006). Today, 98% of world's food needs is provided by 12 plant crops and 14 animal species with wheat, rice and maize alone accounting for more than 50% of the global energy intake (Thrupp 2000). Almost one-third of terrestrial lands have farming or planted pastures as a dominant land use (accounting for at least 30% of total area), hence having a great ecological effect on the entire landscape (Wood et al. 2000). Another 10–20% of land is subject to extensive livestock grazing; and approximately 1–5% of food production occurs in natural forests.

Many countries in the developing world are facing rapid growth in population, with related pressure on natural habitat and their native fauna and flora (Stewart et al.2005). In Africa alone, land in cereal production is expected to increase from 102.9 M ha in 1997 to 135.3 M ha in 2025 (Rosegrant et al. 2005).Global consumption of livestock products is predicted to rise from 303 million metric tonnes in 1993 to 654 million tonnes in 2020 (Delgado et al. 1999).

In Nigeria, the need for an extensive agricultural production has increased the total land area dedicated to that sector from 16.5 million ha in 1960 (Agboola 1979) through 21.9 million ha in 1970 (Office of Statistics Nigeria 1972) to 35.3 million ha in 1980**.** In spite of that, the estimated land requirement for food and cash crops in 1995 is 55.6 million ha (Federal Government of Nigeria 1987). This shows that agricultural production in Nigeria is largely land extensive. By 1995, 56 percent of the land in the country is devoted to agriculture. The consequences are all the pressures from cultivation will be placed on a larger part of Nigeria's land cover whose population density has grown beyond levels that can be supported by shifting cultivation (Osemeobo 1988).

WHAT IS ECOAGRICULTURE?

Ecoagriculture is a culmination of approaches to produce food while aiming at integrating biodiversity conservation into agricultural development efforts (Magdoff 2007). Hence the central objectives of ecological agriculture are food security and rural livelihoods with the aim of reconciling the need to conserve biodiversity, the need for food and the need to secure livelihoods (Magdoff 2007). Ecological agriculture

emphasizes on conservation strategies that are more integrated and stressed on the interaction between human and nature, and on achieving fair reconciliations between them (McNeely and Scherr 2003).

The precedent development of agriculture in the absence of ecology has greatly neglected the benefits of ecological farming systems like efficient use of energy flows, the diversity of both above ground and soil organisms, self-sufficiency, self-regulation and resilience (Magdoff 2007). Ecoagriculture stresses the need for 'ecological thinking' in agricultural development and applies ecological principles to agricultural systems (Magdoff 2007). The approach does not intent to look at agriculture and agricultural fields as mutually exclusive units but as complete systems that interact with the surrounding and comprise a fully working ecosystem (Magdoff 2007). It makes it possible for integrated action, at a lower overall cost, to achieve Millennium Development Goals for poverty, hunger, water, and sanitation and environmental sustainability (Scherr and Rhodes 2005).

WHAT IS AGRICULTURAL SUSTAINABILITY?

Agricultural sustainability involves production activities that minimizes the use of external inputs and maximizes the use of internal inputs, which already exists on the farm (Leichardt 1987). According to Harwood (1987), sustainable farming is the farmers' capacity to optimally improve agricultural productivity by rationally utilizing both internal and external resources and being conscious of conserving the catchment's environment. Several different expressions implied to greater sustainability in some agricultural systems to include biodynamic, community based, ecoagriculture, ecological, environmentally sensitive, extensive, farm fresh, free range, low input, organic and permaculture (Gliessman 2005). Sustainable agricultural systems are those that aim to make the best use of environmental goods and services while not damaging these assets (Scherr and McNeely 2008). It further makes productive use of people's collective capacities to work together to solve common agricultural and natural resource problems, such as for pest, watershed, irrigation, forest and credit management (Pretty 2008). Agricultural sustainability does not rule out any technologies or practices on ideological grounds if it works to improve productivity for farmers and does not cause undue harm to the environment (Pretty 2008).

Food system will have to address, or adjust to, many of the challenges affecting it around the world which include, for instance, the collapse in the harvest of wild game and wild fisheries as a result of overexploitation and habitat loss or pollution (Hassan et al. 2005). Hence, agricultural sustainability in Nigeria, will require a significant investment to refurbish damaged resources and ecosystems upon which food supplies, especially of the rural poor, depend (UN Millennium Project 2005).

II. BIODIVERSITY CONSERVATION IN NIGERIA

According to the International Convention on Biological Diversity (2003), "Biodiversity"(biological diversity) means the variability among living organisms from all sources, including among other things, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part including within species-diversity, between-species diversity and ecosystem diversity.

A total of about 7895 plant species identified in 338 families and 2,215 genera have been recorded in Nigeria. There are about 22, 000 vertebrates and invertebrates species. Of these, about 20, 000 are insects, 1, 000 are fishes, 247 are mammals, 123 are reptiles (Federal Government of Nigeria 2001) and 894 are birds (Ezealor 2001). Also about 1,489 species of micro-organisms have been recorded. This ranks Nigeria as one of the richest countries of Africa in terms of biodiversity. All these species of animal and plant are distributed differently within the country's vegetation ranging from the mangrove along the coast in the South to the Sahel in the North (Federal Government of Nigeria 2001).

Biodiversity conserving is the use of biological resources in ways that do not diminish or destroy the variety of genes and species or important habitats and ecosystems (Attuquyefio and Fibril 2005). Conservation of biodiversity could be *in situ* (protection, maintenance and management of variety of life forms in their real habitat) or *ex situ* (collection of some species or their populations and communities in areas away from their real habitat) (Attuquyefio and Fibril 2005).

Biodiversity conservation in Nigeria is the protected area system which is carried out through the establishment of National Parks, Game Reserves and Forest Reserves (Ezealor 2001).

III. IMPORTANCE OF BIODIVERSITY TO AGRICULTURE

Modern day agriculture has become so highly productive agricultural systems only by relying on external inputs (Altieri 1999). On the other hand, ecological agriculture is encouraged by the features of natural ecosystems that ensure their productivity through the internal regulation that is provided through ecosystem services (Altieri 1999), which are the benefits provided by ecosystems that support human life on Earth (Diaz et al., 2006). The persistence of these services is largely dependent upon the maintenance of biodiversity (Altieri 1999). The Millennium Ecosystem Assessment (MEA 2005) highlights four distinct types of ecosystem services as: (i) supporting services such as nutrient cycling, oxygen, and soil formation, (ii) regulating services such as climate stabilization and pest and disease regulation, (iii) provisioning services such as provision of wood, fibre, food, natural medicines, and (iv) provision of cultural assets such as spiritual and religious sites

The Convention on Biological Diversity (CBD 2008), has pointed out the most important ecosystem services to agriculture as:
- ✓ Regulation of pests and diseases;
- ✓ Nutrient cycling, such as decomposition of organic matter;
- ✓ Nutrient sequestration and conversion, as in Nitrogen-fixing bacteria;
- ✓ Regulating soil organic matter and soil water retention;

- ✓ Maintenance of soil fertility and biota; and
- ✓ Pollination by bees and other wildlife.

Variety of soil microorganisms play an important role in the process of nutrient recycling which is also necessary for the maintenance of soil productivity (Laurance 1999).

In Nigeria, insects like bees play a vital role in agriculture as pollinators of crops, aside the production of honey.

IV. THREATS POSE BY AGRICULTURE TO BIODIVERSITY IN NIGERIA

The fragmentation and loss of native habitats resulting from agricultural expansion and conversion of agricultural lands into urban sprawl are widely identified as the most serious modern threats to biodiversity conservation (Main et al.1999).

Agricultural expansion is a primary cause of habitat destruction in Nigeria as it is associated to vegetation destruction and short fallow period. For instance, most of the montane forest patches of the Cross River National Park-Okwango division are seriously degraded through subsistence agriculture and overgrazing resulting to serious sheet and gully erosion (Ezealor 2001). These activities are threatening the existence of species among which is the white-throated monkey (*Cercopithecus erythrogaster*) and Cross River Gorrila (*Gorilla gorilla diehli*) endemic to Nigeria (Okorodudu-Fubara1998). Also natural habitat is fragmented by farming, breaking formally continuous wild species populations into smaller pieces making them vulnerable to extinction.

Some introduced agricultural crops, livestock, trees and fishes have become invasive species, spreading beyond their planned range and displacing native species (Mooney et al.2005). In Nigeria, the use of introduced varieties of crops and complete neglect of local varieties may lead to the displacement of native species. A major example of this is the use of introduced dwarf okro (*Abelmoschus esculentus)* in the place of the native tall okro. Also the local varieties of sword bean (*Canavalia ensiformis*), African Yam Bean (*Sphenostylis stenocarpa*) and lima beans (*Phaseolus lunatus*) are now becoming extremely rare as only introduced cowpea (*Vigna unguiculata*) is being cultivated in many farms. Similarly *Discorea dumetorum*, *Discorea bulbfera*, *Trichosanthus* species (Snake tomato) and *Digitaria exiles* are no longer in popular cultivation as they were replaced by commercially driven introduced varieties thereby threatening the existence of important gene resources of all the above plant species (Emma et al. 2009).

Farmers generally use chemicals to eradicate wild species from their farms in an attempt to mitigate the harmful effects of pests, predators and weeds. However, these practices raise a number of concerns as a result of potential toxicity to beneficial wild species like pollinators, insect-eating birds and other species that prey on agricultural pests (Buchman and Nabhan 1996). Outcome of the work carried out in Nigeria, by Aikpokpodion et al. (2010) to determine the degradation of Endosulfan in Ibadan soil and to evaluate the effect of the recommended rate (0.25% a.i) of the insecticide (Endosulfan-35Ec) on some soil chemical properties revealed that application of Endosulfan-35EC significantly increased the acidity, magnesium and iron content of the treated soil, reduced the concentration of calcium, Potassium and sodium in the treated soil. An average of 3.91ng/g soil of Endosulfan was present as residue in the soil for six months after application. There was 85% population reduction of nematode as a result of Endosulfan application. Also Endosulfan pesticide is moderately persistent in the soil and hinders availability of some soil nutrients. Hence, the negative effects of such practice have gradually and systematically depleted native species and therefore, caused the extinction of wild fauna and flora in the natural ecosystems over the years (Osemeobo 1988).

V. MEETING INCREASED DEMAND FOR AGRICULTURAL PRODUCTS MEANS MORE THREATS TO BIODIVERSITY IN NIGERIA

Human population is expected to grow from a little over six billion today to nine billion by the year 2050 (Perrings et al. 2006). Feeding the world population is said to require the conversion of yet more wild lands, at the expense of biodiversity and ecosystem service provision, if the current model of commercialized monoculture is to be followed (Lambin and Meyfroidt 2011).

According to Food and Agricultural Organization (FAO 2001), the population of Nigeria is expected to increase by more than 50 percent in the coming two decades. During this 20 year period, the rural population is expected to rise by 25 percent and the agricultural component is expected to also grow which will continue to pose serious threats to the country's biodiversity (Federal Government of Nigeria 2001). As a result of population pressure, agricultural expansion and collection of fuel wood, high intensity of logging and illegal exploitation continued to pose serious threats to the Nigeria's forest resources (Crosby et al.1994).

VI. PROTECTED AREAS ONLY CANNOT RESCUE BIODIVERSITY

In response to the threats posed by agriculture to biodiversity conservation, there has been a sharp increase in the number of protected areas in recent years (Chape *et al.* 2005), were the highest levels of protection, effectively protect large areas of land from human use and productivity (Ferraro and Hanauer 2011). Globally, the network of protected areas now covers 11.5% of the worlds' surface area mostly falling within categories I-IV of the IUCN's classification (Schmidt et al. 2009). However, according to Hassan et al. (2005) more than 45% of 100 000 protected areas (PAs) had more than 30% of their land area under crops. In light of political and economic realities, many recently designated PAs in several African countries explicitly permit biodiversity friendly agriculture, usually in areas considered category V or VI in the IUCN system (IUCN 1994).

There used to be 8 National Parks in Nigeria, however, with the reversion of the Yankari National Park to a State game reserve ,the present network of protected areas include 7

national Parks, 15 game reserves (Usman and Adefalu 2010) and 36 forest reserves (Ezealor 2001). Other protected areas include sanctuaries and game reserves meant to conserve wild life and to supplement protein from domestic sources (Federal Government of Nigeria 2001). However, the reality is that many of these protected areas are in fact encroached upon for agricultural production (Ezealor 2001).

While protected areas are important for the conservation of biodiversity although no matter how spacious, the protective area network has primarily failed to halt biodiversity loss (Mace et al. 2010). Hence the need for additional approaches.

VII. ECOAGRCULTURE IN NIGERIA: INTEGRATING PRODUCTION AND BIODIVERSITY CONSERVATION

According to Brussard et al. (2010), biodiversity conservation and food security are two sides of the same coin although they have long being considered mutually exclusive. Although ecologists and conservation biologists focus primarily on biodiversity conservation in non-agricultural lands it has been recognized that a strictly conservation focus is limited in scope, particularly in terms of fulfilling production requirements (Godfray et al. 2010). This is pertinent given that protected areas in Nigeria are encroached by some sort of agricultural systems (Ezealor 2001).

The desire to meet the increased demand for agricultural product and guarantee food security with the need to conserve biodiversity make Nigeria a great potential for ecoagriculture.

This paper outlines agricultural expansion as the main threat to biodiversity conservation in Nigeria. It looks at biodiversity in Nigeria, its importance and the method of conserving it. Most importantly, it looks at the interrelationship between agriculture and biodiversity conservation. I examined some approaches, which in my own opinion will contribute to integrating biodiversity conservation and agriculture to meet the increased demand for food.

In an attempt to integrate biodiversity conservation and agriculture in Nigeria, ecoagriculture should be considered. As proposed by McNeely and Scherr (2003), the ecoagriculture strategy comprises six strategies that consist of many collective measures. Three of the six are specifically designed to make space for wildlife preservation within agricultural landscapes focusing on the unproductive areas. The other three focuses on how to enhance the wildlife habitat value of productive farm lands themselves. The strategies are as follows:

CREATE BIODIVERSITY RESERVES THAT ALSO BENEFIT LOCAL FARMING COMMUNITIES

Here, the strategy involves selecting areas for protection in places where there are clear immediate advantages which includes environmental services, livelihood support, farmland protection for unique agricultural habitats, and add to the benefits that can be achieved from protected areas for local farmers through market and compensation methods (McNeely and Scherr 2003).

DEVELOP HABITAT NETWORKS IN NON-FARMED AREAS

The strategy to improve biodiversity value of agricultural landscapes includes creating habitat in areas in and around abandoned sites, waterways, and forested areas. Also, landscape niches for biodiversity may include schoolyards, parks, agro-ecotourism sites and industrial areas (McNeely and Scherr 2003).

REDUCING LAND CONVERSION TO AGRICULTURE BY INCREASING FARM PRODUCTIVITY

Agricultural expansion at the expense of habitat for wild living species has been an essential human survival strategy (Barrett 2013). Increasing agricultural productivity growth and sustainability in high potential sites may enhance reduction or abandonment of farming in environmentally-sensitive areas. This strategy involves using specific cropping patterns, improved crops or adding organic matter to the soil (McNeely and Scherr 2003).

MINIMIZE AGRICULTURAL POLLUTION

Poor management and excessive use of crop nutrients, pesticides, and penned livestock wastes are a major cause of habitat pollution that can kill wildlife directly or impair reproduction (Wood et al. 2000).Minimizing the use of agricultural chemicals can greatly enhance biodiversity in high input and low-input system through advances in organic farming, integrated pest management (IPM), and soil conservation (McNeely and Scherr 2003).

MODIFY MANAGEMENT OF SOIL, WATER AND VEGETATION RESOURCES

Agricultural system can be improved by means of modifying the management of soil, water and vegetation. This approach comprises several methods such as good logging practices, reduced tillage and improved irrigation efficiency. Suitable logging practices can increase long-term production and prevent much of the damage caused to forests. The costs of farming can be decreased by reduced tillage while protecting the microorganisms that live in the soil. Improved irrigation effectiveness can make more water available for wetlands (McNeely and Scherr 2003).

MODIFY FARMING SYSTEMS TO MIMIC NATURAL ECOSYSTEMS

The combination and arrangement of agricultural systems can be done to mimic the structure and function of natural vegetation. Agroforestry for example, is a dynamic, ecologically based natural resources management system which through the integration of trees on farms and in the agricultural landscape creates an agriculture that provides many of the environmental services of natural systems, including wildlife habitat (Scherr and McNeely 2003).

According to McNeely and Scherr (2003), a joint investigation by IUCN and Future Harvest recognized at least

36 examples of ecoagriculture, from different regions of the world and types of farming systems have been recorded to have substantial positive impacts on wildlife populations, farm harvests and farmer income. For instance, Mew (2000) reported that in Yunan Province, southern China, farmers have decreased the need for pesticides by planting more diverse rice varieties to control rice blast disease. An unusual research trial involving thousands of farmers observed that planting more than one variety of rice helped prevent the spread of the disease throughout the entire crop and increased rice yields by 89 percent. Due to the decline in the rice blast by 94 percent, the fields of rice need less costly chemicals and are friendlier to wild biodiversity. In 2000, 42,500 hectares of rice fields were being planted with this method, and 10 other provinces in China are beginning to test the technique.

VIII. CONCLUSION

Agricultural systems can make more efficient use of energy flows, create self-sufficiency, increase the diversity of above ground and soil organisms, enable self-regulation and enhance the systems' resilience by mimicking natural ecosystems.

Against the increased desire to produce more food and conserve biodiversity in Nigeria, ecoagriculture strategy remains the suitable potential option. However, poor national and international investment in research documenting and evaluating existing ecoagriculture production systems or in pursuing agricultural and conservation research to improve biodiversity supporting and financially viable production systems remain a challenge (Scherr and McNeely 2008).

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