

The book cover features a vibrant, high-contrast photograph of a waterfall cascading over a rocky ledge into a pool below. A stone bridge with a metal railing spans the pool. The background is a dense, lush forest. The title 'Man And' is in a white, bold, sans-serif font, while 'ECOLOGY' is in a large, yellow, serif font with a green outline, set against a dark green rectangular background.

Man And

ECOLOGY

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CHAPTER SIX

ECOLOGICAL ROLE OF AGRO-FORESTRY

BY

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INTRODUCTION

Three keywords can be derived from the term agro-forestry. These are AGRO, Forest and Forestry. AGRO is a Greek word meaning field. The field signifies an area of land for rearing animals or arable land for crops production. Forest refers to the collection of trees while forestry means the scientific management of forest land and its resources for increase productivity. Therefore, Agroforestry is regarded as a combination of woody perennials (trees and/or shrubs) on the management unit with arable crops/or animals. In other words, it encompasses the system of effectively managed farming and forestry simultaneously on the same piece of land. The farming entails cropping or animal production or both.

Agroforestry is not a new system of agricultural practice. It is as old as shifting cultivation (Adegbehin and Omijeh, 1991). The agroforestry in shifting cultivation or slash and burn agriculture was unplanned and the shrubs/trees were scattered and not selected. The trees selected for agroforestry must possess high potential for improving and conserving soil fertility.

At present a typical model of Agroforestry is in a form of alley cropping. In this case, selected and fast growing leguminous shrubs are planted in alleys with arable crops. Other forms of common agro forestry include Silvipastoralism (raising of browsing shrubs and grasses in the same land unit to provide feeds for domesticated animals), agrosilviaquaculture (production of food and \or wood and fish), Aquasilvipastoralism (production of food crops, fodder and livestock in both space and time).

The emphasis on the adoption of agroforestry lies in the fact that pressure on land and recurring of food crisis in developing nations are becoming serious threats to human life. Consequently, the traditional fallow period is drastically reduced resulting in loss of soil fertility and low crop yields. Therefore alternative agricultural technique that restores the loss of soil potential, stabilises crop cultivation and provides feed for animals becomes inevitable.

THE TRADITIONAL FARMERS AND AGROFORESTRY IN NIGERIA

The traditional farmers in Nigeria are those farmers who toil with their traditional farm implements to provide food for man and animal. Farming in Nigeria and even in all African countries is known to be dominated by this class of farmers whose farming practices are influenced by their culture and low level of technology.

Over the years, the traditional farmers started to recognise the role of trees in the soil fertility management and appreciated it as such. The researchers in early 1970s in Nigeria emphasised on clean clearing and tillage using farm machineries powered by tractor. On the contrary, the traditional farmers practised slash and burn agriculture. They have for ages exploited the potential of trees and shrubs for soil fertility restoration

Their farming system encourages tree survival and regeneration in a given piece of land. The scattered trees are usually pruned or coppice. The biomass is allowed to dry and thereafter burnt to ashes. The burning returns nutrients to the soil. And also causes the live-tree to shed leaves on the soil surface while farming activities continue.

The fallen leaves ultimately decompose to form organic matter in the soil as one of the benefits of Agroforestry in soil fertility management.

Most of the non-selected trees that serve diverse purposes in the traditional farming system in Nigeria include:-

- (i) Omphalocarpum procerum (Ibibio name – Etinsak)
- (ii) Dacryodes edulis African pear (Ibibio name –Eben)
- (iii) Harungana madascariensis (Ibibio name –Oton)
- (iv) Ceiba pentandra (Ibibio name – Ukim)
- (v) Xylopia aethiopica (Ibibio name –Ata)
- (vi) Pterocarpus spp (Ibibio name – Ukpa)
- (vii) Pentaclethra macrophylla –Oil bean tree (Ibibio name Ukana)
- (viii) Garcinia kola (Ibibio name –Efiat)
- (ix) Newbouldia laevis (Ibibio name – Itumo)
- (x) Coula edulis (Ibibio name – Ekom)
- (xi) Persea americana (Ibibio name – Eben mbakara)

Acioa barteri, Dialium guineensis and Anthonatha macrophylla have been reported as efficient soil fertility restorers (Okigbo, 1976). The above listed trees are just the few that are commonly found in Western and South Eastern zone of Nigerian.

In the far North of Nigeria, acacia albida, baoba etc are very prominent tree species. In addition to these tree species in Southern and Northern Nigeria exotic leguminous trees such as Leucaena leucocephala, Flemingia macrophylla and paraserianthes falcata are widely used as improved tree species in alley cropping systems.

CHARACTERISTICS OF TREES IN PLANNING AGROFORESTRY

The choice of tree/shrub species in planning an agroforestry scheme is very important in order to achieve the ultimate objectives of the scheme. The following characteristics can serve as guides for selection.

- (i) Adaptation to environment: Trees that are not adapted to the environment should be avoided due to management problem. In the Northern part of Nigeria, drought resistant trees include acacia, leucaena, Azadirachta indica (neem tree), Parkia clappertoniana, Cassia siamea, Eucalyptus robusta.
- (ii) Production of abundant and/or large leaves and resistant to harvesting. The trees selected for agroforestry must produce leaves in abundance and/or the leaves should be large in size. The significance of this selection is to provide enough litter to the soil when it is pruned (cutting of the branches

and/or the top), coppice (cutting the tree at the base of the trunk) lopped (selected removal of branches) and pollardized (removal of all the branches including the top, leaving only the trunk). The harvested trees should have potential for quick recovery and fast growth.

- (iii) Deep rooted and resistant to wind: Trees with profuse shallow roots growth are bound to interfere with agricultural practices and compete with the crops for nutrients. Such root growth will interfere with the harvesting of tuber crops. Trees selected for agroforestry should also be resistant to wind in order to serve as wind break.
- (iv) Restoration potential for soil fertility: Research findings have proved that leguminous shrubs or trees should be preferably used in agroforestry because they fix nitrogen readily in the soil and have high potential for nutrient recycling

THE ROLE OF FALLOW TREES AND SHRUBS IN SOIL FERTILITY RESTORATION

Trees and shrubs are the dominant vegetation of the humid area particularly where deforestation does not take place. The trees have great potential in soil fertility management as follows:

- (i) By providing shade and mat layer which are often necessary in intercepting rain drops impact thereby reducing run off and erosion.
- (ii) By increasing the nitrogen status of the soil through
 - (a) fixation, this made possible by symbiotic nitrogen fixing bacteria and mycorrhiza association in some tree species.
 - (b) exploiting the plant nutrients to appreciable depth in the soil to build up the biomass.
 - (c) Raising the soil organic matter levels and thereby make nutrients available to the crop.
- (iii) Improvement of drainage from waterlogged soils and improvement in infiltration, aeration and reduction in leaching.
- (iv) storing nutrients in their ligneous parts and thereby temporarily conserving these nutrients in the system and thereafter release them when they die and decay into the humus fraction of the soil. This goes a long way to improve

the soil structure, water holding capacity, nutrient retention and by raising cation Exchange capacity of the soil.

THE ROLE OF AGROFORESTRY IN SOIL FERTILITY MANAGEMENT

Appropriate agroforestry systems improve soil physical properties, maintain soil organic matter, promote nutrient recycling, and reclaim degraded land. The dynamics of its capability in the improvement of soil fertility can be appreciated in the following discussion.

Maintenance and improvement of soil physical conditions

Most trees develop canopy thereby protecting the soil against the direct effect of raindrop and high temperature. The protection thereby improves the soil texture and structure. Annual crops or a legume ground cover shortly after land clearing on the same piece of land where trees have already been established also help to protect the top soil layer. Therefore agroforestry systems should contain one of more such covers-tree top canopy, ground cover or a surface litter layer (Sanchez 1987). Such soil physical improvement must be compensated with a good choice and compatible clearing and tillage.

Nutrient recycling: The choice of nitrogen fixing leguminous trees and shrubs gives agroforestry technology a significant position in the traditional farming system. A nutrient recycling potential of agroforestry system on Alfisols and Andepts reveals moderate to high fertility (Nair,1984). The efficient nutrient recycling through symbiotic associations in the leguminous species and the ability to penetrate into deep profiles, trapping and returning the already leached nutrients trapped in the biomass as soil organic matter gives more impetus to agroforestry.

Improvement in Soil Organic Matter:

Organic matter plays a significant role in the improvement of the tropical soils. It contributes to improve soil fertility, water holding capacity, infiltration, soil fertility, water holding capacity, infiltration, soil structure and texture, weed control and improvement of soil

microbes status. Improvement in soil organic matter level of the soil usually results from the litter provided by the trees or shrubs in agroforestry. The tree species provide long – lasting and high amounts of biomass which is incorporated into the soil as organic matter. This can be achieved with alley cropping which usually returns appreciable biomass back to the soil.

It is organic matter that can circumvent the decrease in soil pH, effective cation exchange capacity and the relative proportion of basic cations on the exchange complex. Soil organic matter is a source of ion exchange materials and inorganic nutrients for plants and water conservation hence it is the live-wire of the tropical soil.

Reclamation of Marginal land: A poorly degraded farmland can be reclaimed by the introduction of shrubs and trees and allowing a period of growth and full establishment to take place before farming purposes.

Waste lands reclamation is also possible with agroforestry. Such wastelands include land classes V, IV, VII, VIII, in the USDA land capability classification having one or more severe limitations of slope, erosion, stoniness, rockiness, shallow soils, wetness flooding, etc. (Tejwani 1979). Etukudo (2000) recommended *Gmelina arborea*, *Anacardium Occidentale*, *pinus caribaea*, *Eucalyptus Citriodora*, *Acioa barteri*, *oxytenanthera abyssinica*, *Bambusa vulgaris*, *leucaena leucocephala*, *dacryodes edulis* among others for quick vegetational cover of erosion sites as well as prevention of floods.

ACCESSORY ROLES OF AGROFORESTRY:

- (i) The trees provide stakes for staking and environment for hunting.
- (ii) About 100% of the rural dwellers mainly use deadwood as fuel for cooking.
- (iii) Trees also provide materials for building.
- (iv) Tree species are used to conserve soil water.
- (v) The enhancement of weed suppression is also possible in agroforestry system where the top soil layer covered with thick

mulch and thereby producing smothering effect on the weeds during the fallow period.

- (vi) Some species of trees used in the agroforestry system provides sources of feed for animals e.g. *Persia americana*, *Gliricidia sepium*, *Leucaena leucocephala*.
- (vii) In the drier areas of Africa, trees and shrubs in agroforestry provide windbreaks since they are used as permanent features in the landscape around the farm border.
- (viii) Fibres for mats, baskets and medicinal materials have long been appreciated by farmers who engaged in agroforestry system.
- (ix) Some trees also provide edible fruits, leaves and seeds for man's use. This contributes in alleviating the food problem of our time.
- (x) Agroforestry also provides materials for art objects and making of furniture.
- (xi) A farmer may also benefit from a particular tree which provides excellent shade. The shade is used as a resting point by the tired farmers to drink water or eat and regain strength to continue the farming operations. Excellent trees for shade include *Ficus elastica*, *Hura crepitans*, *Terminalia catappa*, *Cassia siamea*, *ingavera*, *Eucalyptus robusta* etc.

AGROFORESTRY AS AN ECOSYSTEM

The importance of agroforestry as an ecosystem cannot be over-emphasised. Its role as an ecosystem are discussed as follows:

- (i) It provides refuge for terrestrial wild animals:

Agroforestry provides shelter for wild life. The system also provides food, security and other requirements for terrestrial wild animals. A wide range of animals like the antelope, grass cutter, porcupine etc. are commonly found where trees are in abundance. The remains of the farm crops after harvest attract a lot of animals for food. Such crop leftover include the maize grains and cobs, cassava tubers left in the ground, spoiled yam, groundnut seeds and shells, ripe palm fruits, and

kernels etc. The longer the fallow period the more the expectation of wild animal species..

(ii) Refuge for arboreal animals:

Animals that spend much of their life and time on top of trees in search of food and convenience find agroforestry system a good companion. Monkeys and several species of squirrels are commonly found on top of trees. Most birds provide their nests on top of trees. Wild fruits in the agroforestry system serve as food for birds and other arboreal animals. Several ants species and snakes also find the system a convenient environment for existence.

(iii) Increase in the population of snails, earthworms and micro organisms:

The abundance of plant species in the agroforestry makes it possible for the fall of the numerous leaves littered on the ground during fallowing. Temperature is modified. The micro climate is cooler than practically treeless environment. The snails, earthworms and micro-organisms feed on the decayed plant materials in conducive environment. The death of the higher plants, their entire roots, stem and branches add to increase food for wild animals in this ecosystem. Earthworms and other smaller animals capable of being eroded are protected because the trees protect the soil from being carried away by either wind or water erosion through the mechanism of binding the soil particles with the roots of the trees, the leaves intercept the force of the raindrops on the soil while the litter provides protective cover on the soil hence erosion is controlled.

(iv) crop pests, pathogens and weeds control:

In agroforestry system, if the fallowing period reaches about 3 years the pests and pathogens causing plant diseases could no longer find their hosts crop plants. Sometimes as the host plants are eliminated, the pests and the pathogens population is also likely to reduce. In cultural pests and diseases control, fallowing has been used over the years to overcome phenomena of pests and diseases problems. Weeds population is also reduced to minimum in

agroforestry system. The falling leaves and shade provided by the trees are bound to reduce the rapid infestation of weeds.

(v) Preservation and production of aquatic animals and bees:

In agrosilviaaquaculture, trees like mangroves are grown in addition to fish culture. Rice cultivation is also associated in this system. The main tree species of the mangrove include Rhizophora racemosa, R. Mangle, R. harisonii etc. in this system, the mangrove trees are maintained and protected. In some integrated fish/crocodile farms, the mangrove trees provide shelter for the organisms. In this habitat, oysters, shrimps, crabs, lobsters and prawns are raised for economic use and also to feed the crocodiles. The fish population is in great danger due to the presence of crocodiles whose population is favoured at the expense of fish population.

In silviapiculture which is the concurrent keeping of bees for honey and raising of trees, both organism are preserved to maintain the honey production. The modern method of bees keeping is called agrosilviapiculture. Honey, fuel wood, food, fodder, fruits and seeds can be obtained from the system. This system unavoidably preserves the environment (Etukudo, 2000).

It is obvious that the agroforestry system provides shelter, food and security to different species of wild animals ranging from terrestrial to arboreal. The pledge of agroforestry is presented in this chapter to highlight its role as an ecosystem.

PLEDGE OF AGROFORESTRY

I am Agro and Forest
Put together give you
Sustainable food production
But without trees I cannot exist.

Nurse and protect them
No Harm, No death
Through search for fuel and building
Burning and cropping

I am a mother of all terrestrial wild animals
The wild birds are housed and nursed by me
I produced all kinds of wild fruits
To meet the taste of man, animals and birds.

I leave to man all the products I toiled to produce
Crops, fish, animals and honey just to mention but few
Through fallowing I can perform better in my role
Oh man what else can I do for you?

CONCLUSION

In the rural areas, it is evident that much appreciation has been shown in the combinations of non-selected trees with arable crops under conditions of low levels of technological inputs. Agroforestry that is compatible to the environment, culturally acceptable, economical sound and also fitted into the farming systems should be adopted and practised intensively to compensate for the loss of soil and soil nutrients through either short fallowing or continuous cropping system that is currently practised by many farmers in Nigeria.

REVIEW QUESTIONS

- (1) Define the following terminology:
 - (i) Agroforestry
 - (ii) Pruning
 - (iii) Coppice
 - (iv) Pollardizing
 - (v) Looping
- (2) (a) Mention one advantage each of the different methods of harvesting mentioned in question one above
 - (b) Explain and illustrate what you mean by nutrient recycling.
 - (c) Why is it important in agriculture?
- (3) (a) State the role of agroforestry in the fertility maintenance of fragile tropical soils.
 - (b) State five reasons why agroforestry is regarded as an ecosystem.

REFERENCES

- Adegbehin, J. O. & J. E. Omijeh (1991) Agroforestry practices in Nigeria. Extension Bulletin No. 52 NAERLS Zaria
- Etukudo, I (2000) Forests: Our divine Treasure. Uyo dorand Publishers.
- Nair, P. K. R. (1984) Soil productivity, aspects of Agroforestry. Nairobi ICRAF.
- Okigbo, B. N. (1976) Role of legumes in small holding of the humid tropics. In Exploiting the Legumerhizobium Symbiosis in Tropical Agriculture. Uni. Of Hawaii, Honolulu. Dept. of Agronomy and soil Science.
- Sanchez, P.A (1987) Soil Productivity and Sustainability in Agroforestry System. In Agroforestry, a Success of Development. Nairobi ICRAF. PP 205 –233
- TEJWANI, K.G (1979) Soil Fertility Status Maintenance and Conservation for Agroforestry Systems on Waste Lands in India. In Soils Research in Agroforestry ICRAF PP 175-204.