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AGROFORESTRY MANAGEMENT IN NIGERIA AND THE FEDERAL GOVERNMENT INTERVENTION

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1.0 INTRODUCTION

In the course of the article the researcher discovered that the implications of the Federal Government of Nigeria's intervention policy on forest and agroforestry system has not been fully realized by the farmers as it were. However, integrated land-use planning provides an essential strategic framework for balancing land uses. Moreso, such planning processes must be participatory, because it is farmers and other stakeholders who must finally put the plans into practice, and will do so only if they meet their needs and interests.

It is known that forests and trees support sustainable agriculture by, for instance, stabilizing soils and climate, regulating water flows, giving shade and shelter, and providing a habitat for pollinator and the natural predators of agricultural pests. It integrated wisely into agricultural landscapes, forests and trees can therefore increase agricultural productivity. Forests and trees also help ensure the food security of millions of people, for whom they are veritable sources of food, energy and income, in most of the times.

Nonetheless, agriculture is still the major driver of deforestation globally, and agricultural, forestry and land policies are often in disagreement. According to food and agriculture organization of the United Nations, in 2016, "State of the world's forest; Forests and Agriculture: Land-use challenges and opportunities, shows that some countries have been able to attend to, the aspirations of the different sections, increasing the agricultural productivity and food security of their populations while also stopping and even reversing deforestation. Today, the challenge is to support such positive moves in countries, especially low-

income countries, in which food scarcity is still prevalent and where forests are still being lost. [1]

However, planning for integrated land-use provides an essential strategic framework for balancing land uses. Necessarily, such planning processes must be participatory, because it is farmers and the rural duelers that must eventually put the plans into practice, and will do so only if they meet their needs and interests. So, be that as it may, agroforestry has enormous role in commitment to rid the world of the twin scourges of poverty and hunger. As the case may be, this urgently requires closer collaboration and partnerships, across all sectors, as well as, at all scales.

1.1 **AGROFORESTRY AND FARMING**

Earlier on it has been said that agroforestry is a tradition land use system that may provide the solution for the environmental problems in agriculture. It has also been said that agroforestry is the practice of deliberately combining wood vegetation with crops and animal systems to benefit from the resulting ecological and economic integration. Thus, agroforestry is not related to a particular farming system. Fulltime farmers combine trees with crops and/or animals. So, agroforestry is not more intensive or extensive than other types of agricultural land use. But agroforestry is able to eco-intensify production systems through better use of resources,[2] Mosequera Losada et al (2020) as cited by, Pantera et al (2021). In tropical regions, where mineral fertilizer and synthetic pesticides are often not readily available, agroforestry is similar to organic farming.

However, the adoption of agroforestry practices according to Pantera et al, could contribute to increase the sustainability of organic farming and discuss the challenges and opportunities of this adoption. The contemporary agroforestry systems need to be designed to combine environmental benefits with new requirements such as mechanization and the efficiency of labour so as to make the production system economically, reliably sustainable. As the writers submits, until new policy are stated, subsides for the ecosystem services, agroforestry systems provide will be of critical importance to encourage a wider adoption of agroforestry.

1.2 **THE HISTORY OF AGROFORESTRY SYSTEM**

Based on what has been expressed above concerning agroforestry, it is being buttressed here further, that agroforestry is, viewed as a societal response, basically, borneout of a need to fulfill important human needs of food, fuel, fodder, shelter, protection etc. However, the history of agroforstery system began by the cultivation of tree and agricultural crops in intimate combination with one another. This is the ancient practice that farmers used throughout the world. But in Europe until the middle ages, it was the general custom to clear-fell degraded forest, burn the slash, cultivate food crops for varying periods on the cleared area and plant or sow trees before, along with, after sowing agricultural crops. In Europe, this kind of "farming system" has reduced and less popular. In Central America, it has been in place for a long time, the traditional practice for farmers to plant an average of two dozen species of plants on plots larger than one tenth of a hectare.

A farmer, for example, would cultivate coconut (Cocus nucifera) or Pawpaw (Carica paya) with a lower layer of bananas or citrus, a shrub layer of coffee or cocoa, annuals of different stature such as maize and finally a spreading grown cover such as squash. This intimate mixture of different plants, each with a different structure, imitated the layered configuration of mixed tropical forests. But in Asia, for example, the Philippines, there used to be a complex and somewhat sophisticated type of "shifting cultivation", clearing the forest for agricultural use, and the deliberately spreading certain trees which by the end of the rice growing season provided partial canopy of new foliage to prevent excessive exposure of the soil to the sun. This kind of system was indispensable farming and were either planted or preserved from the original forest to provide food, medicines, construction wood and cosmetics. Surely, this meets the socio-economic and environmental benefits of agroforestry practices.

But in Africa, the situation was a little different. According to Amonum, J. J. et al, in quoting Nair (1993), reported that yams, maize, pumpkin and beans, for example, in Southern Nigeria, were typically grown together under a cover of scattered trees. He observed that the Yoruba of Western Nigeria have long practiced an intensive system of mixing herbaceous plants, shrubs and trees crops, claiming that the system is a means of conserving human energy by making full use of the limited space won from the dense forest. Also, in (Ojo, 1996) view, as cited by Amonum, J. I., et al, the Yoruba claims that this system is an inexpensive means of maintaining soil fertility as well as combating erosion and nutrient leaching.

However, there are several examples of traditional, land-use practices involving combined production of trees and agricultural species on the same piece of land in many parts of the world. Some of these examples, are what is now known as Agroforestry. [3]

1.3 **NEW FACE OF AGROFORESTRY**

Due to problems of deforestation and environmental degradation faced, in the tropical regions; individual and institutions have step up their search for appropriate land use approaches. This is not only an additional idea to traditional land-use practices but it is socially acceptable as well and ensures the sustainability of the production based and meet the need for production or multiple outputs. The attempts to design major programmes which would allow local communities to benefit directly from forests, paved the way for new forestry concepts such as social forestry in many countries. According to Amonum, J. I., et al, one of the approaches was experimentation in the general field of intercropping and in particular, it was felt that there was a need for a more scientific approach to intercropping research.

It was suggested that more effort were required with the consideration of crop physiology, agronomy, yield stability, biological nitrogen fixation and plant protection. Moreso, the International Institute of Tropical Agriculture (IITA) extended its work to include integration of trees and shrubs with crop production. Serious work, for example, had also been initiated on the integration of animals with plantation of tree crops such as rubber and the intercropping of coconuts with legumes, by other research organizations.

Thus, the most reliable single initiative that contributed to the development of Agroforestry came from International Development Research Centre of Canada. The IDRC Project Report, Amonum, et al, Posits that it recommended the establishment of an internal organization which would support, plan and coordinate on a world-wide basis, research combing the land-management systems of agriculture and forestry. Based upon this, the International Council for Research in Agroforestry (ICRF) was established in 1977. Thus, in 1991, it was renamed the international centre for Research in Agroforestry (ICRAF) and charged to play a leading role in collecting information, conducting research, disseminating research result and pioneering new approaches and systems.

1.4 **CONCEPT OF AGROFORESTRY**

There have been several attempts in defining Agroforestry. But the major effort began in the mid 1970s and evolved rapidly as studies began on the diversity and scope of Agroforestry practices. In the late 1970s and early 1980s the fate of Agroforestry suffered a great deal of projecting a definitions and a general lack of common understanding caused by inadequate information. The previous attempts to define a broad new area of study have resulted in a conceptual understanding from which to examine complex systems and practices.

So, one of the early definitions summarizes the basis for the study of Agroforestry, therefore, Agroforestry is a sustainable management system for land that increases total production, combination of agricultural crops, and forest plants and animals simultaneously and applies management practices that are compatible with the cultural pattern of the local population.[4] Nonetheless, many

efforts to define the art and science of Agroforestry, the ones giving below may be the most appropriate: Agroforestry is a land sustain use that involves deliberate intention, introduction, or mixture of trees or other woody perennials in crop/animal production fields to benefit from the result ecological and economic interactions. [5]

Furthermore, each of the above definitions according to the authors, has limitations; and several basic ideas can be drawn from them:

(a) Agroforestry is a distinct land-use system which may include combination of agricultural, forestry, horticultural and animal husbandry subsystems and practices. So, simply stated, Agroforestry is a means of managing or using land (i.e a multiple land-use system) that combines trees or shrubs with agricultural or horticultural crops or livestock (i.e. subsystem).

(b) Agroforestry integrates trees with crops and/or animals with the main objectives of reducing risk and increasing total productivity. Farmers have historically used indigenous mixed cropping, practices to minimize the risk of total crop failure by growing a variety of products on the same place of land.

(c) In their ideal forms, Agroforestry systems are both stable and sustainable. Agroforestry practices have greater diversity than do monoculture practices and can distribute production over a longer period. This provides income that is more regular with increased cash flow stability.

(d) To farmers, particularly those who may have difficulty storing or marketing farm produce.

(e) Integration of trees into agricultural systems may result in more efficient use of sunlight, moisture and plant nutrients than in generally possible by mono cropping of either agricultural or forestry crops.

Moreso, in the views of Amonum, et al, the concepts of Agrofrestry have been well explained in several publications. As it is today, there is no doubt, or differences of opinion that Agroforestry:

* Is a collective name for multiple land-use systems involving trees combine with crops and/or animals on the same unit of land;

* Combines production of multiple outputs with production of the resource base;

* Places emphasis on the use of indigenous multipurpose trees and shrubs;

* Involves the interplay of socio-cultural values more than in most other land-use systems; and

* Is structurally and functionally more complex than monoculture.

Thus, in a similar vein, the authors claimed that international Centre for Research in Agroforestry (ICRAF) continued to define Agroforestry as new research findings emerge. So, in their most recent definition of Agroforestry as a dynamic, economically based, natural resources management system that through the integration of trees on farms and in agricultural landscape diversifies and sustains production for increased social, economic and environmental benefits for land users at all levels, thus, Agroforestry often explained as "a new name for an old practice" is no longer a "new term". So, being accepted widely, as an approach

to land use involving a deliberate mixture of trees with crops and/or animals, is as well, considered here.

In addition to the above Agroforestry conceptualized statements, in his own submission, Rinkesh (2022), sees Agroforestry as that which is meant to mitigate the effects of global warming, and that environmentalists, leaders and experts have been recommending the adoption of the subject-matter. According to him, with the increasing demand for food and the negative effects of traditional farming methods, there has been a growing need to adopt a long term vision for tackling food insecurity in more sustainable farming methods. To him, this is how the idea of agroforestry came about. Essentially, Agroforestry's main goal is to combine both modern and traditional land use systems where trees are managed together with crops or animal production.

Therefore, Rinkesh defined Agroforestry as an agricultural system that involves the interaction of trees, shrubs and agriculture where they are designed and managed as a whole unit. In other words, it is the land-use management practice of combining both forestry, and agriculture (some call it agriculture with trees), with the objective of not only improving crop productivity but also increasing biodiversity and soil fertility, and reducing soil erosion. In agroforestry, the ecological function of trees, crops, and animals can increase food production while at the same time reducing the impact of agriculture on the environment.[6] As a matter of clarity, and of course, distinction, in the concept of agroforestry, the "complex agroforestry" need a special mention here.

1.4.1. **CONCEPT OF COMPLEX AGROFORESTRY**

There have been many different system able management systems put forward as viable solutions that will take the pressure off tropical forests. One of the most useful systems is "Complex Agroforestry".

According to Eulis, R. (2003), Complex Agroforestry provides a land-management system that increases production and ecological stability, as well as supporting sustainable development. Complex agroforestry encourages the sustainable development of degraded lands by maintaining human activity, while conserving natural resources.[7] Through its combined economic, environmental and social functions, it is its emphasis on management, economic and environmental qualities that distinguishes complex agroforestry from simple agroforestry systems, such as alley cropping, intercropping or hedgerow systems. Complex agroforestry also has the potential to significantly reduce atmospheric concentration of CO2 and mitigate climate change, with the total carbon fixed by dammar agroforestry at 287. 9t C/ha, (dammar shorea javanica is an example complex agroforestry).

Moreso, Eulis, says that complex agroforestry as a technique is considered as a sustainable management system for land that increases production and ecological stability and supports the sustainable development. This system can assist in a variety of short, medium and long term benefits both for local farmers and government. This system provides cash income to the farmers and a diverse range of product. The environment benefit of the agroforestry are the protection of soils and water resources, micro climate, sequestration of carbon, and the high

degree of spontaneous regeneration which allow conservation of a proportion of the original forest biodiversity.

Therefore, Eulis conceptualized complex agroforestry as forest structures planted and managed by farmers for the production of various forest and agricultural products on the same piece of land. He further stated that complex agroforestry systems in intimately association with a high number of components (trees as well as treeless, lianas, herbs), and the physiognomy as well functioning close to those observed for natural ecosystems, either primary or secondary forests are able to sustain both biodiversity conservation and farmers' economic needs. The complex agroforestry is different from simple agroforestry system such as alley cropping, intercropping or hedgerow systems due to its concept, management, and economic and environmental qualities. This system defined as agro-forest, seem to concern more forestry scientists rather than agriculturists.

1.4.2 **FUNCTIONS OF COMPLEX AGROFORESTRY**

Furthermore, according to Retnowati, there are some functions of the complex agroforestry system called dammar agroforest, which has been practiced by local people in Krui (the Pesisir areas), Lampung Province, Indonesia, since the second half of 19th Century. This system has given significant role to the farmer, the community and the country economically, environmentally and socially.

1. **Economic Functions:** Complex agroforests provide farmers with marketable and sustainable high value product such as resin, fire-wood, fruits, animal fodder, medicines, and high-grade timber. All of these products give

sustainable income to the farmer (directly) and sustainable benefit to the country (indirectly). Through complex agroforestry, the farmers will have the option businesses. This is achieved through the integration production systems which can offer a number of advantages when compared to traditional monoculture forestry planting.

2. **Environmental Functions**: As this system afford environmental benefit; it improve soil fertility by fixing nitrogen from the air and recycling nutrient from the soil, hold moisture, reduce soil erosion, keep valuable topsoil in place, reduce the intensity of downstream flooding and maintain watershed function, and increase biodiversity of degraded lands.

3. **Social Functions:** This system can improve the social welfare of the community by supporting the development of economic and natural resources. Complex agroforestry could provide valuable employment, business opportunities, and develop the village economy with environmental awareness. Through this system, the people could earn sustainable income from varied products, and they will have a better chance access to education, security, healthcare, and information. Also, by meeting the need for subsistence and short term cash income, complex agroforestry system could reduce the pressure on the natural forest. Complex agroforestry has made substantial progress in supporting local and surrounding populations as well as the environment through reducing poverty, increasing income, creating job, increasing food production, preserving and managing natural resources.

4. **Sustainable Development:** The input of complex agroforestry to the sustainable development is very significant through its economical, environmental, and social functions. Therefore, complex agroforest could meet the criteria of sustainable development including:

* Not creating negative impact to the environment;

* Improving forest hydrology functions;

* Improving biodiversity;

* Increasing food and wood productivity;

* Involving stakeholders;

* Appreciating customary right and local community; and

* Increasing job opportunity.

Thus, in his summation, Retnowati posits that the economic risk of complex agroforestry for the farmer is relatively low, as the need for short-term cash income; so that any pressure on forest land is reduced. Furthermore, there is urgent need for intensive land use practice for maximizing output from limited land resources. Complex agroforestry is considered to be very important crops and trees. Therefore, agroforestry complex encourages the sustainable development of degraded lands by maintaining human activity while conserving natural resources?

1.5 **SETTLEMENTS AND LANDSCAPES**

1.5.1 **Rural Settlement:** By rural settlement, it means a local geographical space or area in which the inhabitants establish their self-identity through constant relationships, that is neighbourly relationships, relationships arising from land tenure, the exchange of goods and services, political and administrative relationships. The term rarely covers a well-defined area because many of the criteria relating to the inhabitants' lives zigzag/crisscross, divide or overlap, this entire pattern being stamped on everyone's mind and on the network of mutual support. The inhabitants of the same village are implicated in village life in diverse ways, through their language, lineage, socio-political connections, marketing networks, land tenure and religion. Indistinct of term, "rural settlement," reminds us that rural environment are never the same in every way.

In this place, the farmer and his ancestors have fashioned the general appearance and even the distinctive features of the landscape, unless external forces have stopped in to build roads, railways and other infrastructures. The settlement is the living space in which the farmer works, cultivates the land and generally spends his life. While social structures determine the boundaries of a settlement, the local ecology, climate and economy also have a role to play. Two catchment basins are never the same; one may be humid with tree cover, another denuded with rock soil. Thus a district may revolve round urban activities, while a second is entirely devoted to farming, and a third is uninhabited.

1.5.2 **The Landscape:** This is one of the faces of a settlement, and like a man's face, it is marked by life: it can be smiling, peaceful, green, luminous or dry, troubled, wrinkled, wounded, ravaged and somber. It bears the traces of the past, the wounds and scars of time and man's effort to improve it. The word "Landscape" usually refers to what we see when we observe a rural settlement. In this study, the researcher aims at giving it a more complete, analytical meaning. This is done by peeling off the elements observed with the eye, we being to see how they mask certain economic and social realities of the settlement along with its land tenure, cropping systems and plantations.

A particular aspect of the life of a settlement is its vegetation which is affected by the behaviour of the Local people although in turn it influences microclimates and is useful in many ways where farm production, livestock and erosion by wind and water are concerned. This, the vegetation comprises a great variety of plants, from the very small to the very large. Some only live a few weeks on the ground surface, then disappear after having scattered their seeds; others live a long time, sometimes many hundreds of years. Among these plants, we find trees. So, a forest is composed of a host of plant species. They are massed in given proportions depending on biotic factors, land relief, soil structure, complementarily and competiveness, and their production systems.

The plants living together on a particular piece of land are called "Plant Communities" but the term is rarely used for cultivated lands. Thus, woody species live for more than one year, they are "perennial species". Every species is characterized as life span whose length ensures that the species leaves its mark on the history of landscapes. Some can see the passing of many human

generations and are therefore of continuity in the life of local community, although this continuity has been badly shattered in recent decades.

1.5.3 **ECOLOGICAL BALANCES/IMBALANCES**

A well balanced ecology is attained in a rural settlement when all the biotic and human factors affecting it relates and compensate one another or each other and stabilize the landscape over a long time period.

On the other hand, the local people may clear the forest merely to acquire rights over as much land as possible. After this is done, the crops grown were not very productive and the plots were neglected. So what will become of this land cleared by fire? Will the fields lie fallow after some year of cultivation, or be turned into orchards or grazing land? In any case, the ecological system which existed on these lands when they were covered by forest has been destroyed. Erosion and runoff are moved in and the soil changed on this settlement become regressive and there is no sign of any attempt to remedy the situation.

Therefore, resulting ecological imbalance would lead to severe leaching in the arable soil layer and many minerals would have been carried deep into the soil. Before clearing, the vegetation mitigated the effects of sun scald and rain. It kept recycling the water and soil minerals. So, the soil imbalance is due to brutal destruction of the natural vegetation. However, the soil that was suddenly stripped of cover, without any protection, and attacked by rain, sun and mechanical tools; in a few years time, the soil will have turned red and will be completely unfit for cultivation because human not knowing the subtle, delicate balance between soil, climate and vegetation, used destructive machinery

without bearing in mind to having the elements of soil reconstruction at his disposal.

Therefore, the problem here was not the use of mechanization in itself, but the questionable way which this mechanization, heedless of ecological balancing was put into practice. Thus, it is easy to destroy natural balances; it is very difficult to replace them.

1.6 THE MULTISTOREY FARMING IN RELATION TO AGROFORESTRY

According to Dupriez H. and De Leener P., the feel is the term agroforestry; is more an attempt at semantic replacement than an expression describing the realities of tropical agriculture. Positing further, the people of Europe living in temperate regions have used concepts that divided farming into sectors and in turn subdivided the rural settlements. Agriculture was practised in the fields (ager), in particular cereal and wheat growing and market gardening. The pasture lands whether managed or not (saltus) were either given over in pastoralism, or to extensive or intensive stock-keeping. The forest (silva) was land covered with trees. Wood was its main, but not sole product. Moreso, the authors posited that until the nineteenth century, the wood and forest of Europe were exploited for their acorns (fruits of the oak tree), beechnuts, which were used to feed swine. They were also exploited for their chestnuts, which were a staple food for some human communities.

So, these were the concepts according to which the administrative authorities and academies of the European countries were organized, with the result that the agronomist became distinct from the forestry specialist and the animal

technician. Their respective techniques, schools and research institutions are different. In many cases, they either ignore one another or let competition between their sectors prevail over cooperation. Not infrequently those technicians contradict one another when they speak to smallholders in the field. Also, conflicting political and social interests existed in Europe between the various land users, as it the case today in those parts of Africa where nomadic herders intermingle with farmers and hunters, particularly in Nigeria.

In their views, therefore, Dupriez and De Leener, says for some years now, considerable efforts have been made to integrate all the aspects of plant production under the same umbrella. But uniting in a single concept in a European language, terms which culture and history have done everything to distinguish for centuries is a source of ambiguity. Thus, the abundance of definitions presented by writers attests the difficulty by making distinctions between Agrosilviculture, Agrosilvipastoralism, Agripisciculture etc. which are all specific aspects of Agroforestry. Meanwhile, as a rule, these definitions and distinctions only concern the consumable or commercial production and neglect the other aspects which are the production of fertility and biotic services.

Therefore, the authors made a point that since the straightforward term "farming" was unsatisfactory, they decided in favour of "multistorey farming". So, colonial and post-colonial history has been at pains to distinguish traditional farming and modern farming, as though, traditional farming was not simply farming. In colonial times, there were primitive farming systems and European systems, the vocabulary may have changed, but they wonder whether its content has changed in people's winds. Moreso, the authors have deliberately discarded

this type of ambiguity once and for all, by believing that the term "Multistorey Farming" must take its place beside others of accepted usage such as "Monocropping", "Polyculture" or "Mixed Cropping", "Intensive" or "Extensive Farming".

However, multistorey farming described the positive, familiar face of tropical farming which integrates in a single production system of cultivation of herbaceous and woody seasonal, pluriseasonal, and perennial crops. In this approach, the aim is the highlighting of the many functions of farm systems at grass-root level. It is here that people living in tropical regions, and Africa, particularly Nigerians, reveal the conceptual wealth of some of the methods they uphold. However, one would like to see the scientists look more extensively into the complex sector of multiple crop associations, and pursue the study of their efficiency with the farmers who have developed them.

This is why, the term multistiorey farming or multistorey management of settlements may have been used. By this, it means, that the management of the living resources of a settlement or a field must take into account the synergies and complementarities between species whose habits, physiological characteristics, lifecycles, biotic services, production and field layout are different and diversified. The term multistorey field means any cultivated land area in which several species are grown together. Some may be dominant, others secondary but all play their part in farm production. These are fields where the capital represented by the land is worked intensively and where the growers pursue many farming goals at the same time. Multistorey plantations are fields occupied almost exclusively by wood species.[8]

1.6.1 **THE FUNCTIONS OF MULTISTOREY FIELD**

The plant storey has many meanings, and some of these meaning are in the following:

a. Storeys may also be called 'layers'; and exist in physical terms because the respective morphologies of the associated plants are different, they can be woody, grassy, erect, creeping, climbing, treelike or bushy. The branches in aeriel space and the roots in the ground occupy layers of space more or less superimposed.

b. The story develops in a time sequence because plants of varying ages and life cycles coexist. Saplings grow under the canopy of mature trees. Herbaceous plants cover the soil underneath bushes etc.

c. The storey is also ecological. It comprises very complete food chains and their countless links. Every species in the field has its predators who in turn have their own pests.

d. The story is functional. So, each plant layer and each phase of life fit into the framework of production – of food, fodder, fertility, medicaments and ecological services.

e. Thus, the story is also an example of sound economics. The harvests are spread over the seasons and their economic importance varies. Some are sold, some are for domestic use, while others provide animal fodder.

However, a multistorey field is like a layer with lots of shelves which fill up with the seasons and are emptied depending on the user's needs and his/her

economic circumstances. In most cases unpretentious, always changing way of making the most of one's environment since it is directed towards fulfilling priority family needs, Dupriez and De Leener (2003).

1.7 **THE CONCEPT OF AGRICULTURE**

Although the direction of this research is to investigate the "Agroforestry management in Developing Economies", but then it is also pertinent, to highlight some concepts as relating to agroforestry, as it is the main course of this research. Therefore, it is not misplaced here, to conceptualize the term agriculture, so as to provide a comprehensive understanding of the term agroforestry. However, the word agriculture is used for such a broad range of activities, that it is not so easy to arrive at a satisfactory definition. But agriculture can be understood as the life of the rural population in which production is intimately bound to consumption. Moreso, agriculture may be seen as an occupation or profession through which somebody may derive a livelihood. In another vein, agriculture is a business or industry of which various knowledge of sciences for the production of food, feed, fibre and fuel, may be employed.

But in their views, Ezedinma, F.O.C. et al, agriculture is a purposeful work through which the elements in nature are harnessed to produce plants and animals to meet human needs. This should be seen as a biological production process which depends on the growth and development of selected plants and animals within the local environment. Thus, it should be noted that within natural conditions, plants and animals grow and develop without human prodding and influence.

Nonetheless, agriculture evolved in response to human need for increased food production for a growing population. As such, people began to exploit the growth of plants and animals in order to produce the type and quantity of food and other products met their requirements. Perhaps, as a result of the facts given above, the system of agroforestry was discovered and it becomes a necessity to practice the system and thus, produce more food and other requirements from agriculture, to solving the problems of growing population. Agroforestry is the solution of mankind in the 21st Century, as regards the shortage of food. The effective management of the system by governments and other stakeholders, is a sine quanon.

Should we know, plants are the primary producers in agriculture; and in the process of photosynthesis, they take in carbondioxide from the air, moisture and mineral nutrients from the soil and, by trapping the energy from sunlight, convert these simple compounds into complex food materials that contribute to the growth of leaves, fruits, seeds, fibre, oils and wood. On the other hand, animals are secondary agricultural producers; that feed on plants or parts of plants and convert the complex food materials they contain into meat, milk, eggs, fats hides and wool which are used by humans for various purposes. Therefore, as it were, primitive agriculture made use of the soil, rainfall and the local species of plants and animals when they occurred. But those plants and organisms which reduced the productivity of useful plants and animals were controlled or avoided.

So, coming to modern agriculture, though, scientific and technological tools to control the factors and conditions which affects the growth and development of useful plants and animals has been employed; and as such, this is the basis of

crop and animal husbandry or modern farming. Moreso, organize husbandry of crops and animals, agriculture also includes the exploitation of natural communities of plants and animals in forests, rivers and lakes for food and other human needs.

However, agricultural production takes time and is beset by unpredictable natural hazards which cannot be controlled. Unlike industry, consequently, agriculture cannot adjust rapidly to changing conditions. It is still a localized, and mainly individualized enterprise, particularly in Nigeria. In areas with limited land and strong family attachment to land, high populations lead to fragmentation of farm holdings resulting in farm sizes which are below the minimum to function as economic unit.[9]

1.8 IMPORTANCE AND COMPONENTS OF AGROFORESTRY

The purpose of agroforestry is to combine both modern and traditional land use systems where trees are managed together with crops or animal production. Thus, essentially, this is the main goal of agroforestry. The system involves the interaction of trees, shrubs, and agriculture; where they are designed and managed as a whole unit. However, it is the land use management practice of combining both forestry and agriculture with the objective of not only improving crop productivity but also increasing biodiversity and soil fertility, and mitigating soil erosion, as it were. What agroforestry entails is that the ecological function of trees, crops, and animals can increase food production while at the same time reducing the impact of agriculture on the environment.

1.8.1 **IMPORTANCE OF AGROFORESTRY**

(I) **It improves nutrition and food security:** we know that planting trees in agricultural lands can help increase food production and boost food security. But agroforestry helps in health and nutrition improvement because of the increase diversity and quality of food outputs. Tree planting is part of agroforestry, which can be sued as a source of fuel, food and non-wood products that can be consumed or sold resulting in additional food security. So, trees can provide nutritious fruits, nut, and leaves for consumption in household. Felled trees and their residues can be used as wood energy for cooking and heating while leaves can be used as forage for livestock. Apart from food products, agroforestry also supports the production of a wide range of products such as timber, fiber, fodder and forage, craft products, medicinal products, hedging materials, and gums and resins etc. in addition to the above, trees planting as part of agroforestry system, can be of benefits for the health and survival of humans, animals and crops. Thus, trees can block strong winds, hence protecting crops from damage. Some crops like barley, alf-alfa, and winter wheat are also know to thrive under shelta.

Moreso, trees protect animals from wind chill in cold days while also providing shade on hot days and therefore, helping lower animal stress.

(II) **The creation of resilient livelihoods**: When trees are grown together with crops and animals it can help reduce the vulnerabilities associated with agricultural production and even improve the recovery after natural disasters, hazards and/or socio-economic downturns. Agroforestry economics, for instance,

helps to increase the diversity of production within the system thereby reducing the risk of economic failure. Thus, improved and sustainable productivity leads to increases in levels of farm income. Therefore, agroforestry can bring about sustained employment and higher income, which leads to an improved condition of the rural living standards.

(III) **Climate change mitigation and adaptation:** The growing of trees in agricultural systems can reduce the impact of climate change on agriculture. Sourcing tree products from trees grown on farms reduces the need to cut trees and so reduce the rate of deforestation that is quickly getting rid of the planet's carbon sinks while releasing stored carbon into the environment. Thus, trees in agroforestry systems, therefore, help to mitigate climate change through carbon sequestration. Moreso, agroforestry plays a critical role in improving climatic conditions and weather patterns by modifying microclimatic conditions such as temperature and water vapor content of air and wind speed, resulting in beneficial effects on crops growth and animal welfare. So, generally, this can limit the effects of climate change and global warming on agriculture as it can help in regulating air quality, water concentration, rain cycles, and patterns, and wind erosion.

(IV) **There is also an Environmental Benefits:** With careful plan and integration of agroforestry, it can help protect the natural resources in the environment. Growing trees, for example, can help improve the quality of water and its quantity by filtering and capturing of water resources. As part of agroforestry, trees also support biodiversity by providing a suitable environment,

for insects, animals, and plants. If trees with nitrogen-fixation function are part of the system, agroforestry can help restore soil fertility.

(V) **It support local communities and cultures:** The agroforestry system is designed to help local communities and cultures thrive. With agroforestry in place, and the help of it specialists, indigenous people and local communities can continue with the local benefits and culture while ensuring long term sustainability of the traditional systems. Thus, by preserving indigenous working techniques and species, agroforestry also helps to protect humankind's agricultural heritage. It should also be noted here that agroforestry can lead to decent rural livelihoods, cultural diversity, and maintaining local spiritual benefits. The system of agroforestry helps in the stabilization and improvement by removing the need to move sites of farm activities.

1.8.2 COMPONENTS OF AGROFORESTRY

The modern agroforestry systems are classified based on the present components of its practice; for example:

* **Silvoarable:** This is a situation where trees are grown together with crops.

* **Silvopastoral:** This is a situation where trees are grown together with animals.

* **Agro-silvopastoral:** Is where plants, animals, and trees are kept together.

a. **Agrisilvicultural Systems:** In this system, the components are agricultural crops and tree crops inter-cropped between the trees. The agricultural crops in the system can be grown for up to two years under protective irrigation and up to two years under protective irrigation and up to two years under refined farming. Beyond the specified period, growing grain crops becomes uneconomical but other crop components like fodder crops, shallow-rooted crops, and shade-loving crops can continue to be grown economically. In this case, to get the best yields, farmers should adopt wider spacing.

b. **Silvopastoral Systems:** with this system, the components are woody plants that are grown for pasture. The components can be trees or shrubs primarily grown to produce fodder for livestock or for fruit, timber, fuelwood or to improve the soil. This system can be classified into three categories that include "Protein bank, live fence of fodder trees and shrubs on pasture".

c. **Agrosilvopastoral Systems:** This system combined woody perennials with annual pastures. The systems can be classified into two categories that include home gardens and woody hedgerows for a browse, green manure, mulch and soil conservation. In addition, other systems such as Apiculture with Trees, Aquaforestry and Mixed Wood lots also exist.

In apiculture system with trees, the main components are honey bees and trees that encourage honey production.

In the aquaforestry system, the main components are fish and trees and shrubs that are preferred by fish. In the system, the leaves are sued as feed for fish while the trees are used for bund stabilization around the fish ponds.

In the mixed wood lots, multipurpose trees are grown mixed or separately for various uses such as fodder, wood, soil reclamation, and soil conservation. [10]

Based on the above expressions of Rinkesh (2002), we may submit that agroforestry is not just a way of life or a means to way of life; but it is lie. As long as humans' existence depends on it, we cannot just be in its practices alone, but be engaged in it for societal sustainability and food surplusity, and human socio economic wellbeing. It has been noted in the foregoing that agroforestry system has the potentials in mitigating the effects of global warming and environmentalists, leaders and experts have been recommending the adoption of agroforestry, though, with the increasing demand of food and the negative effects of traditional farming methods, there has been a growing need to adopt a long term vision for tackling food insecurity in more sustainable farming methods. Hence the idea of agroforestry practices. Thus, as an agricultural system, agroforestry, as noted by Rinkesh, is a land use management practice which combines both forestry and agriculture; with the objective of not only of crop improvement, in terms of productivity, but also increase in biodiversity and soil fertility.

Therefore, as we may know, trees and tree products, as the major factor in the agroforestry systems, have economic value, that can get Agroforesters a source of livelihood and potentially reduce their povery levels, especially in developing or emerging economies. So, the newly-produced tree products can be a source of employment and income for people.

1.9 TYPES OF AGROFORESTRY SYSTEMS IN NIGERIA

It has been stated in the scope of this research that the entire country would be covered; but of more necessity concentrated only on some states in the northern part of the country. The states are mentioned in the scope of study. Therefore citing Young (1989), Amonum et al, states that there are several, possibly thousands of agroforestry systems, in Nigeria, but only about 20 are in visible practices. The system exists in different places, with more of it in states mentioned above. Thus, they are so complex and diverse that they need to be grouped and classified into different categories in order to evaluate them and develop some action plans for their improvement.

The systems have been classified into system's structure, that is the composition and arrangement of components; functions, socio-economic scale of management and ecological spread. But as stated above, there are only three basic sets of components that are managed in every agroforestry systems. That is, woody perennial (referred to as "trees"), herbaceous plants or "Crops" and animals. Logically, agroforestry systems may be classified based on their component composition, thus they are:

(a) Agrisilviculture (Crop + Trees)

(b) Silvopastoral (Pasture/animal + Trees)

(c) Agrosilvopastoral (Crops + Pasture + Trees).

Table 1.1: Varieties of Agroforestry practices in Nigeria

S/N	Agroforestry System	Description	Remarks
1.	Taungya	This is a system where food crops are interplanted with trees in a unit area of land for 2-3 years. Food crops cease to exist on land when the trees crops close canopy. The system is effective in providing food for forestry workers and forage for cutting by herdsmen	It is the main Agroforestry model practice in Forest Reserves since 1950 to date. Most of the states owned artificial plantations now being exploited were raised through the Taungya model.
2.	Integrated Taungya	Just like Taungya farming, here when trees canopy is closed, livestock grazing substitute raising of agricultural crops.	This approach aims at starting the idea of land use practice whereby the activities on the land is stretched all the round.
3.	Improved Fallow in shifting cultivation	In this model cover crops on the farmland is introduced in an effort to minimize soil degradation common with agriculture.	This system mainly is to conserve and improve the soil. The soil amelioration due to the system leads to increase in crop yield during the cropping period.

4.	Alley farming	Trees, shrubs and other perennials are planted with agricultural crops to ad to woody plants in the rows.	This model is focused on livestock production. This system is designed to mainly for sheep and goat grazing. Advantages that the land provides crop residues and controls soil erosion through windbreak. Major disadvantage is the competition of hedgerows with crops for water, which always limit crop productivity.
5.	Alley-Cropping (hedgerow intercropping)	Arable crops, in this system are grown between hedgerows of planted shrubs and trees, mostly leguminous species that are periodically pruned to prevent shading of the companion crops and pruning applied as mulch for the crops.	This technique is new; developed at IITA and ICRAF. The trees provides nitrogen from atmospheric fixation, recycle nutrients from the depth of soil, suppress weeds and increase organic matter content of the soil.
6.	Shelterbelts	In this agroforestry system, food crops are planted as shelter. The trees and shrubs are planted in one more rows at right angle to prevailing winds.	This system often increases crop yield because of their beneficial effects on soil and microclimate. The effects on animals is to reduce stress from heat and wind. The labour involvement in this system are

			enormous and species used as hedgerow crops are without edible by-products.
7.	Windbreaks	In this system double rows of trees are planted around the boundary of a food crop farm on the windbreak side. Each windbreak is 150m long with 100 trees planted at escapement of 3m x 3m.	The windbreak advantage is that, it reduces wind erosion and at the same time produce forest with food crops.
8.	Home Garden	The tropical home gardens consist of a group of plants which may include trees, shrubs, vines and herbaceous plants growing around a homestead or compound.	This system is multipurpose trees and shrubs in a multi-story association with agricultural crops that are raised with small livestock in homestead. Home garden is not a formal practice of agroforestry, but a traditional farming system which focuses on agroforestry.

Adapted from Rinkesh (2022).

1.10 **THE HISTORY OF FARMING: THE NEOLITHIC REVOLUTION DYNAMICS**

In Hancock, J. (2022), what we know as farming today had its roots in the Neolithic Revolution which began between 10,000 and 12,000 years ago at various widely dispersed locations across the world, when human forebears first began planting and raising crops. As such, agricultural communities sprang up

almost simultaneously in Mesopotamia, China, Southeast Asia, Africa, Mesoamerica, and South America replacing the hunter-gatherer mode of subsistence that had been in place for hundreds of thousands of years, by man.

Evolutionarily, the shift from hunter-gatherer practice to farming perhaps occurred in stages. For several years, human ancestors lived on the bounty provided by their natural environment. Thus, those earliest upright ancestors might not have had a particular orderly approach to accessing food, but by the time of "Homo erectus", hominids were surely collectors, who planned the use of resources, the location of which was know and monitored. But during the time of the anatomically modern humans, that is, "Homo sapiens", they have had notable knowledge about how plants and animals developed and were going back to the same areas on yearly basis to harvest and hunt dependable sources.

According to Hancock, the original idea for planting might have come from waste dumps, where seeds were observed to germinate and grow. However, as they return regularly, to the same spot, it might not have taken them for too long to become cultivators, who enhanced the productivity of native fields by weeding, pruning and burning. Probably, they started to tilling with a digging stick or hoe to reduce competition and encourage germination. Perhaps they discovered at an early stage that crops did better subsequently, in the year, if the soil was turned after harvest. Thus, they became producers who transplanted small numbers of plants and held a few animals captive. These early gardens, though, were very small and in close proximity to residences and remained small until humans decided to make major commitment to agriculture.

This initial idea for plating, as noted above, surely came from dumps were seeds were seen to germinate and grow. But larger farms might have began firstly, when a specific farmer class emerged. In the early days of domestication process, "Homo sapiens" might not have been consciously selecting superior plant types, but it would not have taken the human ancestors, so long, to become domesticators, saving seeds and clonal material of superior types for another planting season. Those first crops were as diverse as the people and places where agriculture began. Nonetheless, the climates of the earth were plants were first domesticated varied substantially, and as such, an enormous plant and animal species were domesticated in each of them.

Therefore, in the Middle East, there were huge natural stands of wheat and barley, that brought about the early farmers in this region that exploited these as their staple crops. In Southeast Asia, wheat and barley were not conspicuous; but large-grained rice was much, and as a result, rice became one of the crops of choice. As in Mesoamerica and Africa, wheat, barley and rice were not present, so people exploited the locally surplus monocotyledons, that is sorghum in Africa and mazie in Mesoamerica. Thus there was no large-grained of any kind species existed in South America, so the result was that the early farmers there domesticated the tuberous species potato, sweet potato, and cassava, as well as pseudo-grains chenopod and amaranth. So, starchy staples were among the first domesticated crops at all the centres of crop origins, but they were always complemented with a high-protein vegetable and fiber crop.

Moreso, vegetables in the legume family were domesticated in all the major regions, including cowpea, for Africa; soybean, for China; groundnut, for South

America; and lentil and Chickpea, for Near East. Also very important source of vegetable protein, is amaranth and chenopod in the Americas. Thus, fiber was provided by different cotton species in Africa and South America, also in the Near East, flax was domesticated and in China, hemp. To the core family of crops in each region, additional leafy vegetables, spice, oil crops, and fruits were gradually added. Part of the last group to be domesticated were the fruits. While the grape and fig are very ancient and might have been cultivated for about 10,000 years, most other woody fruit crops were among the last additions to farming.

What is responsible for this, is in part, to tree fruits which takes so much time to mature, and since after planting the farmer must wait between 5 to 10 years for a harvest. Upon this, the fruit crops are outcrossed species; seedlings would frequently be inferior to the mother plant because of cross-pollination, and so complex pruning and grafting techniques had to be developed to fully exploit their potential.

1.10.1 **THE CAUSES OF NEOLITHIC REVOLUTION**

The question that has been triggered by ethnobotanists and anthropologists; is what made it so long for farming to emerge? May be the people had the wherewithal to farm long before they actually began doing it. Human ancestors surely gained, considerable knowledge about plants and animals through the very acts of hunting and gathering. Thus, they had observed seasonal patterns of plant development and animal

migrations and noticed seeds germinating and growing on their dump heaps.

Moreso, they burned fields to drive game and must have noticed the subsequent plant regenerations. They had as well, developed an intimate knowledge of how countless plant species could be used for food and medicine and know how to detoxify otherwise poisonous food sources. In Gordon Childe's Dasis Theory, the oldest formal idea about why humans began cultivation is probably suggested that, after glaciations, North Africa and Southwest Asia became drier and humans began to migrate and gathered in areas where there was water. The people first learned how to domesticate the animals that congregated around them, and then, as human populations grew, they learned how to raise crops to avoid starvation.

However, this theory is not less than appealing explanation for agriculture at xeric sites, but it is now observed that mesic areas in Southeast Asia and tropical South America also spawned agriculture. In the classic book of Sauer, "Agricultural Origins and Dispersals (1952)", suggested that farming first arose among fishermen in Southeast Asia. These people had a dependable food source, were sedentary, and therefore had the time and strength to experiment with new food production systems. We also noticed that in this theory, it worked fine in areas where fish and crustaceans were readily available, but it does not explain the origin of agriculture in dry places without seafood, like in the Mesoamerica and Central Africa.

Nonetheless, it has been postulated that agriculture arose as a byproduct of religious ceremony. That is plants providing ritualistic drugs were gathered and perhaps grown. Also, seeds may have been scattered on burial mounds. So also, animals could have been domesticated for sacrifice. Therefore, while religion would have been a forte for Neolithic peoples to apply what they knew about the life cycles of plants and animals, but then, we are still left with our original question of why it took so long for people to begin the farming process? A considerable evidence shows that people were spiritual long before they began domesticating plants and animals.

In addition to the above, other theories developed on the reason why humans began farming, centered around either climatic change restricting resource availability and stimulating agricultural activity or population growth reaching a height where there were no longer sufficient resources to feed the growing masses. As populations increases, food requirements may have risen to the level where alternative sources were need to supply enough sustenance. Perhaps, and simply put, that human ancestors began raising crops when they could no longer collect enough food from the wild to feed themselves and their families.

There was ample evidence that populations were actually increasing during the Agricultural Revolution at most early sites of crop origins, but it is not known whether the invention of agriculture stimulated that growth. Thus, the appropriate answer why it took a long time to begin farming is likely that hunting and gathering was a very comfortable way of life, and humans had to have a very good reason to give it up. In the expression of Juliet Clutton-Brock, cited by the world. History Encyclopedia, states that "with the abundance of food, and

excellent raw materials of wood, bone, flint, and antler it is difficult to see what the Mesolithic people of Europe lacked".

The Stone Age people were complex, intelligent creatures who could immediately adapt to the situations at hand. As they liked hunting and gathering, they were pushed by circumstances only as situation warrant, towards farming by several regionally specific forces, which included population growth, climatic change, overhunting, religion, or a minor desire to have more of something in short supply, be it food, spice, oil, ceremonial colour or fiber. So, food production is specifically the only one of the possible reasons for bringing plants under cultivation.[11]

1.11.2 **THE PRACTICES IN AGROFORESTRY**

Classifying the Agroforestry system: The following are the criteria for classification.

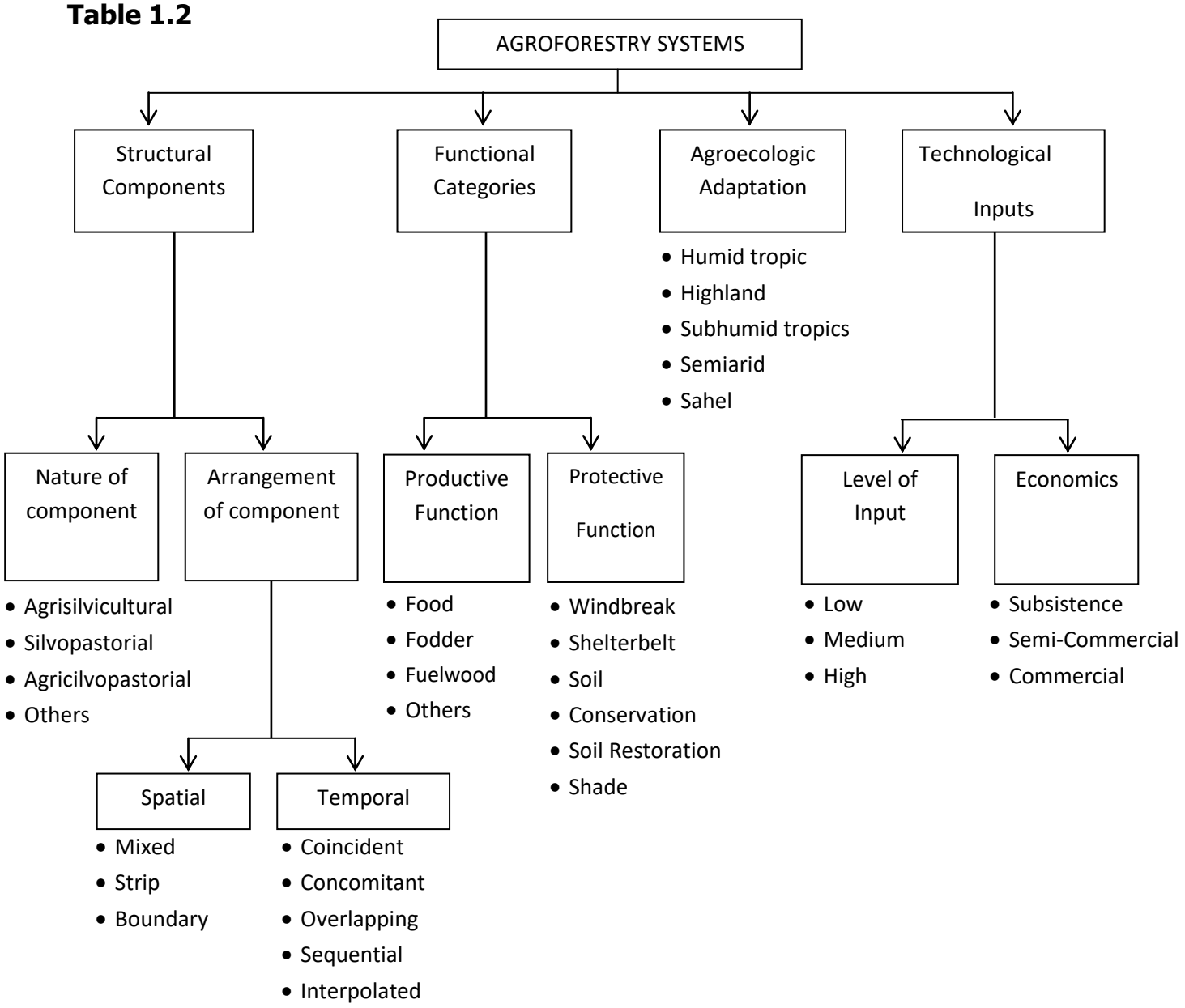
* On the basis of structure – this refers to the composition of the system and it arrangement in space and time. Putting woody species into different parts of farms and the agriculture landscape; can increase diversity, sustainability and productivity.

* On the basis of function – this is the role or use of the tree component, like the timber, fruit, fodder and medicine. Basically, the adding of trees increases the number of products generated by the system, which can acts as a safety net for farmers. The use of trees as windbreaks and to prevent soil erosion may also be important in addition to tree products.

* On the basis of socio economic – means the purpose of the system with regard to human livelihoods, mostly divided into subsistence, commercial, and intermediate production systems. Agroforestry may be needed to meet specific social goals e.g. poverty reduction and food security.

* On the basis of ecology – this case means the purpose of the system sustainability, for tropical, temperature and arid environments that take into account the environmental, ecological and biological conditions of each area.

Table 1.2



THE CLASSIFICATION OF AGROFORESTRY SYSTEM: ADAPTED FROM WORLD AGROFORESTRY CENTRE

1.11.2 **INFLUENCE ON AGROFORESTRY DEVELOPMENT**

In their views, Jianchu Xu, et al, a "One-model-fits-all" approach does not work for agroforestry due to the diverse biophysical and socioeconomic conditions under which systems can be developed. Thus the following are the factors influencing users' decisions and the selections of particular practices include:

* The incentives of government policies, also rules and regulations, on agriculture and forestry.

* The tenure of land, crops and trees, which determine whether it is worthwhile for farmers to plant trees and who benefits.

* The technical support and extension services for the supply of inputs – seed, fertilizer, information on tree management, etc. – and for market delivery – methods and information on value added, market etc.

* Markets accessibility, irrespective of the distance of different markets, road infrastructure, the ability to undertake sales through cooperatives and the possibility of engaging in barter trade.

* The profile of the user group, while include the needs from agroforestry that is, food, cash, medicine, etc. specific skills and traditional practices, labour availability, the level of education, and the aspiration and expectation of people.

* The biophysical conditions which include climate, soil type, slope, soil and water availability and so on.

1.11.3 **INSTITUTIONS AND SECTORS WORKING TOGETHER**

Since agroforestry represents the integration of forestry and practices including crop production, pasture land manage, animal husbandry, fish farming and lots more, agricultural enterprises, multi-agency collaboration is, therefore, the key to a favourable result.

1.11.4 **THE COMPONENTS OF AGROFORESTRY PRODUCION**

In this case, is the elements whose presence can be complementary and reinforcing it well managed.

* Trees for fruit, fodder, fuel, timber and other products, and for services such as soil fertility replenishment. Usually, trees remain in the landscape for a number of years with a rotation length perhaps in decades.

* For annual crops like grains, tubers, roots, vegetables, mushrooms, and flowers; the rotation for these crops is generally much shorter than for trees.

* The animals for draft power, dairy, meat and egg production, fish, snails and other organisms for eating.

1.11.5 **THE AGROFORESTRY SYSTEM MANAGEMENT**

* **Diversification of crop**: The most important aspects of agroforestry is diversification. It benefits covers a large range of food products to eat and sell, improved nutrition, and the ability to spread risk in production due to varying weather which involves floods, drought, etc. As long as different species occupy different spaces in the system, their production can be complementary – the overall output are greater for the system generally, than if one species only was present – and even in collaboration – the total yields are greater than the sum of the individual components if they were grown separately. Thus, diversification can also reduce the risk of pest attack. So, such benefits are not automatic, it all depends on what types of trees, crops, and animals that are combined.

* **The interactions of Trees and Crops**: the tree-crop interactions are agroforestry system and a frame-work for planting. The basic guideline include to:

    (a) Increase the overall value of the system;

    (b) Decrease complementarily;

    (c) Decrease or eliminate competition; and

    (d) Minimize crop displacement, through appropriate tree management.

* **Planting Arrangement and Tree Choice**: There need to be consideration for a particular space as the trees occupies in the farming system, also the total number of trees of the species that need to be planted. Making this possible is necessary to maximize the ecological and socioeconomic benefits from the tree itself and the same time to reduce the potential competition with other components of the system like the annual crops. Selecting the right species with the right form and rate of growth is important, as well as considering at what density to plant it and how to eventually manage it.

* **The use of perennial tree crops**: In this case, the use of Perennial tree crops, in comparison in terms of inputs: time, seeds, fertilizer, and land. The system of agroforestry which uses perennial plants – both tree, shrub and cover crops – provides food and useful materials for humans – fiber, medicine, dyes, edible leaves, spices, poles, honey, fuel wood, fodder, mulches, game, sap products etc. – as well as benefits to the other plants that is soil fertility. Therefore, as we managed agroforestry system, it is self-sustaining and efficient space, where once established, farmers only need prune and harvest, when perennial crops are used. Agroforestry builds a layered garden from ground cover to canopy trees that are all useful to user groups with less maintenance cost.

* **Contour Strips**: using contour strips in agroforestry systems is an effective way to prevent soil erosion in sloping land management.

The agroforestry that is in common practice of developing contours strips from trees, grasses and other plants is cost effective – with low initial establishment and annual maintenance costs compare to other methods – and provides other important ecological functions such as habitat for birds and insects.

* **Conservation of water and soil**: The landscapes of agroforestry have an important function in enhancing soil and water conservation. Agroforestry systems can minimize soil erosion caused by wind and water, and prevent the runoff of sediment and potential pollutants into rivers, while keeping nutrients such as fertilizer in farmland. The system of agroforestry slow water runoff and enhance infiltration, stabilize soil and reduce river bank erosion.

* **Management of soil fertility**: improving the soil fertility, in agroforestry can be critical. Leguminous trees planted as follows in between with crops can accumulate significant amounts of nitrogen in their leaves and roots, which is then made available to crops. Incorporating leaves into soil can increase crop yields enormously. The fallows that improved can also contribute to the control of weeds and provide wood for cooking and stakes for climbing crops. Some of the species used to improve soil fertility also have fodder value and can enhance animal manure quantity and quality.

1.12 IMPLICATIONS OF FEDERAL GOVERNMENT OF NIGERIA INTERVENTION PROGRAMMES IN AGROFORESTRY MANAGEMENT

The assessment of the Federal Government of Nigeria's intervention programmes in the management of agroforestry, cannot be left out, as a topic in this article. As the implication for the government is enormous, requiring a workable policies. Therefore, "the governance and management of land-use change", for agroforestry systems should be guided by right policies.

However, national policies and effect of land management decision can widely affect patterns of land-use change. The expansion, for example of agricultural land may be promoted in response to a need to increase food production or agricultural export revenues, and increases in forest area may be considered as a means of improving livelihood, protecting biodiversity and implementing environmental services. These policies may not be necessarily put together, for special treatment. Good governance and management of land-use change needs policies that should reflect national priorities and that are consistent, based on reliable evidence, and executed properly, such policies need to be supported by right tools and methodologies – such as land suitability assessments and land-use planning – to assist the Federal Government of Nigeria in targeting their interventions and to guide future use.

The heading in this chapter examines the ways in which Nigerian Government addresses land-use change – from forest to agriculture and

from agriculture to forest – in its national policies; and it provides an overview of the use of legal frameworks, and institutional mechanisms for implementing policies on land-use change. Thus, there is a difference between decisions, on land-use change that occur in the "governed" area and those made in the "non-governed" area. The governed area covers land-use decisions subject to formal policies, laws, strategies and programmes which are implemented in accordance with legal provisions and prescribed processes, with formal central or regional or state government approvals or consents. The non-governed area includes those decisions on land-use change that are not subject to such kind of rules ignore the rules through illegal action, or act that is taken in the context of unclear or contradictory formal rules.

While we focuses here, on the governed area and government policies, the implementation of formal policies is influenced by informal, context-specific, rules based on customary practice, cultural traditions and other social norms, including those related to gender, class and religion. Take for instance, women may have access to woodfuel and non-wood forest products but not to timber. So, gender-based differentiation of ownership and use rights in forests can have serious implications for forest management. Youth may also be restricted in accessing forest tenure. Informal rules have an especially strong influence where formal policies fail to provide clear guidance on land-use change, institutions responsible for policy implementation are weak, or the formal policies do not accommodate the needs of stakeholders. The area that is non-governed,

with its informal rules, need to be considered in determining the outcomes of government interventions policy, in the formal area.

According to FAO document, on "Policies for Governing Land-use change between Forest and Agriculture" of 2016, in the influence of national policies on land-use change shows a considerable variation between countries, and between sectors within countries, and between sectors within countries, in the approaches taken to land-use change and the importance placed on conversion from forest to agriculture (and vice versa). An analysis of national-level policies in 35 countries showed that just under half (17) of these countries explicitly addressed land-use change between forests and agriculture, and vice versa, in their main policy documents; 10 of those countries addressed the issue in more than one of their national policies. However, some policies identified a need for strategies to reduce or reverse forest loss: these included Ghana's forest policy, the land profile report of the Lao People's Democratic Republic, Mali's land-use policy, and Zambria's agricultural investment plan and forest policy.

On the other hand, the FAO, reported that sustainable land-use was highlighted in the land policies of Cambodia, Kenya, Niger, Romania, Uganda and Zambia. Policy objectives included the need to increase community participation in integrated land-use system, especially where agriculture and forest areas are contiguous; the enhancement of living standard by taken into consideration the conditions and requirements of

different regions (in a country); and the identification of land areas with natural potential for development.

Furthermore, land-use change has also been addressed in international agreements like that of 2030 Agenda on sustainable Development and the Paris Agreement on climate change. Thus, "the countries that signed the agreement will need to make sure that sufficient emphasis is given to land-use change in their national policies". Given an example here shows that 77% of the INDCs submitted in the case of Paris Agreement included forest-related actions and 88% included actions in agriculture. On the other hand, the convention on Biological Diversity's Aichi Biodiversity Targets state that, by 2020, the rate of loss of all natural habitats, including forests, should be halved and, where possible, reduce to zero (Target 5) and that areas under agriculture and forestry should, be managed sustainably ensuring, biodiversity conservation (Target 7).

However, recognition of the causes of forest loss in a crucial first step in developing effective policies. The study on policy documents of some developing economies shows that the conversion of forests to other land uses is more likely to be identified as a problem in forest policies than in the policies of other sectors. So, policy documents of some of the developing economies state that deforestation is caused primarily by agricultural expansion into forest land. In the policy documents of some – Ghana, Kenya and Cambodia - states that inappropriate land-use practices and environmental policies have encouraged land fragmentation, the expansion of urban development into agricultural land, deforestation, and

encroachment into catchment areas and wetland. These issues are indicative of the Nigerian situation of which the Federal Government has been mitigating.

Moreso, 7 countries of the developing economies, that experienced decreases in forest area and increases in agricultural area from 2000 to 2010 were examined in more detailed, to explain further the causes of forest loss, as stated in their forest policies. Thus, Figure 1, shows that agriculture – shifting cultivation, encroachment, land grabbing and cattle grazing – have been recognized as a contributing cause to forest loss in the forest policies of all the 7 countries, and the conversion of forest to agricultural land was seen as instigated by both corporate and small holder farmers.

The question of linking agricultural investment with environmental compliance and performance standards; suggest that giving support for commercial agriculture by introducing environmental safeguards such as cross-compliance measures can help avoid forest loss, especially in those countries where large-scale agricultural subsidies have had a serious impact on deforestation. In Nigeria, and some of the developing economies, as it were, commercial agriculture has led to forest loss. Subsidies on agriculture they support; and of course by making them cheaper to produce; thereby attracting investors.

The result is that there is usually, a pressure to expand agricultural land, strongly at expense of forests. The examples that may be given, in this

case, is industrial-scale cattle ranching in Nigeria, and soybean production in the Amazon, and commercial oil-palm plantations in Nigeria and Southeast Asia. Both Brazil and Indonesia paid more than $40 billion in subsidies to the palm-oil, timber, soy, beef and biofuel sectors in 2009 – 2012; those countries also accounted for over half of the total global forest loss in 1990 – 2010. Although, deforestation is happening in Nigeria and some countries, especially Mozambique, as a result of two kind of pressures exerted by subsistence farming and commercial agriculture.

Subsidies, though, given to producers of large scale commercial agriculture do not in themselves always lead to deforestation, in the case of some advanced countries. For instance, agricultural subsidies are high but forest area is increasing in those countries. However, regulatory instruments are required to mitigate the potential negative social and environmental effects of agricultural subsidies, mostly in countries that are attractive to investors in large-scale commercial agriculture and where there is a high risk that such investment will result to forest loss.

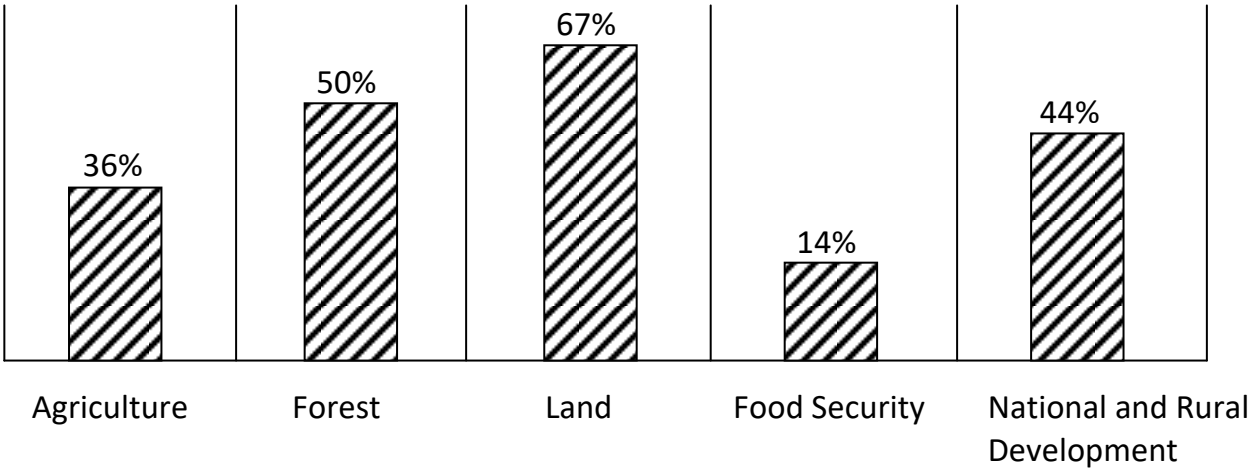
Moreso, talking about "Impact of Investments on Forests", it should be noted that public expenditure on forests is a good indicator of a country's commitment to sustainable forest management. Thus, the majority of the world's forests are publicly owned, and as such public-sector finance is a major source of funding for forestry activities, especially those focused on social and environmental benefits. In most developing economies, nonetheless, public expenditure on forests is disproportionately low

compared with the forest sector's contribution to GDP, and this has contributed to deforestation in those countries, (FAO, 2016).

Some graphic details of expressions given above are thus presented below:

Figure 1.1

PERCENTAGE OF 60 NATIONAL POLICY DOCUMENTS (FROM 27 COUNTRIES ADDRESSING LAND-USE CHANGE BETWEEN FOREST AND AGRICULTURE, BY POLICY TYPE)



1.13 THE LOSS OF FORESTS SINCE THE LAST 10,000 YEARS

The question has been asked, of how much of Earth was used to be filled by forests, and what portion is being covered today? However, the effects of deforestation on the climate are everywhere observed and felt, today. These adverse effects are expected to increase with time. This is the reason why most world leaders pledged to correct deforestation and end it by 2030 at the COP26 climate summit. The world's forests have been dwindling since the last ice age at exponential pace. Thus, to properly

examine the deforestation situation, it will enable us to understand Earth's total available surface area. Although, our world can be massive looking at maps or globes. But then, about 51 billion hectares in total surface area on Earth, more than 70% is taken up by oceans.

Therefore, what is remaining is 4.9 billion hectares of land, of which, not all were habitable. Thus, in the following was how the land was allocated 10,000 years ago by the end of the last ice age and before the rise of human civilizations. The land was inhabitable on Earth 10,000 years ago:

* Barren land (19% or 2.8bn ha): includes deserts, salt flats, exposed rocks, and dunes

* Glaciers (10% or 1.5bn ha): the vast majority concentrated in Antarctica

While in the following are the habitable land on Earth 10,000 years ago:

* Forest (57% or 6bn ha): includes tropical; temperate, and boreal forests,

* Grassland (42% or 4.6bn ha): wild grassland and shrubs;

* Freshwater (1% or <510M ha): lakes and rivers.

By 2018, forests had reduced to just 4 billion hectares; and what was the cause of this? Since human beings discovered how to cultivate plants and livestock for regular sources of food, therefore, they needed land to use. For many years, the loss of greenery was relatively slow. But by 1800, the world had lost 700 million hectares each of forest and grassland,

substituted by around 900 million hectares of land for grazing animals and 400 million hectares for crops. While industrialization in the 1800s, rapidly increased the process.

As the half of Earth's loss of forests occurred from 10,500 years ago to 1900, the other half or 1.1 billion hectares have been lost since 1900. Part of this loss, about 100 million hectares, has happened in the more recent period of 2000 – 2018. Even though urban land use has grown rapidly, it is still small in comparison to the 31% of habitable land now being used for grazing livestock. These land came initially from repurposed grasslands, but forests, as well, has been cleared in the process. So, more importantly, the world rising use of land for crops and agriculture reveals our fast growing population. In 1900, the global population was just 1.6 billion people; and by 2021, it had exceeded 7.9 billion, with hundreds of millions still being affected by food shortage every day.

How can many people be fed without needing more land? Due to meat's large footprint it has become necessary to prioritize crops, and this makes it more attractive, at the same time research is on, and other solutions like lab-grown meat and grazing erosion prevention is being addressed. But with the effects of climate change becoming more felt, it is likely that countries, companies, and people will have to welcome many different solutions at once. [14]

Therefore, and more importantly, on the basis of the above facts that are reviewed in this chapter; thus, the need then arises for the Federal

Government of Nigeria to redirect its policy actions in respect of the country's forests, and at the same time, reinvigorate its focus on agroforestry as required by global standard.

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