Available online at www.elixirpublishers.com (Elixir International Journal)

Agriculture

Elixir Agriculture 50 (2012) 10312-10316

ISSN: 2229-712X

Agroforestry: a panacea to food insecurity in Nigeria

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ARTICLE INFO

Article history:

Received: 9 May 2012;

Received in revised form:

16 August 2012;

Accepted: 1 September 2012;

Keywords

Agroforestry,
Silvopastoral,
Agrisilviculture,
Agrisilvopastoral,
Food insecurity,
Alley cropping,
Shelterbelts.

ABSTRACT

This paper examines agroforestry as a panacea to food insecurity in Nigeria. Agroforestry is defined as a combination of agriculture and forestry, resulting in better management of natural resources and sustainable use of land. It is the planting of trees among crops so as to help sustain environments and livelihoods. The practice of agroforestry is a dynamic, ecologically based, natural resources management system that, through the integration of trees on farms and in the agricultural landscape, diversifies and sustains production for increased social, economic and environmental benefits for land users at all levels. It has some characteristic features which could either be intentional or interactive. Intentional agroforestry is designing and managing combinations for a planned result. Intentional agroforestry can be intensive or integrated. In practice of intensive agroforestry, components are managed to maintain production and environmental benefits. Integrated agroforestry is a blend of agriculture, forestry and environmental science. Interactive agroforestry is designed to minimize negative and maximize positive interactions between trees, other crops, livestock and humans. The goal is to enhance the production of more than one component at a time while providing for environmental benefits. The paper discusses some characteristic features of agroforestry as either intentional or interactive. Silvopastoral, agrisilviculture and agrisilvopastoral are discussed as types of agroforestry systems while alley cropping, forest farming, riparian buffer strips and windbreaks or shelterbelts are described as the most common or popular agroforestry practices. Some limitations to agroforestry practices are also mentioned in the paper.

Introduction

Tree planting was conceived as potential strategy to meet the needs of local people and protect the environment during the 1970s. The worldwide interest in tree planting and management gave birth to several popular terms with 'forestry' endings such as social forestry, community forestry and agroforestry (Tamale *et al*, 1995; Nair, 1993; Foley and Barnard, 1984). There have been various definitions for agroforestry. Simply put, agroforestry is the planting of trees among crops so as to help sustain environments and livelihoods. It is a combination of agriculture and forestry, resulting in better management of natural resources and sustainable use of land. In other words, agroforestry is a method of farming that allows trees and shrubs to grow along with crops and/or livestock, therefore blending agriculture and forestry in the same production system. According to International Centre for Research in Agroforestry (ICRAF), agroforestry is a dynamic, ecologically based, natural resources management system that, through the integration of trees on farms and in the agricultural landscape, diversifies and sustains production for increased social, economic and environmental benefits for land users at all levels.

Barraclough and Ghimire (1995) wrote that though these terms are new names for age-old practices, specialists maintained distinctions among them, defining a precise technical meaning. Social forestry as an umbrella term includes the practice of planting or using trees to purchase social objectives through delivery of benefits to the local people. Community forestry, farm forestry and agroforestry are all forms of social forestry (Nair, 1993; Hobley, 1996; MPFS, 1991). Agroforestry is a collective name for land use systems and technologies involving trees combined with crops and/or animals on the same land management unit (Nair, 1993; Tamale *et al*, 1995).

In a country like Nepal, the practice of agroforestry can be described in two broad categories: farm-based and forest-based. The farm-based practices are home gardens, planting trees on and around agriculture fields, tree woodlots and commercial crop unnder shade trees or agriculture crops intercropped with commercial trees. Forest-based practices, on the other hand, involve specific agricultural practices associated with forests where farmers collect food, fruits and gums (Tejwani and Lai, 1992). Agroforestry system in Nepal is diversified and integrated with livestock, trees and crops. Hence it could be classified as an agro-silvo-livestock keeping system.

This paper focuses on some characteristic features of agroforestry, types of agroforestry, common agroforestry practices, and causes of food insecurity, consequences of food insecurity and how agroforestry can be used to mitigate food insecurity as well as some limitations to agroforestry practices.

Characteristic features of Agroforestry

Agroforestry can either be intentional or interactive. Intentional agroforestry is designing and managing combinations for a planned result. Intentional agroforestry can be intensive or integrated. In practice of intensive agroforestry, components are managed to maintain production and environmental benefits. Integrated agroforestry is a blend of agriculture, forestry and environmental science.

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Interactive agroforestry is designed to minimize negative and maximize positive interactions between trees, other crops, livestock and humans. The goal is to enhance the production of more than one component at a time while providing for environmental benefits.

Types of Agroforestry

There are three main types of agroforestry system, and these are silvopastoral, agrisilviculture and agrisilvopastoral systems.
Silvopastoral. This is a system which involves raising livestock on pastures grown in association with trees. The trees are grown for harvesting purpose and provide shed, shelter, food and so on for the livestock, as it can be seen in figure1 below.

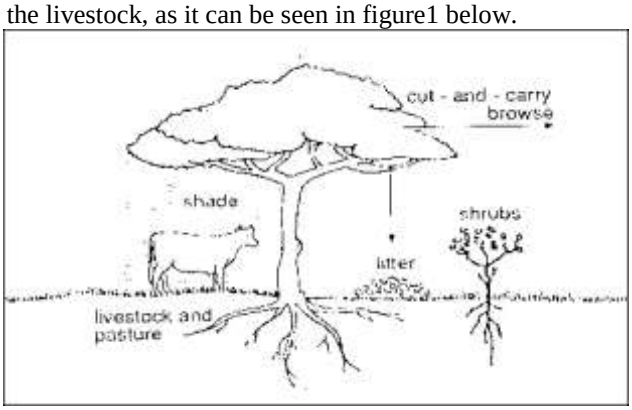

Figure1: Silvopastoral system

Agrisilviculture.

It is a system that involves simultaneous growing of crops and trees on the same piece of land, providing the benefit of both food and forest as shown in figure 2. Examples of agroforestry practices that fall under this system are taungya and alley cropping.

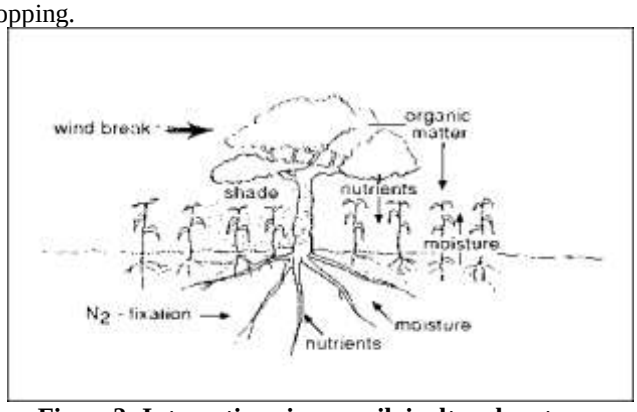

Figure2: Interactions in agrosilvicultural systems.

Agrisilvopastoral.

This is a system that involves three-way mixture based on a combination of crops, trees and livestock. Such a system requires skillful management and can be sustainable even in harsh environments and fragile soils.

Common Agroforestry Practices

The types of agroforestry techniques that are practiced depend on factors such as the region, type of crops, soil climatic conditions, among others. A broad selection of tree species and woody shrubs can be used for agroforestry systems. Some of these trees are suited for acid soil conditions and others for erosion control and some are more appropriate as forage trees. The choice of appropriate species is critical to the success of agroforestry system. In addition to the intended use, the choice of tree and associated crop species also depends on cultural and ethnic factors, which is of social importance. Some of the common agroforestry practices adopted all over the world are forest farming, shelterbelts, alley cropping and Riparian Buffer Strips.

Forest Farming

This practice involves cultivation of exotic and high value forest products along with high quality trees for wood products. Crops like mushrooms, fruit, nuts, berries, herbs and medicinal plants are just few of the many 'wonders' forest farming can produce. These types of forest products can yield high value while the tree matures.

Shelterbelts

This form of agroforestry practice is also known as windbreaks. In this type of practice, multiple or a single layer of trees and shrubs are planted along edges of the fields. This shields the crops or the livestock from the effects of the wind, snow or extreme temperatures. They protect the fields from soil and water erosions as well, therefore creating a more favourable environment for the crops to grow. This system can also be designed to specifically build natural shelter for livestock and this consequently reduces feed costs, odour, animal stress, mortality etc.

Alley Cropping

This is a practice in which agricultural crops are grown along with long term tree crops. It involves growing crops in-between trees planted in rows. The spacing between the rows is appropriately designed to accommodate a matured tree size while leaving plenty of space for agricultural crop to grow and receive sunlight. This requires skillful management and careful planning. The agricultural crop provides the annual income while the tree crop matures. Hard woods like oak, walnuts are generally preferred in alley cropping system.

Riparian Buffer Strips

This practice is also commonly known as 'filter strips'. The purpose of riparian buffer strip is to catch soil nutrient, pesticides and so on from flowing into the water bodies. The trees and shrubs are planted along the river, lake, etc. which in turn also prevents stream bank erosion. Buffer strips can be planned to provide habitation for wildlife and also production of exotic forest products as in the case of forest farming.

Causes of Food Insecurity in Nigeria

There are several factors that are responsible for the rising food insecurity in Nigeria. These include:

Rapid Population Increase

The average population growth of 2.8% in Africa remains the highest in the world(World Bank, 2002). In some countries, the rate is considerably higher. Although fertility rates have begun to decline in a few African countries, overall, Africa is the only region where the 6 to 11-year age group is still growing(World Bank, 2002). In addition, unlike other regions where the ratio of dependents to work-age population has fallen to one-half, the age-dependency ratio in Africa remained close to 1(World Bank, 2000).Rapid population growth increasingly overwhelms African countries physical, economic, and social service capacity to provide for the needs of their people. The results are high unemployment, malnutrition, overcrowded and underserviced squatter settlements, classrooms and clinics and smallholder farms subdivided to the point that they are too small to support a household(World Bank, 2002).

Limited Use of Agricultural Inputs

Low agricultural yields are due to the low intensity of agriculture, particularly the limited use of fertilizer and improved seeds(Ali and Pitkin,1991). For example, although increased consumption of chemical fertilizer is essential in most

smallholders agricultural systems, at present only around 9 kilogrammes of nutrients per hectare are used for agriculture in sub-Saharan Africa and only half this amount is used for growing food crops- compared with 10 to 20 times as much as in the industrialized nations(Table1). Similarly, while farmers are expected to endeavour to use all of the organic nutrients(which can be obtained through agroforestry practices) that are economically feasible not only to replenish nutrients but to improve overall soil structure and health as well, there simply are not enough organic manures and crop residues available to replenish and maintain soil fertility in the higher yield production systems needed to meet growing food requirements and reduce poverty(Borlaug and Dowswell, 2004).

Pervasive Soil Fertility Problem

Although there are some very fertile areas, much of Africa's soil is of relatively poor quality because of the continent's geological history and climate (World Bank, 2002). Some soils are deficient in key nutrients (e.g. phosphorus), have poor water retention and are easily eroded and degraded. A global assessment of soil degradation as well as World Bank strategy for development indicated that across Africa, 65% of arable cropland and more than 30% of all permanent pasture are significantly degraded(Oldeman, 1990; World Bank, 1996). According to Sanchez et al.(1996), during the past 30 years, the net per-hectare loss on about 100 million hectares of cultivated land is about 700kg of nitrogen(N), 100kg of phosphorus(P0 and 450kg of potassium(K). In contrast, over the same period, commercial farmers in North America and Europe have averaged per-hectare nutrient gains of more than 3, 250kg of NPK on 400 million hectares.

Consequences of Food Insecurity

The costs and consequences of inadequate or insufficient diets and hunger in terms of untold human sufferings are enormous and difficult to quantify. For instance, chronic and transitory food insecurity increase morbidity rates, cause stunted growth in children and chronic illnesses, sap strength needed for work and other tasks and reduce the benefits of schooling and the productivity of the people affected(Cernea, 1988a). This, according to Cernea(1988a), could be likened to a vicious circle in which the poverty that causes undernourishment in the first place is reinforced and perpetuated. Hence deprivation turns into starvation and decreases life expectancy.

Agroforestry as a means of mitigating food insecurity in Nigeria Before we can talk of food insecurity, we need to understand what food security means. When we talk of food security,it can be defined as access by all people at all times to enough food for an active healthy life(USDA, 1992) and the ability of food deficient countries to meet target consumption levels on an annual basis(Rosen and Shapouri, 1994).Food security has to do with food which is a basic substance that is needed for the sustenance of life and must be supplied to maintain good health and optimal performance (Iheanacho and Abdullahi, 2006). It must therefore be provided in adequate quality and quantity. Therefore when we talk of food security, it involves availability, accessibility, procurement and intake of adequate quality and quantity of food by individual, household, community or region. It is not determined by where the food is produced, but by whether individuals have access to it. The inaccessibility and failure to procure or afford food in adequate quality and quantity by individual, household, community or region is what is referred to as food insecurity. In the view of Cernea (1988a), food insecurity is the lack of access to enough food.

Sub-Saharan Africa, to which Nigeria forms a part, has a history of food insecurity brought on by meager rains, land degradation, declining soil fertility, bad management of resources and deforestation. According to FAO (2005), Nigeria has the world's highest deforestation rate of primary forests and this led to a loss of more than half of its primary forest between 2000-2005. Causes cited for this are excessive logging, subsistence agriculture and the collection of fuelwood. All these negatively impact on the environment and affect the sustainability, thereby posing threat to food security as a result of crop failure resulting from deforestation, floods, droughts etc. Agroforestry therefore plays a prominent role in supplying a large proportion of rural households' food needs in Nigeria. It does this in two forms. First, through the environmental protection role of trees and forests that enhances water and soil conservation to maintain high levels of productivity. Hence households will have adequate supply of food for their sustenance. Secondly, the direct food commodity contributions such as the supply of fodder, fruit and nuts as well as trees and shrubs that produce gums, resins and valuable medicines which can supplement normal farm yields or serve as substitute products in the event of crop failure.

Agroforestry also plays important role in income and employment generation in Nigeria. Since food security also means both physical and economic access to food, agroforestry practices enable people, especially in the rural areas, to generate significant amounts of income and employment that will place them in a better position to purchase food they cannot or do not produce. Income and employment are usually generated when people become involved in family-or-community- oriented forestry activities such as harvesting, processing and marketing forest products. The income earned from such activities will enable them to have access as well as afford food items they cannot produce, thereby boosting their food security status.

Limitation of Agroforestry Practices

Agroforestry practices have a lot of benefits if adequately practiced, but lack of proper education about high level of uncertainty and accompanying risk associated with it as well as high level of farmers' ignorance stand as impediments to the adoption. In addition, some disadvantages of agroforestry include competition of trees with crops for space, light, water and nutrients which commonly leads to smaller crop yields as supported by table1. Also, it causes impediment to mechanization of plant production and makes management more complex and difficult.

Conclusion

Agroforestry is a collective name for land use systems and technologies involving trees combined with crops and/or animals on the same land management unit Therefore its success is largely determined by the extent to which individual forest and agricultural components can be integrated to help rather than hinder each other. Therefore the choice of tree and crop species combinations is critically important when setting up any agroforestry system.

Recommendation

In view of this, governments at all levels should ensure that adequate information on agroforestry is provided to farmers so as to encourage agroforestry practices in Nigeria. Likewise, forestry sectors across the states in the country should embark

on agroforestry practices through sensitization and enlightenment campaigns to disillusion the minds of rural farmers who perceive agroforestry practice as a risky and uncertain venture. Above all, educational and allied research institutions should be adequately funded and encouraged to carry out research on agroforestry so as to come up with new innovations.

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Table1: Fertilizer Nutrient Consumption per Hectare of Arable Land, 2000

Country	Amount (Kg/ha)
Uganda	1
Ghana	3
Guinea	4
Mozambique	4
Tanzania	6
Nigeria	7
Burkina Faso	9
Mali	11
Ethiopia	16
Malawi	16
Benin	18
Cuba	37
South Africa	51
India	103
United States	105
Brazil	140
France	225
China	279
United Kingdom	288
Japan	325
Vietnam	365
Netherlands	578

Source: Borlaug and Dowswell, 2004

Table1: Yield reduction through shade at different nutrient supply levels.

Crop	Yield with full light (t/ha)	Yield with shade (t/ha)	Yield reduction (%)
Maize	0.5	0.4	20
Cassava	8.9	2.8	69
Yam	9.2	8.4	9
*Maize	1.5	0.7	53
*Cassava	14.4	3.4	76
*Yam	12.1	9.4	22

Means of three villages in Southern Nigeria (Okigbo and Lal, 1978)
*With fertilizer