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THE ROLE OF TREES IN INTEGRATED FARMING SYSTEMS IN BAUCHI STATE

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Abstract

With the aid of structured questionnaires, the role of farm trees in an integrated farming system in Bauchi State was investigated. The prevailing ecological zones in the state were used as strata which paved way for stratified random sampling technique to be employed in data collection. Three Local Government Areas (LGAs) each were used from each of the three ecological zones (Northern Guinea Savanna, Sudan Savanna and Sahel Savanna). Within the nine study LGAs, a total of ninety questionnaires were distributed among farmers practicing integrated farming in Bauchi State. The results show that out of many tree species, ten were found to be used for a variety of uses: medicine, farm tools handle, fuel wood, forage, timber and food. The respondents practiced different forms of integrated farming: crop production and tree culture, animal husbandry and tree culture, tree culture and aquaculture, and crop production and animal husbandry. The study also reveals the level of awareness of the farmers on indirect uses of farm [redacted] trees: protection of farm crops, provision of shade, erosion control and increase soil fertility. Classification of farm trees based on calorific value and packaging of fruit base products of the integrated farming system in Bauchi State were recommended among others.

Introduction

Agro forestry is the generic name used to describe the land use system in which trees are intentionally combined spatially and /or temporally with agricultural crops and /or animals. As a farming practice, agro forestry is very old and widely practiced, especially in the tropical and subtropical regions of the world. With a projected human population growth of 50 percent by the year 2050 the world food demand is expected to be more than doubled (Green *et al*., 2015). Increasing world population requires that agricultural production increase so as to keep up with basic food needs. This indicates that the demand from agricultural areas will increase enormously over the coming years (Tilman *et al.,* 2012). The expansion and intensification of the world's agricultural lands poses the challenge on how to produce enough food without jeopardizing the state of the natural environment. This is especially true in tropical regions, where population growth rates are the highest in the world. For this reason, various agroforestry practices are finding enormous application in many tropical regions and are lifting many out of poverty and mitigating declining agricultural productivity and natural resources. Notable examples are: fertilizer trees that when integrated with inorganic fertilizers can double or triple crops yields in degraded lands, fodder trees that can be used in smallholder zero-grazing systems in ways that supplement or substitute commercial feeds, improved varieties of temperate and tropical fruits that can be used to supplement household incomes and nutrition, medicinal trees that are utilized on farm and conserved in-situ, and fast-growing timber and fuel wood trees that can be grown in various niches within the farm and in commercial woodlots and plantations (Bashir Jama *et al*.,2006). Applying chemical or inorganic fertilizers on depleted lands may be one of the quickest ways of restoring or maintaining productivity. However, it is difficult to use this approach in the case of marginal upland farms (Gholz, 1987). First, there is a need to replace not only the nutrients but also the soil lost through erosion. Inorganic fertilizers can add nutrients but cannot contribute to soil formation, unlike fallow vegetation or scattered trees on farmlands, for example, which can accumulate organic matter from litter by as much as 5 to 7 tons per year (Sharma, 2005).

Second, as mentioned above, the high cost of chemical fertilizers, relative to the farmers' meager in come, is prohibitive. Since most farmers have little or no cash incomes, this type of input is out of question for most (Gholz, 1987).. For these reasons, the objectives of this research were to investigate:

- Multipurpose trees among the woody component of integrated farming system in Bauchi State
- Farmers' experience in integrated farming, and
- Level of awareness on the indirect benefits of farm trees

With a view to show casing same to general public expected to adopt integrated farming as environmentally friendly and economically viable agricultural practice.

METHODOLOGY

A brief about the study area

Bauchi state has a land area of49,259.01 km^2 with a population of 4.6million people and located between latitude90° 30^1 and 12° 30^1 North of the equator and longitude 80° 50^{1}and 11° east of the Greenwich meridian. The state has a typical tropical climate marked clearly by the dry and rain seasons. The average annual rain fall is 700mm in the northern parts and 1300mmin the southern parts. The wettest months are July; August and September, dry season starts in November and ends in April; this is a period of harmattan, when the dust loaded North East trade wind from Sahara desert has a marked drying effect on the vegetation and the general climate of the state. Bauchi state is one the state in northern part of Nigeria that span three distinct vegetation zones, namely, the Northern Guinea Savannah, Sudan Savannah and Sahel Savannah with Sudan Savannah dominating. Northern Guinea Savannah become manifest as one moves along a belt that stretches from extreme western part of the state to the extreme southern part covering Local

Government Areas of Toro, Tafawa Balewa , Dass and Bogoro. The Sudan Savannah type of

Vegetation covers six LGAs of Ningi, Warji, Darazo, Kirfi, Alkaleri and Bauchi. The Sahel zone also known as semi desert type, becomes manifest on the middle of

the state as one moves from south to the north. The character vegetation of the zone is isolated stance of thorny shrubs interspersed by short trees (Bauchi state official diary, 2024).

Procedure for data collection

In order to identify tree species in an integrated farming system which are being used for a variety of purposes ranging from fuel wood, fodder, timber, medicine and food, a stratified random sampling technique was employed. The state was stratified in accordance with ecological zones: Northern Guinea Savannah, Sudan Savannah and Sahel Savannah (BSOD, 2024), hence, there were three strata from which three Local Government Areas (LGAs) were selected. Within the nine study LGAs, a total of ninety (90) questionnaires (Akpan et al., 2015) were distributed purely among rural communities engaged in an integrated farming system. The selected Local Government Areas were Bogoro, Dass and Toro from Northern Guinea Savannah. Ganjuwa, Kirfi and Ningi from Sudan Savannah, and Dambam, Gamawa and Jama'are from Sahel Savanna ecological zone. The questionnaire was made up of two parts: demographic information of respondents as part 'A' and part 'B' deals with aspect of identification of utilities of multipurpose tree species, experience of farmers and level of awareness of the farmers on the indirect benefits of farm trees. The design of the questionnaire were such that the respondents will choose from given options and or freely write their wish in spaces provided as answers to the questions in the questionnaire.

RESULTS AND DISCUSSION

Demographic information of respondents

Majority of the respondents (farmers of integrated farming system) are male (83.33%), married (100%) and falls within an age group of between 31-40years. 42.22% of these personalities attended non formal education and 35.56% obtained secondary school certificate (Table 1). The age group of between 31-40 years is considered as active production age (Wakili, 2024) and therefore the respondents are at their peak level of agricultural production and considering their level of

education, improved methods of agricultural instructions can easily be understood and practiced.

Table 1. Demographic Information of Respondents

Variables	Frequency	Percentage
Sex		
Male	75	83.33
Female	15	16.67
Total	90	100
Marital Status		
Married	90	100
Single	00	00
Total	90	100
Age group		
20-30	20	22.22
31-40	50	55.56
41-50	10	11.11
51-60	08	08.89
Above 60	02	02.22
Total	90	100
Total	90	100
Educational background		
Non formal education	38	42.22
Primary education	10	11.11
Secondry education	32	35.56
Tertiary education	10	11.11
TOTAL	90	100

Source: Field survey 2025

Identification of Multipurpose tree species and their utilities in integrated farming systems in Bauchi State

Many tree species were found to be incorporated in the integrated farming in Bauchi State, out of which ten were found to be used for a variety of purposes.

These values include provision of fuel wood, timber, medicine, agricultural tools handle and food in addition to being apicultural trees (Table2). The family that had the most species was Fabaceae represented by three species: *Acacia nilotica, Parkia biglobosa* and *Prosopis africana. The* families of Ebenaceae, Balanitaceae, Caesalpiniaceae, Rhamnaceae, Combretaceae , Meliaceae and Anacardiaceae had only one species each and were represented by *Diospyros mespiliformis, Balanites aegyptiaca, Detarium macrocarpum, Ziziphus spina-christi, Anogeissus leiocarpus, Khaya senegalensis and Mangifera indica* respectively.

Table2. Multipurpose tree species and their utilities

S/N	Species	Family	Utilities (Uses)
1	*Acacia nilotica* Del	Mimosaceae Pole	medicine, forage, fuel wood, tannin,timber
2	Anogeissus leiocarpus (DC) Guill & Perr	Combretaceae	medicine, forage, timber, fuel wood, pole
3	*Balanites aegyptiaca* Del	Balanitaceae	forage, fruit tree, fuel wood, medicine, Agricultural tools handle
4	*Detarium macrocarpum* Guill & Perr	Ceasalpiniaceae	fruit tree, timber, fuel wood, medicine, forage
5	*Diospyrus mespiliformis* Hochst	Ebonacea	fruit tree, timber, fuel wood, forage
6	*Khaya senegalensis* (Desr) *A. Juss*	*Meliaceae*	timber, fuel wood, medicine, forage
7	Mangifera indica (S Joshi)	Fabaceae	fruit tree, timber, fuel wood, medicine
8	*Parkia biglobosa (Jacq)* R.Br	Fabaceae	timber, fuel wood, medicine, fruit tree
9	*Prosopis africana* Guill & Perr	Fabaceae	fuel wood, timber, forage, tool handle, Medicine, mortar, pestle
10	*Ziziphus spina-christi* (L)Desf	Rhamnaceae	fruit tree, forage, fuel wood, medicine, fence

Source: Field survey, 2025

Farming Experience and forms of Integrated Farming being Practiced

Majority of the respondents (33.33%) spent eleven to fifteen years (11-15years) in the practice of integrated farming in Bauchi State. These farmers engaged in different forms of integrated farming: Tree culture (cultivation of orchard and

tropical shade trees), Animal husbandry (rearing of cattle, sheep and goat), Crop production (cultivation of annual arable crops) and Aquaculture (fish farming). The integration of these forms of agriculture will ensure food security and environmental beautification and conservation (Table 3). The greatest hope for regaining or maintaining productive capacity rests upon low cost biological approaches such as the use of forest fallows or introducing nitrogen fixing trees (Sharma, 2005). Trees can potentially improve soils through numerous processes including maintenance or increase of SOM, biological N_2 fixation, uptake of nutrients from below the reach of crop roots, increased water infiltration and storage, reduced loss of nutrients by erosion and leaching, improved soil physical properties, reduced soil acidity and improved soil biological activity (Wakili and Abdullahi, 2021) Most importantly, trees can influence both the supply and availability of nutrients in the soil. Trees increase the supply of nutrients within the rooting zone of crops through: input of Nitrogen by biological Nitrite fixation, retrieval of nutrients from below the rooting zone of crops and reduction in nutrient losses from processes such as leaching and erosion. Trees can increase the availability of nutrients through increased release of nutrients from soil organic matter (SOM) and recycled organic residues (Buresh and Tian 1998).

Table 3 Farming Experience (Years)

Variables	Frequency	Percentage
Years of Experience		
1-5	15	16.67
6-10	20	22.22
11-15	30	33.33
16-20	20	22.22
Above 20	05	05.56
Total	**90**	**100**
Form of Integrated Farming		
Tree culture and crop production	15	16.67
Animal husbandry and tree culture	12	13.33
Tree culture and aquaculture	12	13.33
Crop production and animal husbandry	51	56.67
Total	**90**	**100**

Source: Field survey, 2025

Level of Awareness of the Farmers on Indirect Benefits of Farm Trees

The respondents of this study claimed to have knowledge of the indirect benefits of trees as component of integrated farming in Bauchi State. These indirect benefits ranges from provision of shade, erosion control, increase in soil fertility to protection of farm crops from excesses of wind and torrential rain.

The integration of agriculture and forestry conservation and production practices in to land use systems that can conserve and develop natural resources while increasing economic diversity at both the farm and community levels will provide a play ground for lost forest resources to be regained and perpetuates the supply of the same for the general well being of mankind. The trees in an agro forestry production enterprise are managed as an independent farm enterprise. Existing cropping land is not converted in to forest but is managed as an agro forestry system by integrating trees in to the existing operation. Likewise, crop farm with existing wood land may be managed as agro forestry systems for special forest products. The trees in agro forestry systems provide forest products such as timber, nuts, and fire wood, as well as shelter for livestock, control of soil erosion, habitat for wildlife, and improved soil fertility through nitrogen fixation when leguminous species are used (Tilman et al.,2012).

Table 4. Level of Awareness of the farmers on indirect benefits of Farm trees

Variables	Frequency	Percentage
Provision of shade	**30**	**33.33**
Control erosion	**25**	**27.78**
Increase soil fertility	**25**	**27.78**
Protection of farm crops	**10**	**11.11**

CONCLUSION

The field survey reveals that Ten tree species were found to be used as a solution to many socio-economic problems of integrated farmers in Bauchi State. Three of these species belong to Fabaceae family (*Acacia nilotica, Parkia biglobossa and Prosopis africana*) and others belong to Ceasalpiniaceae (*Detarium macrocarpum*), Balanitaceae (*Balanites aegyptiaca*), Combretaceae (*Anogeissus ieiocarpus*), Meliaceae (*Khaya senegalensis*) and Ebenaceae (*Diospyrus mespiliformis*). These species provide such values as fuelwood, forage, f*ood, timber farm tools handles and medicine in addition to conservation values.*

The respondents of this study claimed to have known the indirect benefits of farm trees and practiced different forms of integrated farming: crop production and tree culture, animal husbandry and tree culture, Tree culture and aquaculture, and crop production and animal husbandry.

RECOMMENDATIONS

Considering the importance of integrated farming systems, the following are here by recommended:

- That efforts should be made to re-orient integrate farmers on the need to increase the stocking density of the existing trees
- That government and non- governmental Organizations should take advantage of the respondents' experience and level of awareness on the indirect benefits of farm trees and come up with a design pattern of harvest such that annual crops are not over shaded by tree canopy
- That soft loan with long repay period be offered to tree farmers for improved tree culture
- That there should be bases for classification of farm trees based on calorific value to guard against cutting less energy value trees for fuel wood
- That packaging of fruits from integrated farming will go along way in adding value to the products and hence increased revenue to the farmers and therefore farmers should be supported in this direction
- That only social trees capable of co-existing with other species without any negative interaction be incorporated into integrated farming system

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