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AGROFORESTRY PRACTICES AND AGROFORESTRY TREES IN GUINEAN SAVANNAH: THE CASE STUDY OF GALIM-TIGNERE SUBDIVISION, ADAMAWA REGION, CAMEROON

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ARTICLE INFO	ABSTRACT
	The population explosion in developing countries leads to the loss of biodiversity and insufficient arable land. One of the challenges facing these countries is the production of sufficient food and fiber to meet the needs of their people. The objective of this study is to examine agroforestry practices and preferential agroforestry trees among farmers in the Galim-Tignere district in the Guinean Savannah of Cameroon. To do this, a participative and reiterative analysis using a structured questionnaire was conducted with 150 farms distributed in 9 villages. The results showed that five types of agroforestry systems such as homegardens, hedges/rows, trees on farmland, scattered trees on farmland and windbreaks were practiced. Preferred agroforestry trees are fruit trees such as *Mangifera indica, Persea americana, Carica papaya, Citrus species, Psidiumguajava* and some indigenous species such as *Parkiabiglobosa*, *Tamarindusindica, Borassusaethiopum* and *Adansoniadigitata* that are able to meet farmers needs in terms of food, fiber, financial contribution, environmental protection, shade and soil fertility improvement. The results of this study suggest that the agroforestry development is a possibility and a necessity. The system of agroforestry practices and the preferred agroforestry tree species offer enormous potential to increase food production and develop agroforestry practices in the study area. Agroforestry has potentials to improve agricultural land use systems and provide sustainable benefits to farmers.

INTRODUCTION

Many definitions are given to explain agroforestry. Owonubi (2002) described agroforestry as a multiple land use system in which agricultural crops and woody perennials are grown on the same land management unit. According to Alene *et al.* (2008), Agroforestry refers to land-use systems in which trees or shrubs are grown in association with agricultural crops, pastures or livestock, whereby there are both ecological and economic interactions between the tree and other components. Agroforestry practice as a land use option in farming has the potential of enhancing sustainable agricultural production when the inputs are well integrated (Ewel, 1986).

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The increase in population of many developing countries has influenced the production, supply and demand for food especially in urban areas. Shortage of food is a consequence of population explosion, land hunger, attitude of people towards farming and the type of farming system (Kang, 1993). Trees roles in agroforestry are uncountable. Leakey *et al.*, (2005) stated that the increase in the living standard means there is certainly going to be a great increase in the requirements of forest products mainly timber for housing, wood for fuel and in numerable other purposes. Therefore, the need to reforest through agroforestry in order to meet the growing demand for food, medicinal herbs, fuel wood and timber cannot be over accentuated. During the last decade, plantation technology in Cameroon is a disappointing vocation (Njoukam *et al.*, 2010; Ebenezer *et al.*, 2011). Cameroon's timber reserves have

decreased rapidly. Supply can no longer cope with demand. There is a yearning gap between production and supply. Olujobi (2005) indicated that the pressure on the available arable land has resulted into soil nutrient depletion, land degradation and substantial crop yield decline. Considering the importance of agroforestry in the provision of food and other basic needs (i.e fuel wood, staking materials, fibers, timber, medicinal concentrates, oils, fruits, and fodder for animals) for a large proportion of the rural population as well as its role in soil fertility restoration and the control of weeds and environmental degradation (Thaman, 1990; de Foresta and Michon, 1996; Bentes-Gama and Gama, 2004), a critical study of the system will be necessary so as to identity the traditional agroforestry trees among farmers and then document them for future development. The tree species choice is the most important factor to be considered in agroforestry practices (Puri & Bangarawa, 1992). Jagger & Pender (2003) observed that tree species choice be made after careful consideration of their adaptability for growth and benefit for local communities. Other authors observed and reported that leguminous species such as *Faidherbia albida* and *Leucaena leucocephala* cause considerable improvement on crop yields (Pender *et al*., 2004) whereas Tchawa & Demaze (2002) recorded poor performance of crops on apparently rich *Tectona grandis* and *Eucalyptus camaldulensis* soil.

al., 1994; Tchatat *et al*., 1995). Agroforestry had been claimed, to have the potential of improving agricultural land use systems and providing lasting benefits and alleviating adverse environmental effects at local and global levels. This study seeks to document the agroforestry practices and how effective it has been in the Guinean Savannah of Cameroon. The objective of this study is to examine agroforestry practices and preferential agroforestry trees in Galim-Tignere.

MATERIALS AND METHODOLOGY

Study area: The study was conducted in Galim-Tignere, region situated at about 300 km from Ngaoundere, capital of Adamawa region (Cameroon), between 6th and 8th degree of north latitude. This region presents two seasons: one short dry season (November to march) and one long rainy season (March to October). The annual precipitation was 1500 mm; the annual mean temperature is 23.4° C. The mean relative humidity annual rises to 66.79 %. The vegetation was shrub to arboreous. The villages retained within the context of this work were Sabongari, Mayo Sang-Nare, Wogomdou, Mayo dankali, Ngouri, Tagouri, Djaligo, Mboudoua and Garbaya which are inhabited by Niza'a people (Figure 1). The choice has been done at the reasoned matter (easy access, opening to innovations…) with the help of vulgarization Agent of Zone
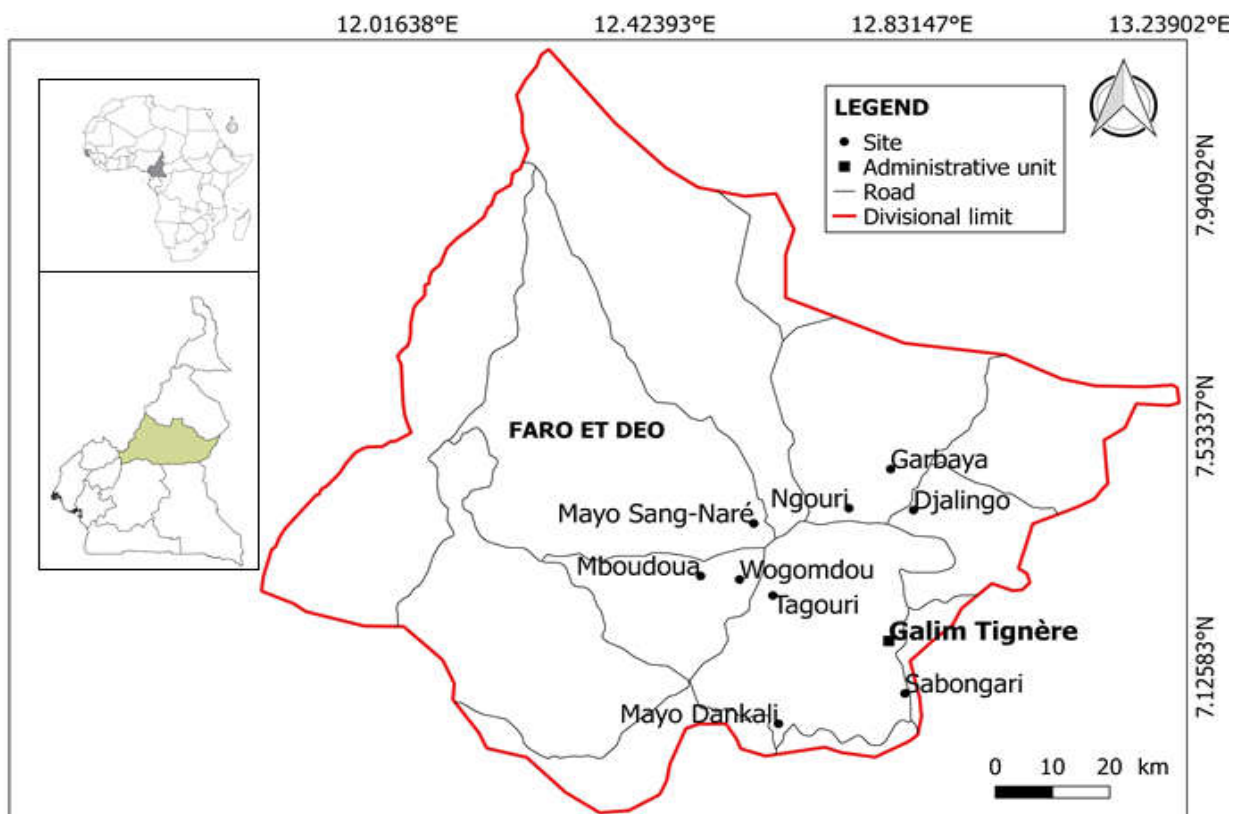

Figure 1. Localization of the study area

The farmers preference of forest trees would definitely be due to their potentials and adaptability to the land area. One of the challenges facing developing countries is the production of sufficient food and fiber to meet the need of their ever increasing population. The traditional system of fallow and shifting cultivation requires more land, which is not available. Also the use of high external input technologies has not been generally successful because of soil, climate and socio-economic incompatibility. Agroforestry practices are being increasingly advocated as possible remedies (Tetio-Kagho *et*

(VAZ) of National Program of Vulgarization of Agricultural Researches of the region.

Data collection and analysis: The used scientific approach was participative and reiterative. Households were randomly selected in each village. Questionnaires were managed to exploitation owners. The people number to survey was taken according to the number that we obtained previously near to the village leaders. The sample rate of surveyed people was 10% per village (Mapongmetsem, 2003). In all, 150

households were enquired. The unstructured questionnaire used included questions on age and function of the Agroforestry system, main cultivated and/or protected species, problems of Agroforestry system management, use of Agroforestry system products, etc. Secondary data concerning household characteristics, such as age, formal education or occupation of the household leaders was collected at the time of survey phase. Agroforestry system size was measured. Complete inventories were carried out to assess total plant, diversity number of species and varieties and abundance of crops and ornamentals. The plant identification was done at the field. Those that were not identified, the specimens were collected, dried and sent to National Herbarium of Cameroon for identification. Plants were recorded with local and/or scientific names. The data was subjected to descriptive statistical analysis such as frequency, mean and percentage. Simple majority was used to calculate species preference in the study area. Data were analyzed using the statistical package SPSS 11.0.

RESULTS

Socio-economic characteristics of farmers: The Table 1 showed the socio-economic characteristics of farmers in the Galim-Tignere.

The table showed that 60.4 % of respondents had no formal education whereas 28.2 % of respondents had primary education. The percentages of those who had reached the secondary and tertiary education were respectively 8.2 % and 3.2 %. As regard as the gender status of respondent farmers, the table 1 showed that the majority of farmer is constituted by the male (82.1 %). The females represented 17.9 % of the farmers. The farmers belong to the different categories of age. The owners belonging to the category of 30 to 45 years old constituted the majority (38.6 %). The younger owners represented 13.3 %. The family size of farmers is often large. The most important (5 to 10 persons) represents 53 % followed by the category of family size of under four persons (24.3 %).

Year of Farming Experience: The year of experience in farming help as to know how long the farmers have been involved in farming. The longer in the farming the more experienced he becomes. Figure 2 showed that 23.3% of respondents have been farming for between 31 years and 40 years, 26.7% of respondents have been farming for between 21 years and 30 years, and 33.3% respondents have been farming for between 11 years and 20 years, while 16.7 % have been farming for the past 1year to 10 years.

Table 1. Socio-economic characteristics of farmers

Socio-economic characteristics	Percentage (%)
Education level	
No formal education	60.4
Primary education	28.2
Secondary education	8.2
Tertiary education	3.2
Gender status	
Males	82.1
females	17.9
Owner old (year)	
<30	13.3
30-45	38.6
46-60	38,4
>60	9.7
Family size (person)	
<4	24.3
5-10	53
≥11	22.7

Table 2. Species preference among farmers

Species	Sabongari	Mayo Sang Naré	Wogomdou	Mayo dankali	Ngouri	Tagouri	Djaligo	Mboudoua	Garbaya	Total	Percentage
Mangifera indica	1	1	2	3	3	2	2	1	3	18	12
Persea americana	1	2	2	1	2	2	3	2	2	17	11.33
Carica papaya	1	1	2	2	2	2	2	1	1	14	9.33
Citrus spp	2	1	2	1	1	1	2	1	2	13	8.67
Psidium guajava	1	2	1	1	1	2	1	1	1	11	7.33
Borassus aethiopum	0	2	0	1	2	0	2	1	0	8	5.33
Parkia biglobosa	1	0	2	0	1	2	0	1	0	7	4.67
Adansonia digitata	1	0	1	2	0	2	0	1	0	7	4.67
Tamarindus indica	1	2	0	0	0	1	0	2	1	7	4.67
Erythrina sygmoidea	2	1	2	1	0	0	0	1	0	7	4.67
Terminalia glaucescens	0	2	0	0	1	0	1	2	0	6	4
Ficus spp.	1	1	0	1	0	1	1	0	1	6	4
Hymenocardia acida	0	1	0	2	1	1	0	1	0	6	4
Dracaena arborea	1	0	1	1	0	1	0	1	0	5	3.33
Syzygium guineense var. *macrocarpum*	1	0	0	1	0	1	0	1	0	4	2.67
Piliostigma thonningii	1	0	1	0	0	0	1	1	0	4	2.67
Securidaca longepedonculata	0	1	0	1	0	1	0	0	1	4	2.67
Daniellia oliveri	1	0	0	0	1	0	1	0	0	3	2
Nauclea sp.	1	0	1	0	1	0	0	0	0	3	2
Total	17	17	17	18	16	19	16	18	12	150	100

Table 3. Categories of Agroforestry practices

Agroforestry pratices	Sabongari	Mayo Sang Naré	Wogomdou	Mayo dankali	Ngouri	Tagouri	Djaligo	Mboudoua	Garbaya	Total	Percentage
Homegardens	6	7	6	5	6	7	7	5	6	55	36,7
Hedges/Row	4	4	0	3	4	5	4	4	5	33	22.0
Scattered trees on farm land	2	4	3	5	4	2	2	2	3	27	18.0
Trees on farm land	3	0	3	4	4	3	3	3	4	27	18.0
Wind break	0	2	2	0	1	2	1	0	0	8	5,3
Total	15	17	14	17	19	19	17	14	18	150	100

Table 4. Uses and Importance of Agroforestry Practiced to the Farmers

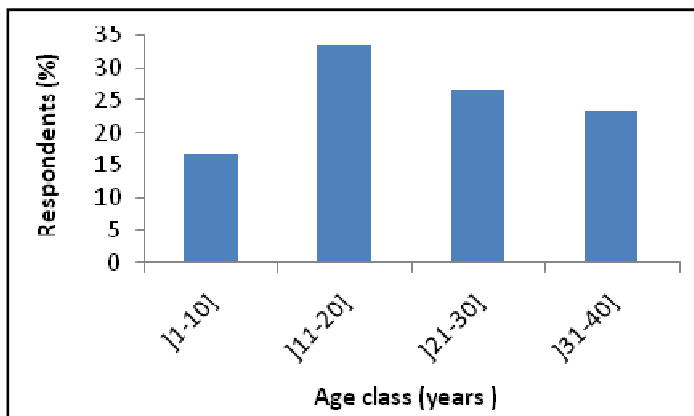|	Total	Percentage
Additional income	47	11.21
Firewood, stakes and timber	64	15.31
Medicinal herbs	62	14.83
Human nutrition	72	25.22
Shade for livestock	58	10.4
Soil improvement	57	9.24
Wind break	20	4.69
Reduce weeding	38	9.1

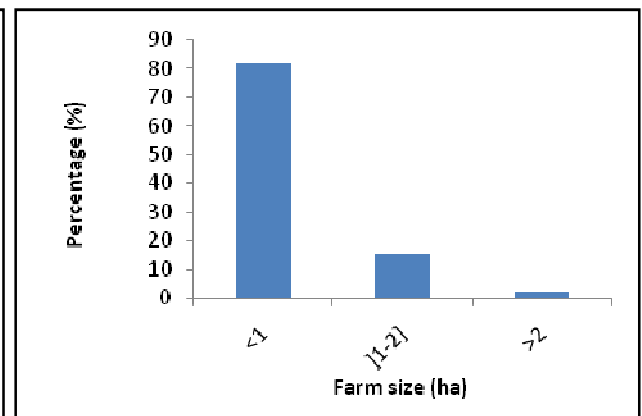**Figure 2. Year of farming experience of the farmers**

Figure 3. Farm size

Species Preferences: A total of twenty (20) tree species were recorded as preferred species for planting. Among these, the 10 most preferred by the large proportion of the farmers included *Mangifera indica* (12%), *Persea americana* (11.33%), *Carica papaya* (9,33%), *Citrus* species (8.67 %), *Psidium guajava* (7.33 %), *Borassus aethiopum* (5.33 %), *Parkia biglobosa* (4.67%), *Adansonia digitata* (4.67 %), *Tamarindus indica* (4.67 %) (Table 2). It is important to note that some species make unanimity and were cited in all villages. There is *Manguifera indica, Persea americana, Carica papaya, Citrus* species*, Psidium guajava*. These species gave much income to farmers by the sale of their fruits.

Agroforestry Practices: Different types of Agroforestry practices are recorded in the study area. Farmers practiced the different types of agroforestry system: Homegardens, woody plants in hedges, trees on farm land, scattered trees on farm land and wind break. The Table 3 presents the different categories of agroforestry practices in the study area. It revealed that the homegardens were the most agroforestry practice in the study area (36 %) followed by the hedges/row (22 %). This study showed equally that scattered trees on farmland and trees on farm land represented both 18 % each. The rare agroforestry practice in the study area was the wind break and it represented only 5.33 % of the farmers.

Uses and importance of agroforestry practices to the farmers: The study revealed that agroforestry practices offered many benefits to farmers in the study area.

Table 4 showed that in the study area, 25.22 % of farmers practiced Agroforestry to improve the human nutrition, 15.31 % practiced it to obtain firewood, stakes and timber, practiced whereas 14.83 % practiced Agroforestry to keep medicinal plants. To improve the soil fertility, 9.24 % found that agroforestry practices were important. In the study area, agroforestry practices were mentioned here and there with various fortunes. There is 9.1 % of farmers practiced Agroforestry to reduce wind and 4.69 % practiced it to prevent wind erosion.

DISCUSSION

Farmers in the study area: The study revealed that farmers planted two or more crops on a piece of land either simultaneously or sequentially. Under these practices, annual crops such as groundnut, cassava, maize, taro, patato and bean were usually grown with perennial tree crops like oranges, avocado, mango and some of the indigenous trees such as African locuste bean tree, Baoba tree and tamarind trees, etc. The social characteristics of respondents with regard to educational level, gender status of the farmer showed that majority of the farmers had no formal education and were mainly males. The majority of these people believed that it is a mere waste of time planting trees, since trees are known to grow naturally on land as a gift of God. However, the potential for improvement of these agroforestry activities is high with a high proportion of farmers reaching or exceeding secondary

education, as reported by Adewusi (2006) in Nigeria. In addition, male dominance in agricultural activities confirmed the report by Adewusi (2006). According to these authors, the predominance of agricultural activities by men is an indication of a labor-intensive and less mechanized farming system in the study area; therefore physically strong individuals are needed. Meanwhile, women are engaged in less arduous housework. The experience in each domain is important. For this, it is difficult to leave the old habits. So the study allows observing that the development of agroforestry system to accommodate modern technology and practices is constrained among other things by years of farming experience. This assertion is reported by Alao & Shuaibu (2011) in Nigeria. The farmers attachment to their habits had created a situation where they returned always to their old ways of farming system like bush fallow such that it has now become difficult for them to adopt a new practice, especially when the old one is still good enough to meet their subsistence needs. Other authors have reported that experience is a barrier to adoption of modern agroforestry among farmers (Oladipo, 1998; Degrande *et al.,* 2007).

Species preferences: The choice of tree species is the most important factor to be considered in agroforestry practices (Puri & Bangarawa, 1992; Alao & Shuaibu, 2011). In this study, twenty preferred species of exotic and indigenous trees were recorded. This number is greater than one recorded in east of Nigeria by Alao & Shuaibu (2011). A total of five of the preferred species belong to the fruits category (Mango, Avocado, papaya, Oranges and Guava) and another four of the preferred group belong to the indigenous fruit trees category (Borassus palm, Baoba tree, Tamarind, African locuste bean tree) while the remaining 10 of the preferred group belong to fire wood, medicinal, staking and constructional materials category and others. These results showed that the most preferred species both exotic and indigenous were fruit species. Many reasons explained the attachment of farmers to the fruits species. First at all, these species were used in the nutritional domain. This report confirmed that what Adewusi (2006) in Eat Nigeria. According to him, fruit (food) trees, both exotic and indigenous are the most preferred, indicating that food is the most crucial to people's existence. In addition of the fruits consumption, they also generate income to the farmers by the sale of their fruits and woods (High & Shackleton, 2000). However, the major challenges faced by farmers in the study area include the constraint to propagation and management of trees on crop land and the pressure from grazing animals. Overgrazing reduces the reproductive capacity of seedling and saplings (Rocheleau & Dianne, 1987) and majority of the farmers lack the knowledge of management practices such as thinning, pruning, prescribed fire and prevention of insects and disease attack on the seedlings.

Agroforestry practices: The category of agroforestry practices varies according to the farmers objectives. In the case of this study, five types of agroforestry system were recorded. They are homegardens, trees on farmland, scattered trees on farm land, row/hedge and wind break. These categories of agroforestry practices in the study area enable farmers to benefit from the products of the trees as an additional advantage to the crop cultivation. These results coroborated the works many authors who pointed out that the farmers plant or retain trees on their farmland, both for food, income, soil improvement, environmental amelioration and for shade during the hot weather period (Gouwakinnou *et al.*, 2009; Adewusi, 2006).

Farm size of respondents: The average farm size varies according to the objectives and the capacity of farmers. Very often the farm is appropriate for improving farming system, but it is difficult to achieve this goal because to their present fragmented status. The land tenure system is also favorable for the development of agroforestry system with the largest proportion as either inherited or purchased makes the ownership personal and transferable to offspring (Adewusi, 2006). In the study area, the farm size is weak contrary to what observed respectively in East Nigeria and in Indonesia (de Foresta & Michon, 1996; Alao & Shuaibu, 2011). This difference could be explained by the fact that in Galim-Tignere, the farmers used agroforestry systems only to resolve the punctual problems. They had other bigger farms in the bush.

Uses of trees: The presence of trees meets some needs of farmers. Trees were used in many domains. The study showed that the respondent farmers either plant trees for additional income, fruits, food, firewood, staking materials, constructional materials, soil improvement, prevention of wind erosion, fodder, shade, medicinal herbs or to reduce weeding. This is in consonance with Adewusi (2006) who stated that farmers plant or preserve trees on their farm land, both for food, income, soil improvement, environmental amelioration and for shade during the hot weather period. Unfortunately, the number of trees in the different types of agroforestry system varies did consequence. In the other tropical regions, the agroforestry systems were a hotspot of vegetal diversity (Boonkird *et al.*, 1984; Okafor & Fernandes, 1987; Le Houérou, 1997). Thus, the farmers of these regions had various uses of trees.

Conclusion

Food and income seem to be the most crucial needs of farmers in the study area. Depending on the preference of the species for planting, the potential contribution of agroforestry to the region may be low or high. For these potentials to be realized at a sustainable level, an intensive extension service would be needed to educate farmers on modern technology and improved agroforestry practices. The size of the farm in the study area must also be improved in order to reach their potential contribution in the life of the farmer. in addition, the level of farmer education and family size are also factors to consider so that agroforestry systems can provide the best benefit to African farmers. Moreover, agroforestry systems biodiversity is a fundamental element of agroforestry systems that must be improved to meet the majority of farmers' needs in the study area.

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