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Diversity and Valorization of Fruit Tree in Guinea Savannah Agrosystems of Adamawa, Cameroun Republic

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Abstract
Agrosystems combines a variety of forms of production that generate socio-economic benefits and environmental services. They are facing challenges in terms of improving people's living conditions and preserving biological diversity. The aim of this study was to characterize the agrosystems of the Adamawa region. About 101 farmers were interview. Floristic inventories were then carried out in plantations. A total of 104 agrosystems with areas ranging from 1 to over 100 ha were identified. Agrosystems less than 20 ha were the most common, while those of 100 ha or more were poorly represented. Two types of agrosystems were identified: monospecific (*Citrus sinensis, Anacardium occidentale, Elaies guinnensis, Persea americana, Musa balbisiana, Coffea arabica, Theobroma cacao*) and multispecific with a diversity of fruit species including *Dacryodes edulis* and *Psidium guajava*. A total of 17 fruit species grouped into 11 families and 14 genera were inventoried. *Mangifera indica* (68.38%) and *Persea americana* (52.24%) ranked first. Raphia sp. and *Terminalia glaucescens* are among the local species found in these orchards. *Zea mays* and *Manihot esculentus* are dominant crops. Fruit trees play an important role in the food, medicinal, socio-cultural and economic life of households. They also help to mitigate the effects of climate change.
Keywords: Agrosystem, fruit trees, local species, Cameroon.

1. Introduction
Biodiversity plays a very important role in the functioning of ecosystems and the various services they provide (Hooper *et al*., 2005; Tilman *et al.*, 2006; Balvanera *et al.,* 2006; Mauchamp, 2014). As a result of the increasing population growth in recent years, human activities are the main cause of its degradation and destruction (Tchotsoua *et al.*, 1998). Efficient and sustainable improvement of natural resource management calls for agroforestry practices, which combine trees with other crops or livestock (Torquebiau *et al.,* 2002). Agroforestry systems are important both ecologically and socio-economically. They are seen as a way of conserving biological diversity (Manfo *et al.,* 2015) and also as an alternative for mitigating the effects of climate change (Mapongmetsem, 2013).
In urban areas, the problems of undernourishment and malnutrition are constraining people to exploit all available food resources (Makumbelo *et al.,* 2005). Among these food resources, a large number of tropical fruits occupy the prime position due to their nutritional value in terms of calories, proteins, various minerals and vitamins (Mbemba & Remacle, 1992; Favier *et al.,* 1993). Laflèche (2017) has shown that fruit trees have multiple uses, generate benefits and can be economic safety nets.
A great deal of work has been done on the fruit-growing potential of Cameroon's ecological zones, such as Kuate *et al.* (2005) on fruit farms in the peri-urban areas of Yaoundé in Cameroon; Woin & Essang (2003) on the role of fruit growing in food security, its economic issues, its cropping systems and its place in securing land tenure; and Kouebou *et al.* (2013) on the biodiversity and food value of fruit in Cameroon. Despite the multitude of works carried out on fruit trees in Cameroon, few studies have focused on fruit trees in the Guinean high savannahs. However, the Adamaoua region has been identified as one of the fruit production basins (Sougnabé *et al.,* 2010). The aim of this study was to characterize the agrosystems in the

high Guinean savannahs of Cameroon, with a view to improving the sustainable management of this agroforestry system.

2. Materials and Methods

2.1. Description of the Study Area

This study was carried out in the high Guinean Savannahs of Adamawa (Fig 1). The high Guinean savannas of Adamawa correspond to the transition zone between the Sudano-Sahelian north and the forested south. This zone is located between latitudes 6 and 8 degrees North and between longitudes 10 and 16 degrees East. It composed by five Departments (Djerem, Faro-et-Déo, Mayo-Banyo, Mbéré and Vina). It has a highland Sudano-Guinean climate, with a rainy season (April to October) and a dry season (November to March). Annual rainfall of 1,600 to 1,800 mm is spread over 7 to 8 months (Deffo *et al.,* 2009).

The soils are predominantly red ferralitic structures developed on old basalt (Yonkeu, 1993). Vegetation types range from grasslands and shrub savannas to tree savannas dominated by *Daniellia oliveri* and *Lophira lanceolata* (Letouzey, 1968). Unfortunately, these species are subject to anthropogenic pressures, leading to a decline in their density (Mapongmetsem *et al.,* 2012).

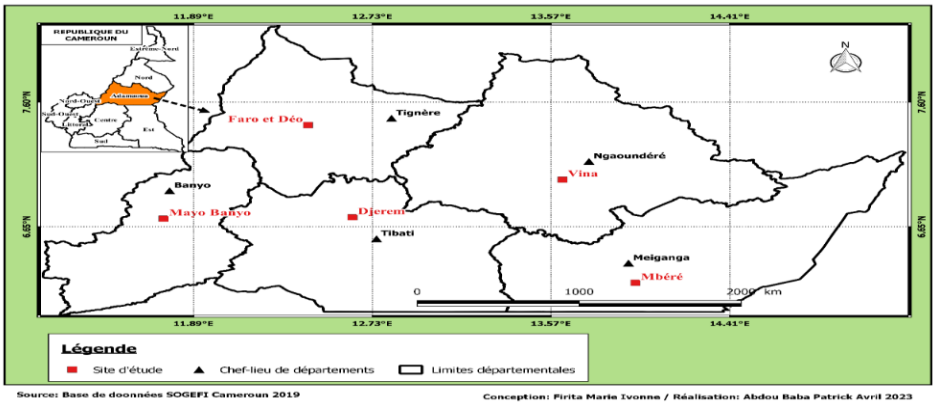

Figure 1: Location map of study sites

2.2 Sampling

The methodological approach was carried out in two phases: a survey phase with farmers and floristic inventory phase. The ethnobotanical surveys were conducted by means of semi-structured interviews using a questionnaire drawn up in advance. The questionnaire consisted of closed, open and guided questions. The open-ended questions gave respondents the opportunity to express their opinions. The closed questions were answered by yes or no, and the open-ended questions required respondents to choose one or more of the proposed answers. The main sections of the questionnaire concerned the structural and functional characterization of agrosystems and their management constraints. A total of 104 agrosystems were identified in 12 arrondissements belonging to the five Divisions of Adamawa: Tignere, Mayo-Baleo, Banyo, Mayo-Darle, Meiganga, Dir, Ngaoundal, Tibati, Ngan-ha, Ngaoundere III, Ngaoundere II and Nyambaka.

Floristic inventories were carried out in transect of 10 m wide and 50 m long, according to the size of the plot. All woody plants above breast height were systematically counted. Species were identified in situ. The agrosystems identified were categorized according to the frequency of a fruit species. Two categories of agrosystems were noted: monospecific and multispecific. Monospecific agrosystems are those in which a single species is dominant in the agrosystem at a frequency of over 80%. Multispecies agrosystems are characterized by a mixture of species with low frequencies. In each agrosystem, the frequency was calculated according to the formula: (n: number of individual fruit tree; N: total number of fruit trees).

2.3. Data Analysis

The data collected were subjected to an analysis of variance. Statgraphic 5.0 software was used for this purpose. The Windows Office Excel spreadsheet was used to produce the graphs.

3. Results

3.1 Structural and Functional Characterization of Agrosystems

3.1.1. Structural Characterization of Respondents

The age of the orchards varied between 0 and 100 years. The distribution of respondents by age group is shown in Fig 2. Results shows that respondents with less than 20 years age is the largest with 68,6%, follow by the [60-80] age group (21,6 %). On the other hand, the [60-80] and [80-100] age groups are poorly represented, with 8,8 and 0,9 % respondent respectively. The analysis of variance shows a highly significant difference (P<0.001) between the different age groups.

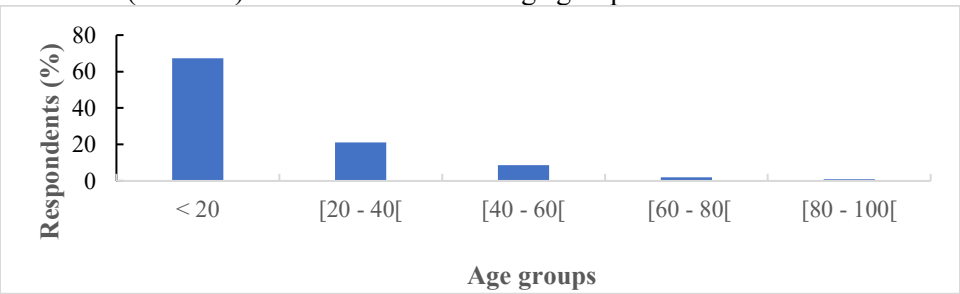

Figure 2: Breakdown of respondents by age group

The number of producers vary in the different Divisions (Figure 3). The Vina Division has the highest number of farmers (35), follow by Djerem and Mayo-Banyo with respectively 20 and 16 farmers.

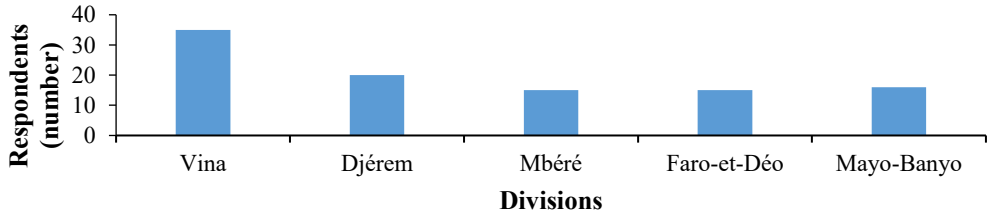

Figure 3: Distribution of the number of farmers by Divisions

Analysis of the distribution of orchards by age group (Table 1) shows that the [0-20[age group is generally the most represented in all the Divisions, with the highest 7.5±4.19 in Mbéré, followed by the Faro-et-Déo (6±1.41). The [20-40[age group is predominant in Mayo Banyo (3.5±0.82). The [40-60[age group is most represented in Djerem (2.5±0.70). Orchards aged 60 and over are mostly found in the Vina. Analysis of variance reveals a highly significant difference (P<0.001) between Divisions.

Table 1: Distribution of orchards by age group

Divisions	**Age group**				
	]0-20[	**[20-40[**	**[40-60[**	**[60-80[**	**[80-100[**
Vina	5.5±2.64^{a}	2±0.81^{a}	0.75±0.31^{a}	0.25±0.1^{a}	0.25±0.1^{a}
Djérem	5.5±0.70^{a}	2±0.00^{a}	2.5±0.70^{b}	0±0.00^{a}	0±0.00^{a}
Mbéré	7.5±4.19^{a}	0±0.00^{a}	0±0.00^{a}	0±0.00^{a}	0±0.00^{a}
Faro-et-Déo	6±1.41^{a}	1.5±0.70^{a}	0±0.00^{a}	0±0.00^{a}	0±0.00^{a}
Mayo-Banyo	5±2.24^{a}	3.5±0.82^{a}	0.5±0.2^{a}	0.5±0.2^{a}	0±0.00^{a}
F	0.11^{ns}	0.82^{ns}	5.07*	0.58^{ns}	0.39^{ns}

The values marked with the same letter are not significantly different at the 5% level in the column

In terms of area, the highest producers (80,7 %) have less than 20 ha, followed by those of [20-40[ha with 9,61% (Fig 4). Only one grower has an orchard of 100 ha or more.

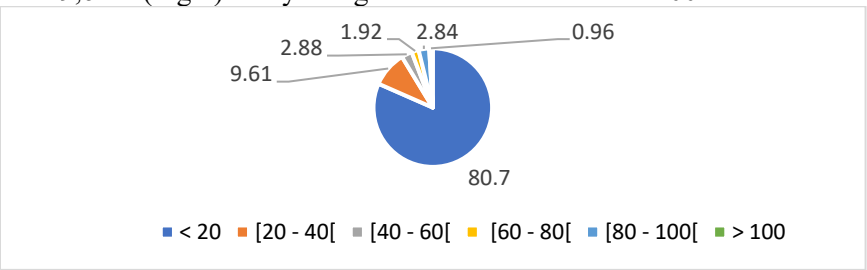

Figure 4: Distribution of producers (%) by area

The distribution of orchards by area in the divisions are presented in the table 2. It is shows that the agrosystems less than 20 ha range was the most represented in all Divisions, with 9.5 ± 3.60 ha in Mayo-Banyo and 4.5 ± 2.08 ha in Vina. However, orchards with an area of [20-40] ha were found only in Vina and Djerem, with 1.75±1.06 and 1.5±1.12 ha respectively. On the other hand, orchards of 40 ha or more are only found in the Vina. Analysis of variance does not show any significant difference (P>0.05) between Divisions.

Table 2: Distribution of agrosystems by surface area

Divisions	Surface area of agrosystems (ha)					
	< 20	**[20-40[**	**[40-60[**	**[60-80[**	**[80-100[**	**≥100**
Vina	4.5±2.08[a]	1.75±1.06[a]	0.75±0.31[a]	0.50±0.26[a]	1±0.81[a]	0.25±0.1[a]
Djérem	8.5±0.70[a]	1.5±1.12[a]	0±0.00[a]	00±0.00[a]	0±0.37[a]	0±0.00[a]
Mbéré	7.5±3.91[a]	0±0.00[a]	0±0.00[a]	00±0.00[a]	0±0.37[a]	0±0.00[a]
Faro-et-Déo	7.5±2.12[a]	0±0.00[a]	0±0.00[a]	0±0.00[a]	0±0.37[a]	0±0.00[a]
Mayo-Banyo	9.5±3.60[a]	0±0.00[a]	0±0.00[a]	0±0.00[a]	0±0.37[a]	0±0.00[a]
F	0.35[ns]	0.85[ns]	0.95[ns]	0.39[ns]	2.33[ns]	0.39[ns]

The values marked with the same letter are not significantly different at the 5% level in the column

3.1.2. Functional Characteristics of Agrosystems

Farmers in agrosystems are adepts of agricultural diversification (Table 3), combining fruit species with annual crops. However, 22.18% of producers do not grow crops on their plots because the woody plants are already tall, creating lack of space, and the decline in soil fertility. It is therefore important to note that all the producers have at some time cultivated annual crops in association with woody plants. The most common were: Zea mays (64.88%) and *Manihot esculenta* (35.16%). Legumes such as *Phaseolus vulgaris* and *Arachis hypogea* account for 21.02% and 19.70% respectively. The Convolvulaceae family, represented by *Ipomea batatas* (19.76%) is common in orchards. Other crops (25.06%) are also found. These include *Ananas comosus* (5.56%), *Xanthosoma sagittifolium* (5.26%), *Colocassia esculenta* (1.64%), *Capsicum frutescens* (1.32%), *Saccharum officinarum* (1.32%), *Abelmoschus esculentus* (3.16%), *Dioscorea alata* (1.64%), *Solanum tuberosum* (3.5%), *Solanum lycopersicum* (1.66%). Crops may vary from year to year depending on the needs of each producer.

The results of the surveys shows that farm owners use family (70.1%) and external labor (29.9%) to carry out work in their agrosystems. About 84.69% of farmers carry out maintenance work on their plots which essentially consist of weeding and pruning.

Table 3: Rate (%) of annual crops grown in agrosystems

Types of crops	Divisions					
	Vina	**Djerem**	**Mbere**	**Faro-et-Deo**	**Mayo-Banyo**	**Mean**
Zea mays	95.8	56	73.3	46.7	52.6	64.88
Ipomea batatas	41,7	16	13.3	6.7	21.1	19.76
Arachis hypogea	12.5	16	13.3	6.7	31.6	19.70
Manihot esculenta	37.5	40	46.7	20	31.6	35.16
Phaseolus vulgaris	16.46	04	13.3	0	21.1	21.02
Others	20.9	08	13.3	20.1	89.5	30.36

3.1.2.1. Typology and importance of agrosystems

Two types of agrosystem were identified in the study areas: monospecific (39.11%) and multispecific (60.89%). The monospecific species include: *Citrus sinensis, Anacardium occidentale, Elaies guinnensis, Persea americana, Musa balbisiana, Coffea arabica* and *Theobroma cacao*. Multispecies trees include Citrus sinensis, Citrus reticulata, Mangifera indica, Persea americana, Musa balbisiana, Dacryodes edulis, Theobroma cacao, Coffea arabica and Elaies guineensis.

A diversity of fruit species was noted in the agrosystems visited. A total of 17 fruit species (Table 4) grouped into 11 families and 14 genera were identified in the agrosystems of the high Guinean savannahs of Adamaoua. The mango tree (*Mangifera indica*) is the leading fruit tree with a proportion of 68.38%. It is followed by the avocado (*Persea americana*), which accounts for 52.24% ; then by banana (*Musa balbisiana*) and oil palm (*Elaies guineensis*) with 35.9% and 26.46% respectively. In terms of genera, the Citrus is the most diverse, with four species, the most dominant of which is the orange (*Citrus sinensis*) tree at 25.36%, followed by the lemon (Citrus limon) tree with 16.26%. *Prunus cerasus* (cherry), *Citrus*

maxima (grapefruit) and *Cola acuminata* (cola) are the least important fruit trees in the zone's agrosystems, but are nevertheless appreciated by the local population.

The local species present in the agrosystems are Raphia sp. (20.16%), *Borassus aethiopium* (16.51%), *Ricinodendron heudelotii* (1.63%), *Terminalia glaucescens* (21.6%), *Voacanga africana* (15.2%), Senna sp (7.27%), *Croton macrostachyus* (8.12%) and *Terminalia macroptera* (16.2%).

Table 4: Frequency (%) of fruit species recorded in the study areas

Fruits Species	Divisions					
	Vina	Djerem	Mbere	Faro-et-Deo	Mayo-Banyo	Mean
Citrus sinensis	0	36	12.5	46.70	31.60	**25.36**
Citrus reticulata	0	12	0	33.30	5.30	**10.12**
Elaies guineensis	0	28	25	26.70	52.60	**26.46**
Mangifera indica	100	76	81.3	26.70	57.90	**68.38**
Musa balbisiana	16.70	44	50	26.70	42.10	**35.90**
Psidium guajava	33.3	32	6.3	20	31.60	**24.64**
Persea americana	58.3	48	87.5	20	47.40	**52.24**
Citrus limon	33.3	16	0	26.7	5.30	**16.26**
Carica papaya	4.20	20	6.3	13.30	10.50	**10.86**
Cola acuminata	0	04	0	6.70	15.80	**05.30**
Citrus maxima	0	08	0	6.70	0	**02.94**
Annona muricata	0	08	0	6.70	15.80	**06.10**
Theobroma cacao	0	04	12.5	0	52.60	**13.82**
Dacryodes edulis	0	28	25	0	47.40	**20.08**
Coffea arabica	0	0	0	0	42.10	**08.42**
Anacardium occidentale	29.20	16	18.8	0	0	**12.80**
Prunus cerasus	0	0	6.3	0	0	**01.26**

The agrosystems of the Guinean high savannah plays a role in food, economic and medicinal production. The fruits are mainly for sale (97.35%). Only 5.30% of producers do not sale theirs produces. However, among cash crop farmers, it should be noted that a very small proportion of the fruit (around 25%) is consumed by the family. The sale of fruit enables producers to provide food and other household needs. Also, by growing fruit, producers provide employment by hiring labor out their family to work on their farms. 10.5% of producers use other parts of the trees besides the fruit as a source of medicines. These non-wood forest products are: bark, leaves and roots (Table 5).

Table 5: Fruit species and importance in pharmacopoeia

Species	Parts used	Functions
Theobroma cacao	Bark	Increases blood flow and regulates circulation
Psidium guajava	Leaves	Relieves constipation, diarrhoea and stomach ache
Carica papaya	Leaves and roots	Treats measles

Several activities are linked to fruit processing opportunities (Fig 5). Only 32.95% of fruit producers process their products. The fruits processed are palm (*Elaies guineensis*) nuts, lemons (*Citrus limon*), mangoes (*Mangifera indica*), soursops (*Annona muricata*), cocoa (*Theobroma cacao*), orange (*Citrus sinensis*) and papaya (*Carica papaya*) into juice or oil. Palm fruits are the most know processed by 68.8% of farmers. *Theobroma cacao* and *Citrus sinensis* rank second, with 10.5% each. *Carica papaya, Mangifera indica* and *Annona muricata* are the least transformed.

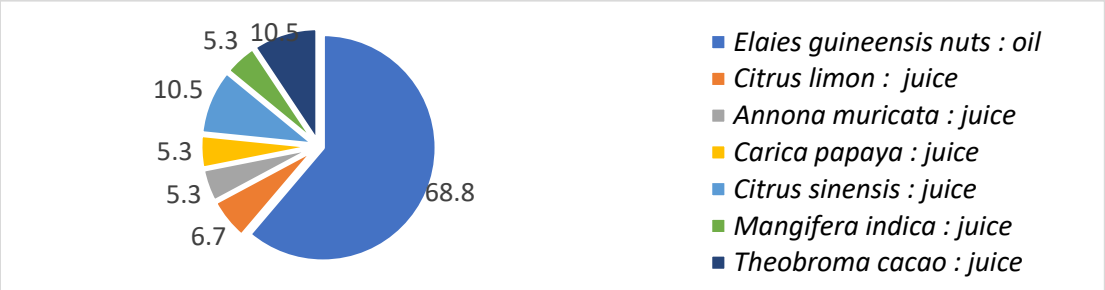

Figure 5: Agri-food processing (%) of fruit and derivatives

3.2 Constraints on agrosystems management

The agrosystems of Adamawa are faced with several constraints that not only result in low fruit productivity but also hinder the development of producers.

3.2.1. Socio-economic constraints

Six socio-economic factors that hinder the development of fruit production (Table 6): difficulty to have access to selected cultivars, enclavment, inaccessibility of agricultural inputs, lack of good agricultural practices, bush fires and theft in the field. Producers in the Mbere (23.33%) and Djerem (22.5%) Divisions are finding it increasingly difficult to have access to selected cultivars. Producers in the Vina (15.71%), Faro-et-Deo (43.33%) and Mayo-Banyo (28.94%) Divisions are finding it extremely difficult to have access markets to sell their produce because the roads are almost impassable. The poor quality of the roads is an obstacle to the sale of fruit, as it is difficult for producers to transport to the market. Some fruit producers prefer to sell their produce in their plantations, which makes them to lower the prices.

Access to inputs is one of the problems faced by 31.57% of producers in Mayo-Banyo Division, 30% in Faro-et-Deo and 27.5% in Djerem. These farmers mention the lack of means to obtain inputs and the bat state of the roads. The more the roads are degraded, the more difficult it is for the producers to transport theirs produce. Although these products are available with the local vendors, they raise the prices to compensate for the high transport costs. The lack of good farming practices means that fruit trees are poorly maintained, with poor pruning and inadequate harvesting methods. Farmers have no knowledge of how to process the produce, which leads to major fruit losses. Producers complained the lack of institutional supervision, as they do not receive enough technical support. Only 36% of producers in Djerem and 6.7% in Mbere have access to technical advisers, while Mayo-Banyo has 52.60%. Producers in the Faro-et-Deo zone did not mention the presence of any support agents. These agents are from MINADER, ACEFA, INADES-FORMATION, MINEPIA, AFOP and FODECC. Bush fires in the dry season and theft are also some problems faced by 12.85% producers in Vina, 16.66% in Faro-et-Deo and 18.42% Mayo-Banyo Divisions. Bush fires are mostly caused by human activities (farmers and grazers). Farmers set fire in their fields to avoid clearing land, meanwhile grazers set bushfires to encourage grass growth in order to feed their livestock. Poorly controlled bush fires have a negative impact on fruit production.

Table 6: Socio-economic constraints (%) on fruit production in the Divisions

Constraints	Divisions				
	Vina	Djérem	Mbere	Faro et Deo	Mayo-Banyo
Inaccessibility to selected cultivars	16.42	22.5	23.33	13.33	15.78
lack of access to inputs	15	27.5	13.33	30	31.57
Enclavment	15.71	0	0	43.33	28.94
Lack of good farming practices	23.57	17.5	10	26.66	18.42
Bush fires and field robbery	12.85	0	0	16.66	18.42

3.2.2. Environmental factors

About 18.29% of farmers mentioned that yields in agrosystems had fallen because of the loss of soil fertility over time, as the soil is a potential target for climatic hazards. Producers analyses environmental factors in terms of three main parameters: rising temperatures (44.3%), late or sudden rainfall (31.2%), and strong winds (24.5%), which contribute to loss of quality and quantity in fruit yields, leading to financial instability.

3.2.3. Parasitic plants

The presence of parasitic plants causes a great deal of damage to fruit species. 21.5% of producers acknowledged that they are responsible for the drop in fruit yields and the decline of fruit trees. In agrosystems, these haemiparasites have been observed on avocado (*Persea americana*) and citrus trees. Fruit trees attacked represent 43.10% compared to 56.9% of unattacked fruit trees. To prevent the spread of parasitic plants, farmers developed two strategies: manual protection by cutting off all parasitic branches, used by 72.1% of producers, and burning of parasitic trees (27.9%).

4. Discussion

The agrosystems of the Guinean High Savannahs are mostly young (less than 20 years old) and those that are 80 years and above are less frequent. Our results do not corroborate those of Ndiaye *et al*. (2020) in lower Casamance (Senegal), who found that 86.1% of mango orchards were above 20 years old. This age range proves that fruit growing activities in the Adamawa region is recent. The area of agrosystems < 20 ha was the most represented. This result contradicts those of Bourou *et al* (2020), who reported that the area < 0.5 ha is the largest (68.63%) in cashew plantations in the northern zone of Cameroon, and only 3.92% have ≥10 ha. The large surface areas of orchards in the Adamawa zone indicate producers who are heavily involved in commercial fruit production, with large family size in order to enable them provide basics necessities for their families (food, health, etc.) and/or plantations that are prepared to export fruit.
Family labour accounted for 70.1% of the laborforce, which is similar to the work of Tossou *et al* (2009), where family labour was 50%. However, according to Bourou *et al.* (2019), in fruit orchards and other tree species (North Cameroon region), only 9% of producers use family labor. Pruning is carried out by orchard famers in order to reduce the height of fruit trees. Weeding facilitates access to the plantation. In Lower Casamance, weeding and ploughing are the two mechanical practices used by mango producers (Ndiaye *et al.,* 2020).
Mango (Mangifera indica), avocado (*Persea americana*) and banana (*Musa balbisiana*) are the most widely used of the 17 fruit species found in the study area. They account for 68.38%, 52.24% and 35.9% of orchards respectively. The results obtained are similar to those of Sougnabé *et al* (2010), who found that avocado, mango and banana are the most important species in the Adamawa zone. However, our results differ from those of Kuaté *et al.* (2005) for fruit farms in the peri-urban area of Yaoundé, which shows that avocado (23.9%), mango (23.7%) and plumbs (21.3%) are the most represented species. This difference could be explained by the objectives of the farmers, who attach importance to species with a high financial interest, hence their abundance in the orchards compared with other species. This reflects the very important role that fruit trees play in farmers' food security. With regard to the Citrus genus, our results corroborate those obtained by Etchike *et al.* (2020) who confirmed the dominance of this genus in agroforests in the forest-savannah ecotone zone of Cameroon. Orchard species play a very important economic, food and medicinal role. Farmers provide food for households and employment. According to Kuaté *et al* (2005), the sale of fruit provides incomes for food (67.2%), medical care (54.5%), education (45.4%), savings (25.4%), purchase of agricultural inputs (12.7%) and shelter (3.6%). Some producers also process fruit. Palm nuts are the most processed fruit, accounting for 26.7%. Fruit processing enables farmers to conveniently sell, conserve their produce, and earn more incomes. The work of Kuaté *et al* (2005) revealed that oil palm contributes to food and household income through the palm wine extracted, which is highly appreciated, the red oil from palm nuts used for cooking, and palm kernel oil, which is exploited for its therapeutic value.
The agrosystems studied show that the annual crops grown in association are mainly grasses (*Zea mays*), tubers (*Manihot esculenta*) and legumes (*Phaseolus vulgaris* and *Arachis hypogea*). It has been shown that legumes in association with rhizobia play a role in converting atmospheric nitrogen into mineral nitrogen, and cereals improve soil structure and function by entering into symbiosis with bacteria and fungi (Grundon, 1998). The benefits of combining annual crops with trees include income from the sale of both products, household food security, weed control and better use of cultivated resources (Rodrigo *et al*., 2001; Opoku-Ameyaw *et al*., 2003). In Senegal, studies by Ndiaye *et al*. (2017) showed that the preferred annual crops in cashew plantations are legumes (groundnuts and cowpeas), cereals (millet and maize) and tubers (cassava and sweet potato).
The highest proportion of local species is Raphia sp. (20.16%), which is a source of wine for farmers. *Ricinodendron heudelotii*, from the Euphorbiaceae family, although less common (1.63%) in the orchards, is used by farmers as spices for meals. This species is highly appreciated for its edible seeds (Djeugap *et al.,* 2013). The fruit of the *Borassus aethiopium* tree is eaten in various forms by local people.
The main obstacles to the development of the fruit industry in the region are the enclavment of the farm lands and ignorance of good farming practices. As a result, the unskilled laborforce that does not master the phytotechnical approaches to production cannot produce optimally, despite the agricultural potential available. There is also a lack of farmer organisation, limited access to basic seeds and good quality agricultural inputs, and inadequate implementation of good fruit and harvest maintenance practices and processing techniques. The work of Bourou *et al* (2019) in orchards in the North Cameroon region showed that the constraint linked to production is the use of local varieties that are sensitive to pests and diseases.

In the same vein, these authors noted the absence of a phytosanitary treatment program, the lack of a suitable formulation of mineral fertilizer and an appropriate irrigation system, poor harvesting practices and, finally, poor organization of fruit marketing and sales. The presence of haemiparasites also causes considerable damage to fruit species in Adamawa. The results of Dibong *et al* (2010) in the Littoral region of Cameroon shows that parasitic plants caused considerable damage to crops, affecting fruit production yields. A proportion of 9.14% of farmers report a reduction in field productivity periods due to climate change and its negative impact on the environment, which reduces orchard productivity periods and variance in production season, which requires more inputs and more intensive monitoring. According to Tchétangni *et al* (2016) in their work on farmers' perceptions of the effects of climate change on cashew nut production in the commune of Savalou in Benin, the majority of producers perceive climate change as the major constraint on cashew nut production.

Conclusion

The study concludes that, agrosystems less than 20 years and with the surface areas less than 20 ha were the most represented in the high Guinean savanna of Adamawa. The agrosystems of this region have a significant potential for plant species diversity. They help to ensure food security and represent a source of household income. Several annual crops are grown such as *Zea mays, Manihot esculenta* and *Phaseolus vulgaris*. Out of the 17 fruit species surveyed, *Mangifera indica* and *Persea americana* were the most common. Local species include Raphia sp., *Borassus aethiopum, Terminalia glaucescens, Voacanga africana,* Senna sp*., Croton macrostachyus* and *Ricinodendron heudelotii.* Fruit species in agrosystems are subjected to many production constraints of which, difficult access to inputs, poor farming practices and difficult access to selected cultivars are outstanding. In order to make better use of the Adamawa agricultural potentials and improve fruit production so that fruit cultivation becomes a reliable source of income, there is an urgent need to develop strategies to improve stakeholders' access to quality agricultural inputs.

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