

Evaluation of Wild Edible Plant Species in the Logone Valley, Cameroon

Froumsia Moksia^{1*}, Souare Konsala¹, Todou Gilbert¹, Hamawa Yougouda²,
Nnanga Jeanne Flore¹, Tchobsala¹

¹Department of Biological Sciences, Faculty of Science, University of Maroua; P.O Box 814 Maroua, Cameroon

²Department of Agriculture, Breeding and Derived Products, National Advanced School of Engineering, University of Maroua, P. O Box 46 Maroua

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ABSTRACT

A study was conducted to evaluate the diversity of edible plant products in the Logone flood plain. Interviews were conducted with households in 35 villages and in rural and urban markets; a sample of 815 persons was interviewed to evaluate and quantify the various edible plant products and to determine the flows of the exploited products. The results showed that the edible plant products used in the area were: fruits, leaves, flowers, seeds, hypocotyls, tubers, roots, barks and stems. These edible products were harvested from 48 plant species belonging to 24 families, in which 36 species were fruit trees, 9 species produced leaves and / or flowers, 2 species produced seeds and once specie produced hypocotyls. The total annual quantity of products harvested was important as fruit (377.9 t); leaves (85.93 t); flowers (1.66 t); seeds (31.86 t) and hypocotyls (47.37 t). These products were of significant socio-economic value for the rural populations. The sale of the products generated a total income of 31 478 990 francs CFA. The rest was distributed between consumption and offers. These products were part of the human diet and their marketing brought back a substantial income that contributed to the household economy. Local people were developing interest in exploiting different bush products. The exploitation activities of the various products were intensifying; the requested species must be domesticated to ensure future generation of the availability of these resources.

KEYWORDS: Plant products, socio-economy, food, Flood Plain, Logone, Cameroon

INTRODUCTION

In sub-Saharan Africa, demography is important, the majority of the population is poor, and its agricultural land is degraded with low production which does not ensure the daily food needs of the population. To fill the food gap and boost the income of very poor households, people use various forest products for their food, health, housing and financial income [1]. Important natural resources exploited in forests and on which rural people depend are non-timber forest products [2, 3, 4]. Non-timber forest products refer to biological resources other than timber and industry that are harvested from natural or man-made forests [5, 6]. In plants, they include various organs including: leaves, stems, bark, roots, bulbs, rhizomes, tubers, fruits and seeds, edible fungi [7]. They provide rural populations with the products they need to survive with [8, 9]. These resources contribute in supplementing the food consumption of the rural populations [10, 11]. Non-timber forest products, given that their diversity and variability in quantity and quality, are of great ecological and socio-economic importance [12, 13, 14, 3]. Various plant organs are consumed and marketed in local, national, regional and international markets [15, 16, 17, 18, 19, 1]. The collection, process and sale of these non-timber forest products thus enable rural populations to earn income enabling them to buy manufactured products and produce tools [20, 3, 21].

In the Sudano Sahelian zone of Cameroon, vegetation is poorly diversified and severely degraded due to significant anthropogenic activities and climatic hazards. The level of logging has exceeded the increase in woody biomass [22, 23]. Deforestation leads to an impoverishment of the original flora and a decrease in soil fertility. The exploitation of non-timber forest products in the woodland is heavily practiced by the local populations for family consumption and marketing. As a result it becomes an imperative to record the various edible plant products used in the area and their socio-economic importance, in order to develop appropriate strategies for a sustainable management.

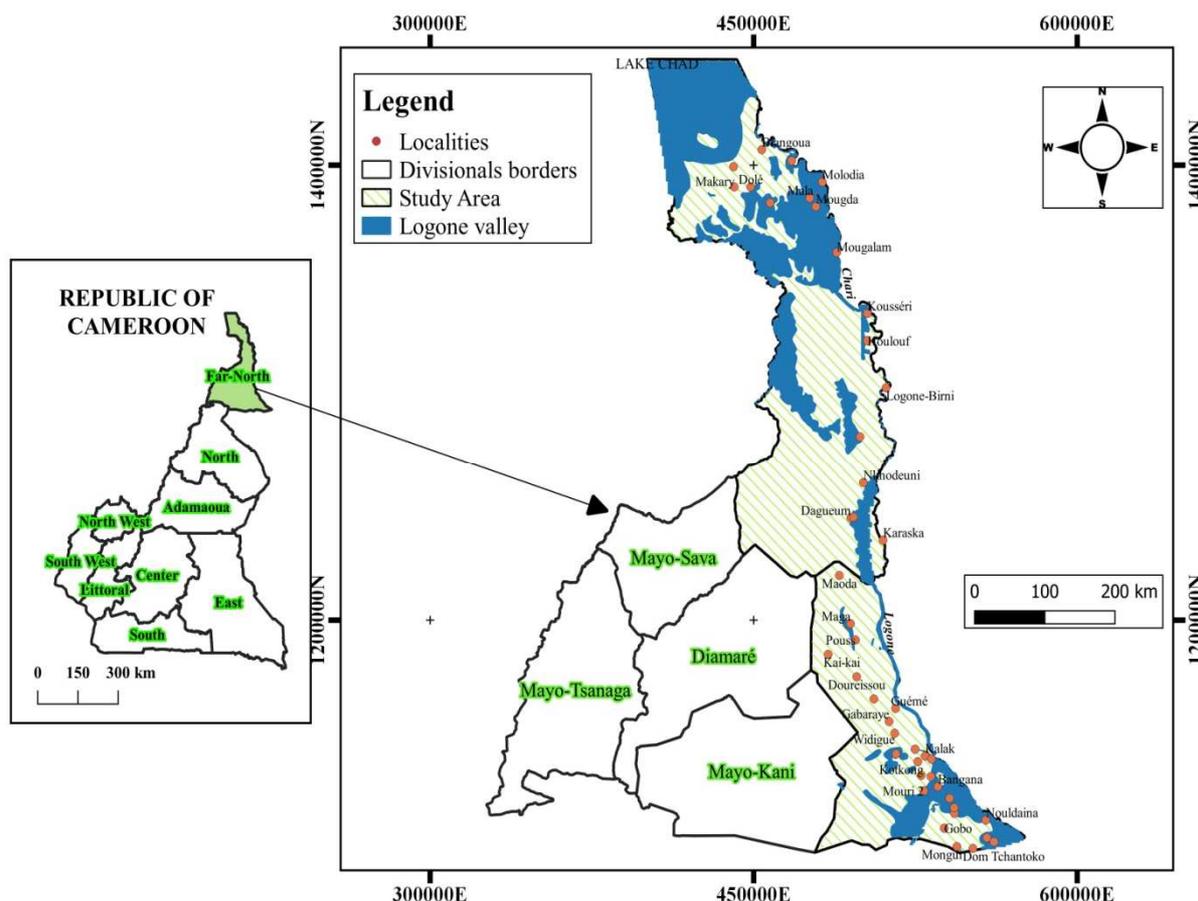
The present work generally aims to determine the diversity of edible plant species and their socio-economic importance for sustainable management. More specifically to:

- acknowledge the edible plant species exploited and their consumed parts;
- evaluate the quality and the quantity of the edible products exploited;
- determine their socio-economic value of the edible plant products.

MATERIAL AND METHODS

Study area

The investigations were carried out in the Logone Valley covering part of the Mayo Danay and Logone and Chari divisions in the Sudano Sahelian zone of Cameroon (Figure 1). It was located between 10 ° North latitude, 16 ° East longitude and the average altitude is between 250 and 300 m. The study area was characterized by a Sudano-Sahelian climate with two seasons: a long dried season that lasts for 8 months (October to May) and a short rainy season of 4 months (June to September). The average annual rainfall was 800 mm. The average annual temperature was 28 ° C with a minimum of 18 ° C and a maximum of 45 ° C. The zone belongs to the Sahelo-Sudanian sector in the great complex of steppes with thorny species. The woody and herbaceous vegetation presents elements of the Sudano-Sahelian savannahs, dry savannahs and Sahelian steppes consisting of wooded savannahs and shrubby savannahs with a remarkable irregular grassy carpet that has been severely degraded under the pressure of human activity [24, 23, 25].



Localization of the study site.

Data collection

The interviews were conducted on 815 people belonging to a various ethnolinguistic groups distributed in 25 different villages located in the Logone flood plain. In each household at least one person was interviewed. Villages were selected based on the accessibility criteria, present ethnic groups and their exploitation activities. The investigations were also conducted in 25 rural markets and 8 urban markets. The stratified probability sampling method (sex, age) was adopted [26]. A sample of 815 people was considered ageing between 15 and 60 years, in which 414 men and 401 women were interviewed. This interview targeted: women were the main people concerned in the use of plant products and recovery; children, concerned in collecting and picking fruits and old, holders of information relating to the evolution and history of the soils. The interviews were conducted individually or in groups based on a questionnaire that focused on the following: knowledge of plant species, edible species, consumed parts, their availability, the qualities and quantities of the products collected the mode of exploitation, collection periods, their socio-economic importance, and their use by the population, the income generated. The evaluation and quantification of products with high socio-economic value was made with stakeholders at various levels (collectors, wholesalers, retailers and consumers). To quantify and follow the exchanges of the products, a register was given to the collectors having accepted the

collaboration. The investigating officers visit the operators once a month to update the register on all the information concerning the transactions of the exploited products. In this register, these were noted: the products exploited, the quantities harvested, those consumed, sold and offered, the quantities processed and the final product, the units of sale and the prices on the markets, the income generated, the constraints related to the exercise of the activity. Quantification was done using a Roberval type weighing scale, capacity 50 kg and the unit of measurement for all products was in kg. For each non-timber forest product collected, the contents of the units of measurement used for sale weighed 10 times to determine the average weight.

RESULTS

Edible Vegetable products exploited in the Logone flood plain

The various edible wild plant products exploited were fruits, leaves, flowers, seeds, tubers, barks, roots, hypocotyles. These products were eaten fresh or dried, raw or processed. (Table I). A total of 47 edible plant species belonging to 24 families were identified. Among these species, 36 were spontaneous fruits whose fruits were variously appreciated for consumption and some marketed by the populations. The most popular fruit species were: *Balanites aegyptiaca*, *Ziziphus mauritiana*, *Tamarindus indica*, *Hyphaene thebaica*, *Borassus aethiopum*, *Diospyros mespiliformis*, *Detarium microcarpum*, *Ziziphus spina-christi* and *Ximenia americana*. Exploited fruit was an important source of food for the people. Their consumption contributed to reduce the number of daily meals and the left over products was commercialized to provide a substantial income to the local populations. Some were conserved and were used as food supplement during food scarcity period.

Seeds and stones were exploited for consumption, oil extraction and production of hypocotyls (Table 1). The seeds of *Sclerocarya birrea* were directly consumed after extraction of the lignified stone. Those of *Balanites aegyptiaca*, locally called "Pouyadi", undergo a treatment to make them edible. The stone of *Borassus aethiopum* were sown to the populations for the production of hypocotyls locally called "mbachi" which were heavily consumed and marketed. The sale of these products provided a substantial income for farmers.

Populations exploited and consumed the leaves and / or flowers of 9 species. These were: *Adansonia digitata*, *Balanites aegyptiaca*, *Crateva adansonii*, *Tamarindus indica*, *Bombax costatum*, *Leptadenia hastata*, *Celtis integrifolia*, *Hymenocardia acida*, *Piliostigma reticulatum*. These leaves and flowers were consumed as vegetables and additives because of their mucilaginous quality. In this zone, characterized by the long dried season, the populations seek the leaves and flowers of the perennial species as vegetables to make sauces.

The species exploited for tubers and roots were: *Dioscorea dumetorum*, *Tacca leontopetaloides*, *Cissus populnea*, *Cochlospermum tinctorium* and *Asparagus officinalis*. These tubers and / or roots had some toxic or irritating effects and could not be directly consumed by the populations; they must undergo a particular treatment. The treatment eliminated irritation and toxic effects. The tubers of *Dioscorea dumetorum* and *Tacca leontopetaloides* were treated to give the "Djiba" and the consumable flour "Chii". The roots of *Cissus populnea* were dried and used in the kitchen for the sauce. The bark of *Grewia venusta* was dried and used as an additive in the sauce for its mucilaginous quality and the stems of fresh or dry *Cadaba farinosa* were used to sweeten the porridge.

Edible bush products were distributed regularly and periodically throughout the year, which allowed farmers to have at least one additional product for their consumption. As these products were considered secondary, their marketing contributed significantly to the economy of the poor rural family.

Table I. Edible Vegetable products exploited in the flood plain.

Specie	Family	Frequency of quotations of the edible parts (%)					
		Fruit	leaf	Flower	Seed	Hypocot	Ro/tub/ste/bar
<i>Adansonia digitata</i>	Bombacaceae	21.11	32.25				
<i>Ampelocissus africana</i>	Vitaceae	15.41					
<i>Annona senegalensis</i>	Annonaceae	34.11					
<i>Asparagus officinalis</i>	Asparagaceae						7.23
<i>Balanites aegyptiaca</i>	Balanitaceae	95.75	97.28	2.74	94.67		
<i>Bombax costatum</i>	Bombacaceae	6.12	11.17	73.25			
<i>Borassus aethiopum</i>	Areaceae	79.53				89.87	
<i>Cadaba farinosa</i>	Capparaceae	27.81					36.61
<i>Capparis fascicularis</i>	Capparaceae	5.14					
<i>Capparis sepiaria</i>	Capparaceae	3.22					
<i>Celtis integrifolia</i>	Ulmaceae	10.31	42.12				
<i>Cissus populnea</i>	Vitaceae	7.11					31.24
<i>Cochlospermum tinctorium</i>	Cochlospermaceae						2.71
<i>Crateva adansonii</i>	Capparaceae		46.52				
<i>Detarium microcarpum</i>	caesalpiniaiceae	66.71					
<i>Dioscorea dumetorum</i>	Dioscoreaceae						48.57
<i>Diospyros mespiliformis</i>	Ebenaceae	67.21					
<i>Ficus gnaphalocarpa</i>	Moraceae	4.81					

<i>Ficus ingens</i>	Moraceae	5.32					
<i>Ficus platyphylla</i>	Moraceae	3.45					
<i>Ficus polita</i>	Moraceae	5.67					
<i>Ficus sur</i>	Moraceae	6.42					
<i>Ficus sycomorus</i>	Moraceae	6.53					
<i>Ficus thonningi</i>	Moraceae	5.21					
<i>Gardenia ternifolia</i>	Rubiaceae	3.47					
<i>Grewia villosa</i>	Tiliaceae	3.22					
<i>Grewia flavescens</i>	Tiliaceae	3.21					
<i>Grewia venusta</i>	Tiliaceae						37.28
<i>Hexalobus monopetalus</i>	Annonaceae	33.47					
<i>Hymenocardia acida</i>	Hyménocardiaceae	6.71	12.23				
<i>Hyphaine thebaica</i>	Arecaceae	82.71					
<i>Lannea schemperi</i>	Anacardiaceae	7.49					
<i>Leptadenia hastata</i>	Asclépiadaceae	6.87	67.57	67.52			
<i>Parkia biglobosa</i>	Mimosaceae	43.14			12.4		
<i>Piliostigma reticulatum</i>	caesalpiniaceae	13.51		13.37			
<i>Sarcocephalus latifolius</i>	Rubiaceae	27.34					
<i>Sclerocarya birrea</i>	Anacardiaceae	39.46			42.16		
<i>Strychnos innocua</i>	Loganiaceae	8.24					
<i>Strychnos spinosa</i>	Loganiaceae	8.11					
<i>Tacca leontopetaloides</i>	Taccaceae						35.36
<i>Tamarindus indica</i>	Caesalpiniaceae	86.57	83.35	73.58			
<i>Vitellaria paradoxa</i>	Sapotaceae	34.21					
<i>Vitex doniana</i>	Verbénaceae	27.76					
<i>Vitex madiensis</i>	Verbénaceae	24.28					
<i>Ximenia americana</i>	Olaceae	56.37					
<i>Ziziphus mauritiana</i>	Rhamnaceae	87.83					
<i>Ziziphus spina-christi</i>	Rhamnaceae	57.64					

Harvesting mode of the various products

The mode of exploitation of the products varied with the type of organ to be sampled and the species. Fruit, leaves, flowers, seeds, tubers, bark and roots. The various collection methods were: the gathering (72.24%), pruning, trimming, felling down trees (20%), direct picking on the tree (5.46%) and debarking and digging (2.30%). The main people were women (61.17%), children (35.43%) and men (3.40%). The harvesting of leaves and flowers was mainly the activities of women who were assisted by children. The method of harvesting leaves and flowers by felling down trees was an unsustainable practice; it did not take into account the renewal of the resource.

Quantities and distribution of edible products exploited

The total annual quantity of fruits collected was 382.9 t. These great quantities came from fruit collection from the 10 most popular fruit species (Figure 2). The most exploited fruits in order of importance of fruits collected were: *Balanites aegyptiaca* (87.45 t), *Borassus aethiopum* (81.20 t), *Hyphaene thebaica* (78.8 t) and *Ziziphus mauritiana*: (73.75 t). On the other hand, *Hexalobus monopetalus* (1.2 t) and *Detarium microcarpum* (3.5 t) recorded the smaller quantities. *Ximenia americana* (23.3 t); *Sclerocarya birrea* (12.3 t) and *Tamarindus indica* (16.4 t) produced significant amounts. Local people, concerned with the diversifying sources of food products to cope with the lack of agricultural production, had developed an interest in the collection of non-timber forest products.

The total annual quantity of leaves collected from *Balanites aegyptiaca* and *Adansonia digitata* was 85.93 t. The collected *Bombax costatum* flowers were quantified at 1.66 t (Figure 2). The high increasing population, the low agricultural production and poverty favored overexploitation of the edible species. The total annual quantity of *Balanites aegyptiaca* seed collected was 31.86 t. The annual amount of hypocotyls exploited was 47.37 t (Figure 1). Only two species were exploited for at least two types of edible and commercial valuable: *Balanites aegyptiaca* for fruits, leaves and seeds and *Borassus aethiopum* for fruits and hypocotyls. They might deserve special attention for sustainable management.

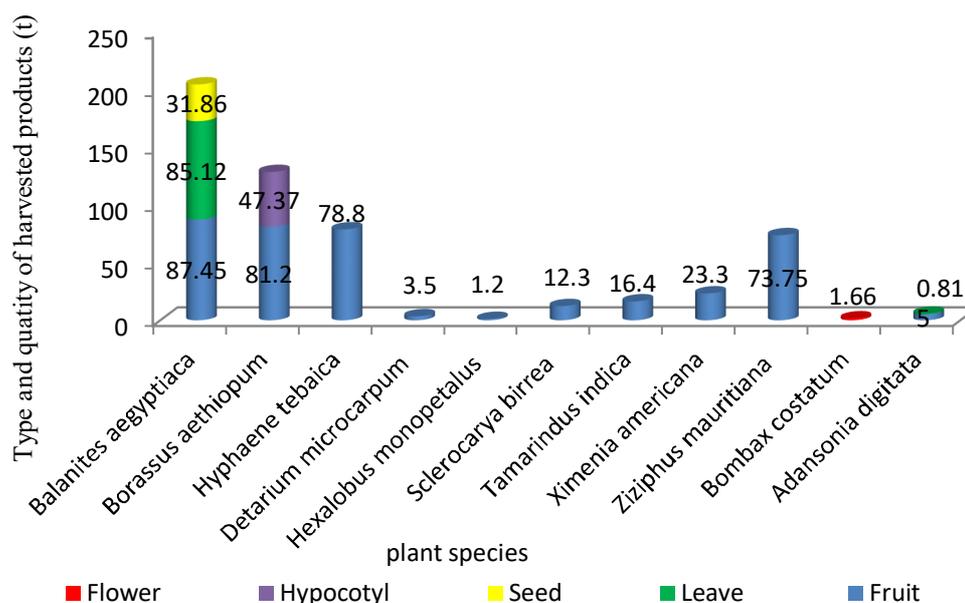


Figure 2. Annual quantities of products collected in the floodplain.

The various products collected were used for consumption, sale and supply with varying proportions. The annual quantity of non-timber forest products (fruits, leaves, flowers and seeds) consumed represents 20%; the quantity offered resulted to 5.02% of the total production and 74.98% represented the sold quantity. This variability was showed by a significant difference between the quantities of products collected in the different transactions ($p < 0.001$). These bush products were offered to relatives, guests and relationships that lived in the city and do not had access to these wild edible products. The offer was a symbol, an important action of solidarity in the African society which allowed maintaining the family and friendly relationship. Most of the production was marketed to generate substantial income to boost the household economy. Although, in general, the purpose of the exploitation of non-timber forest products was a priority for commercial purpose. It was also one of the factors of degradation of the resources which compromised their sustainable management.

Transformation and valorization of the collected products

The traditional treatment of volatilization of seeds of *Balanites aegyptiaca* gave a final product called "Pouyadi" (Fig. 4 a). The stages of treatment were:

- The collection and storage of fruits: ripe fruits and stones were recovered under bush trees or barns and were stored by farmers;
- The extraction of the seeds: the stones were crushed using stones or hammers to collect the seeds. It was often done in family, during the day or in the moonlight;
- The elimination of the integuments: this stage was done by a brief scalding to separate the seeds from its integuments;
- the baking: once the integuments were released, the seeds are brought to boil for a long period of 5 to 6 hours during which the cooking water was thrown away and replaced regularly 4 to 5 times, about every hour, this to eliminate the bitterness contained in the seeds;
- The soaking: the cooking was followed by soaking with water for 12 hours of which the soaking water is also changed 4 to 5 times. At the end of this operation, the seeds were well washed. This operation helped to further eliminate the very bitter taste of the seeds;
- The coloring: part of the seeds was removed to acquire a color for decoration. The most frequent encountered colors were bright red and indigo. This coloration was obtained by mixing the seeds of *Balanites aegyptiaca* with red millet or calyces of red *Hibiscus sabdariffa* and to acquire the color red or indigo;
- The drying: the seeds thus obtained, considered less bitter and consumable, were dried in the sun and then packaged.

At the end of these steps, the seeds were made consumable and marketed. The seeds were also used for oil extraction which had nutritional and / or medicinal properties. The hulls were burned and the ash was recovered to extract the traditional salt used in cooking.

Preparing cakes of *Ziziphys mauritiana* "Yabande"

The production of "Yabande" based on the fruits of *Ziziphys mauritiana* was done through a traditional method (Figure 4 b). The process follows the steps opposite:

- collection of fruits: farmers collect a good amount of ripe fruits;
- sorting and drying: the fruits were carefully sorted to eliminate the undesirable ones and then dried in the sun;
- pounding and sieving: the women pound the dried fruit in a mortar to extract the dry pulp, a fine mesh sieve was used to obtain the pulp flour;
- formulation of the dough: the mixture was consisted essentially of water (200 cl) and flour from pounding fruit (1 kg), giving a viscous paste;
- molding: the paste was introduced into a mold to give the desired shape. To prevent adhesion of the paste on the walls of the mold, a layer of millet flour was previously applied in the mold;
- Baking: a pot was heated to dry for 5 to 10 minutes; the molded cake was introduced into the pot for 5 to 10 minutes of cooking;
- conditioning: after cooking, the cakes were exposed for cooling and then introduced into a bowl and were ready for consumption and marketing.

The yield of flour after pounding and in relation to the initial weight of the fruits was about 35%, the weight of the cores represented 55% and the losses were estimated at 20%. The losses were enormous, they were recorded at two levels: during the pounding and the different phases of sieving.

Treatment of tubers

The traditional treatment of *Dioscorea dumetorum* tubers by evaporation and fermentation gave a final edible product called "Djiba" (Figure 4c). The process began with the collection of tubers; peeling and cutting into thin strips; flushing the product in a container. Then a quantity of leaves and / or calyces of *Hibiscus sabdariffa* or *Tamarindus indica* fruits were added. The mixture was boiled for 1 to 2 hours where the cooking water was discarded and replaced at least 4 times. After cooking, the product was soaked and washed with plenty of water, at least 3 times. The treatment process took about 24 hours to eliminate bitterness and precipitate toxicity. The final product "djiba" thus obtained was consumed by the family especially in times of scarcity and was sold on the markets.

In the case of *Tacca leontopetaloides* "Chii" tubers, the treatment process of obtaining flour was also traditional (Figure 4d). The process was conducted as follows:

- the tubers were collected, peeled and grated with a trunk of *Senna singueana* that had a very rough bark; the grated product was introduced into a polyethylene bag;
 - Then follows a long wash in a bowl, the cleaning water was removed gradually and the floury dough (starch) settled;
 - the floury dough was recovered, spread and dried in the sun;
- the flour thus obtained was ready to be used.

The flour of *Tacca leontopetaloides* was widely used by people in times of scarcity and was used to produce cakes highly appreciated and sold in the market and in the administrative offices of the place.





Figure 4. Seeds of *Balanites aegyptiaca* "Pouyadi" untreated and processed consumables a); Fruits and cakes "Yabande" of *Ziziphus mauritiana* b); finished products "Djiba" *Dioscorea dumetorum* c) cakes of *Tacca leontopetaloides* "chii" d).

Marketing of the exploited products and income generated

The total quantity of edible products marketed was 302.07 t. It varied according to the different products exploited and needed by the consumers. Fruit accounted for 35.94 %, hypocotyls (30.30 %), leaves represented 20.60 %, and seeds had a share of 12.59 % and flowers 0.56% (Figure 5). The variability of the quantity quantities of the products sold was shown by the variance calculation ($p \leq 0.0231$). The quantities of leaves and seeds sold were solely from *Balanites aegyptiaca* and those of the flowers were from *Bombax costatum*. The leaves, flowers and seeds of other species were solicited but the quantities sold were less important and had not been evaluated.

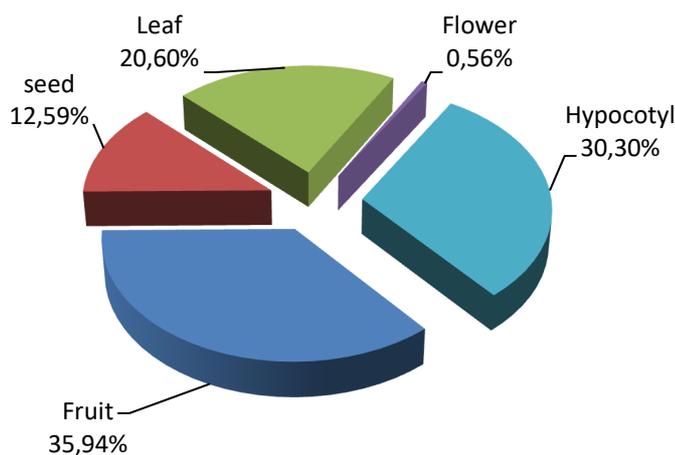


Figure 5. Quantities of the various marketed edible products.

The products collected were sold primarily in the markets of the different villages in rural and urban markets (Figure 5). In urban areas, these products were sold in detail along the streets and traveling agencies. Wholesalers buy products in rural markets for resale in urban markets to obtain a large profit margin. Trade in products crossed the borders of the country. The products were sold on the markets using tools (cups, bowls and bags) of various measurements and capacities, which were the best way of fixing prices in the market. These prices varied according to the periods and place of sale; as any commercial product, prices obeyed the law of demand and supply. Most often, prices in urban markets double those in rural areas.



Figure 5. Sale of edible vegetable products in rural and urban markets.

The marketing of large quantities of collected products made it possible to report an increase in the economy of rural households or a substantial total income of 31 478 990 francs CFA. The fruits were sold for 8 550 715 F CFA, the seeds and hypocotyls yielded 14 497 775 F CFA, the contribution of the leaves was 809 500 F CFA and that of the flowers was 246 000 F CFA. "Yabande" brought a modest sum of 175 000 CFA francs. The economic value and contribution of these products to the people's economy was very important. For some households, the annual aggregate income from the sale of the harvest products was an important farm income. The combination of these revenues thus enabled farmers to cope with the food deficit.

DISCUSSIONS

Variability of non-timber forest products

In the floodplain of Logone, the edible plant products used were fruits, leaves, flowers, seeds, hypocotyls, tubers, roots, bark, and stems. They entered the human diet and contributed to the household economy. These products were harvested from 48 plant species, 36 were fruit species, 9 species produce leaves and / or flowers, 2 species were exploited for their seeds and one species could produce hypocotyls. In Cameroon, [27] listed 74 fruit species nationally, of which 18 were similar to this study. Similarly, [28] had inventoried in the Sudano-Guinean and Sudano-Sahelian savannas of Cameroon, 55 edible fruit species among which 27 were similar to the present study. Similar species were characteristic of Sahelian and Sudanian vegetation [23]. The various edible products exploited constituted an important source of food to the population which, made it possible to supplement their daily food need and a source of good and service. [29, 30, 31, 28] had shown that the diversity of food products of plant origin exploited in the savannas contributed to supplement the food ration and represented a substantial source of income to ensure the well-being of the rural populations. In addition, they provided rural populations with the essential elements for their survival [32, 33]. In this zone, the fruits, leaves, flowers and seeds exploited were mostly eaten dry. For the populations, drying was one of the methods of preserving food, with the long dry season. The same observation was made by [31, 28] on the products of the feeding trees in the Sahelian countries and some wild edible fruits exploited in the Sudano-Sahelian zone of Cameroon.

The edible organs of the exploited plants could undergo transformations by traditional methods to give derived products (paste, flour and oil) used for food. The study of [34, 35, 28] showed that certain exploited non-timber forest products undergo transformations to extract various derived products: oil, pulp, and butter in the Sudano-Sahelian zones of Cameroon. In addition, [36] showed that in Central Africa, the seeds of *Balanites aegyptiaca*, *Vitellaria paradoxa*, *Borassus aethiopum* allowed produce various products.

The main methods of exploitation practiced by the populations were: gathering and gathering on the tree, felling down trees and partial felling of trees. Exploitation activities were unsustainable practices; they were more intensive on the resource and represented an important ecological constraint. Similar methods of exploitation of non-timber forest products were described by [37, 38, 39]. These authors indicated that the intensity of exploitation depended on the domestic and / or commercial demand of the product. Indeed, the degree of commercialization of the product and access to the market or proximity to the market had an

ecological consequence to the resource. The increasing demand of the edible plants products was consequently high on the resource. In addition, the method of harvesting fruit was extremely harmful and typically unsustainable [37] (Tchatat et al., 1999).

Socio-economic importance of exploited products

The quantities of edible products used by the populations were becoming increasingly important; they varied according to the type of product. The population was interested in exploiting non-timber edible forest products, which were chronologically well distributed and cover the whole year. The diversity of products, the amount harvested and their availability throughout the year allowed rural farmers to fill the gap in agricultural production and ensure the daily food security of families. These results corroborated those of [33, 28] who identified various types of products and estimated respectively 105.70 t and 83 t for the amount of non-timber forest products used in home gardens in the Sudano-Guinean zone of Cameroon and 18.694 t, for the quantities of fruit harvested from 11 wild species in the high Guinean savanna and Sudano-Sahelian savannah areas. At the national level, [40] quantified at 488.57 t for the production of *Gnetum* spp leaves in the Cameroon's forest zone. But these authors noted that there was still no formal structure to determine the socio-economic value of NWFPs in Cameroon. However, the distribution and availability of different non-timber forest products in the periods of the year allowed farmers to have at least one product during the year [33]. This availability of products made it possible to ensure family food security and the sale of the surplus. This made possible to contribute to the family's monetary income [37, 41].

To convene and satisfy the needs of local populations, the various products collected were part of different social and economic circuits. The amount of product exploited was distributed by farmers for family consumption, offers to friends and relatives and marketing for a substantial income in the economy. For the different products, the quantities marketed, consumed and offered depended on: the quantity collected. These results were different from those of [42] who studied the socio-economic value of hut gardens and showed that 60 % of the products were consumed, the quantities offered and distributed as gifts to relatives, third and neighbors to strengthen the bonds of friendship and solidarity, represented 10 %. In addition, the results of [43] showed that the total quantity produced in the South-West region amounts to 3 991.1 kg, that consumed to 1197.4 kg and sales to 2793.7 kg. The difference between these results was due to the methodology adopted for data collection. The edible wild products were played an important role in the relationship. An important quantity was covered the offers to relation, it contributed to keep up the relationship in the family and friendly. The donation of non-timber forest products to other members of the community was a very important aspect of economic life in rural Africa [44, 45].

A great quantity of edible products used (fruits, hypocotyl seeds, leaves and flowers) was marketed. In the markets of southern Cameroon, large quantities of non-timber forest products were sold [46, 21]. The marketing of products (fruits, leaves, flowers, seeds and derived products) exploited in the floodplain, gave a substantial income estimated at 31 478 990 CFA francs. The social value and the contribution of these products to the economy of the population were very important. These results were similar to those of [43] study which estimated the annual income from the marketing of *Gnetum* at 2 245 928 000 CFA francs, wild mangoes at 1 152 000 CFA francs, and [21] estimated that the income generated by CFAF 4 102 124 940 was the sale of non-timber forest products in the Takamanda Forest Reserve, [47, 48] had estimated that the income from the exploitation of dungeons and the exploitation activities of forest was greater. These edible products were presented throughout the year and contributed effectively to an increase on the farmers' incomes. However, the exploitation and marketing of NWFPs as they occurred in Central Africa remained to some people as a strategy to increase their income and not a guarantee of sustainable management of non timber forest products or the promotion of agroforestry practices [49].

These products, which were used in rural areas, were sold in urban markets in the three northern regions of Cameroon and their marketing crossed the country's borders. Similarly to the leaves of *Gnetum africanum* and *G. bucholzianum* (okok or eru) harvested in the Congo Basin, the products were subject to regional and international trade. A large quantity of non-timber forest products was exported and allowed the development of a large market to the neighboring countries and even to Europe [40, 23, 9, 50]

CONCLUSION

Investigations had shown that floodplain populations exploit a wide variety of non-timber forest products that were: fruits, leaves, flowers, roots and / or tubers, bark, stems. These exploited products made it possible to fulfill important socio-economic functions. The quantities exploited were large and used for family consumption, sale to provide cash income and make offers. The offer helped to maintain family and friendships. However, the quantities sold were larger. The quantity, diversified, the year-round availability of the various products exploited and the income generated by the sale enable poor rural people to improve their well-being. As a result, the populations showed an interest in the exploitation of non-timber forest products. Farmers' concern

was to diversify the sources of food and generate income to cope with inadequate agricultural production and environmental poverty. However, harvesting practices that were intensive and selective posed a significant threat to the species involved and were not sustainable. It is to be feared that these resources will disappear in future.

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