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Sustainability Assessment of Non Timber Forest Products in South-Eastern Cameroon Rainforests

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Abstract Non timber forest products (NTFP) are vital for subsistence and cash income. However, the question of how NTFP-dependent societies are likely to benefit sustainably from these vital resources remains unanswered. This study assesses the sustainability of major species of NTFPs in the Gribé forest located at the northern periphery of the Boumba-Bek National Park. The local ecological knowledge on NTFPs was obtained from local people in the village. A total of 20 households were interviewed on the marketed NTFPs, plant parts used, usage, mode of collection, development stage of the plant organs, knowledge of the natural history of the species, their perception on species abundance in the forest, and local practices for conservation. To assess individual species vulnerability, the above-cited parameters were scored following a 3-categorized ranking system, using local people's perception and existing data from forest resource assessment previously conducted in the area. Preference ranking was used to determine suitable species for enterprise development. The study shows greater economic significance of *Aframomum* spp., *Diospyros* spp., *Afrostyrax lepidophyllus* Mildbr, *Baillonella toxisperma* Pierre, *Beilschmiedia louisii* Robyns & R.Wilczek, *Cola acuminata* (P.Beauv.) Schott & Endl., *Diospyros* sp., *Garcinia kola* Heckel, *Gnetum* spp., *Irvingia gabonensis* (Aubry-Lecomte ex O'Rorke) Baill., *Pentaclethra macrophylla* Benth., *Piper guineense* Schumach. & Thonn, *Ricinodendron heudelotii* (Bail.), *Scorodophleus zenkeri* Harms, and *Tetrapleura tetraptera (Schum. & Thonn.)* Taub. in Gribé forests. On the other hand, greater vulnerability is reported for *Baillonella toxisperma* Pierre in this forest. The assessment identified great potential for market development for some NTFP and argued that the following priority interventions areas should be considered for sustainable NTFP exploitation: optimizing NTFP production through domestication (for both important and threatened species), creating a collectors' network, developing processing technology, supporting the establishment of a conducive policy environment that removes all regulatory bottlenecks to facilitate market integration by primary producers.

Keywords: *NTFP, local knowledge, economic significance, ecological vulnerability, sustainability*

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1. Introduction

In recent decades, non-timber forest products (NTFPs) have attracted the attention of scientists, policy makers, business operators and indigenous groups as a means to improve the quality of life in rural areas. As from the early 1980s, some pioneering studies showed that the long-term financial return from sustainable NTFP harvest could far be more important than the net economic benefits of timber production or conversion of the same area of land to agricultural fields [1,2]. This optimism fueled much excitement in the conservation community about the prospects of establishing sustainable forest management systems that could help maintain biodiversity while simultaneously providing sustainable economic returns to local people and governments. The global trade of NTFP has been estimated to be USD 11 billion, and NTFP accounts for as much as 25% of the income of close to one billion people [3].

In Cameroon, the importance of NTFPs in rural and forest economies is immense. They contribute to the generation of income of the forest-dwelling population and are used to meet subsistence needs for food, traditional medicines, handicrafts, ornaments and religious or socio-cultural practices [4,5,6,7]. In Gribé village, although we surmise that there may be as many as 500 NTFPs, 42 different products were reported to be most frequently sold by the local people including *Diospyros* spp., *Ricinodendron heudelotii* (Bail.), *Afrostyrax lepidophyllus* Mildbr, *Cola* spp., *Baillonella toxisperma Pierre*, *Pentaclethra macrophylla Benth* Benth., *Beilschmiedia louisii Robyns & R.Wilczek* Robyns & R.Wilczek, *Monodora myristica* Gaertn, *Irvingia gabonensis* (Aubry-Lecomte ex O'Rorke) Baill., *Piper guineense* Schumach. & Thonn, *Scorodophleus zenkeri* Harms, *Aframomum* spp., *Tetrapleura tetraptera* (Schum. & Thonn.) Taub [8]. The financial benefits from these NTFPs collection can only be viable over time if their collection is ecologically sustainable.

A question of critical importance to resource users and policy-makers is how NTFP-dependent societies are likely

to benefit sustainably from these vital resources. Indeed, most species of NTFPs have been reported to be the target of their economic pursuit and are subject to unsustainable extraction. Evidences of excessive extraction of stem bark of *Scorodophleus zenkeri* Harms, *Annickia chlorantha* (Oliv.) Setten & Maas and *Garcinia lucida* Vesque , leaves of *Gnetum* spp. in South, Centre and South West region of Cameroon show that unregulated use of these resources can lead to their depletion. Despite the lack of scientific evidence on the ecological impact of NTFP gathering in tropical forests, intensive fruit gathering is likely to affect the population dynamics of a given species, as shown for *Prosopis africana* (Guill. & Perr.) Taub. in West Africa [9].

The fundamental principle of sustainable forest management is two-fold. On one hand, it comprises the potentials of forest management to meet the needs of current and future generations. On the other hand, it includes the potentials of forests to regenerate and maintain existing stock of resources. This implies forest management to be socially acceptable and equitable, ecologically benign, and economically profitable to local communities.

On an ecological point of view, there have been several attempts to develop appropriate tools to investigate the sustainability of NTFP populations. A set of basic ecological information needed to understand the ecological sustainability of NTFP population has been defined [10], including species availability and yield, natural regeneration capacity, harvest intensity and its impact on the regeneration of the species. Some authors proposed a framework for rapid species vulnerability assessment based on community's socio-ecological knowledge and field scientific evidence. These frameworks integrate socio-economic information on use pattern with the natural history of the species [11,12].

On socio-economic point of view, recent developments on NTFP sector have shown that community-based enterprises have a scope for local economic development, harnessing social equity and conserving natural resources. Hence, the context of the Gribé village characterized by low market integration of primary NTFP collectors, prevalence of subsistence and personal use raised much challenge on developing value chains of key selected NTFP to sustain the livelihood of local communities. This requires not only raw materials availability, but also commercial sustainability, available and accessible markets for the products, legal access to and control over NTFP, equitable distribution of benefits and appropriately storage and processing technology.

In ecological research, recent literature has demonstrated complementarity between local ecological knowledge and scientific sources of information for achieving sustainability and effective biodiversity conservation planning for a given species [13].

In this study, participatory rapid appraisal methods and a modified framework building on the above mentioned frameworks [11,12] is used to assess the ecological vulnerability profile of major commercial species of NTFP and their potential for enterprise development in Gribé community, situated at the northern periphery of the Boumba Beck National Park (South-east Cameroon).

2. Materials and Methods

2.1. Study Area

This study was conducted in Gribe village, Southeast Cameroon, located at 03°00'10'' N and 14°49'25'' E, at the northern periphery of the Boumba Beck National Park (Ffig.1). This village was chosen because there was an ongoing ecological survey on NTFP within the framework of the Forest Savannah Sustainability Project (FOSAS), a joint Cameroon-Japan project funded by the Japan International Cooperation Agency (JICA) and the Government of Cameroon. The vegetation of this region is described as semi-deciduous forest mainly comprised of Sterculiaceae and Ulmaceae tree species [14]

The local population consists of two major and indigenous ethnic groups: the Baka, semi-sedentarised hunter-gatherers and the Konabembe, Bantu-speaking agriculturalist. It was reported that a total population of approximately 400 Baka and 300 Konabembe, organized in 94 and 74 households, respectively live in the Gribé village [15]. The main forms of their livelihoods are shifting cultivation, hunting, gathering, cacao cultivation, and NTFPs collection and marketing.

Annual rainfall varies from 1300 mm to 1600 mm [16]. Average temperature is 25°C. The area is subject to a guinean equatorial climate with four seasons divided as follows:

- a long dry season from December to mid-March;
- a short rainy season from mid-March to June;
- a short dry season in July-August;
- a long rainy season from August to November.

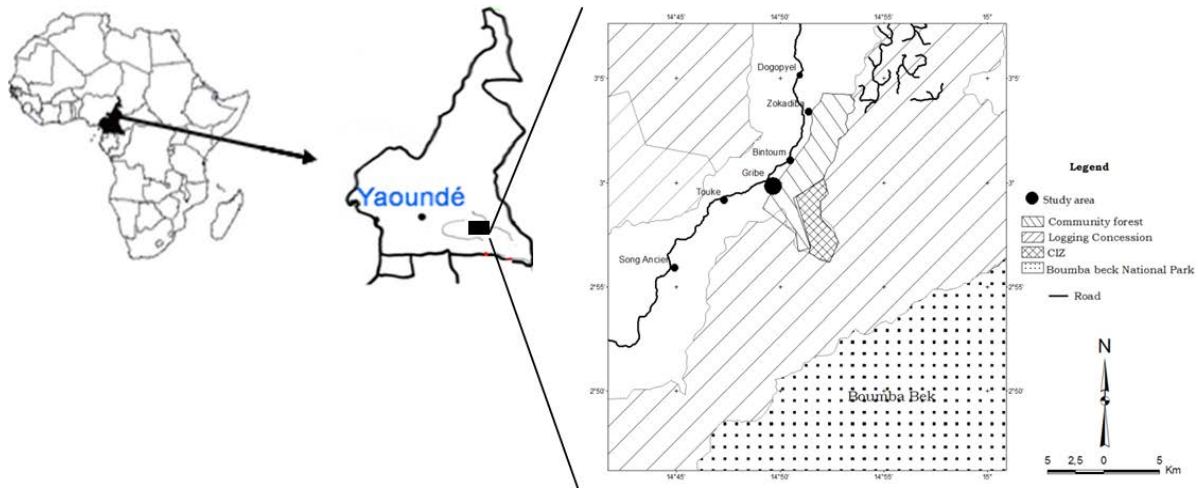

Figure 1. Location of the study area

3. Data Collection and Analysis

The study used key informant surveys to record the local ecological knowledge on NTFPs. A total of 20 individuals were interviewed on the main commercial NTFP exploited, the plant parts used, the usage, the mode of collection, the development stage of the plant parts (organ) collected, the knowledge on the reproductive biology of the plants, their perception on species abundance in the forest, and the local practices of conservation. From the interviews, a list of 13 main NTFP species were selected, on which semi-structured interviews were made to establish the ranking of the NTFPs on the basis of the following 12 criteria [12]: market demand, margin/profit, availability, impact of harvesting on survival of species, time required for harvesting, regenerative potential, contribution to income, potential for employment, processing technology, interest, accessibility and uses. Each of the criteria was scored using a 3 categorized ranking system, 1 standing for low, 2 for moderate and 3 for high.

The study used existing data from forest resource assessment previously conducted in the area [8,17,18] and the perception of local resource users. For the assessment of NTFP vulnerability, a rapid vulnerability assessment was developed as a quick way of collating both scientific information and local knowledge about NTFP species to determine whether or not a species is vulnerable in the resource use zone. It combines some existing frameworks [11,12] where the following parameters are considered:

- the use frequency (P1) calculated as the number of household reporting a specific use divided by total number of households – the vulnerability of a given species increases with its popularity and use,
- the different types of usages of the species (P2) – the higher the number of different usages of a given species, the higher the harvesting pressure,
- The plant part used - (P3). The vulnerability of a species depends on the ability of the plant part collected to regenerate rapidly or not. For example, bark extraction, stem cutting or roots harvesting might affect growth rate or end up killing the plant, whereas collection of latex, fruits and leaves will have little effect on the plant [10]. On the other hand, periodic collection of fruits will have less effect on plant species population than intensive fruits gathering (Figure 2),
- the mode of collection (P4) – gathering of fallen plants parts will have lesser effects on the plant than harvesting on standing plant,
- the stage of development of the organ collected (P5). Plant organs collected at maturity will have lesser effects than if they were collected earlier.

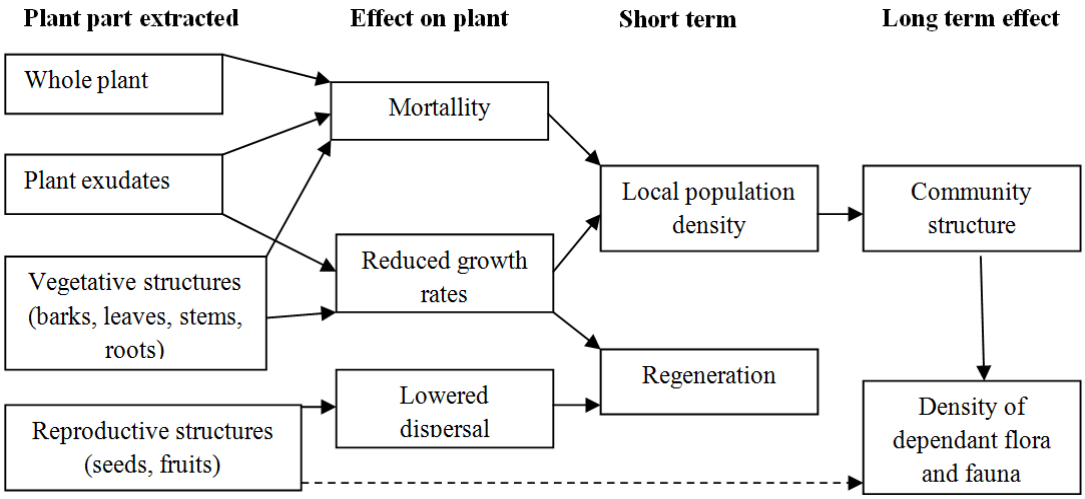

Figure 2. Diagram showing possible Ecological Impacts of NTFP Extraction [19]

The scoring of vulnerability parameters was based on a 3-categorized ranking system as proposed by [11], A value of 1 indicates that a species is less vulnerable for the parameter considered, a value of 2 represents a moderate vulnerability and a value of 3 characterizes a very vulnerable species for the considered parameter.

The overall vulnerability of a given species is determined as the cumulative value of vulnerability scores for all the parameters considered, using the following formula:

$$(\mathrm{VI}) = (\mathrm{VP1} + \mathrm{VP2} + \mathrm{VP3} + \mathrm{VP4} + \mathrm{VP5} + \mathrm{P6}) / 6.$$

VI < 2, indicates that the plant species is less vulnerable in its present use condition

2 ≤ VI < 2,5 indicates that the species is moderately vulnerable

VI ≥ 2,5, means the species is very vulnerable.

4. Results and Discussion

4.1. Most Preferred NTFP for Commercialization

From the interview of resource users, a list of 14 NTFP species emerged as important commercial NTFPs in the village. Maximum citations were recorded for *Afrostyrax lepidophyllus Mildbr* Mildbr, *Baillonella toxisperma Pierre* and *Irvingia gabonensis* (Aubry-Lecomte ex O'Rorke) Baill., *followed by Ricinodendron heudelotii* (Bail.) and *Gnetum spp*. Minimum citation was recorded for *Garcinia kola* Heckel and *Beilschmiedia louisii* Robyns & R.Wilczek, (Figure 3).

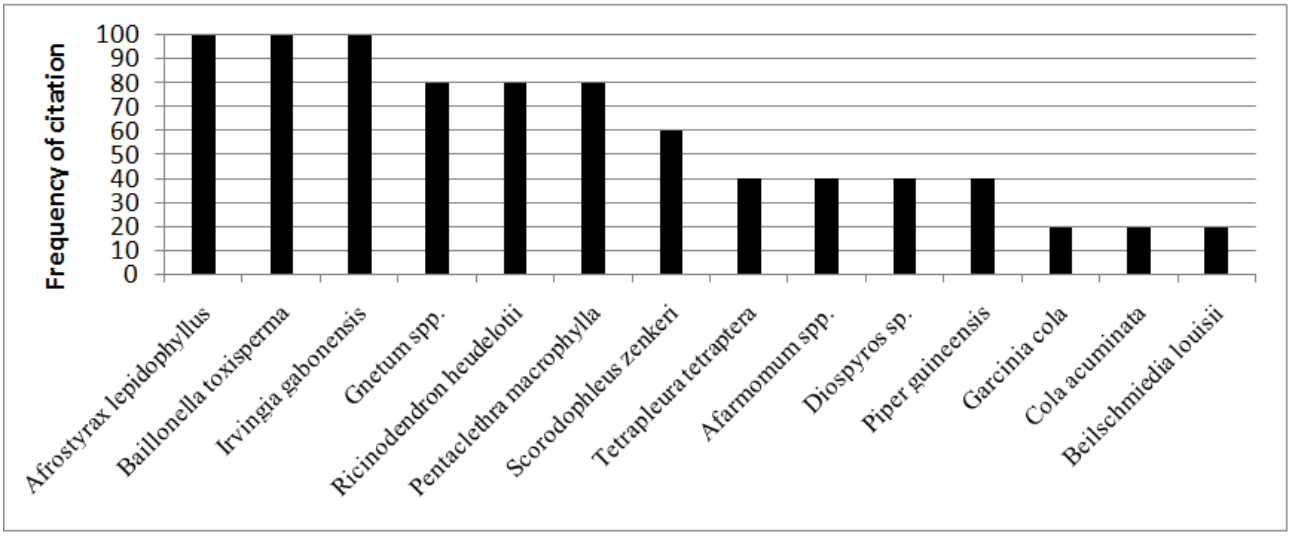

Figure 3. Most-cited commercial NTFP in Gribé village

4.2. Plant Parts Used

For the above commercial NTFP species, fruits represent the majority of part used, followed by stem barks and leaves (Figure 4, Table 1).

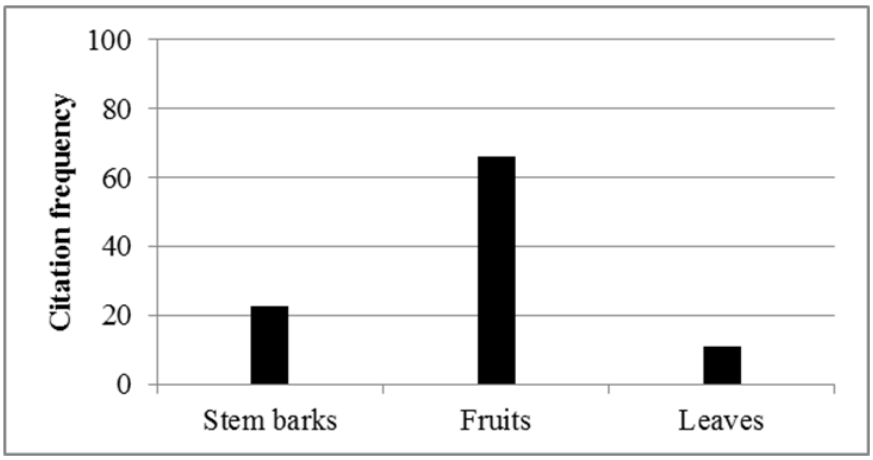

Figure 4. Citation frequency of NTFP used parts

The fruits of *Aframomum* spp. are harvested at maturity, mainly for trade.

For some species like *Afrostyrax lepidophyllus* Mildbr, *Baillonella toxisperma* Pierre, *Irvingia gabonensis* (Aubry-Lecomte ex O'Rorke) Baill., *Ricinodendron heudelotii* (Bail.) and *Tetrapleura tetraptera* (Schum. & Thonn.) Taub., both fruits and stem bark are extracted from the plant. Fruits are intensively gathered for self-consumption and for trade, whereas the stem bark is used in traditional medicine.

Table 1. Main plant parts collected on the major NTFP of Gribé forest

Species	Used parts			
	Leaves	Fruits	Stem Bark	Root bark
Aframomum spp.		X		
Afrostyrax lepidophyllus Mildbr		X	X	
Baillonella toxisperma Pierre		X	X	
Beilschmiedia louisii Robyns & R.Wilczek		X		
Cola acuminata (P.Beauv.)		X		
Diospyros sp.		X		
Garcinia kola Heckel		X		
Gnetum spp.	X			
Irvingia gabonensis (Aubry-Lecomte ex O'Rorke) Baill.		X	X	
Pentaclethra macrophylla Benth.		X	X	X
Piper guineensis Schumach. & Thonn.		X		
Ricinodendron heudelotii (Bail.)		X	X	
Scorodophleus zenkeri Harms		X		
Tetrapleura tetraptera (Schum. & Thonn.) Taub.		X	X	

4.3. Species Ecological Vulnerability Assessment

The scoring of vulnerability parameters shows that *Baillonella toxisperma* Pierre is the most vulnerable species. Factors contributing to high vulnerability of this species included the intensive fruit gathering, the competing use of this tree for timber by logging companies. Intensive fruit gathering for oil extraction have been reported to affect reproduction potential [20]. *Baillonella toxisperma* Pierre is also listed as "vulnerable" by the IUCN Red List [21]. Logging operations involved in its exploitation competes with, or exclude local collectors. Previous ecological assessment of NTFP conducted in Gribé forest also reported lowest population density for *Baillonella toxisperma* Pierre (0.1 ± 0.1 stems/ha) and poor natural regeneration index [17].

Moderately vulnerable species include *Irvingia gabonensis* (Aubry-Lecomte ex O'Rorke) Baill. and *Gnetum* spp. For *Irvingia gabonensis* (Aubry-Lecomte ex O'Rorke) Baill., Previous forest measurements also reported low density values of this species in Gribé forests (1.9 ± 1.6 stems/ha) and low natural regeneration index [17]. Investigating on the ecological determinants of this specie's population trend, some authors pointed out high seeds mortality attributed to predation and pathogens, and high density-dependent mortality of seedlings [22]. For *Gnetum* spp., this IUCN Red List near-threatened species is among the 10 most important NTFPs in Congo Basin countries, and one of the most used and valued in Cameroon [6]. The harvesting method (cutting of lianas) and the destruction of this species habitat by slash and burn agriculture and forest logging are the main threats to the survival of its population.

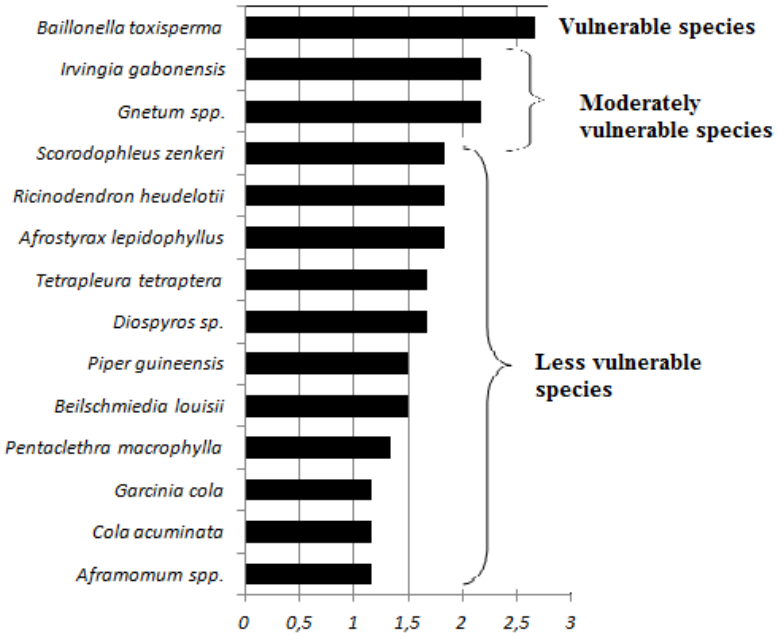

Figure 5. Ecological vulnerability parameters of the commercial NTFP in Gribé forest

4.4. Local Conservation Strategies

Integrating local knowledge about NTFP management is increasingly seen as essential in forging solutions appropriate to local conditions and optimizing NTFP integration in the agricultural landscape based on resource users' priorities. From the interview with local people, it appeared that the following two major local conservation strategies are practiced in the village:

- ***Farmer's managed natural regeneration***

This is a practice largely used in the area. This consists of maintaining and upkeeping the naturally regenerated individuals of some important NTFPs. During forest clearing and farm preparation, local people usually preserve useful plants that will be part of the created agroecosystem, delivering diverse goods and services including NTFPs. Desired plant species are selected in a field. For each of them, a decision is made as to how many stems will be chosen for growth, and the remaining stems are cut-down. Farmers then grow a variety of crops between and around the trees including species that are compatible with crops. If the density and canopy is managed appropriately, they can get more benefits, which increase household income and crop production. According to some authors, farmer's managed natural regeneration is cheap, rapid, locally led and implemented, uses local skills and resources and has been highly successful [23,24]. Such practices are age long techniques that span decades or even centuries in rural areas This dynamic knowledge of conservation is passed on to generations, thus highly resilient and surely transferred than externally imported ones.

- ***Tree planting***

In Cameroon, illegal forest logging and increased population pressure and demand for food has resulted in conversion of large forest areas and reduced supply of various forest products including NTFPs. This has led to the promotion of NTFP domestication as a viable measure to reduce harvesting pressure on natural forests and to increase the provisioning of forest products that used to be extracted from natural forests. NTFP domestication is an important component of the Cameroon's National NTFP Development Plan [25].

Unfortunately, there is a general reluctance of local people to plant NTFPs in Gribé area, because NTFP exploitation is based on a local perception that they will always be available without caring about their long-term sustainability. From the survey conducted with the villagers, tree planting is poorly practiced in the area. The survey revealed that only 12% of the farmers interviewed have already planted an NTFP species. Most farmers think plant normally grow naturally and there is no need to plant, and some feel discouraged because trees take too much time to start the production of fruits, and consequently, they could not be benefited from the trees they have planted. Household respondents identified various other obstacles to tree planting, such as scarcity of planting materials, poor knowledge of tree regeneration techniques.

While agroforestry practices including NTFP domestication have become more popular in rural areas of West and Central Africa [26], there have been little initiatives to empower local people on these techniques in the Gribé area.

4.5. NTFP Species' Potentials for Market Development in Gribé Village

The above-mentioned NTFP species have different potentials for commercialization. Table 2 shows the advantages/disadvantages of different NTFP species for various potentials and constraints. The market demand shows higher scores for *Aframomum* spp, *Irvingia gabonensis* (Aubry-Lecomte ex O'Rorke) Baill. , *Ricinodendron heudelotii* (Bail.), *Afrostyrax lepidophyllus* Mildbr, *Pentaclethra macrophylla* Benth, *Scorodophleus zenkeri* Harms and *Piper guineense* Schumach. & Thonn. The local people think it is more profitable to invest in gathering *Aframomum* spp, *Irvingia gabonensis* (Aubry-Lecomte ex O'Rorke) Baill. and *Ricinodendron heudelotii* (Bail.). This is because of the higher price of *Ricinodendron heudelotii* (Bail.), higher productivity of *Irvingia gabonensis (Aubry-Lecomte ex O'Rorke) Baill* and the larger availability of *Aframomum* spp., as perceived by local informants. These three species contribute most to the income of local people. Total sales of 2,220.750 CFA francs (approximately USD 4500) of *Irvingia gabonensis* (Aubry-Lecomte ex O'Rorke) Baill., *1,333.300 CFA (USD 2700)* of *Ricinodendron heudelotii* (Bail.), *1,500,000 CFA* (USD 3000) *of Aframomum* spp was reported during the 2013-2014 NTFP campaign in Gribé village [8]. *Afrostyrax lepidophyllus Mildbr*, *Pentaclethra macrophylla* Benth *and Gnetum spp* contribute less to the income because the prices are lower, despite large availability. *Irvingia gabonensis* (Aubry-Lecomte ex O'Rorke) Baill and *Afrostyrax lepidophyllus* Mildbr have higher economic potentials, because shortage of labor power results in lower amounts of collection, and only a small part of the production was actually harvested.

For all these species except *Gnetum* spp., the plant parts traded are fruits that are gathered on the forest floor and thus, have less impact on the survival of the population. The time duration of the collection is higher for *Gnetum* spp. (year-round), *Aframomum* spp and *Ricinodendron heudelotii (Bail.)* (6 months), *Irvingia gabonensis (*Aubry-Lecomte ex O'Rorke) Baill. (4 months). The collection of *Afrostyrax lepidophyllus Mildbr* and *Scorodophleus zenkeri Harms* last two months and the collection period of *Pentaclethra macrophylla* Benth is quite short, 1-2 months only.

Higher densities and good natural regeneration potentials were reported for Aframomum spp, Ricinodendron heudelotii (Bail.), Afrostyrax lepidophyllus Mildbr, Pentaclethra macrophylla Benth and Scorodophleus zenkeri Harms in this forests [17], whereas lower densities of Garcinia cola, Cola sp and Beilschmiedia louisii Robyns & R.Wilczek were found in this forest [18].

Overall, the application of the 12 criteria for the matrix ranking reveal that the top 5 most suitable species for commercialization and with high potentials for enterprise development are *Aframomum spp, Irvingia gabonensis (Aubry-Lecomte ex O'Rorke) Baill. , Ricinodendron heudelotii* (Bail.), *Afrostyrax lepidophyllus* Mildbr and *Pentaclethra macrophylla* Benth (Table 2).

Table 2. Ranking of scores for different attributes of NTFP species recorded in Gribe.

Species	Market demand	Margin/profit	Availability	Survival of species after harvest	Time duration for harvesting	Regenerative potential	Contribution to income	Potential for employment	Processing technology	Interest	Accessibility	Uses	Total score	Rank
Aframomum spp,	3	3	3	3	3	3	3	2	1	2	3	1	30	1st
Irvingia gabonensis (Aubry-Lecomte ex O'Rorke) Baill.	3	3	2	3	3	1	3	3	1	3	2	1	28	2nd
Ricinodendron heudelotii (Bail.)	3	3	2	3	3	3	3	1	1	3	1	1	27	3rd
Afrostyrax lepidophyllus Mildbr	3	2	3	3	1	3	2	3	1	3	2	1	27	4th
Pentaclethra macrophylla Benth	3	2	3	3	1	3	1	1	1	2	2	1	23	5th
Gnetum spp.	2	1	3	2	3	2	1	1	1	2	2	1	21	6th
Scorodophleus zenkeri Harms	3	2	1	3	1	3	1	1	1	2	2	1	21	7th
Piper guineense Schumach. & Thonn	3	1	1	3	1	1	1	1	1	2	2	1	18	8th
Garcinia cola	1	1	1	3	1	2	1	1	1	2	2	1	17	9th
Cola sp,	1	1	1	3	1	2	1	1	1	2	2	1	17	10th
Beilschmiedia louisii Robyns & R.Wilczek	2	1	1	3	1	1	1	1	1	2	2	1	17	11th
*Tetrapleura tetraptera (*Schum. & Thonn.) Taub.	1	1	1	3	1	1	1	1	1	2	2	1	16	12th
Diospyros sp,	1	1	1	3	1	1	1	1	1	2	2	1	16	13th
Baillonella toxisperma Pierre	1	1	1	3	1	1	1	1	1	2	1	2	16	14th

Source: based on interview of local people, market and ecological surveys by Fongnzossie et al. (2014), Hirai (2014), Tajeukem et al. (2014).

4.6. Social Organization and NTFP Exploitation

The actors of collection and their modus operandus

In Gribé village, NTFP collection is an every body's concern. They are gathered on a daily basis as they are important component of local people's livelihood. The intensity and social organization for the collection vary with the collection period. From July to September when most of the valuable NTFP are ready for collection (e.g. *Afrostyrax lepidophyllus Mildbr*, *Baillonella toxisperma* Pierre, *Irvingia gabonensis (Aubry-Lecomte ex O'Rorke) Baill. , Klainedoxa gabonensis)*, villagers, mostly Bakas establish in temporary camps inside the forests for the whole period for the collection. These are the primary collectors. They often go very far from the village and the collection requires a lot of man power. A second category of collectors referred to as secondary collectors are village merchants, mostly Bantous who goes in the forests and buys the products collected by primary collectors to come back in the village and sell to traders coming from neighboring city of Yokadouma. In the transaction between vendors and producers, NTFP are bought or exchange into commodities. It is worth mentioning that products exchange into commodities is often the preferred transaction mode in the forests. The reason is that the basic needs of primary collectors settled very far in the forest are much about food, cigarette, drinks, cloths rather than money in cash because they can't buy anything inside the forest with money. So, during their travel in forest for NTFP collection, the village merchants often provide collectors with little money, but many commodities like food, cloths, drinks, etc. From the discussion with primary collectors settled inside the forest, about 40 to 60% of their total products can be exchange into commodities and they will bring the remaining to sell in the village. In the village there are local semi-wholesalers who buy and store the products, waiting from city merchants to come and buy. During the rest of the year, collectors usually don't settle inside the forest for the collection activities. NTFP are often sold in containers called "Kumbo". There is a great deterioration of prices of products when bought inside the forests. For example, a "Kumbo" of *Irvingia gabonensis (Aubry-Lecomte ex O'Rorke) Baill.* that cost about 2000 CFA francs in the village will cost around 500 CFA francs or exchange into a bundle of plantain inside the forest.

Access to NTFP resource

In Gribé village, there is no restriction in the access to NTFP resources, especially NTFP of plant origin. The forest area used by local people overlaps several forest titles with diverse regulation on resource use. These are agrofoest zones, community forests, community hunting zones, logging concession. It appeared from the discussion with collectors that collection takes place in all of these land use categories.

Community organization

In Gribé village, NTFP collection is done on an individual basis. There is an experience of community forest in the village which has fail in several aspects in establishing a platform of join and common interest work. Also this community forest is shared by several villages with often divergent interests. Though the simple management plan of the community forest has identified NTFP exploitation as an income source, little efforts has been done in mainstreaming the NTFP issues into the community forest management. Much focus has been put on Timber exploitation which has results in considerable fragmentation of forest habitat, pushing community members to go very far in the forest in the search of NTFP. There has been a recent and promising attempt to create new village association to promote NTFP collection. The success of the initiative will be rooted in developing leadership skills among villagers and establishing a framework that favors dialog, transparency and accountability.

Policy environment

A conducive legislative and policy environment is also critical for the sustainable use of NTFP. In Cameroon, lessons learned from the 20 years of application of the 1994 forest law and subsequent texts reveal a number of constraints hindering the sustainable utilization of NTFP and their contribution to local economy. Although NTFP accounts for about 58% forest employments in Cameroon, it only contributes to 0.4% to the gross domestic product [27]. NTFPs exploitation has been controversial especially regarding its profitability and its contribution to socially sustainable development. The major constraints identified are related to the weaknesses of the legislative framework that do not facilitate the access of communities or farmers' organizations in the development of the NTFPs collection and marketing chains.

The majority of informants suggested that there is a need for simplification of the NTFP exploitation policy. Within the framework of the ongoing process of revising the Cameroon's forest law, significant improvements have been suggested to improve the following aspects of NTFP exploitation:

- Simplification of access to NTFPs and Special Forest Products (SFPs),
- Updating of the list of NTFPs and SFPs, and associated types of permits,
- Development of a tracking system for permits and monitoring of quantities used,
- Simplification of the transport of different types of NTFPs
- Revising the taxation regime for NTFPs

For the promotion of NTFPs at commercial scales, market information is also very important and so far lacking. At present in Gribé, there is poor market integration by primary producers who have no choice but to sell their products in village site at low prices. Existing market structure is imperfect with regard to infrastructure and the nature of competition and demand/supply characteristics. Recent evidence shows that when selling NTFP raw, farmers can only gain 30% of the real value of the product. However, processing techniques for NTFP are not yet introduced in this community despite significant development in this field.

Implication for sustainable NTFP exploitation in Gribé forest

It is clear that Gribé forest has great potentials for NTFP production as shown by high densities of some high economic value NTFP and high amount of annual collection and sales [8,17]. The main issues limiting local people's sustainable management of NTFPs include poor access to markets, poor social organization, lack of

information on market demands, prices and authorization systems too complex to be applied at the local level.

A step-by-step approach to ensure sustainable NTFP management should include:

- Optimizing NTFP production in a new agroforestry system through the domestication of important and depleted NTFP species,
- Creating a collectors' network and support the establishment and development of a small-scale NTFP enterprise as a viable approach to facilitate information sharing and the development of the value chain of key NTFP.
- Developing processing of products from NTFP raw materials through capacity building and technology transfer - Experiences from West and Central Africa so far indicate that household's income from marketing of NTFP can be significantly increased through on-farm production improvement and post-harvest technology. Farmers involved in the production of Njansang (*Ricinodendron heudelotii* (Bail.)) realized an average 31% increase of their selling price and 80% increase in their income derived from this NTFP in southern Cameroon [28].
- Removing administrative barriers and facilitate market integration by primary producers,
- Establishing a monitoring system with adequate indicators to track resource flow, legal compliance, transparency and accountability in the sector

5. Conclusion

There is also an assumption that any harvesting of wild plant products from the forests and other natural and modified ecosystems can be detrimental to the long-term viability of target populations and species. Though the promotion of NTFP harvesting as a conservation strategy is already more than 30 years old, our knowledge about the ecological effects is still limited. Despite the ubiquity of the topic in the literature, there is still little primary empirical evidence regarding the ecological effects of the exploitation of NTFPs, and the number of studies adopting this approach is decreasing in the last few years.

The purpose of this study was to assess the sustainability of some major NTFP in the Gribé forest using local ecological knowledge and forest measurements. It appears from the results that there is an economic significance of *Aframomum spp., Afrostyrax lepidophyllus Mildbr, Baillonella toxisperma* Pierre, *Beilschmiedia louisii Robyns & R.Wilczek, Cola acuminata* (P.Beauv.), *Diospyros sp., Garcinia kola* Heckel, *Gnetum spp., Irvingia gabonensis (Aubry-Lecomte ex O'Rorke) Baill. , Pentaclethra macrophylla Benth, Piper guineense* Schumach. & Thonn, *Ricinodendron heudelotii* (Bail.), *Scorodophleus zenkeri* Harms, *Tetrapleura tetraptera* (Schum. & Thonn.) Taub. in Gribé forests. However, greater vulnerability was reported for *Baillonella toxisperma* Pierre in this forest and the study urges for immediate interventions to develop participative domestication activities for this species.

The assessment identified great potential for market development for some NTFP and argued that the following priority intervention areas should be considered for sustainable NTFP exploitation: optimizing NTFP production through domestication (for both important and threatened species), creating a collectors' network, developing processing technology, supporting the establishment of a conducive policy environment that removes all regulatory bottlenecks to facilitate market integration by primary producers.

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