

Marketing *Ricinodendron heudelotii* Kernels and *Gnetum* spp. Leaves Around Lobeke National Park, East Cameroon

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Summary

This study investigated the marketing of Ricinodendron heudelotii kernels and leaves of Gnetum buchholzianum/G. africanum around Lobeke National Park in Eastern Cameroon. Non-timber forest products (NTFP) supply chain actors were identified and their financial benefits and problems encountered in their activities assessed. Semi-structured interviews were conducted among 152 producers in eight villages and 120 traders in four markets. Direct actors are producers, wholesalers, retailers and consumers. The annual mean profits (AMP) of producers of R. heudelotii varied significantly between 120,013 FCFA in Kika and 23,992 FCFA in Koumela, whereas those of traders varied significantly between 442,880 FCFA in Yokadouma and 14,800 FCFA in Kika (P=0.05). Producers of Gnetum spp. earned AMP between 324,740 FCFA in Mambele, and 74,657 FCFA in Koumela, while traders earned between 2,182,700 FCFA in Yokadouma and 1,397,933 FCFA in Moloundou (P=0.05). The problems encountered include difficulty to process and seasonality of R. heudelotii, long walking distances to collection sites and animal threats, low prices and lack of market information. NTFPs are collected from natural stocks and minimally processed using rudimentary tools. Domestication of NTFP species, improved processing and access to market and market information, collective action and establishment of local NTFP enterprises will enhance the benefits of actors.

Résumé

Commercialisation des graines de *Ricinodendron heudelotii* et des feuilles de *Gnetum* spp. autour de Parc National de Lobéké à l'Est du Cameroun

La commercialisation des graines de Ricinodendron heudelotii et de feuilles de Gnetum spp. a été étudiée autour du Parc National de Lobéké au Cameroun. Les acteurs des chaînes d'approvisionnement de produits forestiers non ligneux (PFNL) ont été identifiés, ainsi que leurs bénéfices financiers et les problèmes rencontrés. Des questionnaires semi-structurés ont été utilisés auprès de 152 collecteurs de 8 villages et de 120 commerçants de quatre marchés. Les acteurs principaux sont les collecteurs, les grossistes, les détaillants et les consommateurs. Les marges bénéficiaires annuelles des collecteurs de R. heudelotii variaient significativement entre 120.000 FCFA à Kika et 23.992 FCFA à Koumela. Par contre, les marges des commerçants variaient significativement entre 442,880 FCFA à Yokadouma et 14.800 FCFA à Kika. La marge bénéficiaire des récolteurs du Gnetum était plus élevée (324.740 FCFA) à Mambele qu'à Koumela (74.657 FCFA). Les commerçants ont gagné 2.182.700 FCFA à Yokadouma et 1.397.933 FCFA à Moloundou (P=0,05). Les problèmes rencontrés étaient: les difficultés de transformation, la saisonnalité de R. heudelotii, les longues marches pour les collectes, l'agression des animaux, les faibles prix de vente et le manque d'information sur le marché. Les PFNL sont collectés à partir de stocks naturels et traités au de façon minimaliste à l'aide d'outils rudimentaires. La domestication des espèces PFNL, l'amélioration de la transformation et de l'accès au marché et à l'information sur celui-ci, des actions collectives et l'établissement d'entreprises PFNL locales pourraient améliorer les avantages des acteurs.

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Introduction

Non-timber forest products (NTFPs) are biological materials collected from the forest, plantations, wooded land and farmlands, apart from timber, or other industrial wood products that are used at the household level, marketed, or have social, cultural or religious significance (16, 23, 35). They are an important source of livelihoods for the rural population all over the world (1, 13). They provide food, medicine, construction material, fuel wood, as well as resources of spiritual and cultural significance (11, 27). NTFPs are traded both locally and in international markets, making them an important source of income (21, 32). According to Awono *et al.* (4), about 38% of vegetal NTFPs in Cameroon are used as food and the annual economic value for sixteen of them is estimated at 32 billion FCFA (US\$ 64.7 million), which represents about 0.2 percent of the Gross Domestic Product (GDP) for Cameroon. The value of NTFPs extracted from forests worldwide amounted to US\$18.5 billion in 2005 (10). NTFPs add to peoples' livelihood security and act as a safety net (27). At least 283,000 people in Cameroon work at various degrees in the value chains of NTFPs (3).

Ricinodendron heudelotii kernels and *Gnetum buchholzianum*/G. *africanum* leaves (hereafter referred to as *Gnetum* spp.) are priority NTFPs in the Lobeke landscape and other areas in Cameroon, including some countries in West and Central Africa. Priority NTFPs have been defined as those products which have high economic/trade value or are important for auto-consumption, that is value for livelihoods; products whose demand exceed supply; species which have multiple uses; species from which multiple parts are used and species which are classified as vulnerable or protected, e.g. on the IUCN Red list, CITES listed and/or protected by national law (12).

The cotyledons of *R. heudelotii*, commonly called njansang are a major source of income not only at the local and national levels but also at the international level where they act as foreign exchange earner to Cameroon and other countries of Central African States (25). According to the latter authors, about 71,585 metric tons of *R. heudelotii* kernels were produced and traded in the humid forest zone of Cameroon between 2003 and 2010 and valued at equivalent to \$US 708,770. A market survey in 1995 showed that 35,952 kg of *R. heudelotii* kernels were marketed in the humid forest zone of Cameroon, for a total value of 43,432,200 FCFA, about \$US 78,967 (19). The humid forest zone of Cameroon is the main production area of *R. heudelotii* kernels, which is traded to neighbouring countries including Central African Republic, Gabon, Equatorial Guinea and Nigeria (20), and also to Europe (30, 32). In the Mokoko River Forest Reserve in Cameroon, *R. heudelotii* kernels are regarded as one of the most valuable NTFPs. It is an open access resource and commonly exploited by local women (31).

Well-dried kernels can last for up to two years, enabling them to be stored and sold throughout the year in urban markets (8). An evaluation of the contribution of *R. heudelotii* kernels to the household economy in Akonolinga (Centre Region of Cameroon) in 2010 showed that income generated by a half of the households surveyed amounted to an average of 430,000 FCFA (\$US 860), while the remaining households earned between 15,000 and 54,000 FCFA (\$US 30 to 108) (9).

Gnetum spp. leaves, locally known as 'eru' or 'okok' play a major role as source of food and income among others. The annual sale of *Gnetum* spp. in Cameroon was estimated at about 5.7 billion FCFA (\$US 11.4 million) (4). Nkwatoh *et al.* (24) observed that about 607,862 metric tons of *Gnetum* spp. leaves was produced and traded between 2002 and 2008, and valued at about 631,167,345 FCFA (\$US 1,262,334), showing that trade in the resource is increasingly important. *Gnetum* spp. leaves contribute about 76% of annual household income, with traders earning on average 729,327 FCFA (\$US 1,458) (13). Trade of the latter resource is also important within and between the countries of the Congo Basin. This includes Cameroon, Gabon, Equatorial Guinea, Congo-Brazzaville, Democratic Republic of Congo, the south of the Central African Republic, and the humid zones of Nigeria (14, 29). Export markets to the African diaspora in Europe are large, as is the market from Nigeria to the United States of America (14, 29, 32). The large-scale exporters, exporting to Oron, Nigeria via Idenau in Cameroon make annual average profits of 3,060,393 FCFA (\$US 6,120) per person. The species are ranked among the 10 most important NTFPs in the Congo Basin countries and the 19 most used and valued NTFPs in Cameroon (13). According to Awono *et al.* (4), the monthly income of traders from the sale of *Gnetum* spp. leaves is more than two times the minimum guaranteed wage in Cameroon (2 x 31,625 FCFA). This paper is aimed at identifying main actors and their activities in the market chains of these important NTFPs, determining the financial benefits they reap and the problems they face in their activities in the Lobeke landscape.

Materials and methods

Study area

This study was conducted in eight villages (Mambele, Yenga, Dioula, Mbateka, Mbangoye, Kika, Libongo and Koumela); and four markets (Yokadouma, Libongo Kika and Moloundou) around Lobeke National Park (LNP) in Cameroon. The park is situated between latitudes 2° 05' to 2° 30'N and longitudes 15° 33' to 16° 11'E. It has a surface area of about 217,854 hectares and located in the Moloundou Sub Division of the Boumba and Ngoko Division of the East Region of Cameroon. Figure 1 shows the location map of Lobeke National Park.

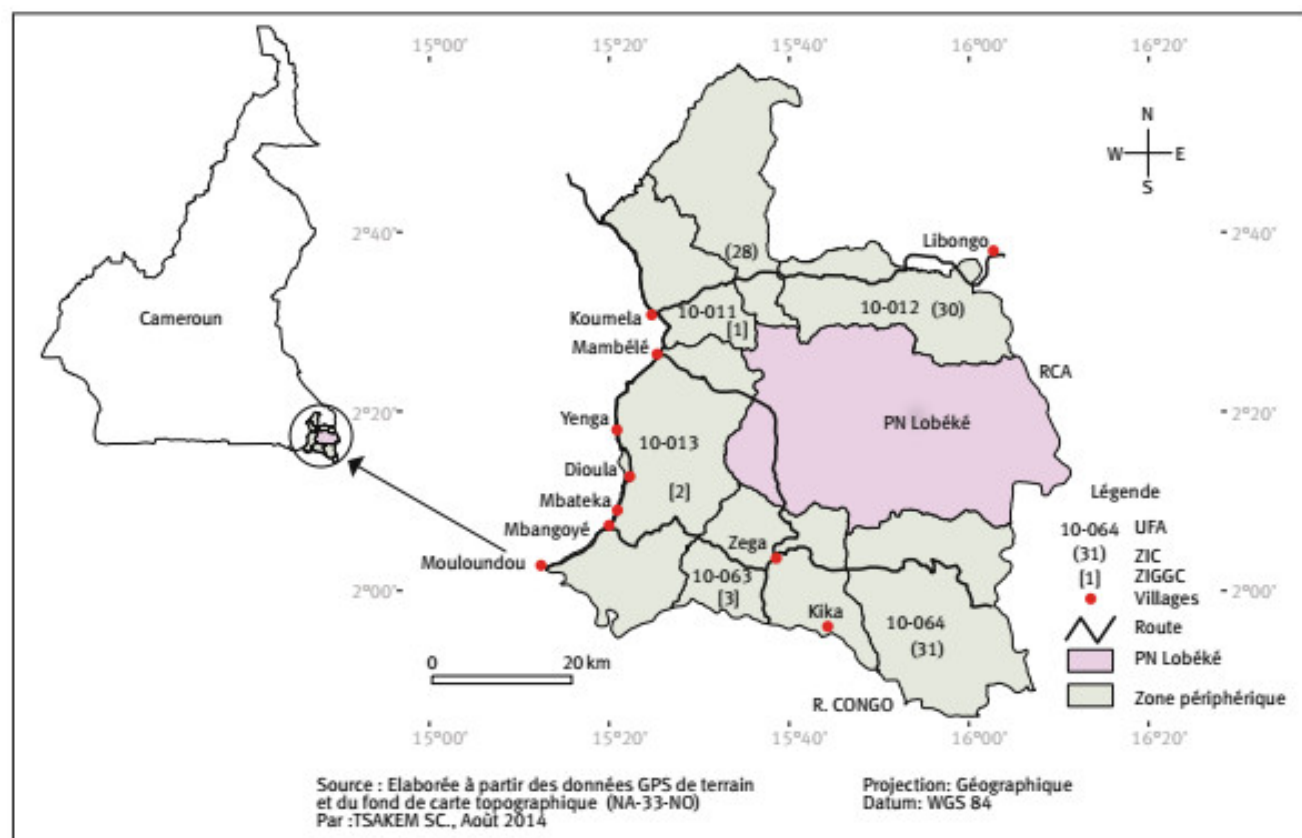


Figure 1: Lobeke National Park.

Data collection and analysis

The study villages and markets were purposively chosen based on their proximities to the LNP to ensure that NTFPs collected and sold were actually from the Lobeke area.

Primary data were collected through individual administration of semi-structured interview guides to 152 out of 728 collectors systematically selected based on their longevity (at least five years) in the collection and sale of NTFPs and their willingness to participate in the survey. Semi structured interviews were also conducted for 120 out of 436 traders randomly selected from four markets, while key informants were individually interviewed based on their knowledge and involvement in the NTFPs sector. Observation was used in villages and markets to identify the commonly collected and commercialized NTFPs, collection and transformation methods, sale and the prices practiced at each level.

Quantitative data from field measures such as heaps, cups, bowls, basins, buckets and bags were converted into universal units such as kilograms (kg). Data were put into Excel and analysed using SAS statistical package Version 9.0. Statistical comparisons were done using the Student-Newman-Keuls test at the level of $\alpha=5\%$.

The difference between cost of production and total sales was used to determine profits of collectors, whereas the difference between the buying and selling prices was used to establish traders' profits (6).

Monthly profits of actors were calculated in equation 1.

$$X_{ij} = Q * (P_s - P_c) \quad 1$$

where:

- X_{ij} monthly profits generated for produce i by collector or trader j ;
- Q monthly quantity traded;
- P_s selling price per unit of produce;
- P_c cost price (or cost of production) per unit of produce.

Annual mean profits were calculated by multiplying the net profit of collectors and traders by the number of months per year that they sell NTFPs, and divided by the number of collectors per village and traders per market respectively.

Results

Collection and processing of *Ricinodendron heudelotii* kernels and *Gnetum* spp. leaves

Collectors of *R. heudelotii* kernels gather fallen fruits mostly from the secondary forest and agroforest (active farmlands, fallows and cocoa plantations).

Fruits are transported and piled up at home where the pulp is left for one to two months to completely rot. The rotted fruits are then thoroughly washed and boiled at a temperature of about 100°C for 5 to 8 hours, after which they are spread on a mat to cool and to get dry. Heat from boiling causes little cracks to develop on the hard shell. Cracks are opened up using a knife, flattened nails or other tools with pointed tips to extract kernel from shell. Extracted kernels are carefully washed and sun dried, after which they are ready for sale or consumption (Figure 2).

Gnetum spp. leaves are harvested from the secondary forest and to a smaller extent from agroforest. The leaves are harvested by pulling vines from support trees, felling small support trees, climbing up big trees and plucking mature leaves from accessible vines. After harvesting, the leaves are tied into bundles of 0.5 kg and sold as such or further reduced into smaller bundles (0.1 kg) of well-arranged single leaves which are finely sliced into strips of about 1 mm. The strips are then sold immediately or cooked for consumption (Figure 3). *Gnetum* spp. leaves are highly perishable, so the left-over is dried in the sun to avoid rotting. Dried *Gnetum* is soaked in water for some time before it is cooked. Some local enterprises however package the dried leaves mostly for export. Ninety eight percent of collectors harvest both species of *Gnetum* but prefer *G. buchholzianum* to *G. africanum*.

Marketing of *R. heudelotii* kernels and *Gnetum* spp. leaves

It was observed in this study that collectors of *R. heudelotii* kernels gathered 10.6 tons and sold 9.4 tons of kernels in 2013. Of this quantity, they sold 96 and 4% of *R. heudelotii* kernels to primary wholesalers and retailers respectively. Primary wholesalers in turn sold 64.5% and 35.5% of their product respectively to secondary wholesalers and retailers. Secondary wholesalers on their part sold 100% of product to retailers who also sold all the product to consumers (Figure 4). Collectors do also sell small quantities of kernels to retailers, who sell to consumers in smaller markets within the Lobeke landscape. The unit of sale is the bowl or 'kombo' (2.2 kg) which sells at 1,000 FCFA (\$US 2) in the villages when the product is abundant and increases to 1,800 FCFA (\$US 3.6) when the product is scarce. The same quantity is sold at

2,000 - 2,500 FCFA (\$US 4-5) in markets in the time of abundance (September to November) and increases to 3,000-5,000 FCFA (\$US 6-10) when kernels are scarce. The product is bought in 'kombos' and assembled in bags of 50-100 kg in cases where it has to be further transported to other markets outside the Lobeke area. Retailers sell in heaps at 50-100 FCFA (\$US 0.1-0.2) and in glass (0.15 kg) for 250-400 FCFA (\$US 0.5-0.8) when the resource is abundant or scarce respectively.

The findings of this study reveal that the annual mean profits of collectors and traders varied across villages and markets respectively. The annual mean profits of *R. heudelotii* collectors in Kika (120,013 FCFA) (\$US 240.026) and Yenga (111,890 FCFA) (\$US 223.78) showed no significant difference, but were significantly higher than that of collectors in Mbateka (73,273 FCFA) (\$US 146.474) which was also significantly higher than that of *R. heudelotii* collectors in Libongo (39,258 FCFA) (\$US 78.516), Mambele (31,142 FCFA) (US\$ 62.284), Dioula (29,769 FCFA) (\$US 59.538) and Koumela (23,992 FCFA) (\$US 47.984), which were not significantly different, but were significantly higher than that of collectors in Mbangoye (10,304 FCFA) (\$US 20.608) at $P=0.05$ (Figure 5). The annual mean profit per trader of *R. heudelotii* kernels in Yokadouma (442,880 FCFA) (\$US 885.76) was significantly higher than that of traders in Libongo (50,100 FCFA) (\$US 100.2), which was also significantly higher than that of traders in Kika (14,800 FCFA) (\$US 29.6) ($P=0.05$) (Figure 6). Collectors harvested an estimated quantity of 107 tons of *Gnetum* leaves in 2013 and sold 90.6 tons. Of this, they sold 84,11 and 5% of their product respectively to primary retailers, secondary retailers and consumers. Primary retailers sold 96 and 4% of their product to secondary retailers and consumers respectively, whereas, secondary retailers sold all (100%) of their product to consumers (Figure 4).

Collectors harvest *Gnetum* leaves and sell to primary retailers in quantities ranging from 50 to 100 kg in their homes, but sometimes in the market. Secondary retailers buy 0.5 and 0.1 kg bundles of *Gnetum* leaves in small quantities (15 to 25 kg) from primary retailers and process by slicing and selling to consumers in heaps at 25 FCFA (\$US 0.05) per heap. When collectors and primary retailers sell directly to consumers, the latter slice the product by themselves before consumption. These usually buy in very small quantities (1 to 2 kg). Four short *Gnetum* channels were identified.

Figure 5 shows that the annual mean profit of *Gnetum* harvesters in Mambele (324,740 FCFA) (\$US 649.48), Kika (270,400 FCFA) (\$US 540.8) and Dioula (263,467 FCFA) (US\$ 526.93) were not significantly different, but were significantly higher than those of *Gnetum* harvesters in Yenga (150,107

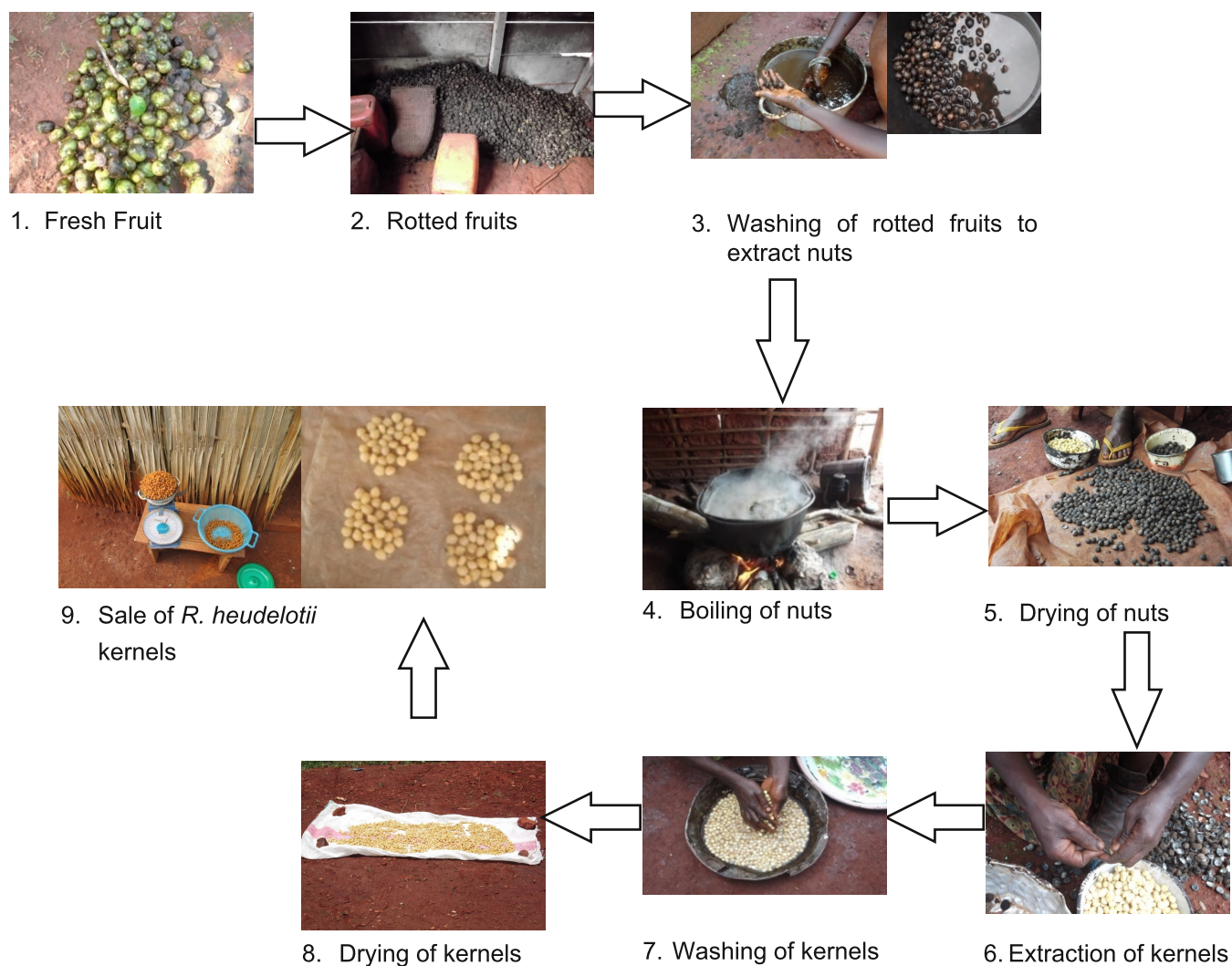


Figure 2: Steps in the processing of *R. heudelotii*.



Figure 3: Steps in the processing of *Gnetum* leaves.

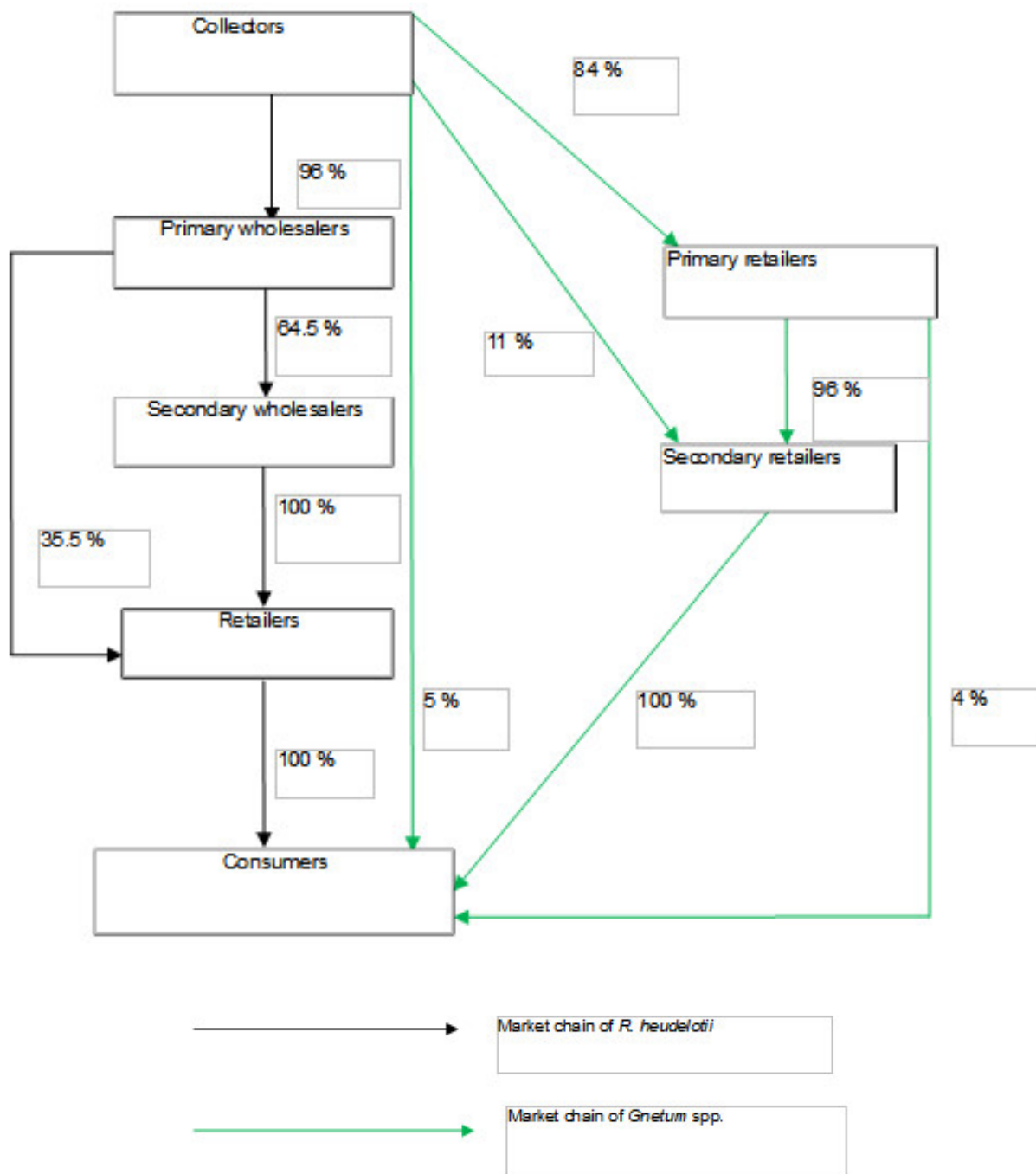


Figure 4: Market chains of *R. heudelotii* kernels and *Gnetum* leaves around Lobeke National Park.

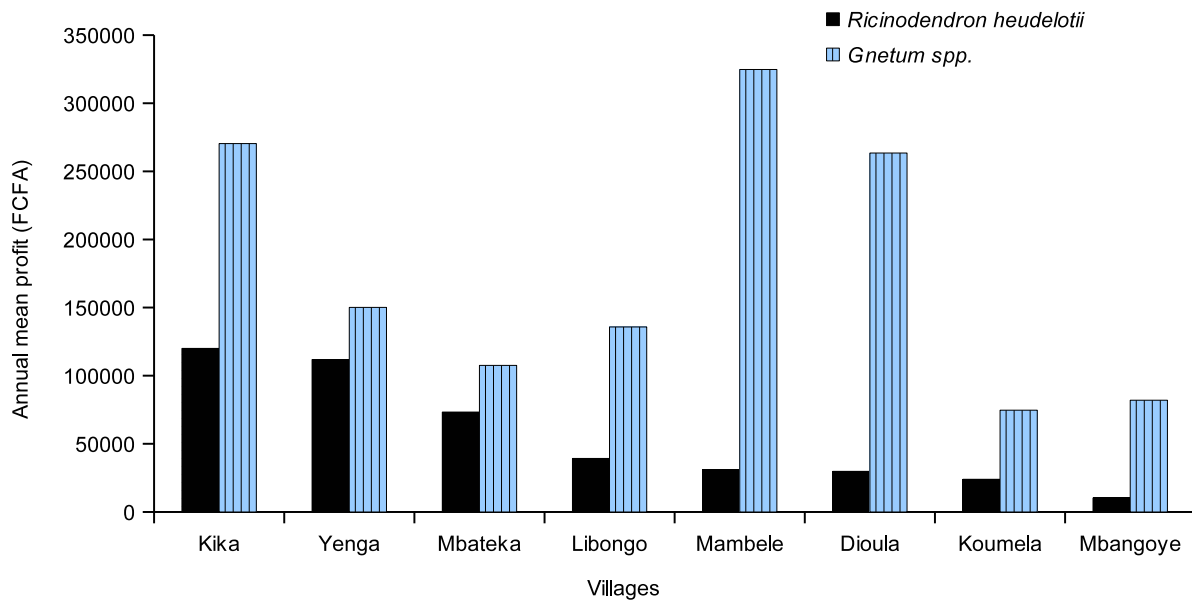


Figure 5: Annual mean profits of producers of *R. heudelotii* kernels and *Gnetum* spp. leaves in villages around Lobeke National Park.

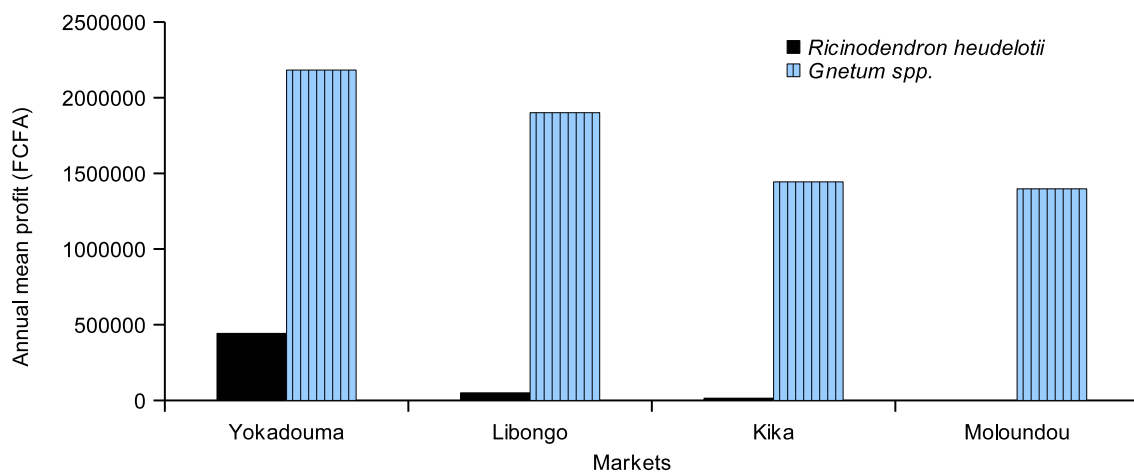


Figure 6: Annual mean profits of traders of *R. heudelotii* and *Gnetum* spp. leaves in markets around Lobeke National Park.

FCFA) (\$US 300.21), Libongo (135,778 FCFA) (\$US 271.55) and Mbateka (107,575 FCFA) (\$US 215.15) which showed no significant difference.

These were significantly higher than the mean annual profits of harvesters in Mbangoye (81,976 FCFA) (\$US 163.95) and Koumela (74,657 FCFA) (\$US 149.31) which showed no significant difference ($P=0.05$). The annual mean profit of *Gnetum* traders in Yokadouma market (2,182,700 FCFA) (\$US 4,365.4) was not significantly different from that of traders in Libongo (1,900,889 FCFA) (\$US 3,801.77). These were significantly higher than those of traders in Kika (1,443,865 FCFA) (\$US 2,887.73) and Moloundou (1,397,933 FCFA) (\$US 2,795.86) which showed no significant difference (Figure 6). *Gnetum* leaves were sold in all four markets and are highly consumed locally in the zone, almost daily and throughout the year. It was also abundant in all four markets and recorded the highest number of traders in each market.

Problems of collecting, processing and marketing *R. heudelotii* and *Gnetum* spp.

Our findings show that 63% of *R. heudelotii* collectors and 68% of *Gnetum* spp. harvesters identify long trekking distances to collection sites as a problem in their activities. Collectors travel long distances (at least 3 km) to get *Gnetum* spp. leaves because of diminished quantity of the resource around homesteads. Fifty one percent of *Gnetum* spp. harvesters identified threat from wildlife which moves from the protected area into the secondary forest where the product is mostly collected. Difficulty to climb large support trees was mentioned by 26% of collectors, limited markets (5%) and high perishability of product (3%) as problems encountered in their activities. All collectors indicated that processing *R. heudelotii* is very cumbersome and time-consuming, whereas, 17% pointed out that there is no production in some years. Apart from these, other problems encountered by collectors of both NTFPs in the area include low prices of products, which are determined by traders. Traders also complain of intimidation and extortion of money from them by forestry and other officials due to lack of trade permit which is very cumbersome to acquire.

Discussion and conclusion

Collectors used local rudimentary knowledge to process NTFPs, leading to a low level of efficacy. In line with our findings, Mbosso *et al.* (17) and Nkwatoh *et al.* (25) observed that processing methods are purely traditional. According to Awono *et al.* (3), simple equipment such as the diesel-powered locally made cracking machine for *R. heudelotii* can boost production, reducing the processing time by 50-75%. A manual extraction time of 60 minutes, 8 seconds was observed for 1 kg of *R. heudelotii* kernels and a mechanical extraction time of 42 minutes, 4 seconds where the machine running time was 2 minutes, 8 seconds and sorting time was 39 minutes, 56 seconds for the same quantity of kernels (17). The latter authors also reported that 26% of collectors in a survey thought that kernel quality obtained from mechanical extraction is as good as that obtained from manual extraction since products from both extraction methods are washed before drying, whereas, 65% of collectors were of the opinion that the quality of *R. heudelotii* kernels obtained from mechanical extraction is not as good as the one obtained from manual extraction. The reason was that the machine breaks kernels into two or more pieces and the mixture of kernels and shells which result in adhesion of small shell particles to kernels make them look dirty. Mechanical abrasion resulting from contact between kernels and shells also give kernels a dirty appearance (17). Difficulty in cracking *R. heudelotii* nuts led ICRAF (World Agroforestry Centre) to conceive and produce a machine for cracking nuts in the context of the project "Increasing small-scale farmer benefits from agroforestry tree products in West and Central Africa". One of these machines was found in one of the study villages (Mambele) but was not frequently used because collectors thought some kernels were broken and not marketable. However, ICRAF was still working on the machine to improve on kernel quality.

The pressure exerted on *Gnetum* spp. near homesteads, destruction of their preferred habitats for agriculture and collectors' preference for the large-leaved *G. buchholzianum* which abounds in the secondary/primary forests have forced collectors to go far to the forest to collect the resource. Harvest methods are mostly destructive as collectors' desire is to harvest large quantities within the shortest possible time, which threaten the sustainability of the species. Lingondo *et al.* (15) report that actors in the *Gnetum* market chain in the South West Region of Cameroon also prefer *G. bulchhozianum* to *G. africanum* because it has larger leaves, is easier to select before shredding,

produces a relatively larger quantity after shredding, stays longer without shedding leaves, has a higher yield per vine, tastes better and does not shrink after cooking. However, Nkwatoh *et al.* (24) report that there is no marked difference in taste between the two species but also observed that *Gnetum* dealers prefer *G. buchholzianum* with its dark green, thick leaves and tough fibres because the leaves can be stored for a longer period (5-10 days), than *G. africanum* with its light green leaves and weak fibres which can only be stored for about 2-3 days. A bundle of *Gnetum* leaves in the South West and Centre Regions of Cameroon weigh approximately 1 kg (5, 15), unlike in the Lobeke landscape.

There was no direct link between collectors and consumers of *R. heudelotii* kernel because the product is not highly consumed in the study area, which is limited in the origins of its inhabitants than in semi-urban and urban set ups in the zone with people from different regions and a wide range of feeding habits. In line with our findings, Nkwatoh *et al.* (25) reported that in the humid forest zone of Cameroon, bulk buyers move from house to house and buy kernels of *R. heudelotii* which are assembled and transported to main market centers (Mamfe, Kumba, Nkongsamba, Douala, Edea, Kribi, Yokadouma, Abongbang, Sangmelima, Ebolowa, Mbalmayo and Yaounde) and sold to wholesalers who also buy in bulk to re-sell in the same markets, export to Gabon, Europe, USA and other countries harbouring high populations of Cameroonians. The latter authors also identified the home use buyers who buy kernels in small quantities (glass or cup) for home consumption. Bulk buyers measure product in 15 litre buckets and other containers that are direct fractions of 15 litre bucket, such as $\frac{1}{2}$ bucket and $\frac{1}{4}$ bucket (25). They also reported that the cost of a bucket at the start of the production season is usually high (\$US 36-44), and drops (\$US 24-28) at the peak of production, but later increases to \$US 44-54 towards the end of the production season.

The much time required to produce (collection, decaying of fruit pulp and kernel extraction) *R. heudelotii* kernels is also a disincentive hence, low profits. Collectors do not consider the time spent to collect and process NTFPs in pricing the products. The bargaining power of individual collectors also determines the prices they receive for the product. According to Che (7), the Baka in Yenga sold *R. heudelotii* kernels very cheap (5,000 to 7,000 FCFA (\$US 10-14)/basin of 22 kg) meaning 227 to 318 FCFA (\$US 0.5-0.3) /kg whereas the Bangando who have higher bargaining power and sometimes store product and sell in times of scarcity, sold at 25,000 and 45,000 FCFA (\$US 50-90)/basin, that is 1,136 to 2,045 FCFA (\$US 2.27-4.09)/kg when products are abundant and scarce respectively.

The total average benefits for collectors of *R. heudelotii* in a month varied between the South West/Littoral Regions with US\$ 9.4, Centre/South Regions with \$US 4.7 and East Region with \$US 6.0, pointing out that collectors in South West/Littoral Regions derived more benefits, while those in East and Centre/South Regions produced and sold at a deficit (25).

Differences in annual mean profits of traders could be as a result of variation in prices due to differences in availability of product and volume of trade. This could also be attributed to corresponding differences in population size, hence demand in the various market locations. According to Nkwatoh *et al.* (25), traders of *R. heudelotii* had a market margin of \$US 17.4 for the South West/Littoral Regions, \$US 21.1 for the Centre and South Regions and \$US 25.4 for the East Region. Traders have higher mean annual profits than collectors because they determine the price at which they buy, and lack of market information for collectors make it difficult for them to project quantity demanded which is a function of market price setting (20).

Unlike our findings, collectors in the Centre (4) and South West/Littoral regions of Cameroon (24) sell *Gnetum* leaves in 1 kg bundles. The short chains observed in our study are probably due to the absence of significant transformation from harvest through delivery to consumption. Tajoacha (33) equally reported the presence of four channels for *Gnetum* trade around the Takamanda forest reserve in the South West Region of Cameroon, with the longest chain consisting of producers, brokers, wholesalers, semi wholesalers, retailers and consumers. Seven channels were observed in *Gnetum* trade in the South West and Littoral Regions of Cameroon, with the longest involving collectors, wholesalers, exporters, importers, retailers and consumers (22). This is because the product from this area goes into neighbouring Nigeria and beyond to Europe and America to supply the African diaspora in those areas.

Disparities in annual mean profits of *Gnetum* harvesters may be as a result of differences in quantity of product harvested per village or in the availability of a market. The result of this study differs from that of Ndumbe *et al.* (22) who reported higher annual mean profits of harvesters in villages in the South West and Littoral Regions of Cameroon including Bachou-akagbe (1,295,453 FCFA) (\$US 2,590.9), Tapkwe (713,558 FCFA) (\$US 1,427.1), Bache (605,748 FCFA) (\$US 1,211.5) in Manyu Division and Bonamateke (609,707 FCFA) (\$US 1,219.41), Nkapa camp (509,933 FCFA) (\$US 1,019.9) and Souza (484,222 FCFA) (\$US 968.4) in Mungo Division), which are closer to the big market from Nigeria.

According to Che (7), Baka women had a monthly sale of 100 kg each of *Gnetum* leaves at 22,500 FCFA (\$US 45) while Bangando women sold 40 kg each at 6,600 FCFA (\$US 13.2) in Yenga.

The presence of large quantities of *Gnetum* leaves in all four study markets is also proof of abundance of the resource in the zone, especially as traders from far off towns in the country are not involved in its trade in this zone due to its high perishability. The result of this study is similar to that of Ndumbe *et al.* (22), who reported different average annual profits for different markets in the South West Region of Cameroon including Muea (431,118 FCFA) (\$US 862.2), Limbe (412,262 FCFA) (US\$ 824.5), Tiko (839,100 FCFA) (\$US 1,678.2), Mutengene (1,270,014 FCFA) (\$US 2,540.0) and Fiango (693,978 FCFA) (\$US 1,388.0).

Unlike our study, they also reported differences in exporter profits in different Nigerian markets including Ikom (1,051,711 FCFA) (\$US 2,103.4), Ikingi (5,010,000 FCFA) (\$US 10,020) and Calabar (3,119,467 FCFA) (\$US 6,238.9).

Ruiz Perez *et al.* (26) characterized NTFP markets in the humid forest zone of Cameroon and identified four categories including frontier markets (category I) of Abang Minko, Kenzou and Kye-Ossi with small to medium value of transactions and very high dependence for their supply on other areas; the two large urban markets (category II) of New Bell (Douala) and Mfoundi (Yaounde) whose size and spread of linkages give them a national projection, whereas they rely on more distant supply areas; a group of medium-sized markets (category III) of regional importance, with a medium level of self sufficiency, acting as secondary nodes for the small, local markets and intermediate assembly points for the two large urban markets; and small local markets (category IV) with a high level of self-sufficiency that act as local exchange places as well as suppliers of the regional and national markets. Yokadouma market which recorded the highest annual mean profits for both NTFPs is thus, a category III market where *R. heudelotii* kernels and *Gnetum* leaves are amassed and transported to bigger towns in the country and beyond. On the contrary, Libongo, Kika and Moloundou markets belong to category IV and are located in NTFP source areas where traders from Yokadouma and other towns come to buy. The volume of trade in Yokadouma is therefore bigger than in the other markets, consequently higher trader profits.

Our study villages are located along an 85 km stretch of main road between Salapoumbe and Moloundou, except for Libongo and Kika which are off the road.

The Bangando and Baka are major inhabitants, the latter being hunter-gatherers who are just getting settled in villages through government effort. The Baka (29% of NTFP producers) have low bargaining power and barter is still common among them. The socio-economic and cultural characteristics of villages are similar so differences in mean profits probably depend more on individual than community involvement in NTFP activities. For example, the amount for which an individual sells a unit of NTFP may depend more on the urgency of need for money (such as in cases of ill-health, payment of school fees) than on the fixed unit price of the product. Lack of other sources of income could compel individuals to collect more NTFPs to sell to meet basic needs, enabling them to make more profits than those who collect less. Angelsen *et al.* (2) point out that reliance on NTFPs for income is highly variable within and across villages due to economic and social contexts, availability of alternative employment, proximity of markets and forests, extent of forest degradation, family traditions and a host of other factors.

Similar trends were observed between some of our results and those from other studies but the absolute values were much higher for sites in the South West/Littoral and Centre regions than ours. This is possibly because such sites are more exposed to larger markets like Yaounde, Douala, Kumba and neighbouring Nigeria where demand for the NTFPs is high.

Marketing of NTFPs in our study site is not yet developed, with traders determining the price they pay for a particular product, unlike in other places where similar studies have been carried out where collectors bargain with traders on the prices they will either pay or receive. Other markets have unions of NTFP traders (22) through which they can take decisions for the benefit of members but this is not the case with our study markets.

Several reasons account for the problems encountered by actors of NTFP supply chains in our study. Collectors of *Gnetum* spp. had to trek long distances into the forest to locate the resource as a result of forest clearance for purposes which have led to destruction of the preferred habitat of the species. This agrees with the findings of Ndumbe *et al.* (22) who observed that majority (97%) of *Gnetum* harvesters in the South West and Littoral Regions of Cameroon indicated longer search times due to product scarcity and long distances travelled to harvest *Gnetum* leaves which have increased in the past decade, as some of the difficulties faced in their activities. Eighty five percent of *Gnetum* collectors around Takamanda forest reserve mention unavailability of the product as a major problem (33).

NTFP collectors faced threats from wildlife because the latter moved from the protected area into the secondary forest and fallows where *Gnetum* spp. abound to feed on the leaves. This is in line with Moutsamboté (18) who observed that leaves of *G. africanum* and *G. buchholzianum* are consumed by gorillas at Nouabale-Ndoki forest in the Republic of Congo. Similarly, *Gnetum* leaves also play a role in the diet of other forest dwellers such as chimpanzees and gorillas (28).

The shell of *R. heudelotii* is naturally hard, hence much time is taken to process it. The species does not fruit every year, limiting the availability of the resource. This agrees with Tchoundjeu and Atangana (34) who report that most *R. heudelotii* trees produce fruit only once in two years, leading to lack of the resource in some years.

NTFP collectors complain of low prices because they are ignorant of the prices that are practiced in big markets and in other places. Prices are imposed by traders and market places are almost absent in most study villages thus, people cannot interact with other market participants.

The absence of credit facilities also limits the extent to which both collectors and traders can operate. This facility will enable collectors to pay for enough labour and tools to harvest and process NTFPs whereas, traders will be able to buy and stock larger quantities of NTFPs which they can sell for a longer period (than a year for *R. heudelotii* kernels). The bad state of roads and poor transportation facilities lead to high transportation cost which most collectors cannot afford, and causing traders who brave it to the production zone to pay very low prices.

Conclusion and recommendations

R. heudelotii kernels and *Gnetum* spp. leaves are important sources of income to both collectors and traders in the study area. Both NTFPs are freely collected, mostly from the secondary forest and agroforest, and undergo minimal or no processing (for *Gnetum* spp.) before sale. Marketing of both NTFPs is mostly carried out by women, and individually.

Traders of *R. heudelotii* earn about four times as much profit as collectors annually, whereas, those of *Gnetum* spp. earn approximately seven times as much profit as harvesters. An improvement in the methods of processing will boost production, whereas collective action and the creation of local NTFP enterprises can enhance the benefits of actors in the sector. Sustainable harvest methods should be developed for *Gnetum* spp., while both NTFPs should be domesticated by collectors in different farm systems.

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