AGRICULTURAL LAND USE, COLLECTION AND SALES OF NON-TIMBER FOREST PRODUCTS IN THE AGROFOREST ZONE IN SOUTHEASTERN CAMEROON

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ABSTRACT This study examined (1) land use pattern and impact of the shifting cultivation on the forest, (2) importance of Non-Timber Forest Products (NTFPs) to the livelihoods and (3) production and sales of wild fruits with market values, among the local people in the Non-permanent Forest Domain near Gribe village. The results suggested a forest recover from the cultivated land, which is due to small scale of land clearance, long fallow periods, remnant trees in the cleared fields, as well as the land inheritance system. It is also suggested that such an extensive land use may improve the availability of some plant NTFPs, while affecting negatively the wild animal's abundance. The wild fruits contributed significantly to the household economy, but the fruit production varied extremely from year to year and the sales of the products led to a greater economic gap between the Baka and the Konabembe, who had different relationships with the market. In order to combine forest conservation with the people's interest, it is important to understand the availability of NTFPs, and appreciate the potentials of people's knowledge of the forest and their capacity for managing the forest and NTFPs.

Key Words: Shifting cultivation; Resources collection; Fruit production; Household economy; Baka hunter-gatherers; Konabembe agriculturalist.

INTRODUCTION

In recent years, there have been increasing interests in the conservation of the tropical rainforests. In Cameroon, commercial logging and shifting cultivation have been seen as major factors for the forest destruction (Ichikawa, 2012), whilst measures to prevent further deforestation, such as the designation of national parks, placing restrictions on the hunting and gathering of wild animals and plants by the local people, zoning of the forests into different use categories and the promotion of environmental education, have been implemented via initiatives by international organizations, the government, and NGOs (Ichikawa, 2012). In addition, the international community has recently decided that the conservation of biodiversity and the reduction of greenhouse gas emission are global environmental issues that affect the future of the entire human society. Conservation of tropical rainforests has thus attracted global concern (Ichikawa, 2012).

On the other hand, many local people have long been living in the forest, developing unique culture based on the forest. There is a trend, therefore, that the international community has implemented conservation strategies, such as community-based conservation and collaborative management, that involve the local people as active participants in the forest conservation. In Cameroon, for example, a method of distributing the benefits from the national park and sport

hunting to the local people has been taken into account, while restricting their access to the resources in the protected areas. However, the benefits for the people have not only failed to match the loss incurred by the restriction, both qualitatively and quantitatively, but have also caused social confusion and conflicts caused by uneven distribution and methods of distribution among the different groups of people. Identifying a way of combining forest conservation with sustainable resource use by the local people is still a highest priority issue (Hattori, 2012).

An approach focusing on Non-Timber Forest Products (NTFPs) is considered to be an effective approach in the present situation. NTFPs are defined as all forest products excluding timber, and as forest resources that sustain the lives and culture of the people (Peters et al., 1989). Unlike in the case of the commercial logging, the people have been able to use the NTFPs without a large scale disturbance. The use of NTFPs may have even contributed to facilitating forest regeneration and material circulation in the ecosystem (Ichikawa, 1992). The core of the approach that focuses on NTFPs lies in following the interdependent relationships between human activities and the forest.

Previous studies on the use of NTFPs discussed the potential for compatibility of forest conservation and the lives of the people from various viewpoints. One of the points in these studies is that NTFPs have economic value that exceeds commercial logging. A case from Democratic Republic of the Congo shows that the economic value derived from only part of the NTFPs, if converted into market value, well exceeds two billion dollars. By contrast, the income generated from commercial logging was approximately 1.2 billion dollars (Debroux et al., 2007). A second point is that NTFPs provide opportunities to obtain cash. Some NTFPs are widely traded outside the region. The people's active involvement in the commercial network of NTFPs has been reported in Cameroon (Awono et al., 2008). A third point is compatibility of the people's life and culture with the global environmental issues. Expectations of the NTFP-based approach have risen, due to the acknowledgment of the importance of forests to the ecosystem-based adaptation against climate change (Nogherotto et al., 2013).

On the other hand, various problems have been highlighted. One of such issues is the overexploitation of NTFPs, together with confusion in the society caused by the commercialization of NTFPs (Ruiz-Pérez et al., 2004; Mwangi & Mai, 2011). In recent years, merchants frequently visit local communities in search of NTFPs, and request the residents to provide them with bushmeat and wild fruit of economic value. This could result in an increased risk of resource depletion and the acceleration of an unequal social relationship between the hunter-gatherers and the agriculturalists regarding such resources. There are also cases where the people do not always have a close relationship with NTFPs (Lescuyer et al., 2012). The latter case indicates that a static view that sees the people as always relying on NTFPs should be avoided, since the livelihood of the people is multidirectional.

Despite many issues having been discussed, the issue that should be of concern is the fact that there has not been a comprehensive and detailed study to elucidate the relationship between forest resources or NTFPs and the local people's life. Many of the previous studies have focused on NTFPs from the viewpoint of a particular discipline. For instance, the main achievement of botanical studies was

the compile a list of useful plants. However, such studies failed to provide a quantitative account of the abundance and distribution of different NTFPs, and ignore the impact of human use on NTFPs availability. In addition, although economists and anthropologists have recounted a macro view of the potential and the problems that NTFPs might have, they have not conducted long-term research into local societies to understand the actual use of NTFPs by the people i.e., the NTFPs' contribution to their livelihood, the ways in which people give value to NTFPs, and the social relationships among the residents regarding the use of NTFPs.

This paper will describe the relationships between the forest, NTFPs and the livelihood activities of the Baka hunter-gatherers and the Konabembe Bantu-speaking agriculturalists living in Gribe village, southeastern Cameroon, focusing on following three issues: (1) land use patterns in shifting agriculture and its impacts on the forest vegetation, (2) contribution of the NTFPs to the people's livelihood and (3) sales of NTFPs in the local community to examine the economic role of NTFPs, in particular, wild fruits in the household economy. The major part of the land surrounding the Gribe village has been classified either into Logging Zone or Boumba-Bek National Park where the people's livelihood activities have been restricted (Njounan Tegomo et al., 2012). This paper aims at providing detailed accounts of the relationships between ecology and availability of NTFPs and people's society.

METHODS

I. Study Area

Gribe village (03°00'10'' N and 14°49'25'' E) is located at the northern periphery of the Boumba-Bek National Park in the East Region of Cameroon (Fig. 1). The mean annual temperature is around 24ºC and the temperature tends to be constant year-round. The mean annual rainfall is approximately 1500 mm with a considerable variation from year to year (Yasuoka, 2006). The rainfall regime over the Cameroon rainforest is mainly governed by the intertropical convergence zone (Njitchoua et al., 1999). Consequently, there are four seasons in a year, minor rainy season (from March throughout May), minor dry season (June throughout August), major rainy season (September throughout November) and major dry season (December throughout February) (Fig. 2).

The vegetation type is classified as semi-deciduous forest around the study village, and as mixture of evergreen forest and semi-deciduous forest in the Logging Zone and Boumba-Bek National Park (Letouzey, 1985). Nkongmeneck (1999) reported a high tree diversity of this area based on his study in the park area. He recorded 390 tree species, of which 270 were canopy species. The dominant families are: Annonaceae, Ceasalpiniaceae, Euphorbiaceae, Fabaceae, Rubiaceae, Ulmaceae, Olacaceae, Sterculiaceae, Tiliaceae and Combretaceae. The canopy height reaches to 50 m both around the village and in the park. The highest tree recorded around the village had 55 m for *Triplochiton scleroxylon*

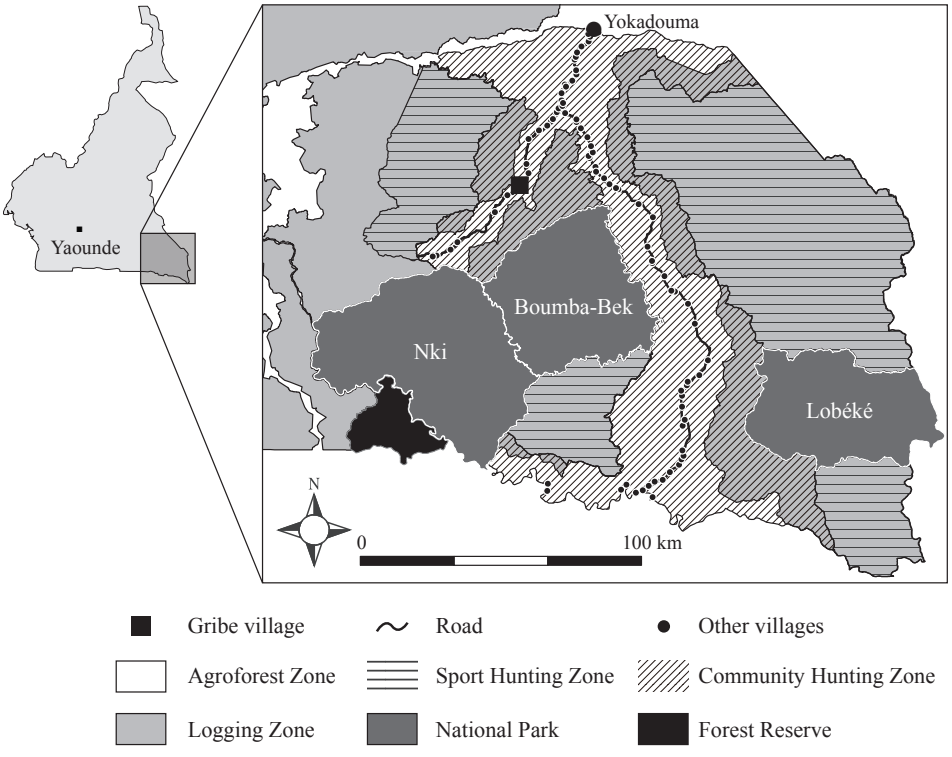


Fig. 1. Study area and land use classification by the Cameroon government.
Source: World Resources Institute (2012).

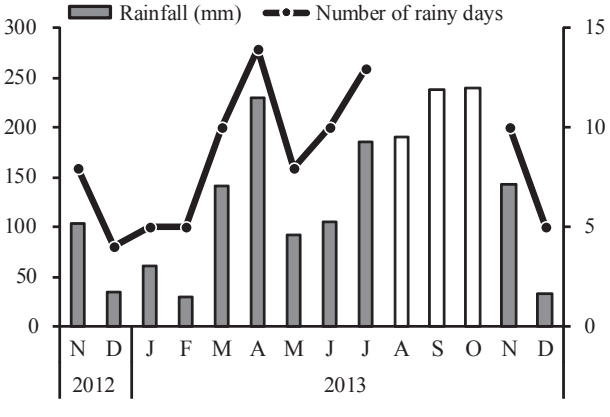


Fig. 2. Monthly rainfall and number of rainy days at the study site.
The data between August to October in 2013 (mean monthly rainfall at Yokadouma from 1983 to 1993) derives from Cameroon Forest Watch database, cited in Yasuoka (2006). The data for the other months were obtained at Gribe village by using a pluviometer.

(Sterculiaceae) (Hirai, unpublished data).

The village is inhabited by approximately 400 Baka and 300 Konabembe, and the numbers of their household are respectively 94 and 74 according to Toda (2014, this issue). All of the Konabembe houses are built along the roadside, and their settlement comprises the center of the village. On the other hand, 75% of the Baka household lives along the road, while keeping their distance from the Konabembe settlements. The remaining 25% of the Baka household lives in small scale agricultural camps in the Agroforest Zone that the Cameroon government designates under the zoning or official land use plan (Njounan Tegomo et al., 2012).

The main form of livelihood of both the Baka and the Konabembe are hunting animals, collecting NTFPs and shifting cultivation to grow plantain, banana, cassava and other crops for their subsistence, and cacao cultivation and NTFPs trading for their cash incomes. Whereas the Baka mainly depend on wild animals and plants of the forest, leading a nomadic life in the forest, their subsistence activities have rapidly changed since the 1950s (Althabe, 1965); they began to make sedentary settlements along the roads and to cultivate their own field (Kitanishi, 2003), due to the administrative policy of the colonial and post-colonial governments and the penetration of market economy (Wilkie & Curran, 1993).

There are many restrictions on the resource and land use in connection with the creation and management of protected areas and zoning plan proceeded between 1999 and 2001 by the Cameroon government with supports of World Wide Fund for Nature (WWF) and German Technical Cooperation (GTZ) (Njounan Tegomo et al., 2012). The farming and hunting are banned in the Logging Zone, Sport Hunting Zone (ZIC; Zones d'Intérêt Cynégétique) and the park that constitute most part of the study area and these zones are classified as "permanent forest domain" (Fig. 1). The farming is authorized only in the lands classified as "non-permanent forest domain," namely the Agroforest Zone expanding approximately 3 km on both side of the road for the farming, whereas hunting by local people is permitted only in the Community Hunting Zone (ZICGC; Zones d'Intérêt Cynégétique à Gestion Communautaire) which include Agroforest Zone and a part of the Logging Zone. However, a lot of regulations are imposed on the hunting activity in terms of target species, captive numbers and methods to use (Usongo, 2004 cited in Hattori, 2012). In the park, although collection of plant NTFPs is authorized, camping is banned.

The Baka and the Konabembe spend most of the year in their settlements, yet they often spend the minor dry season, when specific wild fruits grow in abundance, in camps in the forest. As many previous studies have mentioned (Kitanishi 2003; Yasuoka, 2006; Hattori, 2012), the Baka and the Konabembe in Gribe village have close social relationships through a frequent exchange of labor, food and other daily materials. In contrast, the Konabembe far exceed the Baka in terms of political and economic position, and this sometimes causes conflicts in their social relationship.

There are ten mercantile households inhabiting the village. The seven households among the ten have migrated from Yokadouma or outside the region, even from remote countries such as Mali, whereas they have lived in the village for a long

time. The merchants sell everyday sundries and food to the villagers, and buy bushmeat, wild fruits and cacao beans from the villagers. This area is rich in trees bearing wild fruits that are widely sold in and outside the country as oily condiments (e.g., *Irvingia gabonensis*). The villagers collect and sell such products to the merchants to earn cash. There are many merchants from cities such as Yaounde and Douala who visit the village in search of the wild fruits and other NTFPs.

II. Date Collection and Analysis

(1) Agricultural land use

The first objective of this paper is to clarify the impact that the shifting cultivation has on the forest. I conducted interviews with the villagers from February 2012 to 2013 on the cultivated plots that had been used by any of the villagers; the questions related to: the year of land clearance, vegetation types at the time of land clearance, the person who cleared the land, approximate labor input (number of days and persons) for the clearance and involvement of paid employment, and the crops planted or sown. Also, a Global Positioning System (GPS, Etrex 20 by Garmin Co., Ltd.) was used to determine the location and size of each plot. Additionally, tree species names with 10 cm diameter at breast height (DBH) and over standing in each cultivated plot, and their precise locations, were recorded. Data of the species names were collected in the Baka language with their pronunciation. The plant specimens were identified at Millennium Ecological Herbarium in Yaounde. Based on these data, I will describe (1) land use pattern and its relation to the land ownership, (2) scale, distribution and history of land clearance, and (3) density and distribution of some major tree species whose fruits contribute to the people's subsistence and household economy.

(2) Collection and use of forest products

The second objective of the study is to quantitatively elucidate the importance of the NTFPs to the people's livelihood. Thus, the names, weights, collecting places (active cultivated plots, fallow and forest) of the products that the villagers collected and brought to the settlement were recorded. Also, the weights and prices of items purchased from the merchants were recorded. As for the Baka, three groups living in different areas were selected as research subjects, and these were named as groups A, B and C. The total number of investigated households was 41 in total. This research has been carried out from September 2012, until present on a daily basis, with the assistance of two literate Baka men. Additionally, to clarify the spatial range of their products collection from GPS track data, I requested each of 56 Baka women to carry a GPS (same model as above) at the times of their leaving the settlements. This survey was carried out from September to November 2012 and obtained 208 records in total from 56 Baka. Five households were selected from the Konabembe, and each head of the household has been asked to keep a record of collected products from March 2012 until the present. I will describe the following two topics, using the data obtained from the survey of the Baka household: (1) spatial range of the product

collection obtained from the visualized data by using ArcMap 10.1 (ESRI Co., Ltd.), (2) forest types in which the products were collected and the proportion of the NTFPs by category (e.g., food, medicine and tool material etc.) both in weight and in frequency (number of the procurement times) to the total products brought to the settlements. Detailed description and analysis of the remaining data both on the Baka and the Konabembe will be given in a forthcoming paper.

(3) Sales of the forest products

In order to examine importance of NTFPs to the household economy, the third objective, a record of names, weights and prices of the forest products (including cacao beans) that had been collected and sold by the people to the merchants have been kept from September 2012 until present on a daily basis. I will describe the major trading flow, followed by sold products and the difference in sales amounts between the Baka and the Konabembe.

As wild fruit hold a prominent position among a number of forest products, fluctuation in fruit production may have great influence on the NTFPs trade. In this regard, I describe fluctuation in fruit production for the following 10 species: *Afrostyrax lepidophyllus*, *Baillonella toxisperma*, *Beilschmiedia louisii*, *Irvingia excelsa*, *Irvingia gabonensis*, *Irvingia robur*, *Klainedoxa gabonensis*, *Klainedoxa microphylla*, *Panda oleosa* and *Ricinodendron heudelotti*. To monitor their fruit-falls, 6–25 reproductive individuals growing in nearby the village were selected for each species, and land under the crown of each tree was divided into four quadrants. Under each of the quadrants, a trap was set up before the trees started dropping the fruits and was kept in place until it completed dropping. The monitoring started from May 2012 for *A. lepidophyllus*, *B. toxisperma*, *I. gabonensis*, *K. gabonensis* and *P. oleosa*, whilst from June 2012 for *R. heudelotti* and from November 2012 for *B. louisii*, *I. excelsa*, *I. robur* and *K. microphylla*. The area of each trap was 0.159 m^2 at the initial stage from May to September 2012, but it was changed into trap of 1 m^2 (1 m × 1 m) set on the ground for all the species except *B. toxisperma* and *I. robur* whose fruits are larger but probably fewer in number. For *B. toxisperma*, two traps of 0.159 m^2, one of 1 m^2 (1 m × 1 m) and one of 4 m^2 (2 m × 2 m) were used for each individual at the initial stage, but all traps were changed into trap of 4 m^2. For *I. robur*, trap of 4 m^2 was used for each individual for an entire period of the monitoring. The number of ripe fruits fallen into the traps were monitored on a weekly basis. Based on the calculation of the mean density of fallen fruits, I estimated the change in fruit production between 2012 and 2013. Whereas the study was launched in May 2012 and has continued until present, I use the data obtained from May 2012 to October 2013. Detailed description on the fruiting phenology is in preparation.

All of the above research was carried out with the participation both of the Baka and the Konabembe and was continued even when I was absent from the village.

RESULTS

I. Agricultural Land Use

(1) Land use pattern and customary land ownership

Both the Baka and the Konabembe practice shifting cultivation with mixed cropping, which involves different kinds of crops at the same time in the same plot.

Table 1 shows a process whereby a plot is cleared and planted, and then change to fallow and forest. It also shows the major crops grown in each stage. With regards to the new plots within one year after the land clearance, annual crops and perennial crops are planted together, making the plots richest in crop diversity. Many people plant cacao saplings in the plots. Harvest of groundnuts and maize is normally completed within a year. Root and tuber crops, such as cocoyams, sweet potatoes and cassava, as well as okra and red pepper are harvested in small amounts until the second or third years after the clearance. Perennial crops, such as plantain and sweet banana, the suckers are transplanted in the first year plots, and harvested from the second year in most cases. The reason for the people clearing new cultivated plots every year is to seamlessly harvest both annual and perennial crops.

Table 1. Change in cultivated plot with time course and the major crops

Major Crops	Year-old (y/o) of plot and vegetation class				
	1 y/o	2 y/o	3 to 10 y/o	10 to 30 y/o	30 y/o <
	Active plot *nbier toto*[1] *pie mies*[2]	Active plot *bonjo* *pie pock*	Young fallow *wundo* *ebur*	Old fallow *di wundo* *djas ebour*	Secondary forest *di wundo* *duk*
				Mature cacao plot *nbier cacao*[1]/*pie cacao*[2]	
Groundnut	P-H[3]				
Maize	P-H				
Tobacco	P-H				
Cocoyam	P-H	H			
Sweet potato	P-H	H			
Okra	P-H	H			
Cassava	P-H	H	Hr		
Red pepper	P-H	H	Hr		
Plantain	P	H	H		
Banana	P	H	H	Hc	
Gnetum africana	Gs-H	H	H	H	H
Cacao	P-C	P-C	P-C	C-H	C-H

[1]: Names by the Baka.
[2]: Names by the Konabembe.
[3]: P: Planting or sowing; H: Harvest or collection; C: Cutting trees and weeding in cacao plots; Hr: Harvested rarely; Hc: Harvested when the farmers remove the weeds and trees covering the cacao saplings to facilitate the growth of saplings; Gs: Grow spontaneously.

The cultivated plots enter a young fallow stage in the third year after the clearance. In this stage, the plots left without care (such as weeding) for the crops, and the surface is covered with weeds whilst seedlings of pioneer tree species (typically *Musanga cecropioides*) begin to grow. Although the land was covered with the weeds, plantains and sweet bananas continue fruiting as they have grown taller than the overgrown weeds, and their fruits are harvested from time to time.

The old fallow stage starts approximately 10 years after the clearance of the plot. Pioneer tree species have grown tall in the early period of this stage, and the canopy often closes as a consequence. Therefore, this represents a turning point for the people to decide whether they turn the plot into a cacao field or leave it as fallow. When they turn the plot into a cacao field, trees and herbs preventing the cacao from growth must be cut, burnt and removed. In some cases, where plantains and bananas planted in the first year remain in the fallow, the fire improves the growth environment and eventually, such crops begin to fruit once again. Thus, turning the plot into a cacao field also resulted in re-harvesting of plantains and bananas.

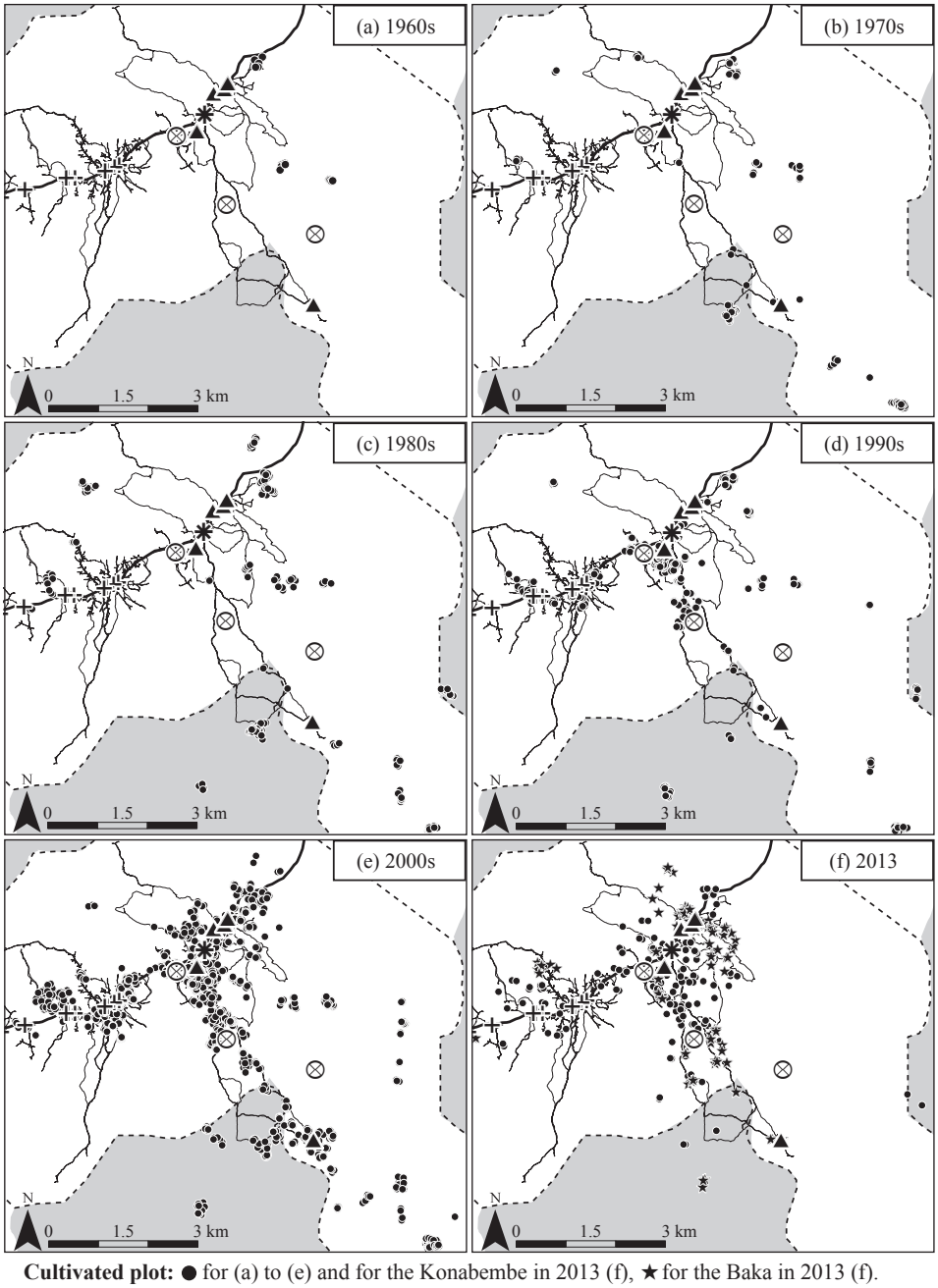
The fallow forest in 30–40-year-old is called *di wundo* in the Baka language, and *duk* in the Konabembe language, meaning "the forest that was once a farmed land". It can be regarded as the old secondary forest. They hold that the soil fertility at this stage of land has recovered and it again becomes available as a cultivated plot.

It is hard to distinguish the area of old secondary forest created after a long period of tens of years from the natural forests since both have almost the same appearance and structure (cf. Tajeukem et al., 2014, this issue). On the other hand, from the viewpoint of usufruct of the villagers, the right to such old secondary forests always belongs to the person who first cleared the land, even if the forest regains the natural vegetation. The person who clears the land remains eligible to keep the land regardless of the forest succession. Furthermore, such a usufruct can be either inherited by descendants, or given to their relatives.

(2) Change in the distribution range and number of cleared plots

The survey on the agricultural land use collected information for a total of 3,911 cultivated plots cleared by the living people and their ancestors. Out of the total, 1,902 plots were from approximately 90 Baka households which represent 93% of the total Baka households, and 2,009 from approximately 65 Konabembe households representing 90% of the total Konabembe. Spatially, the survey covered most areas of the village except for those which were beyond 5 km range from the roadside or the central settlement.

Year of the land clearance ranged from 1961 to 2013 for the recorded plots, and its distribution range appears to expand with time (Fig. 3). In particular, a marked expansion of the distribution range were found between 1960s and the other decades. However, this is mainly due to the fact that the survey could not record locations of the earlier plots (cleared from 1961 to late 1990s) as much as that of more recent plots, since many people did not remember their earlier plots in detail. As evidence for this, the numbers of recorded plots decreased continuously and exponentially with the time going back; number of the recorded



Cultivated plot: ● for (a) to (e) and for the Konabembe in 2013 (f), ★ for the Baka in 2013 (f).
Settlement: ✱ for the Konabembe, ▲ for the Baka, ✚ for the both groups inhabiting at the marginal area, ⊗ inhabited by the Konabembe until 1980s, but abandoned (cf. Toda, 2014, this issue).
Zone: ⬚ Agroforest Zone, ▭ Logging Zone; they are applicable only for (e) and (f). ∿ Piste.

Fig. 3. Distribution of the cultivated plots cleared since 1960s.
Filled circles and star-shaped marks represent the center point of each plot. Map (e) includes plots of 2011. Map (f) shows the plots by the group.

plots was 239 in year of 2013 and 216.4 plots/year from 2000 to 2011 (total = 2,380), whilst it was only 15 in total for 1960s (excluding the plots of 1968), 82 for 1970s (excluding the plots of 1970), 187 for 1980s and 547 for 1990s (Fig. 4). Moreover, the central settlement of the Konabembe village had experienced three times of shifts by 1980s (Fig. 3). If these settlement shifts are taken into consideration, much more plots would have been recorded around the previous and abandoned settlements before 1980s.

The data for the plots cleared after late 1990s can be used for an accurate examination on the temporal change in distribution range of the plots. A comparison between three maps showing the location of each plot cleared during 1990s, 2000s (including 2011) and in 2013 (Fig. 3 (d) to (f)) shows no major change in the distribution range through these periods. Most of the plots were located either within a few kilometers from the settlements or the road side both for the Baka and the Konabembe. As this distribution patterns show, the people tend to select a land to be cleared for a new plot nearby their active plots, and consequently, the plots clump up in the specific areas of the village. On the other hand, a few isolated plots are found away from the plot-aggregated areas. Such plots were either mature cacao plots owned by the Konabembe or plots cleared by the Baka who have been living in their camps in the forest.

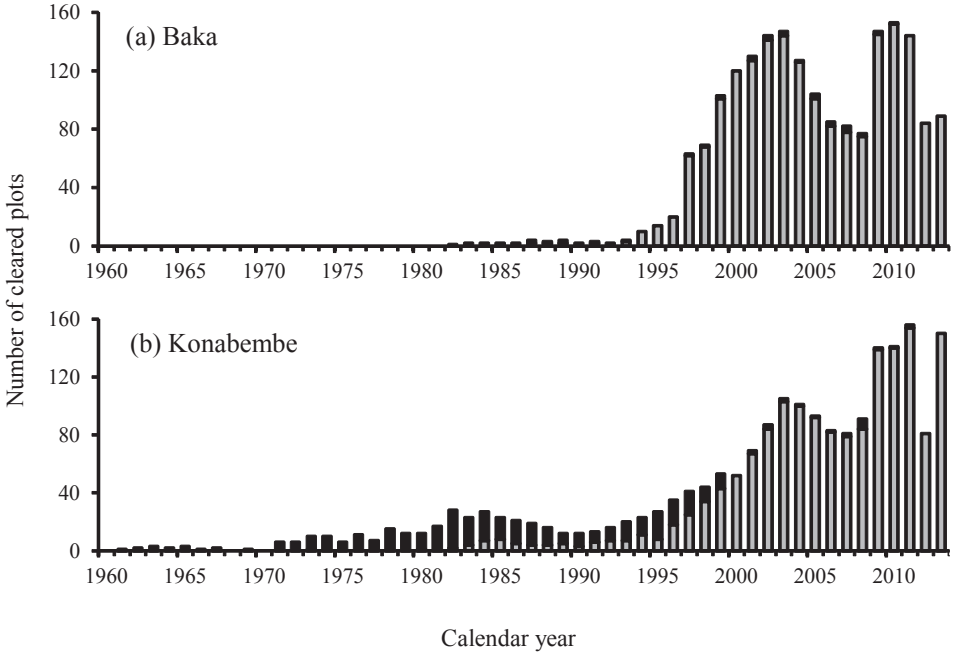


Fig. 4. The Number of general cultivated plots and matured cacao plots cleared by the Baka and the Konabembe from 1961 to 2013.
Gray bar indicates the number of general cultivated plots (N = 1,857 for the Baka and 1,610 for the Konabembe), whilst black bar indicates the number of cacao plots (N = 45 for the Baka and 399 for the Konabembe). As for the cacao plot, the year of the clearance was determined as the year in which the plot became available for harvest.

The number of plots cleared by the Baka surged from the late 1990s to early 2000s with a peak period around 2003, whilst only a few plots were recorded from early 1980s until late 1990s (Fig. 4 (a)). Despite the small number, the Baka also created cacao plots from 1980s at the latest. As for the Konabembe plots (Fig. 4 (b)), the number of plots increased almost continuously from 1960 right up until 2013 with two peak periods; the first peak was around 1983, and the second around 2003 similar to the pattern of the Baka.

This fluctuation in the number of cleared plots in Gribe is similar to the case of Ndongo village which is located approximately 100 km to the southeast of Gribe. According to Oishi (2012), who investigated the expansion of cacao cultivation in Ndongo, the first peak was associated with an expansion of logging operations which increased the access to a market economy, and brought money and merchants into the area. The second peak period, according to Oishi, resulted from rising cacao prices triggered by the decline of production in other countries (see also Varlet, 1997; Duguma et al., 2001; Shikata, 2007). Similar situations may have occurred in Gribe, affected by the economy of a wider region, which deserves further investigation.

(3) Vegetation types at the time of land clearance

There has been no significant change in the distribution range of the plots since late 1990s to 2013. Indeed, the people have not viewed the "primary" or mature forest, which belongs to no one, as a place to clear the fields. As agriculture in

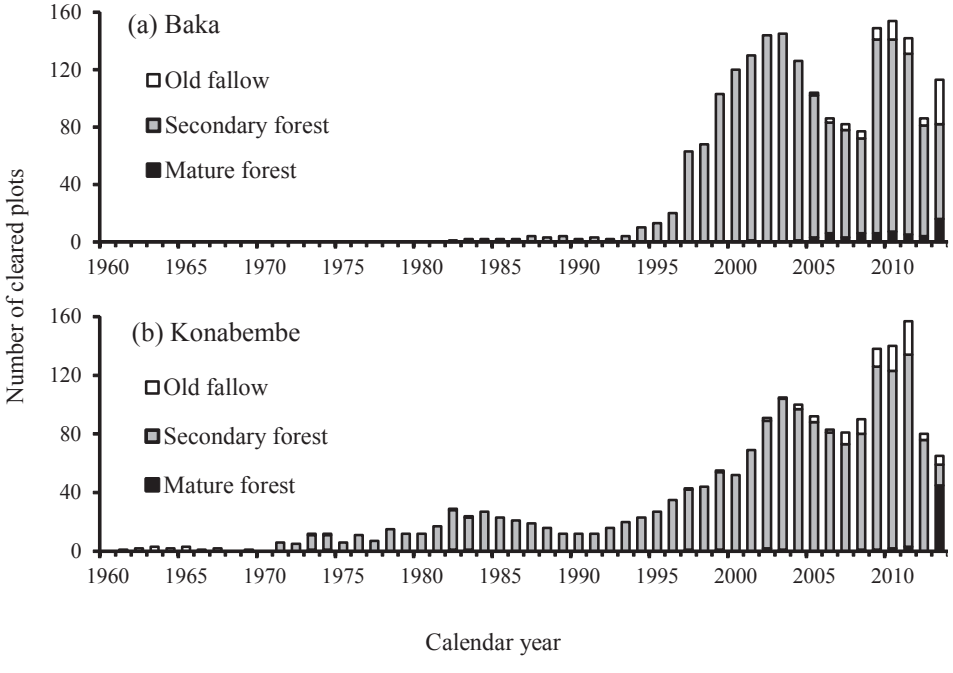


Fig. 5. Vegetation types at the time of land clearance.

this region could not be sustained more than a few decades, the question is how have the villagers increased the cultivated plots? One of the reasons is related to their customary land tenure and inheritance system. As far as the Konabembe are concerned, the cultivated plot of a man is inherited by his eldest son after his death. The eldest son should then equally divide and share the plots with his brothers. Based on such inheritance system, as many as 93.1% (N = 3,657) of the plots were cleared in the old secondary forest and a mere 2.2% (N = 86) in the forest which were free from apparent human intervention (Fig. 5). A small ratio (4.6%, N = 180) of plots were also cleared in the old fallow land, but such plots were for cacao cultivation.

(4) Scale of land clearance

The second reason for the increase in the cultivated plots without expansion into the "primary" forest is the small clearance scale and relatively large area of the Agroforest Zone in which cultivation is allowed. Table 2 shows the surface area and number of plots which both the Baka and the Konabembe cleared from the end of 2012 to the beginning of 2013 (major dry season). The total number of plots cleared by the Baka and the Konabembe amounted to 239 plots, whilst the total area was 46.9 ha. Mean area of the plot was 0.12 ± 0.16 ha for the Baka and 0.24 ± 0.24 ha for the Konabembe. In terms of comparison between the two ethnic groups, the Konabembe plots were significantly larger than those of the Baka, according to ANOVA. The difference was almost double.

The Agroforest Zone, to be allocated to cultivation for Gribe people is estimated at 7,144.5 ha. In the year 2012–2013, the people cleared a total of 46.9 ha for cultivation. Thus, simple arithmetic suggests that it will be another 150 years before a cultivated plot once cleared will be re-cleared again. It can be said that this time length is sufficient for a cleared plot to be covered again with an old secondary forest. From this, it seems unlikely that farming land would expand beyond the Agroforest Zone, or that people would suffer from crop shortage as long as the agricultural production remains on the present level.

Although the number of cases in which people have cleared the "primary" forest represent only 2.2% of the total plots, all of these concentrate in the past 5 years (since 2005, Fig. 5). In particular, the number of plots cleared by Konabembe in "primary" or mature forest exceeded that in secondary forests in 2013. It is important to follow up whether or not this change will expand in future.

Table 2. Size (ha) of the plots cleared by the Baka and the Konabembe between 2012 and 2013

	Total area	No. plots	Mean area ± SD	MAX	MIN	ANOVA
Baka	10.60	89	0.12 ± 0.16	0.85	0.004	$P < 0.0001$
Konabembe	36.32	150	0.24 ± 0.25	1.35	0.002	
Total	46.91	239				

Table 3. Trees with high values as subsistence and/or cash income source

Scientific name	Subsistence[1]		Cash income[2]	Individual number	Frequency (%)	Density (stems/ ha)
	Baka	Konabembe				
Irvingia gabonensis	○	○	○	34	1.08	0.70
Baillonella toxisperma	○	○	○	2	0.06	0.04
Afrostyrax lepidophyllus	△	○	○	15	0.48	0.31
Ricinodendron heudelotti	△	○	○	110	3.50	2.27
Beilschmiedia louisii	△	○	○	14	0.45	0.29
Klainedoxa gabonensis	○	△	×	21	0.67	0.43
Panda oleosa	○	△	×	12	0.38	0.25
Irvingia robur	○	△	×	3	0.10	0.06
Irvingia excelsa	○	△	×	5	0.16	0.10
Klainedoxa microphylla	△	×	×	0	0.00	0.00

[1]: ○: They eat proactively during the fruiting seasons in the settlements in the village or the camps in the forest. △: Not eaten proactively, or rarely eaten. ×: Never be eaten.
[2]: ○: Bought by merchants. ×: Merchants do not consider them as subject to buy in Gribe.

(5) Trees growing in the cultivated plots and its uses by the people

The people living in the forest region in Cameroon leave various trees uncut in their fields for various reasons, such as their utility and difficulty of cutting down (Komatsu & Hanawa, 2000; Carrière et al., 2002; Shikata, 2007). The survey on the plots cleared in 2012 and 2013 shows 3,142 trees (DBH ≥ 10 cm) in total remaining in a cleared area of 46.9 ha. A total of 240 species was recorded, and the tree density was 66.4 stems/ha. It was pioneer species growing immediately after the clearing, such as *Musanga cecropioides*, which marked the highest occurrence in terms of individual number. On the other hand, some of major trees whose fruits play an important role to the people's livelihood and/or household economy were also recorded. These are: *Irvingia gabonensis*, *Baillonella toxisperma*, *Afrostyrax lepidophyllus*, *Ricinodendron heudelotti*, *Beilschmiedia louisii*, *Klainedoxa gabonensis*, *Panda oleosa*, *Irvingia robur*, *Irvingia excelsa* and *Klainedoxa microphylla* (Table 3).

The fruits (kernels) of *I. gabonensis* and *B. toxisperma* are rich in lipid and energy, and are indispensable oily condiments to their side dishes. Moreover, since the fruits are used widely both within and outside the country, they were traded between the people and merchants. For this reason, both the Baka and the Konabembe intensively collected the fallen fruits of these species during the minor dry season between June and August by constructing their camps in the forest.

The distribution of *I. gabonensis* in the cultivated plots, including its omnipresence and higher density may have been facilitated by human interventions (Fig. 6), but this deserves further investigation, in particular in comparison with its distribution in natural vegetation. By contrast, *B. toxisperma* is distributed only over specific places, and the individual number is also low in the study area.

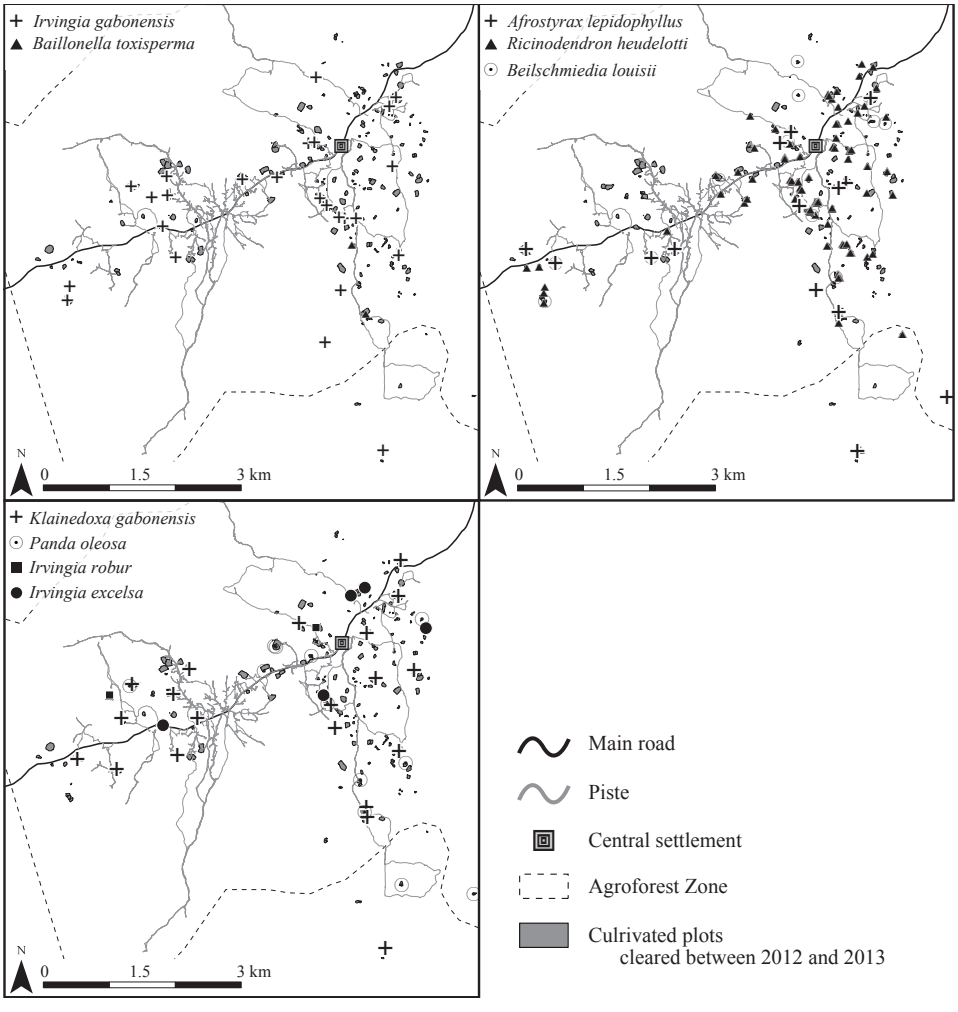


Fig. 6. Distribution of the ten species in the cultivated plots cleared between 2012 and 2013. *Klainedoxa microphylla* was not confirmed.

A. lepidophyllus, *R. heudelotti* and *B. louisii* were growing relatively with middle to higher frequencies, and were distributed across a wide area. Fruits (kernels) of these species are also popular among the Konabembe people as condiments for meat dishes (Table 3). As these fruits are traded within the country, the Konabembe asked the Baka to collect them for selling to the merchants. On the other hand, the Baka rarely eat these fruits despite the fact that they gathered them at the request of the Konabembe. According to the Baka, the reason for not eating these is that the fruit of *R. heudelotti* have hard shells and require laborious work to take out kernels and to dry them before eaten. For a similar reason, *B. louisii* is rarely eaten by the Baka themselves.

The kernels of *K. gabonensis*, *P. oleosa*, *I. robur* and *I. excelsa* were also important wild edible species; they are used as oily condiments by the Baka. The Baka camp out in the forest during the minor dry season for an intensive gathering of the fruits of *I. gabonensis*. The first two species were often eaten to sate their hunger during the laborious work of taking out the kernels. *K. gabonensis* and *P. oleosa* were found at middle level of frequency. *K. gabonensis* can be found almost everywhere in the forest and Agroforest Zone, whilst *P. oleosa*, an understory tree with shade tolerance, grows usually in the closed forest in a small scale population cluster. The Baka frequently use kernels of *I. robur* and *I. excelsa*, as oily condiments from the major dry season to the minor rainy season. In 2013, when the fruit from *I. gabonensis* was lean, the Konabembe also used those kernels to substitute those of *I. gabonensis*.

The fruit of *K. microphylla* were only rarely eaten by the Baka. However, in a year like 2013, when the amount of fruit-fall is scarce, there may be opportunities to eat them. *I. robur* and *I. excelsa* were found at low levels of frequency, and their distribution pattern could not be identified.

II. Collection of Forest Products by the Baka

(1) Collected products

Table 4 shows the numbers of households and their members of the three Baka groups on whom livelihood studies were made. The three groups include the households that moved-in from forest camps and those that moved-out. The numbers of the moved-in and moved-out were almost equal, remaining 25–30 during the survey period.

Household A4 belonging to group A was taken as an example to show how forest products were collected and consumed. There were a total of five members in this household; an adult man, his wife, their two sons (8 and 5 years old), and the man's mother. They remained in their settlement during the study period, obtaining various products from their cultivated fields and forest. The following is based on the data on 63 days of survey from 28 August to 14 November, 2012. The survey was conducted every day from early morning until evening to record all the products brought into the settlement.

Table 4. Number of households and members of each group from 28 August to 23 October, 2012

Group	Total number of households studied	Total number of members	Number of members by age-class (year-old)					
			male			female		
			0–10	11–50	50 <	0–10	11–50	50 <
A	8	31	6	9	1	4	10	1
B	17	70	8	21	3	6	27	5
C	16	61	11	20	1	7	21	1
Total	41	162	25	50	5	17	58	7

NOTE: The households were mostly comprised of nuclear family.

Table 5 shows the number of procurement times and weight (kg) of products by category. The household members went out for procurement activities for a total of 100 times, from which they obtained a total of 91 different items, and those were categorized into food, clean water, inessential items (such as tobacco), medicinal plants, materials for tools, building materials and firewood. Total weight of these products reached 953.3 kg, and total number of the procurement times was 293. Of these, NTFPs accounted 68.1% of the total weight and 49.2% of the total number of the procurement times (Table 6). Other than NTFPs, crops comprised 31.9% in weight and 50.9% in procurement times, and purchased item (cassava flour) 0.04% and 0.3%, respectively.

As for the food, plantain, cassava and sweet potatoes, accounted for 92% of the total weight of starchy food (148.3 kg) and 74% of the total number of procurement times (96 times) (Table 5). Although wild yams (*Dioscorea mangenotiana*, *D. burkilliana*, *D. praehensilis*) and yam-like species (*Dioscoreophyllum cumminsii*, Menispermaceae) were gathered in the forest, the amount was small (4.3% in weight), though the frequency of procurement was relatively high (13%). The cultivated yams (*Dioscorea burkilliana* and *D. praehensilis*) were also recorded, although the harvest was small both in weight (1.1%) and in procurement time (3.1%). The mean weight of the starchy food was 2.4 kg/day/household.

Major part of side dishes was obtained from NTFPs; the proportions of NTFP in weight and procurement times were 100% for mushrooms (*ngebge*, *sakusa*, *djokalanu*, *nguendekunda*, *ngbe*, *tulukanga*, *tulutimi*, *mosele* and *mombundjabundja* in Baka name), meat, fish and oil or oily condiment, whilst vegetables, sweet fruit and condiment were both from agriculture and NTFPs. The mean fresh weight of the side dishes was estimated at approximately 0.8 kg/day/household, but fresh weight of the duikers and *I. gabonensis* were not recorded.

Inessential items and medicinal plants included three and five species, respectively; tobacco, fruit of a Solanaceae (*ndaka* in Baka) and *Cola* spp. for the former category, and tobacco, bark of *Beilschmiedia louisii*, *mobumbu* (a wild tree in Baka) and two unidentified trees for the latter. Of these, tobacco was the most important.

Materials for tools and building included many species and all of those originated from the forest; barks of *Marantochloa* spp. for basket making, those of *Megaphrynium macrostachyum* for mats, coarse leaves of *Ficus exasperata* for scrubber, *faka* (copal) for fuel of lamp, leaves of *Ataenidia conferta* for substitute of plates and fruit of *mondanga* (a wild tree in Baka) for toys (ball for football and target for lancing practice to imitation hunt). As for the house building materials, *Baissea multiflora*, a wild vine, served as rope, leaves of *Raphia monbuttorum* and *Megaphrynium macrostachyum* were used for thatching.

Table 5. Products obtained by household A4 (30 August to 14 November, 2012)

Category	Crop or NTFP	Product name	No. species or crop varieties	Times of procurement	Weight (kg)[3]
Starch food	Crop	Plantain	9	21	71.4
		Cassava	Unrecorded	35	59.3
		Cocoyam	Unrecorded	4	1.3
		Sweet potato	2	15	5.8
		Yam (cultivated)	2	3	1.7
		Propagule-like crop	2	4	2.4
	Wild tube	Yam and Yam-like plant	4	13	6.3
	Wild fruit	*Panda oleosa* (kernel)	1	1	0.1
Sweet fruit	Crop	Banana	4	9	19.5
		Papaya	1	8	10.5
		Avocado	1	4	5.5
Vegetable	Crop	Okra	1	7	0.9
		Cocoyam leaf	1	6	1.7
		Cassava leaf	1	1	0.2
		Mulukhiya	1	1	0.1
	Wild leaf	*Gnetum africana*	1	2	2.6
Condiment/Oil	Crop	Red pepper	Unrecorded	4	0.2
	Wild fruit	*Piper guineense*	1	1	0.8
		Aframomum spp.	1	9	2.6
		Aframomum spp.	1	1	0.3
		Drypetes gossweileri	1	1	0.3
		Pentaclethra macrophylla	1	1	0.1
		Irvingia gabonensis (kernel)	1	2	1.9
Mushroom	Wild	Unidentified	9	9	1.8
Bushmeat	Wild	Rodent	5	6	0.6
		Duiker	2	2	Unidentified
		Small size bird	1	2	0.2
		African snail	1	1	0.1 >
Fish	Wild	Cat fish	1	1	0.1
Clean water		Fresh water	1	1	10.0
Inessential item	Crop	Tobacco	1	24	48.7
		Fruit of a Solanaceae crop	1	2	0.4
	Wild fruit	*Cola* spp.	1	3	0.5
Medicinal plant	Crop	Tobacco	1	1	0.5
	Wild tree	Cf. text	4	4	0.3
Material for tool[1]	Marantaceae	Cf. text	6	12	13.9
Building material[2]	Wild vine	Cf. text	2	2	0.3
	Raphia palm	Leaf and leaf stem	2	5	79.2
	Wild tree (timber)[4]	Cf. text	14	18	132.4
	Marantaceae	Cf. text	2	4	21.4
Firewood	Wild tree	Unidentified	Unrecorded	43	447.6
Total			91	293	953.3

[1]: Tools included basket, matting, scrubber, resin-fueled lamp, tableware and toys.
[2]: Building materials included pillars, leaves for roofing, frames and walling material.
[3]: Fresh weight except for the kernel of *I. gabonensis*.
[4]: Woody stems used for house pillars are not categorized as NTFP.

Table 6. Proportion of the crops and NTFPs to the total weight and the total times of procurement

Category	Weight (kg)	Proportion (%)		Times of procurement	Proportion (%)	
		Crop	NTFP		Crop	NTFP
Starchy food	148.3	95.7	4.3	96	85.4	14.6
Sweet fruit	35.5	100	0.0	21	100	0.0
Vegetable	5.5	52.3	47.7	17	88.2	11.8
Condiment/Oil	6.2	3.3	96.8	19	21.1	79.0
Mushroom	1.8	0.0	100	9	0.0	100
Bushmeat	0.8	0.0	100	11	0.0	100
Fish	0.1	0.0	100	1	0.0	100
Inessential item	49.6	99.1	0.9	29	89.7	10.3
Medicinal plant	0.8	66.8	33.3	5	20.0	80.0
Tool material	13.9	0.0	100	12	0.0	100
House building material	233.2	0.0	100	29	0.0	100
Firewood	447.6	0.0	100	43	0.0	100
Clean water	10.0	0.0	100	1	0.0	100
Total	953.3	24.1	75.9	293	50.9	49.2

(2) Place and spatial range of the products collections

Table 7 shows the places where each product was obtained. The places were split into five categories: cultivated plot cleared a year ago, cultivated plot cleared 2 years ago, fallow, forest and village (purchase).

Seventy percent of the starchy food was obtained from the first or second year cultivated plots. Plantain was also collected from fallow plots which had been cleared 3 or more years ago; 7% in total weight of starch food and 12.5% in total procurement times of starchy food. All the vegetable relishes and bushmeat were obtained either from cultivated plots, fallows or forest. Most of the vegetable relishes were leaves of cassava, cocoyam and *Gnetum africana*. Among these, the first two are agricultural products while the last is a wild vine species which grows both in cultivated land and forest. Vegetables were obtained easily during their agricultural work. Meat was obtained by setting traps in and around the cultivated plots, or in the forest.

Mushrooms and fish were obtained from the forest. As mentioned in the previous section, the nuts of *I. gabonensis* are particularly important to making an oily sauce. *Irvingia* trees often remain in cultivated plots and when their fruits drop, they are quickly collected. Apart from the foodstuff, many medicinal plants, materials for tools and house building were obtained from the forest. There was only one item (cassava flour) obtained through purchase in the village.

The spatial range of the product collection by the household A4 woman and man married couple, who collected 93% in weight and 94% in procurement times, was always in the Agroforest Zone (Fig. 7). The mean distance and time between the settlement and the collection sites of the woman was 4.0 ± 3.1 (SD) km and 2.9 ± 2.0 hours (N = 17), respectively. The place most frequently used for collection was her active plots (82% of total recorded times), which were approximately 1.5 km away from her settlement, whereas she made long distance trips twice to collect various NTFPs including wild yam tubers.

Table 7. Proportion of the places where the products were collected in terms of the total weight (W%) and the total times of the procurements (P%)

Category	Cultivated plot		Fallow	Forest	Village (purchase)	Unknown
	1-year-old	2-year-old				
Starchy food						
W	33.1	37.0	6.9	3.3	0.2	19.4
P	36.5	19.8	12.5	7.3	1.0	22.9
Fruit						
W	1.4	21.4	39.6	0.0	0.0	37.5
P	4.8	19.0	47.6	0.0	0.0	28.6
Vegetable						
W	37.9	0.0	50.5	0.0	0.0	11.7
P	66.7	0.0	13.3	0.0	0.0	20.0
Condiment/Oil						
W	3.2	4.8	24.8	60.8	0.0	6.4
P	15.0	10.0	20.0	40.0	0.0	15.0
Mushroom						
W	2.9	17.1	0.0	80.0	0.0	0.0
P	11.1	33.3	0.0	44.4	0.0	11.1
Bushmeat						
W	20.0	46.7	33.3	0.0	0.0	0.0
P	9.1	27.3	27.3	0.0	0.0	27.3
Fish						
W	0.0	0.0	0.0	100	0.0	0.0
P	0.0	0.0	0.0	100	0.0	0.0
Inessential items						
W	74.1	15.8	0.3	0.4	0.0	9.4
P	72.4	6.9	6.9	3.4	0.0	10.3
Medicinal plant						
W	66.7	0.0	0.0	20.0	0.0	13.3
P	40.0	0.0	0.0	40.0	0.0	20.0
Tools material						
W	8.3	1.8	44.2	45.7	0.0	0.0
P	33.3	16.7	16.7	33.3	0.0	0.0
House building material						
W	0.0	0.0	7.3	92.7	0.0	0.1
P	0.0	0.0	13.8	82.8	0.0	3.4
Firewood						
W	46.4	14.9	13.5	7.0	0.0	18.2
P	41.9	14.0	20.9	4.7	0.0	18.6
Clean water						
W	0.0	0.0	0.0	100	0.0	0.0
P	0.0	0.0	0.0	100	0.0	0.0
Whole						
W	31.3	14.5	11.8	28.8	0.0	13.6
P	32.9	14.0	16.4	18.8	0.3	17.5

NOTE: See Table 6 for the total weight and the total number of the procurements of each category.

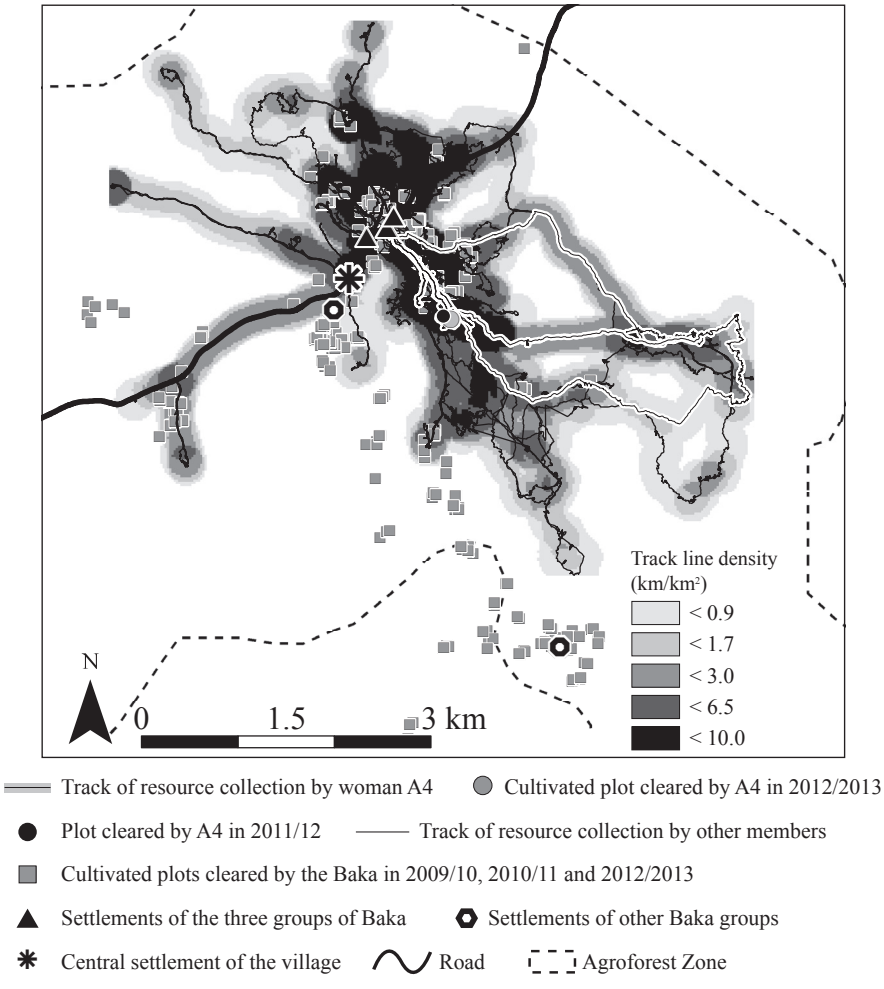


Fig. 7. Range of product procurements by the 56 Baka.
The range was determined from the GPS track data. The numbers of recorded tracks were 121 from 15 persons for the group A, 37 from 20 for the group B and 50 from 21 for the group C. All of tracks were merged into one to calculate the track line density, by using Spatial Analyst Tools (Line Density) of the ArcMap 10.1.

As shown in Fig. 7, other household members' procurement activities took place in a similar way; the mean distance and time was 3.4 ± 3.1 km and 2.6 ± 2.0 hours for the group A (N = 121 from 15 persons), 4.4 ± 3.2 km and 4.6 ± 2.6 hours for the group B (N = 37 from 20 persons), and 2.7 ± 2.1 km and 2.2 ± 2.1 hours for the group C (N = 50 from 21 persons).

(3) Exchange of products and labor

In order to understand the Baka's livelihood, it is also important to elucidate the exchange of their products and labor with the Konabembe. They sometimes

Table 8. Claimed motivation to obtain the products and to work

Motivation of obtaining the product	Number of cases
For self-consumption	257
For sale	1
Upon Konabembe's request for collection	5
Request by Konabembe in exchange for agricultural labor	8
Unrecorded	23

collect products for exchange, in addition to consuming them by themselves. As shown in Table 8, most of the items were obtained for the purpose of consumption by themselves, whereas there was few cases in which they motivated by obtaining cash. On the other hand, there were some cases where they collected wild fruits such as *Aframomum* spp. engaged in agricultural labor (weeding and carrying harvested plantains) on requests from the Konabembe. In these cases, it was not cash, but starchy food (26.7 kg in total) such as plantains (67.7% of the total weight) and cassava (18.0%), papaya (13.1%), cocoyam leaves (0.4%) and tobacco (0.8%) that were bartered with their products and labor.

III. Sales of Forest Products

(1) Fluctuation in fruit production

I examine fruiting pattern as well as annual and seasonal fluctuation in fruit production for the ten species described in RESULTS I (5) (Table 3), as those fruits play important role to the household economy. The fruits fell in different season of the year, depending on the species. Moreover, the dropping season changed from year to year as shown in Fig. 8, which recorded the fruit droppings of major NTFP species, *I. gabonensis*, *B. toxisperma*, *A. lepidophyllus*, and other species in the year 2012 and 2013.

In 2012, *I. gabonensis*, *B. toxisperma* and *A. lepidophyllus* dropped the fruits from early June to August. Each of these trees had its visible peak fruiting around July. However in 2013, the fruit season started July, and later than the previous year. Moreover, the cumulative number of fallen fruits was significantly decreased; the droppings were only 1.1% for *B. toxisperma*, 10.8% for *I. gabonensis* and 31.2% for *A. lepidophyllus* of the previous year.

Both *Panda oleosa* and *R. heudelotti* continued dropping fruits for as long as 6 months from June, when the survey was started, until late December in 2012. In addition, they did not have a clear peak fruiting. *P. oleosa* was continuously producing fruit from December 2012 until October 2013. The fruit-fall of *R. heudelotti* had an intermission between the major dry season and minor rainy season, yet it restarted fruiting from June, just like the previous year.

The fruit of *K. microphylla* did not drop during the period from the dry season until the minor rainy season, which is similar to the fruiting pattern of *R. heudelotti*. In contrast, *I. robur*, *I. excelsa* and *B. louisii* fruits were observed from the major dry season until the minor rainy season, when the other species did not bear fruits.

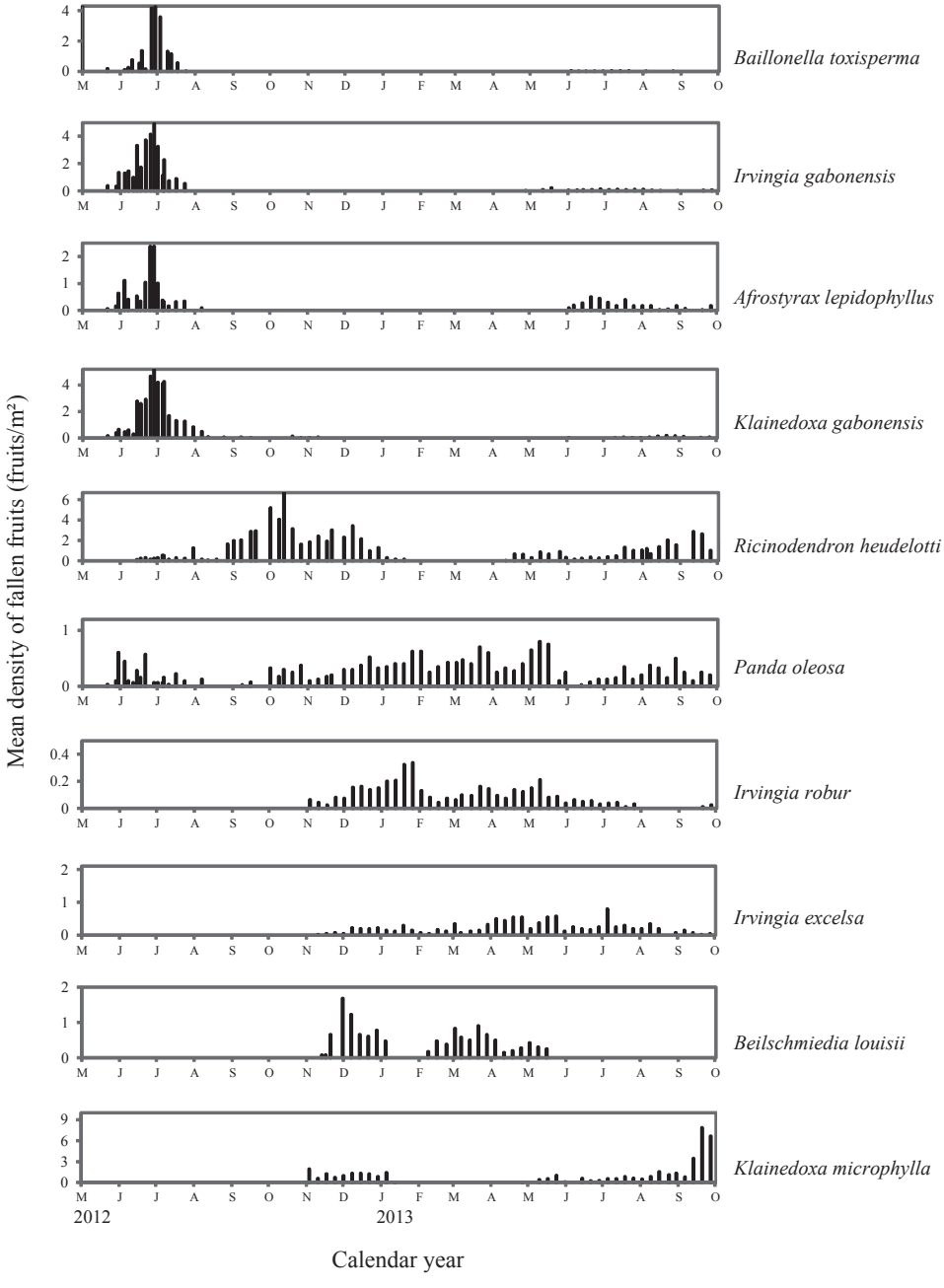


Fig. 8. Fluctuation in the number of ripe fruit droppings from May 2012 to October 2013.

(2) Trading flow between the people and merchants

Both the Baka and the Konabembe frequently sold the forest products and agricultural products. The primary sales partners were the merchants inhabiting the village. The secondary partners were the merchants from the cities outside the forest. There were 13 such merchants from the cities during a survey period from 30 August, 2012 to 10 June, 2013, whilst the number of their visits totaled 162; the number of merchants and the name of the cities in which they were based were one from Douala, one from Yaounde, eight from Yokadouma and three from Nigeria. The merchants sold the products they purchased from the villagers in urban areas by themselves, and also often sold the same items to other merchants from the cities. There were also a few cases where the villagers trade the products without involvement of the merchants. The Konabembe gathered the forest products not only by themselves, but also often by asking the Baka in order to obtain more products. The Baka hardly decline such requests, and they received money, used clothing, food and alcoholic drinks after or before handing the forest products to the Konabembe.

(3) Sold products

The survey recorded a total of 42 different products sold by the people to the merchants, consisting of agricultural crops, tree crops, wild animals and plants during the above-mentioned period (1,169 days). The number of sales cases was 3,057 in total, of which 359 cases (11.7%) were made by 14 Baka and 345 Konabembe coming from other villages. The total sales prices amounted to 28,602,175 FCFA, of which 2,505,950 FCFA (8.8%) were made by other villagers (Table 9).

NTFPs accounted 70% of the total number of sales cases, and 20% of the total sales prices. The results by ethnic group show a significant difference; the Baka sold almost only NTFPs (99% of the total sales cases and prices by the Baka), whilst the Konabembe sold both NTFPs (58% of the total sales cases and 16% of the total sales prices by the Konabembe) and agricultural crops. As for the cacao beans, which marked the highest proportion (78%) of the entire total sales prices, total number of sales cases for the Konabembe was 77 times more than that for the Baka, whilst the sales prices was 197 times more than the Baka. Thus, NTFPs contribute more significantly to the household economy of the Baka.

Among the NTFPs, the wild fruit was highest in terms of variety (13 species), and 90% of the total sales prices were consisted of three species, namely *Irvingia gabonensis* (39.2%), *Ricinodendron heudelotti* (24.9%) and *Aframomum* spp. (26.5%). A certain number of the fruits of *I. gabonensis*, *Baillonella toxisperma* and *Afrostyrax lepidophyllus* collected in 2012 had already been sold before the beginning of the survey on 30 August in 2012. When this is taken into account, the proportion that these species contributed will significantly increase.

As for the fruit and nuclei of *R. heudelotti*, which are used as condiment, both the number of sales cases and the sales prices were markedly higher in the Baka. The Baka collected the fruits and nuclei which had dropped on the ground in the forest and cultivated plots, and sold them to merchants. However, both the number of sales cases and the sales prices of the kernels were significantly higher in Konabembe. Gathering the fruit of *R. heudelotti* is easy, but it requires a great

Table 9. Sales (FCFA) of forest products from the villagers to the merchants (30 August, 2012–10 June, 2013)

Category	Name	Total sales[1]	Sale from the villagers to merchants within Gribe village				Sale from the villagers in Gribe village to merchants from cities			
			Baka		Konabembe		Baka		Konabembe	
			No. sales cases	Sale Price	No. sales cases	Sale Price	No. sales cases	Sale Price	No. sales cases	Sale Price
Crop	*Cucumis* sp. (Seed)	39,000			2	39,000				
	Red pepper (fresh)	5,400			10	3,400				
	Red pepper (dry)	300							2	28,000
	Plantain	2,000			1	2,000				
Tree crop	Cacao bean	22,359,850	9	106,300	696	20,977,950				
	Avocado	4,975			13	4,625				
Wild fruit	*Diospyros* spp.	28,500			2	28,500				
	Ricinodendron heudelotti (fruit)	52,500	132	50,400	2	1,100				
	R. heudelotti (nucleus)	27,700	50	25,700						
	R. heudelotti (kernel)	1,333,300	4	10,500	228	965,300				
	Afrostyrax lepidophyllus	106,600	1	600	4	8,500			1	97,500
	Cola spp.	17,000			5	5,000			3	12,000
	Baillonella toxisperma (seed)	1,000	1	1,000						
	B. toxisperma (oil)	3,000			1	3,000				
	Pentaclethra macrophylla	103,600	8	4,700	43	47,900			10	38,000
	Beilschmiedia louisii	22,500	10	3,900	22	16,100				
	Monodora myristica	400	1	400						
	Irvingia gabonensis	2,220,750	34	185,700	51	491,600	2	5,200	74	1,346,250
	Piper guineense (dried)	33,050	18	16,150	20	10,900				
	P. guineense (fresh)	12,000	6	2,000						
	Scorodophleus zenkeri	219,150	24	66,400	31	94,750			2	12,000
	Aframomum spp. (fresh)	1,436,400	444	419,700	458	526,000	1	1,500	8	52,900
	Aframomum spp. (short)	2,000								
	Aframomum spp. (long)	14,500	1	2,000	2	9,500				
	Aframomum spp. (dry)	47,000			3	8,000				
	Tetrapleura tetraptera	700							1	700
Wild leaf	*Gnetum africana*	41,700	135	37,900	6	1,900				
Mushroom	Mushroom (specie unknown)	237,100	6	2,600	28	32,500			5	128,000
Palm	*Raphia monbuttrorum* (stem)	2,600			2	2,600				
	R. monbuttorum (leaf)	5,400			3	5,400				
Livestock	Chicken	58,500			22	50,500				
Bushmeat	Pangolin	46,500	6	6,000					12	40,500
	Pangolin (Scaled skin)	14,500	8	14,500						
	Wild hog	3,500	2	3,500						
	Duiker (*Cephalophus* sp.1)	13,400	2	3,900	5	9,500				
	Duiker (*Cephalophus* sp.2)	2,000			1	2,000				
	Duiker (*Cephalophus* sp.3)	7,800	2	7,800						
	Porcupine	3,000			2	3,000				
	Turtle (*Kinxys* sp.)	4,500	1	1,500	1	1,500				
	Smoked animal	1,500			2	1,500				
Fish	Smoked fish	65,500			6	7,000				
	Fresh fish	1,500								
Total		28,602,175	905	973,150	1,672	23,360,525	3	6,700	118	1,755,850

[1]: There were cases where the villagers from surrounding villages sold the product to the merchants staying in Gribe. The total sale price includes the sales from other villages (2,505,950 FCFA).

amount of effort to remove the kernels from the fruit's nucleus. Therefore, the unit price of the kernel is far more expensive than the fruits or nuclei. Consequently, 11.2 times of difference in the total sale prices was found between the two groups; 86,600 FCFA for the Baka and 966,400 FCFA for the Konabembe.

As for *I. gabonensis*, there was no major difference in the number of sales cases between the two groups (Baka's sales by 1.5 times more than that of Konabembe), but the Konabembe sales amount was by 2.6 times more than the Baka (Table 9). This can be attributed to two reasons; the first reason may relate to the difference in the timing of sales. The unit price of the product started from 500 FCFA/kg in early July, 2012, followed by 1,500 FCFA/kg in late August, and reached over 2,500 FCFA/kg in October in the same year. However, there was no significant difference in the periods of the sales between the two groups (Fig. 9 (a)).

The other reason is the difference in the amount per transaction between two groups. The mean, minimum, maximum amount (kg) in one sale, and the total amount for all trade was respectively 4.9 ± 4.1 (SD), 1.6, 19.2 and 166.4 for the Baka, whilst it was 7.9 ± 7.4, 1.6, 32.0 and 379.2 for the Konabembe. The Baka sold only a small amount and kept most of the remaining for their own consumption. The unit price went down when the amount sold per sale was small even in the same season; the mean unit price was 1,061 FCFA/kg for the Baka, whilst it was 1,264 FCFA/kg for the Konabembe (Fig. 9 (b)). The number of transactions with merchants from the cities was much higher among the Konabembe compared with that of the Baka. As the merchants from the cities want to purchase a large amount at one transaction, the Baka hardly afford an opportunity to trade with the merchants, because they usually possess only a small amount for sale. Consequently, a large gap occurred in the sales amounts between the two groups.

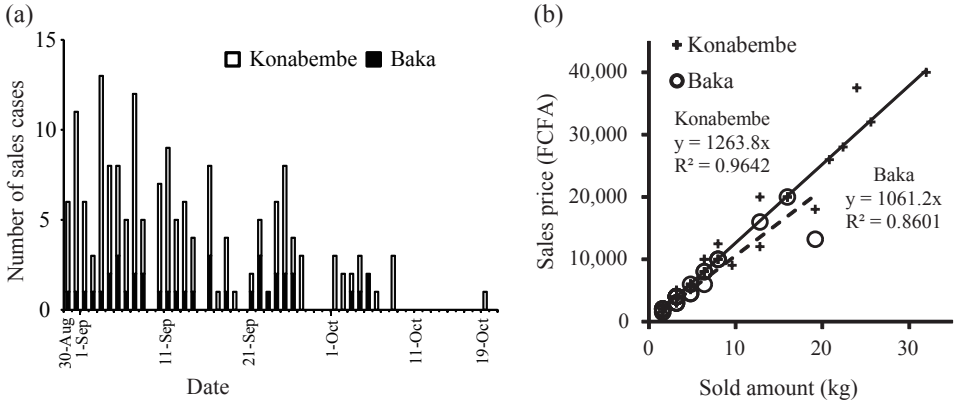


Fig. 9. Difference in the number of sales cases (a), and relationship between sales amount and prices (b) of kernels of *Irvingia gabonensis*.

DISCUSSION

I. Impact of Shifting Cultivation on the Forest

The study examined firstly land use pattern, distribution range of cleared plots as well as scale of land clearance in shifting cultivation among the Baka and the Konabembe to discuss impact of their agriculture on the forest. The both groups have been cleared their plots every year to successively harvest various crops. However, the size of the clearings were small; e.g., 0.12 ± 0.16 ha/plot on the average for the Baka and 0.24 ± 0.25 ha/plot for the Konabembe in 2012/2013, and the time length of the cultivation with planting, sowing and weeding was only 2 years. Most plots enter into a long fallow stage after two-year cultivation, whilst a few plots turn into cacao fields (Fig. 4). Similar pattern and clearing scale are reported from other area of southeastern Cameroon (Oishi, 2012; Shikata, 2007).

There was no major change in the number of cleared plots per year over the period from late 1990s to 2013, whereas a temporal increase was found in it around 2000 in association with a raised price of cacao economy. Similarly, no major change was found in the spatial range of the plots distribution across whole area of the village. This is due to following two reasons: (1) the people often clear the land near from their settlements, within 3 km in most cases, and (2) the people tend to clear secondary forests inherited from their ancestors (90% of all plots recorded). Thus, the people rarely select "primary" or mature forest as place to clear (2% of total plots recorded), though they view the "primary" forest as a good place for crops due to higher soil fertility. Consequently, the "primary" forest remains in the remote areas of the settlements. Kimura (1998) reports similar situation from his study in Yalisanga village in Democratic Republic of the Congo, and points out that the secondary forest is easier to clear than the "primary" forest in terms of labor input.

Total area of the active plots accounts for only 1.3% (46.9 ha/year × 2 years) to the whole area of the Agroforest Zone (7,144.5 ha). A simple arithmetic suggests that it will be another 150 years before a cultivated plot once cleared will be re-cleared again. This period would allow sufficiently recovering the soil fertility together with the forest regain which is indispensable for the shifting cultivation with no chemical fertilizer. Indeed, as the fallow period was about 30 years at least, the zone contains five-folds of redundancy (150 years ÷ 30 years), if the people can use all part of the zone.

The people leave various trees uncut when they clear the forest. In the case of 2012/2013, a total of 3,142 trees (DBH ≥ 10 cm) representing 240 species remained on the cleared land (46.9 ha in total) with a density of 66.4 stems/ha. Tajeukem et al. (2014, this issue) recorded density of 400–500 stems/ha (DBH ≥ 10 cm) for the forest outside the Agroforest Zone (cf. T5 to T16 in Fig. 2, Tajeukem et al., 2014). The difference between the two densities suggests that land-clearing by the people removes approximately 80% of the tree individuals. Yet, according to Carrière et al. (2002), remnant trees on the cultivated plots contribute to rapid reconstitution of forest and enhance diversity of both plants

and animals in regenerating forest. In fact, tree diversity in Agroforest Zone is even higher than that of non-Agroforest Zone (Tajeukem et al., 2014, this issue).

Thus, despite the long fallow periods required for shifting cultivation, it is thought to have little serious impact on the level of chipping away of large sections of the forest, due to their inheritance system, the small scale of land clearance and remnant trees. Rather, the shifting cultivation contributes to generate diverse forest stands with rich species compositions and multi-layered structure, as far as the long fallow period is maintained. The patches of secondary forest in different recovery stages are distributed mosaic-like in the zone, in which a diversity of NTFPs can be found.

II. Importance of NTFPs to the Livelihood of the Baka

Secondly, this study examined how NTFPs contribute to the people's livelihood from the case of a household (A4) of the Baka. A series of 63 times (days) survey conducted in major rainy season in 2012, recorded a total of 91 different agricultural, timber and non-timber forest products collected by the members of the household. Those products were collected in the cultivated plots, fallow and "primary" or mature forest, and brought to the settlement to be used as food both for staple and side dishes, medicinal plants as well as materials for tools and house building.

As for the staple or starchy food, domesticated crops such as plantain and cassava occupied 92% of the total weight of starch food (148.3 kg), whilst NTFPs (wild yam and wild fruits) only 4.3%. Such a high dependency on the crops for staple food among the Baka have been reported by previous studies in other areas in southeastern Cameroon (Kitanishi, 2003; Yasuoka, 2011; Hattori, 2012; Oishi, 2012). As Hattori (2012) pointed out, the sedentarization led to changes in the subsistence activities of the Baka, which has influenced on their diet.

However, way of involvement with the crops appears to be different from village to village. According to Hattori (2012), the Baka living in Malea Ancien (40 km to southwest of Gribe), procures most of starchy crops by exchanging their labor with agriculturalists (Konabembe). In contrast, the Baka of Zoulabot Ancien (50 km to southwest of Gribe) obtain most of their crops by cultivation by themselves (Yasuoka, 2011); this is because there is a few agriculturalists in the village. Unlike these areas, the Baka of Gribe procures most of their starch crops by their own cultivation despite many Konabembe are nearby them. Indeed, as the previous studies pointed out, the Baka of Gribe also exchange their labor with the Konabembe for staple food, but the amount obtained from them is relatively small (19% of the total weight of starch crops). Fig. 7 displays this situation well; the Baka visit at high frequency their cultivated plots as well as fallow and forest expanding around the plots to procure both the crops and NTFPs.

Beside the crops, wild yam was collected as staple food. According to Hattori (2012), wild yam, one of the most favorite food for the Baka, may continue to be a staple food, as it grows in colonies and is easily harvest in bulk. This is applicable for the Baka of Gribe, as they collected at a relatively high frequency despite the collected amount is small.

As for the side dishes, high proportions were recorded for NTFPs of vegetable, oily condiment, mushroom, bushmeat and fish. The spatial range of the collection was limited in and around their cultivated plots in most cases, yet those areas consist of different types of forest patches. Among the collected NTFPs, mushrooms and wild fruit were diverse and it is probably based on the diversity of the forest types which has been positively affected by people's practices of shifting cultivation. Such interrelationships between the people and forest should be taken into consideration in seeking a way for forest conservation, though human livelihood activities have often been considered as negative to the forest environment by ecologists and conservationists.

Much smaller proportion of bushmeat is noteworthy in the side dishes both in terms of amount and frequency; as small as 0.5% (0.01 kg/day/household). Moreover, the captured species were limited to following three; small rodent, duikers (probably blue duiker) and small bird. According to (Hattori, 2012), the Baka of Malea Ancien hunted over wide range of the forest beyond the Agroforest Zone, then percentage of the bushmeat to the total weight of the side dishes reached to 83% and the consumed amount was approximately 1.0 kg/day/two persons. The major species captured were peter's duiker (52% to the total weight), bay duiker (9%) and red river hog (10%).

Bobo et al. (2014, this issue), who studied animal distribution and abundance in a wide range including Gribe, recorded only blue duikers and medium-sized monkeys with a low abundance in the major area of the Baka's livelihood activities in Gribe (Fig. 7). This suggests a significant low level of bushmeat availability in this area. The future tasks are to detail the bushmeat availability of the Agroforestry Zone as well as hunting activities by the Baka outside the zone.

III. Fluctuation in Fruit Production and Livelihood

The results of the survey on phenology of the wild fruits and their production in 2012 and 2013 showed an extreme difference between the 2 years. The fruit dropping periods for four species, namely *Irvingia gabonensis* and *Baillonella toxisperma*, which were used as subsistence food and as a source of cash income by both the Baka and the Konabembe, and *Afrostyrax lepidophyllus* and *Ricinodendron heudelotti*, which were used as a subsistence and cash crop by the Konabembe, began in early June in 2012, whilst they were after the beginning of July in 2013. In addition, the production was so small, almost nothing compared with that in 2012. It is clear that there is a significant annual fluctuation in both the fruit-dropping period and in the fruit production.

How, then, does this fluctuation influence the livelihood of the villagers? I attempted to examine this from three viewpoints, namely the Baka's livelihood, the fruit sales of the Konabembe and the social relationship between the Baka and Konabembe. During the survey on the Baka's livelihood, they were not consuming the above-mentioned fruits at high frequencies. The amount of fruits sold to merchants was also significantly low, compared with the Konabembe. This is because the Baka had stayed at forest camps to collect fruit of *I. gabonensis* before the survey started, almost all the collected fruit had been exchanged with

the Konabembe for crops, alcoholic drinks, used clothes, and so on. Whilst the fruit of *I. gabonensis* can be dried and stored for long periods of time, they are not eaten in large quantities on one occasion. Presumably, the Baka prioritized enriching their life in the forest camp rather than stockpiling the fruit for their future needs, thus exchanging them for items brought in by the Konabembe. However, apart from *I. gabonensis*, the Baka also enjoy the fruits of *I. robur*, *I. excelsa* and *Panda oleosa*, which the Konabembe consume rarely. The survey clearly showed that these fruits were abundant in 2013. It can be said that the Baka may collect other species of fruits, which could be their side dishes when the above-mentioned four species bear little fruit.

The fruits of the above-mentioned four species proved to be a highly lucrative source of income for the Konabembe in 2012. The majority of the fruits of the four species collected had been sold in June, July, and August when the survey was launched on the fruit sales. Seen in this light, the forests in the surveyed area have significantly high economic value. However, this changed completely in 2013, with almost no cash earnings from selling wild fruits. Faced with these circumstances, the Konabembe would have had to choose from one of the following three options: (1) invest more labor in crops and cacao cultivation, (2) invest more labor in hunting and selling bushmeat, and (3) collect *I. gabonensis* and other fruits in other areas where they are available. However, each option came with its own risks. With (1), low yield harvest and the volatile price of cacao (Shikata, 2013), with (2), being arrested by the forest authority (Hattori, 2012) and with (3), conflict with other villagers over the resources; in fact this was attempted by some Konabembe with assistances of the Bake men in 2013, and some of them were ousted by the local residents (Hirai, unpublished data). Future research will investigate whether there exists an agreement between villages over collecting each other's resources, and whether this means that inter-village conflict could be avoided. The Konabembe place a greater value on wild fruits as a source of income, eating only a few species of fruit by themselves. To this extent, it can be said that they are vulnerable to annual fluctuation in fruit production.

It must also be noted that the fluctuation may have an effect on the social relationship between the Baka and the Konabembe. Many Konabembe profited considerably from the sales of wild fruits in 2012. They may have then used the income as seed money to employ the Baka more frequently for their agriculture. Both parties had different relationships to the market with respect to wild fruit. It is though, in years with abundant wild fruit such as 2012, this would lead to a greater economic gap between the Baka and the Konabembe, as well as to the further entrenchment of their unequal employer-employee relationship. However, in years with a low yield, the Konabembe become economically unstable, which may be connected to the easing of the employer-employee relationship between the Baka and the Konabembe.

CONCLUSION

Shifting cultivation has been considered as a major cause of forest degradation. This study suggests, however, a possibility of successful forest recover from the cultivated land, which is due to small scale of land clearance, long fallow period, remnant trees contributing to a rapid reconstitution of the plant diversity, as well as the land inheritance system which facilitates the reuse of secondary forests of abandoned old plots. Through such a land use system, patches of secondary forest stands in different recovery stages are generated and distributed mosaic-like in the Agroforest Zone. Consequently, both the starchy crops and some of the important plant NTFPs are made available, or even enriched, whereas, a low availability was recorded for wild animals. The future tasks are to collect sufficient data for supporting these points, to make a comparison with the case of the forests without human intervention, to examine the abundance of the wildlife in the Agroforest Zone as well as hunting activities by the Baka outside the zone. To facilitate a co-existing relationship between the people's activities and forest in the Agroforest Zone or Non-permanent Forest Domain will become a more important issue, as spatial range of resource collection by the people are likely to be limited by the Cameroon government.

This study revealed that the forest of Gribe has significant economic potentials, as it contains wild fruit trees with high market values. In order to improve people's household economy, previous studies encourage the commercialization of such wild fruits (e.g., Leakey & Simons, 1998), and recommend tree domestication or plantation (e.g., Atangana et al., 2001; Fongnzossie Fedoung, 2014, this issue). However, as this study illustrated, there is an extreme fluctuation in fruit production, which indicates difficulty in stable procurements of the fruits. Even if it is stabilized by domestication techniques, fruit sales would lead to a greater economic gap between the Baka and the Konabembe, as well as to the further entrenchment of their unequal employer-employee relationship, as both parties have different relationships to the market with respect to wild fruit.

The search for the integration of forest conservation with the people's interest has been thought to be an attempt at finding out a point of compromise in the complex web of interactions between the forest and people. It is difficult, however, to identify such a point, and to control the local society in that direction with external forces. It is more important to observe carefully the ecological situation of the forest and its NTFPs, uses of NTFPs by the people, and social relationship among different groups of people. We have to understand the availability of NTFPs and their changes, and appreciate the potentials of people's knowledge of the forest, and people's capacity for managing the NTFPs.

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