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CHANGE IN LAND USE AMONG THE BONGANDO IN THE DEMOCRATIC REPUBLIC OF THE CONGO

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ABSTRACT The change in land use of the Bongando people in the tropical rainforests of the Democratic Republic of the Congo was studied. This research used several datasets on land use from the 1960s to the present. Most of them are based on the long-term fixed point research in the Wamba region, where primatological and anthropological research has been conducted by a Japanese team. The patterns of change in land use across the years show that crop fields and secondary forest areas have been gradually expanding at a moderate pace. The Bongando people circulate crop fields mostly in secondary forest areas. In this sense, they render a minimum burden for the forest environment. Meanwhile, they frequently enter forest areas to stay in hunting/fishing camps. Such stays form a considerable portion of their subsistence. For nature conservation and development programs, this type of data-based information on local people's land use is indispensable.

Key Words: Land use; Tropical rainforest; Bongando; Democratic Republic of the Congo; Subsistence activities.

INTRODUCTION

This study describes the change in land use among the Bongando people, who are Bantu slash-and-burn farmers living in the central part of the Democratic Republic of the Congo (DRC).

The local people's utilization of the tropical rainforest is one of the most critical issues in the global environmental problem. Since the 1950s, experts have warned of the destruction of forests by shifting cultivation (FAO, 1957). The density of forest animals is decreasing due to the hunting activities of local people, and thus the "empty forest" scenario (Redford, 1992) has become a reality. Meanwhile, the local people's traditional lifestyle and value system will be destroyed if strict conservation policies are executed without consideration. At any rate, changes in land use should be evaluated through a concrete field survey.

The human impact on tropical forests in Africa has been studied mainly through the use of remote sensing data (e.g., Nackoney & Williams, 2012; 2013; Hickey et al., 2013). Prior studies have articulated the overall inclination toward deforestation. However, the actual practices of local people related to subsistence activities are

not fully explained. For example, people in tropical forests usually set snares in the forest and frequently visit small camps settled in forests for hunting or fishing. Remote sensing techniques cannot detect such activities hidden in the forest. Their results have affected the zoning plan around nature reserves. Thus, to improve accuracy, field surveys using GPS, especially participatory mapping, have been adopted (Lewis, 2012).

This study, therefore, presents microscopic data on changes in land use. This work is a long-term, fixed point observation type of investigation centered at the Wamba region in DRC. In conjunction with the Bonobo research by Japanese primatologists, the group of authors responsible for this study has been conducting research in this area from the 1980s. No similar long-standing research has been conducted. This paper presents the summary of the results of these studies, focusing on changes in land use.

RESEARCH AREA, PEOPLE, AND METHODS

Research Area

The study was conducted in the habitation area of the Bongando people in eastern part of Equateur Province, DRC (Fig. 1). The study area is remote from the economic and political center. The nearest large port Befoli, facing Malinga River, is 100 km away by road from the villages covered by the research. The area is also 100 km away from the nearest small airstrip in Djolu, where only small aircraft can land. The airport for regular flights is located 400 km away in Boende.

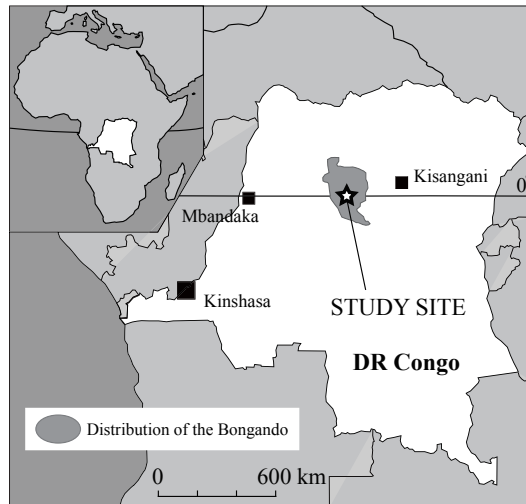


Fig. 1. Habitation area of the Bongando.

The Bongando land is composed of a low flat plain 300 m to 400 m above sea level. The daily maximum and minimum temperatures are about 30°C and 20°C, respectively, throughout the year. The annual rainfall is about 2000 mm. The major and minor rainy seasons occur from September to mid-December and from April to June, respectively (Vuanza & Crabbe, 1975).

The vegetation of the study area has been documented by Kano & Mulavwa (1984) (Fig. 2). The forest is roughly classified into dry primary forest, swampy primary forest, and secondary forest. In the dry primary forest, the canopy is usually closed with emergent trees reaching 50 m in height. Undergrowth is sparse. The forest is home to a diversity of species, most belonging to the family Caesalpiniaceae. The swampy primary forest near the river also has a variety of species, but the species composition differs from that of the dry primary forest. Tree height is lower than that in the dry primary forest (less than 30 m) owing to the swampy ground. This area is flooded when the level of the river rises; hence, fields are not cleared in this area. The secondary forest is classified into three categories by successional stage: (1) secondary scrub, predominantly *Aframomum* spp.; (2) young secondary forest, predominantly *Musanga smithii*, *Albizia gum-mifera*, *Croton haumanianus*, and *Macaranga* spp.; and (3) aged secondary forest, predominantly of the Marantaceae family, such as *Sarcophrynium macrostachyum* and *Haumania liebrechtsiana* (Kano & Mulavwa, 1984).

The Bongando People

The Bongando are a Bantu ethnic group that belongs to the Mongo cluster (Murdock, 1959; Hulstaert, 1961; 1972). They usually speak Longondo (the Bongando mother tongue), whereas Lingala, a lingua franca spoken around northwestern DRC, is used in communications with outsiders. The population is estimated to be around 450,000 to 500,000 residents (Kimura, 1992). They live dispersed in an area of about 48,200 km².⁽¹⁾ The population density is 9.3–10.4 persons/km².

Data and Methods

History of ecological anthropological study in the Wamba region

Since 1973, a Japanese team has been conducting research on the bonobo (*Pan paniscus*) in the village of Wamba (Kano, 1992). Following the primatological studies, ecological anthropology research started to shed light on the subsistence of the Bongando people (Takeda, 1990; 1996; Sato, 1983; 1984; Kimura, 1992). Kimura, the first author of this work, began his anthropological study in 1986. The second author Lingomo, who was born in the village of Iyondje, adjacent to Wamba, and is a native Bongando, has been working with the first author, Kimura (Lingomo & Kimura, 2009).

In 1990, the Luo Scientific Reserve was established for the conservation of bonobos. However, amid the subsequent political disorder of former Zaïre from 1991 and the Congo war from 1997, primatological/anthropological research and conservation activities had been discontinued until the mid-2000s (Furuichi &

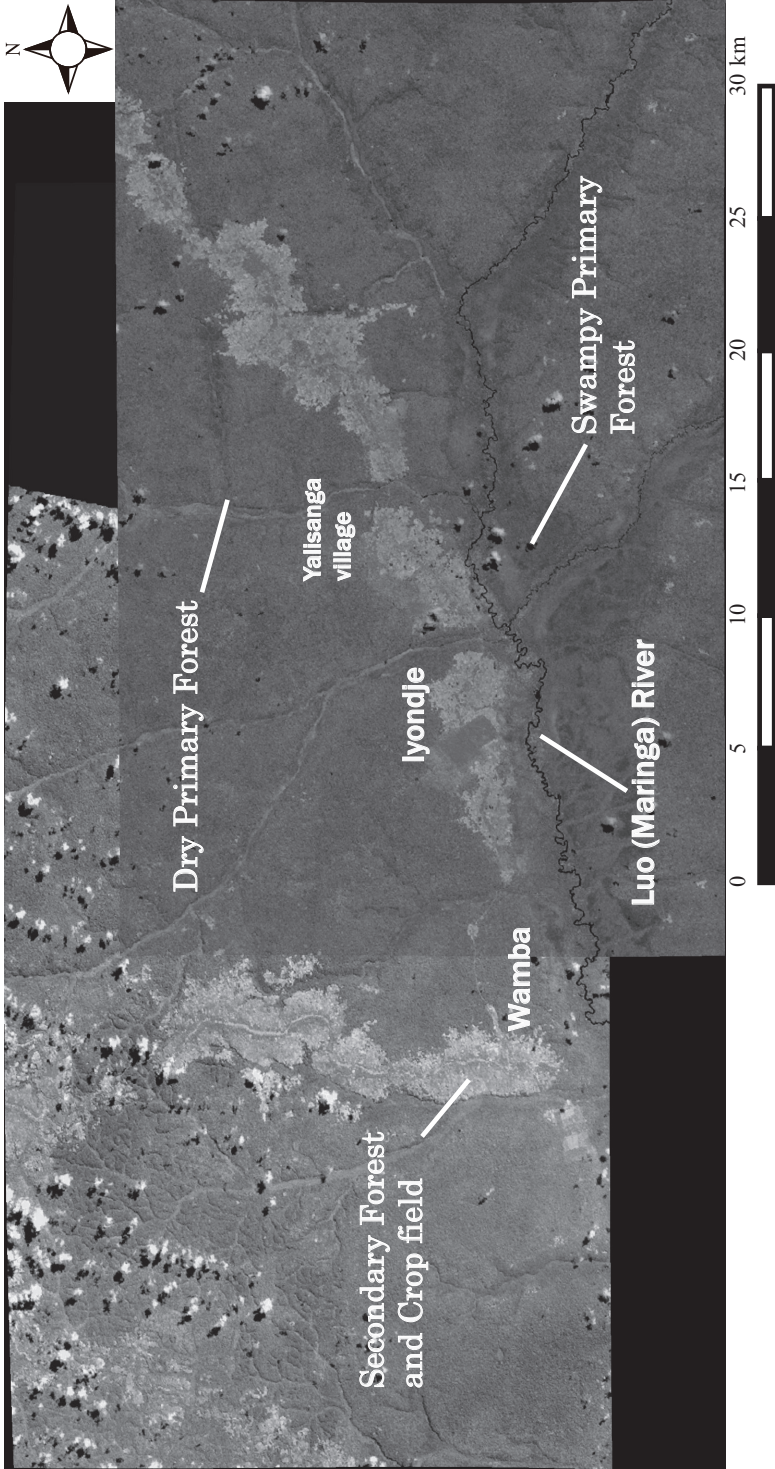


Fig. 2. Landsat scene of the study area.

Mwanza, 2003; Tashiro et al., 2007). In 1993, Lingomo established the NGO Forêt des Bonobos in Iyondje, which promotes nature conservation activities. For this work, he contributed the description of subsistence activities of the Bongando people.

After the termination of the war, Kimura resumed his anthropological research, in collaboration with Lingomo. In the 2010s, new Japanese researchers, including Masuda (the third author) and Yamaguchi (the last author, contributing his work to this volume, 2015) entered the Wamba region to promote new research. Masuda conducted participant observation of the fishing activities, whereas Yamaguchi measured fields and the position of snares.

Data and method

A number of datasets are used in this work.

- Aerial photos around the Wamba area, taken from 1959 to 1960 (Fig. 3). They were taken by the Belgian colonial government, and preserved in the Royal Museum for Central Africa in Tervuren, Belgium.
- Satellite image data of Landsat TM⁽²⁾ taken in 1986 and 2000 (Fig. 2), and Quickbird image taken in 2007.
- Land use map of Yalisanga village in 1988. From August to September 1988, Kimura conducted pace measuring of Yalisanga village in Iyondje, where he stayed. Paths and crop fields around Yalisanga were measured. The data obtained, including “number of steps” and “direction of walking,” were analyzed with a portable computer charged with a solar battery (Kimura, 1998).
- GPS field data of Yalisanga village, taken by Kimura and Yamaguchi in 2007 and 2013–2014.

For the GIS analysis, the free software QGIS 2.8.1, Kashmir 3D 8.9.7, Mapsource 6.16.2, and ERDAS Viewfinder 2.1 were used.

RESULTS

Subsistence Activities and its Historical Change

The Bongando are basically cassava farmers. However, hunting, fishing, and gathering also comprise the main subsistence activities of the Bongando. They are best described as “multi- subsistence” people rather than “cultivators.”

Agriculture

The Bongando slash and burn both secondary and primary forests to prepare fields. The most important crop in Bongando agriculture is cassava. Tubers make up the staple of the Bongando diet, and the leaves are also used as a side dish. Other produce includes bananas, yams, maize, rice, and a number of vegetables.

Coffee was a major cash crop for the Bongando up to the 1980s. In those days, coffee was planted in about a quarter of the area of their fields (Kimura, 1998). However, the Congo war in 1990 had a serious impact on the local economy. The trucking, shipping, and air network of the DRC collapsed. In the Wamba

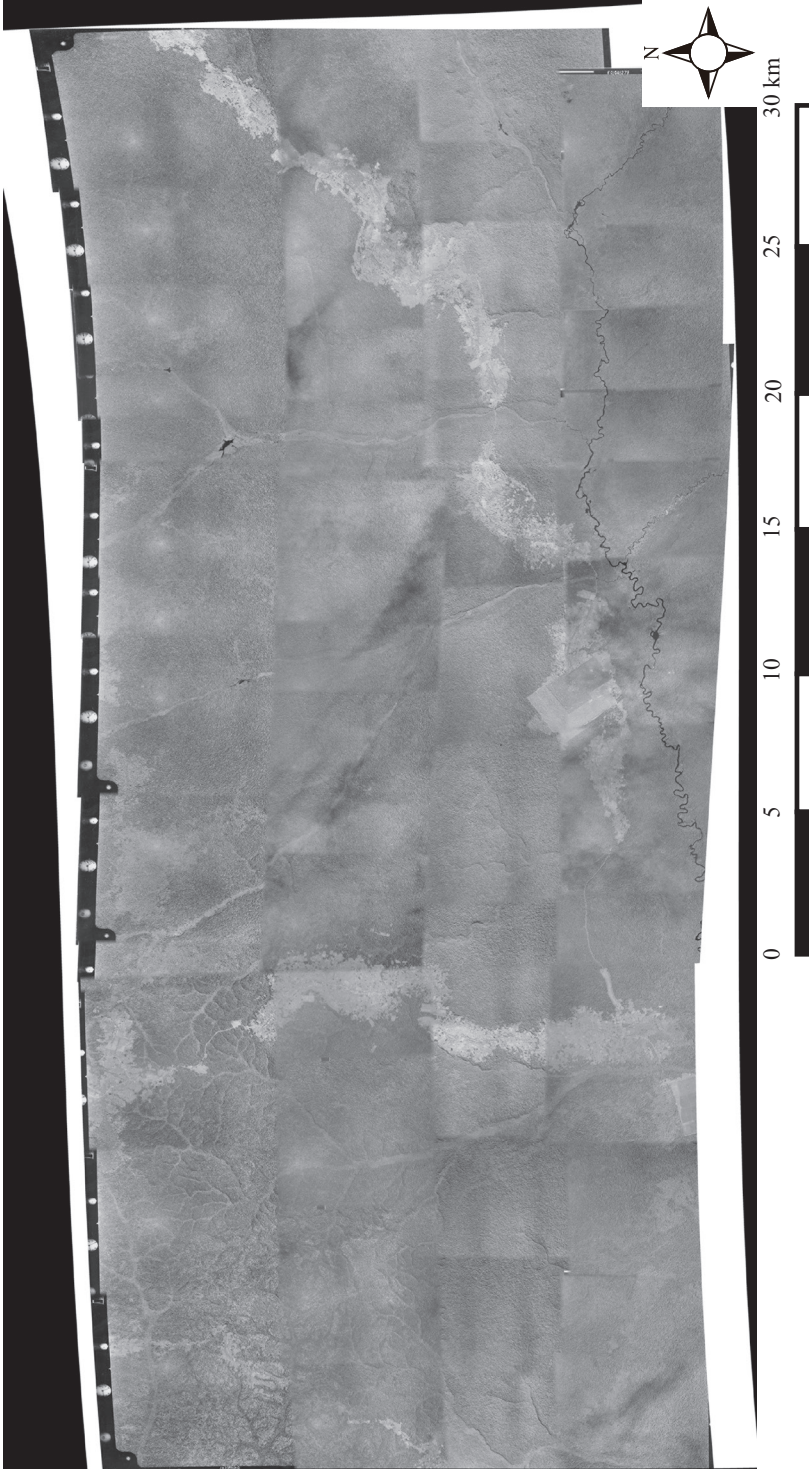


Fig. 3. Composite aerial photo of the study area from shots taken in 1959 and 1960.

area, roads and bridges were left in disrepair. River transportation also stopped, and thus, the ships ceased to come to Befori, the nearby port town facing the Luo (also called Maringa, a tributary of the Congo River). Scheduled air service to Boende (a local city 400 km away from Wamba) also stopped. Given the lack of transportation and the danger from the fighting, Christian missions and plantation companies managed by Europeans or Americans all retreated. As a result, the villagers were left with no means for selling coffee beans, their main cash crop. Subsequently, few coffee fields remain around the village.

In the agricultural activities of the Bongando, field clearing is conducted only by men, mainly in the dry season from January to March. Small shrubs and vines are cut (this work is called *bengi*), and then large trees are felled (*bolemo*) (Fig. 4). After the shrubs and trees are dried, they are burnt. When clearing the field, the Bongando evaluate the forests as follows. The secondary forest is easier to clear than the primary forest, because the trees in the former are small. However, in certain cases, they choose to clear the primary forest because (1) it is believed to be ideal for growing coffee (this information was obtained in the 1980s), and (2) the newly cleared field can be monopolized by the extended family of the man responsible for clearing.

Hunting

According to Takeda (1990), in the 1970s, the Bongando people are at least 37 species of mammals, 10 birds, 29 fish, 12 reptiles, 21 insects, and 22 wild gathered plants. Before the 1990s, collective hunting with nets (*botai*) or with a bow and arrows (*bakimano* or *bakula*) was frequently conducted. However in the 2000s, these hunting techniques were no longer observed after large mammals, such as the bush pig, African buffalo, and elephant, disappeared near the village.

Recently, the Bongando people hunt mainly by setting up traps with nylon



Fig. 4. Field clearing.



Fig. 5. Trapping.

string (*nilo*) and steel wire (*nzeki*) near the village (Fig. 5). Shotgun hunting aiming at large mammals is also conducted in primary forest areas far from the inhabited area.

The high hunting pressure has resulted in the “empty forest” phenomenon around the village. At present, the Bongando people hunt not only for eating. After their coffee production ceased, the selling of bush meat has become the predominant way to earn cash, and large amounts of smoked bush meat have begun to be transported to Kisangani (Takamura, 2015; in this volume). Before the Congo war from 1990’s, they hunted mostly for their own consumption, but their present motivation is cash. (A detailed description of their hunting practices is presented in Appendix)

Fishing

Fishing is mainly done using nylon nets (Fig. 6). Fishhooks or traps are also used by men while women engage in fish bailing (*mpoha nse*). Fish poison is also used. In the rainy season when the river swells, trap fishing is conducted more frequently. Fish bailing, on the other hand, takes place in small streams during the dry season. The catch increases in the rainy season, as fish migrate to inundated riverside forest. Fishing sites can be classified into two types. One is the river or small stream near the village, and the other is fishing camps far from the village.

Kimura et al. (2012) reported that owing to the “empty forest” phenomenon, the Bongando now obtain more protein from fish than from bush meat. Fish catch are not only consumed by the villagers themselves, but are also dried and, formed into packets (*libate*) for sale. (A detailed description of fishing is presented in Appendix)

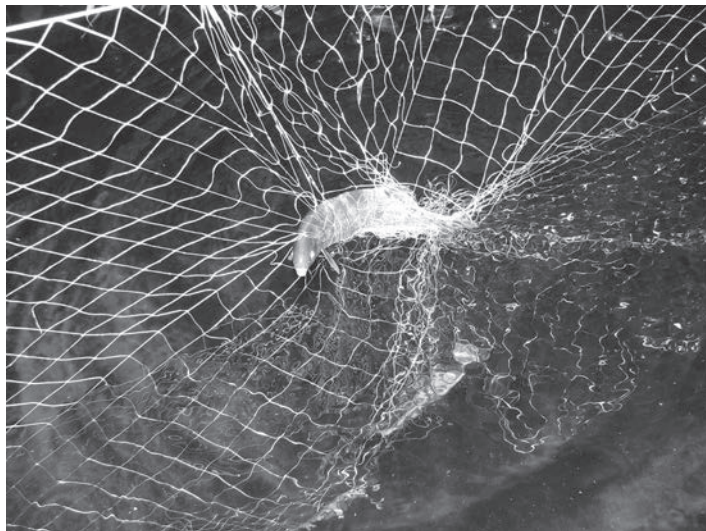


Fig. 6. Net fishing.



Fig. 7 Edible caterpillars.

Gathering

A variety of wild leaves, fruits, nuts, mushrooms, as well as edible caterpillars (Fig. 7), termites, and honey, are also gathered. Caterpillars are frequently found in July–September, and most of them are dried to sell in urban areas. (A detailed description of gathering practices is included in Appendix 3.)

Animal husbandry

The Bongando also keep goats, pigs, chickens, ducks, and pigeons, which are rarely eaten but are exchanged as bridewealth (Kimura, 1992). The 150 residents of the village in the study kept a total of roughly 60 goats, 250 chickens, and 40 ducks. Animal husbandry is not as important as their subsistence activities. Goats are not milked, although the eggs of the chickens and ducks are eaten occasionally. Male goats and pigs are not castrated.

Wage labor and commercial activities

Opportunity for wage labor is rare. There were two coffee plantations in the study area, but both are currently abandoned. Further, no logging company operates in this area.

For buying and selling goods, the villagers have begun to journey to the markets near Kisangani, the third largest city in DRC (Takamura, 2015; in this volume). The direct distance from Wamba to Kisangani is 280 km, but the path is about 400 km, which the Bongando cover on foot or by bicycle. A trip to and from Kisangani takes about a week on foot. They carry dried meats, fish, caterpillars and mushrooms, live chickens, goats and pigs, distilled spirits, cucurbitaceous oily seeds (*nsiyo*), coffee beans, and other produce, and then purchase commodities available in Kisangani.

Change in Land Use

Spatial structure of the resident area

Bongando settlements extend along established roads (Kimura, 1992). Crop fields and secondary forests stretch up to 1 km to 2 km on either side of the village, and a vast primary forest extends behind them. A few people live in the *behetsia* (village in the forest with cassava fields), and temporary hunting/fishing camps in the forest (*nkumbo*) are also established.

According to the Bongando informants, they lived dispersed in the forests before the roads were paved. They shifted village sites every several years. The Bongando began to settle near the road around the 1930s.

Expansion of field and secondary forest area: 1960s to 2000s

Using the aerial photos taken in 1960 (Fig. 3) and Landsat scenes taken in 1986 (Fig. 2) and 2000, this study examined how crop field and secondary forest areas around the village have been expanding. The boundary between the field/secondary forest and primary forest is relatively clear in this area. In the analysis, segmental aerial photos were linked using the software PhotoRecord, and then geometric correlation was given using the Georeferencer function of QGIS. (The Landsat scenes were already correlated.) Next, the boundaries were traced, and the area of the field and secondary forest was determined.

The comparison of these three scenes (Fig. 8) confirms the progress of crop field/secondary forest expansion (Fig. 9). By measuring crop field/secondary forest area in a determined rectangle, we find that these areas have extended 1.44 times by 1986 and 1.66 times by 2000 in width to the 1960s (Fig. 10).



Fig. 8-1. Expansion of secondary forest and field area in 1960.

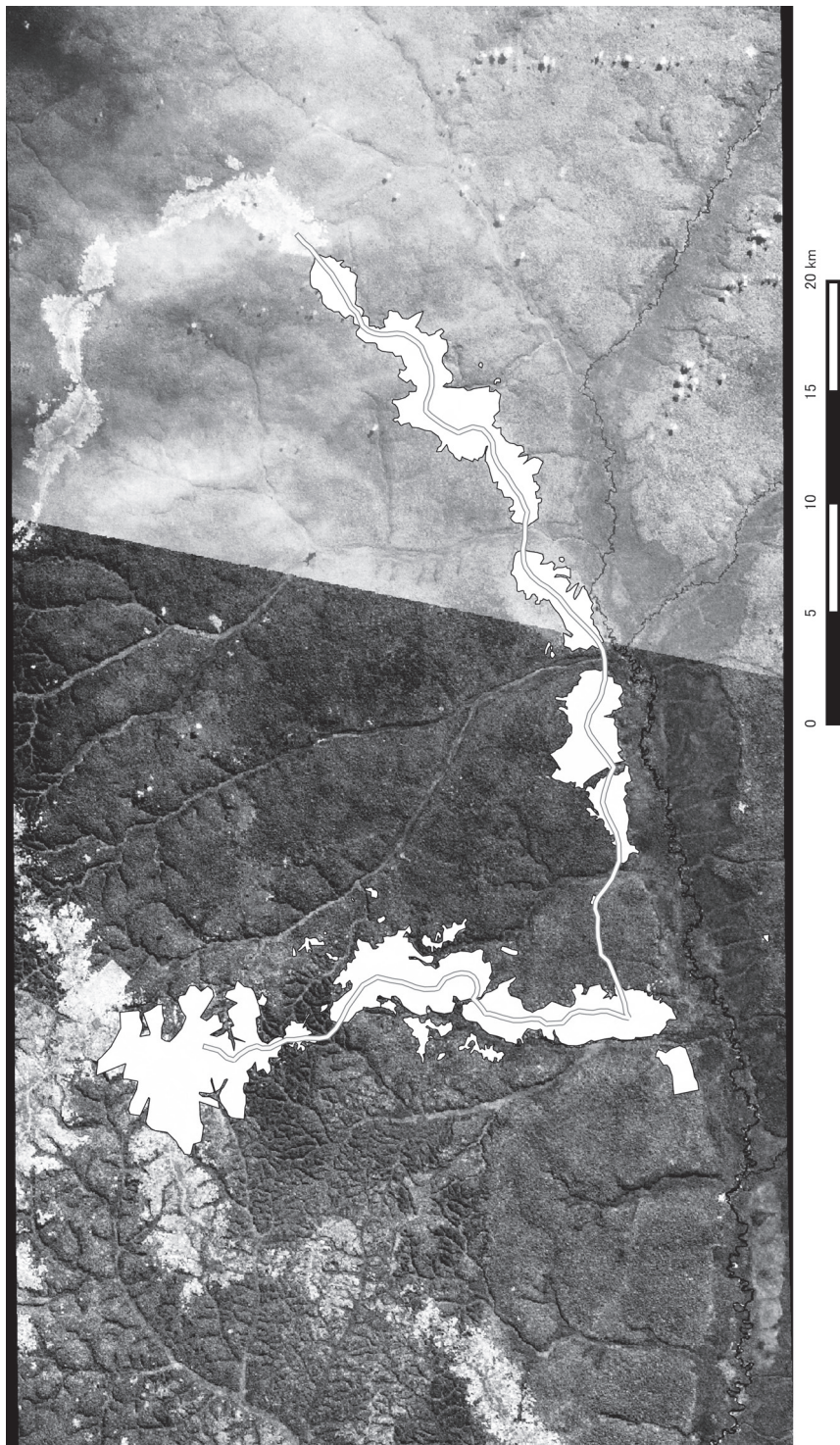


Fig. 8-2. Expansion of secondary forest and field area in 1986.

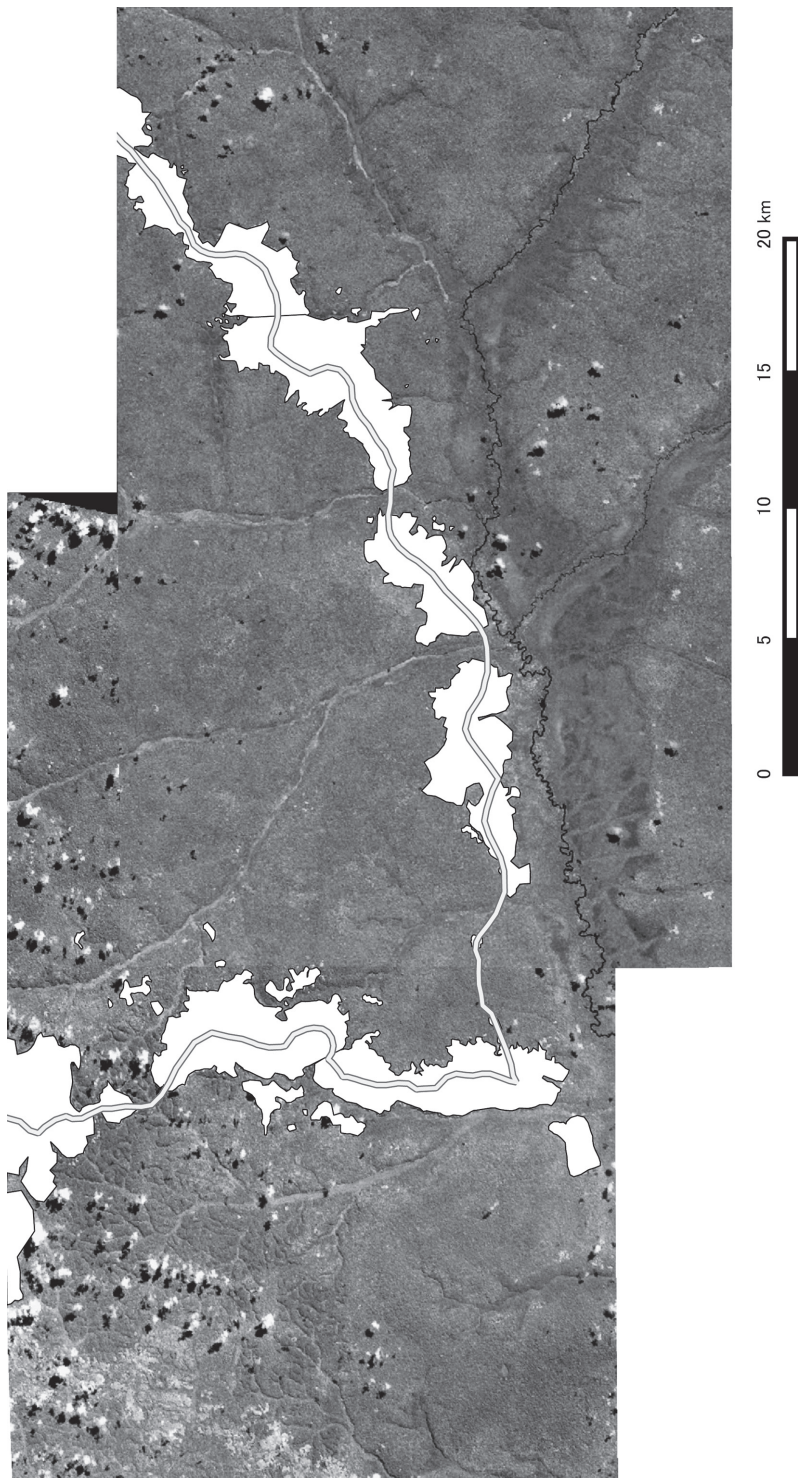


Fig. 8-3. Expansion of secondary forest and field area in 2000.

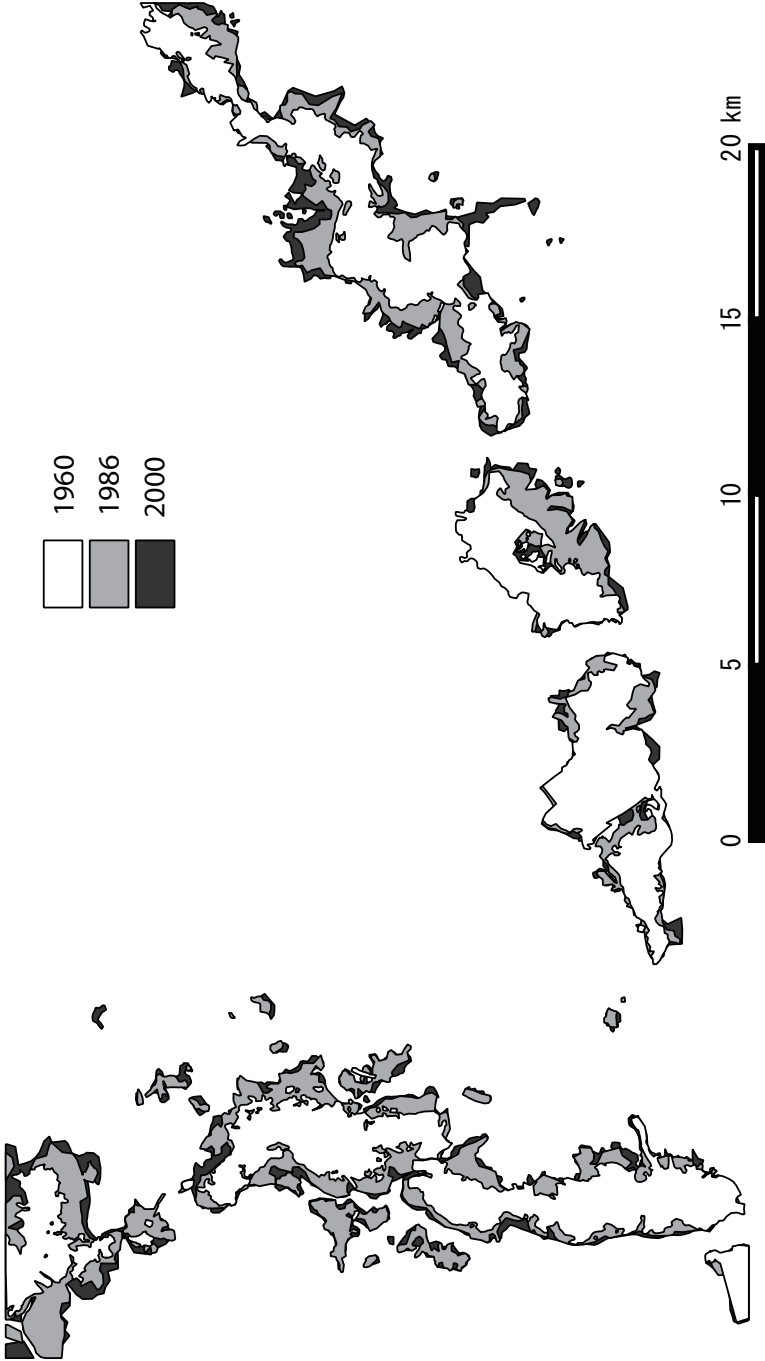


Fig. 9. Comparison of secondary forest and field area of 1960, 1986 and 2000.

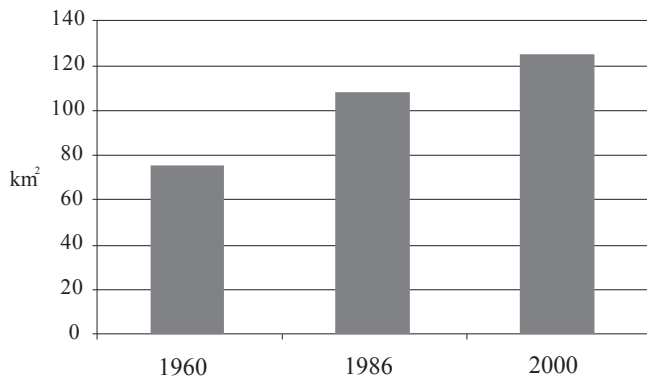


Fig. 10. Increase of secondary forest and field area shown in Fig. 9.

Crop field rotation

In 1988, Kimura conducted pace measuring of the crop fields (Fig. 11) in Yalisanga village (Kimura, 1998). At the time, GPS devices were non-existent. Thus, the measurement took about two months. After the anthropological research in this area resumed in 2005, the researchers began to use GPS for the measurements. A census of the fields of Yalisanga was conducted twice in 2007 and 2013–2014.

Fig. 12 shows the position of crop fields in each year. Three points are evident: (1) the periphery of the secondary forest was expanding gradually but steadily, and (2) the crop fields were rotated in the secondary forest area fairly well, which shows the villagers mostly used the secondary forest for the clearing of new fields. (3) Paths running through the forest has remained the same in the past 25 years, which implies that the villagers have used the areas near the village in the same manner.



Fig. 11. View of crop field from the aircraft.

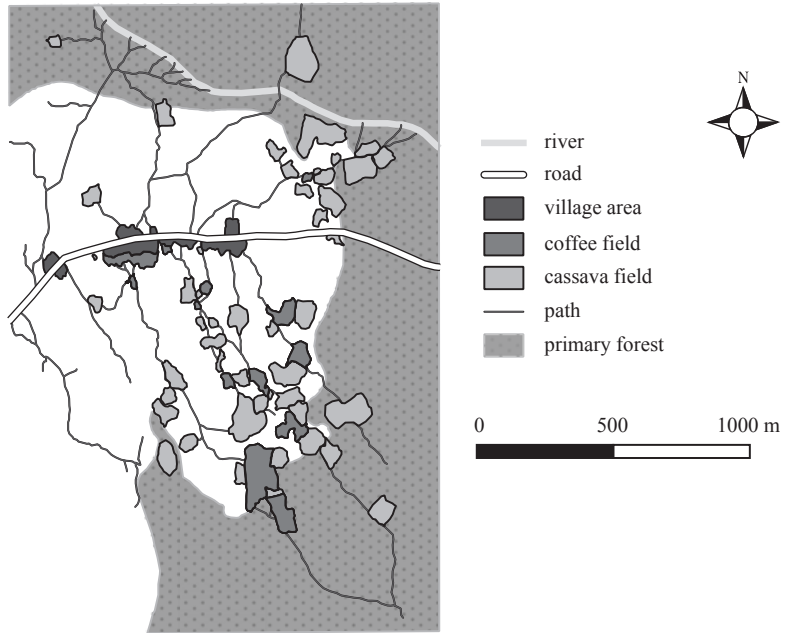


Fig. 12-1. Position of crop field around Yalisanga village in 1988.

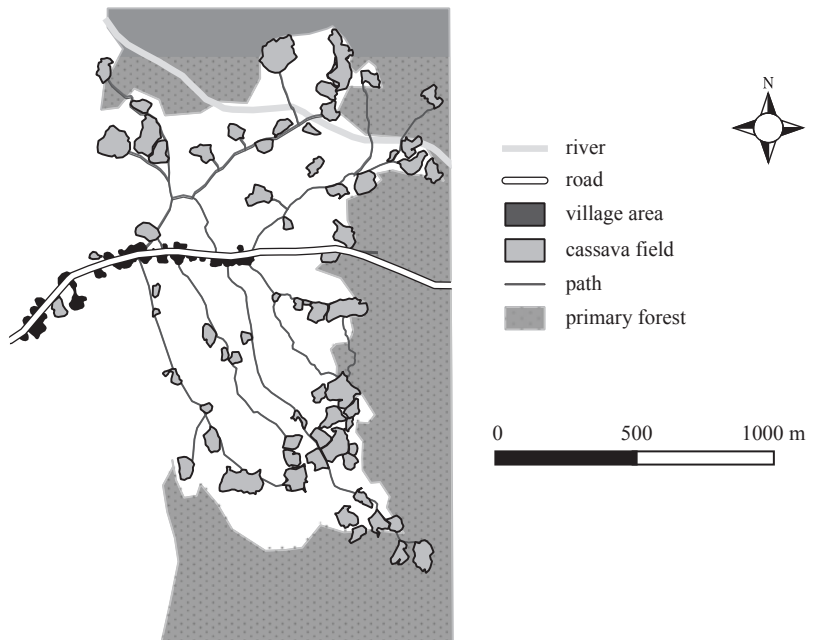


Fig. 12-2. Position of crop field around Yalisanga village in 2007.

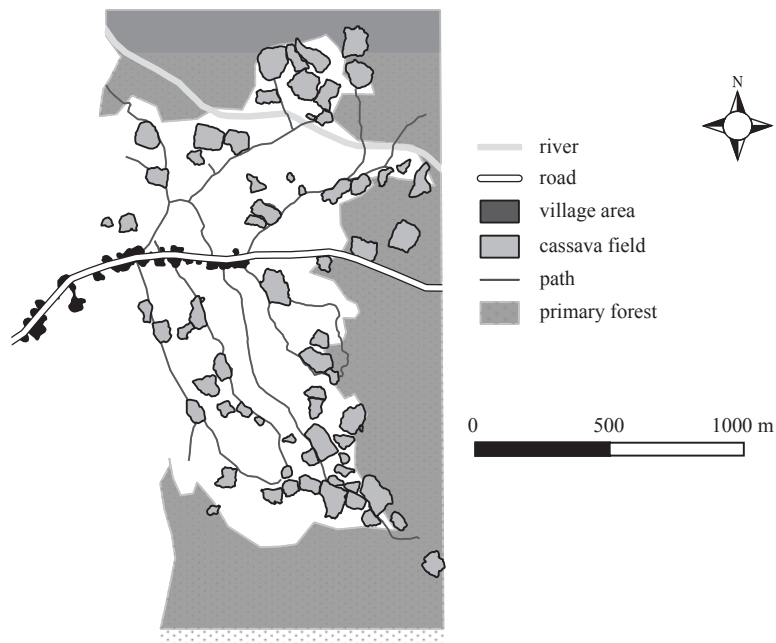


Fig. 12-3. Position of crop field around Yalisanga village in 2013 and 2014.

Expansion of the snaring and fishing areas

Fig.13 shows the distribution of snares set around Yalisanga village. In 2014, almost all snares of the Yalisanga villagers around the village were measured. Most snares were set within 2 km from the village.

Meanwhile, as shown Fig. 14, a cluster of snares apart from those in Fig. 13 were detected in the southern part of the study village. Data on this cluster were taken from a hunting camp (*behetsia*) on the other side of the Luo (Malinga) River. Based on this new information, the Bongando people intensively conducted hunting in the camp in the forest. At times, they stay in such hunting/fishing camps for several weeks to several months. The extent of hunting/fishing activities in the camp is not negligible.

Masuda, the third author, conducted a one months participant observation of activities in the fishing camp located on the Boongo riverside (a branch of Luo [Malinga] River). The site is about one day on foot or 2–3 days on the dugout canoe from the main village. The villagers of Yalisanga frequently visit the camp and sometimes stay there for several months. They say that their village was located in that area until 1933 and that they have visited the place since.

DISCUSSION

The land use pattern of the Bongando is characterized by the following two

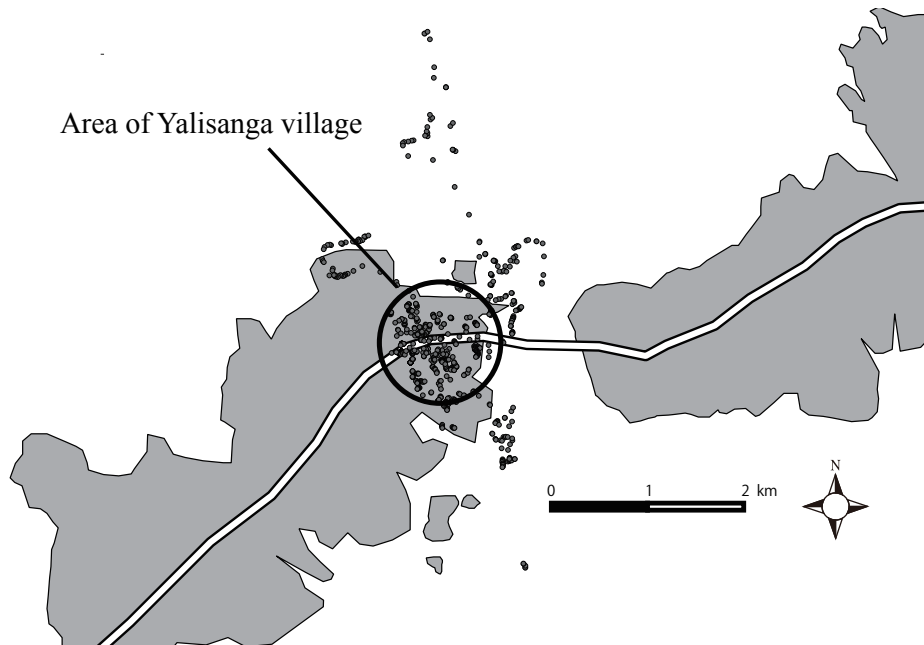


Fig. 13. Position of snares near the village set by the Yalisanga men.

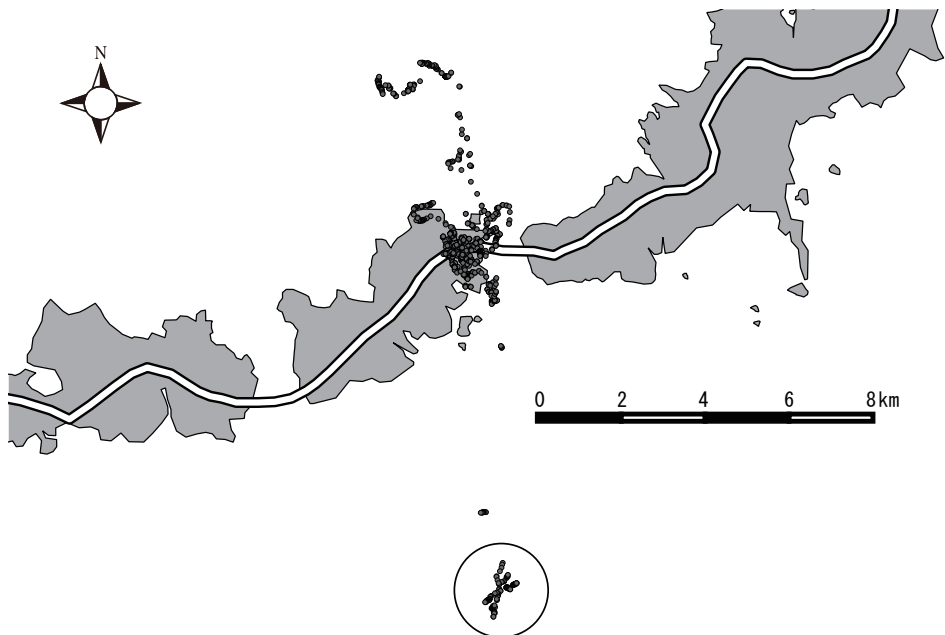


Fig. 14. Whole position of snares set by the Yalisanga men.

points.

One is their spatially compact field–fallow system. Even as the secondary forest area gradually encroaches the primary forest (from our observation, the area has expanded 1.66 times in the recent 40 years), villagers have maintained most of their fields within the narrow strip of secondary forest. Considering their population growth, this pattern of land use can be seen as minimizing the burden on the forest environment. This may reflect the cultivation system of the Bongando people, in which coffee was the main cash crop up to the 1990s. Compared to the satellite image of, for example the forest of southeastern Cameroon,⁽³⁾ the boundaries between field/secondary forest and primary forest are quite sharp. Further comparative study is expected in the future.

Another point is that their subsistence activities are not limited to the area near their village. They Bongondo frequently visit hunting/fishing camps (*nkumbo* and *behetsia*). Staying in such camps is part of their life, and a number of these camps can be called “satellite villages in the forest.” Their occasional excursions to these satellites enable villagers to earn protein-rich foods. In certain cases, the zoning proposed by nature conservation programs neglect such aspects of life of the local people (cf. Yasuoka, 2006). The Wamba region is not an exception. International NGOs, such as African Wildlife Foundation (AWF) and Bonobo Conservation Initiative (BCI), seek to establish nature reserves in the region. Forêt des Bonobos, of which Lingomo serve as head, also support such initiatives. The present research shall offer basic data concerning these matters.

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NOTES

- (1) The area of the Bongando territory was measured by referring to the ethnic map of l'Institut Géographique du Zaïre (1982) and that of G. Hulstaert (cited by Philippe, 1965). Information from the Bongando was also consulted.
- (2) Landsat images were obtained from Maryland University's website (Online 1).
- (3) Cacao, which is cultivated by agroforestry and do not need much insolation, is the main cash crop in southeastern Cameroon.
- (4) This appendix was mainly written by the second author Lingomo.

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Online

1. <http://glcfapp.glcf.umd.edu:8080/esdi/index.jsp> (Accessed March 8, 2015).

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Appendix: Bongando Subsistence Activities

In this description,⁽⁴⁾ a number of Bongando terms appears. When a term is usually used in plural form, both singular and plural forms are shown, like “*isai/tosai*” (=singular/plural). An item which have two or more Bongando expressions is written as “*biilo* or *boilo*.” In principle, scientific names are shown at the first appearance of the local terms.

1. HUNTING

We classified hunting methods into seven categories; trapping, bow-and-arrow hunting, dog hunting, spear/stick and eyes hunting, gun hunting, gathering hunting, and digging land hunting.

1.1 Trapping

The principal hunting method is trapping. Whereas the local people set traps in the forest near villages and fields, they also trap intensively when they are in the forest camp (*behetsia* and *nkumbo*). The two main types of traps used are nylon and wire (*njeki* and *bombuka*). Nylon is used for traps that catch animal by their legs: antelopes, porcupines (*Atherurus africanus*), bush pigs, and some birds, such as crested Guinea-fowl (*lokanga*, *Guttera edouardi*), quail, and Nkulengu rail (*Himantornis haematopus*). *Bombuka* is used to trap animals by the neck, and it is the most common type of trapping. The main game caught chiefly by *bombuka* is small mammals—rats, porcupines, squirrels, checkered elephant-shrews (*itoko*, *Rhynchocyon cirnei*), pangolins, and mongooses—as well as some reptiles, like vipers and cobras. Some middle-sized mammals (blue duikers [*mboloko*, *Cephalophus moniticola*] and monkeys) and other reptiles are also caught in this way. There are four kinds of *bombuka*: (1) *bombuk'ombuka*, wire snare or cord made from vine; (2) *bombuk'oleko* or *lipapa*, fruit of *Ongokea gore* (*boleko*) that is used as baits for catching animals, especially rats; (3) *bombuk'a simbokilo*, in which *simbokilo* (a kind of truffle like mushroom) is used as bait; and (4) *lok-inga*, the threads of *Raphia* sp. used for catching small mammals. A wire snare is sometimes used for *bombuk'ombuka*, but cord made from vine is used for all other types. *Bombuka* is used for traps on the ground as well in branches of tree or in fallen trees when the targets are climbing animals.

There are three other types of traps. *Imote* is made from threads of *lokosa* (*Manniophyton fulvum*) to catch crested Guinea-fowl, Nkulengu rail, quail, and terrestrial tortoise (*Kinixys erosa*). *Lopote* is glue from the sap of *landolphia* vines, which is used for catching small birds and hornbills. *Itelevayi* is for checkered elephant-shrews. The durability of trap differs by type: *bombuka* is durable for 10 months at the maximum, and nylon and *njeki* last for about five months.

1.2 Bow and arrow hunting

There are two kinds of bow-and-arrow hunting: *bakula* (*likula*) or *bakimano* and *lotongo*. *Bakimano* refers to hunting done by a group, and *lotongo* is done alone or by just a few hunters. The *lotongo* method employs imitation calling of animal voice: *loma* for antelopes, *ntsatsia* for monkeys, and *bomwete* for checkered elephant-shrews, squirrels, and galagos (*lisile*, *Galago demidovi*).

In terms of materials, there are three kinds of arrows: *likula*, an iron arrow; *loliki*, *lolengo*, *litimbo* or *ngile*, a poisoned arrow; and *bolel'isanga*, an arrow without poison. The bow for the *likula* arrow can be made of various types of wood, as follows: *biilo* or *boilo* tree (*Diospyros alboflavescens*), *kulutende* or *bolesolia* tree (*Pancovia* sp.), *bokendju* tree (*Aidia congolana*), *bosehe* tree (*Garcinia punctata*), *beo* or *boketo* tree (*Massularia acuminata*) or *litsulanvua* tree (*Pleiotheca pycnantha*). For the *loliki* arrow, there are two kinds of bows: a *lipaku* bow made from a *lihindo* tree (*Eremospata hookeri*) and the *ngile* or *litimbo* bow, made of either the *beo* or *boketo* tree or the *boseke* tree (*Carpolobia glabrescens*). Threads from the *lokosa* tree are used for both kinds of bows. Both the *loliki* and *bolelisanga* arrows are made from palm or raphia tree boughs taken from the lower part of the tree. The animals killed by bow-and-arrow hunting are usually small, such as monkeys, squirrels, antelopes, checkered elephant-shrews, and birds. According to our observations, the people in Yofala hamlet hunted with bow and arrow only once in two years.

1.3 Dog hunting

When dog hunting is used, wooden bells (*eleho*) are attached to the dog's neck. *Eleho* is made from the *bosulu* tree (*Pterocarpus casteelsii*), *bokomu* tree (*Myrianthus arboreus*), *bolongo* tree (*Symphonia globatifera*), and *bohumbo* tree (*Grewia pinnatifida*). Men train the dogs to hunt such animals as porcupines, dark mongooses, checkered elephant-shrews, abbot's duiker, and squirrels. In some cases of dog hunting, nets are used: *iteko* (for chequered elephant-shrews and squirrels), *bopone* (for porcupines and mongooses), *ntombi* (also for porcupines and mongooses), and *botenga* (for porcupines and middle-sized mammals). The spear, machete, ax, knife, and stick are important for killing game in dog hunting. When the target game animals enter holes in trees, people may use axes and machetes to cut down the whole tree. Smoke can be used in trees or ground holes for forcing animals out or killing them. This system is called *mpoha* (*nyama*). Dog hunting is also combined with other hunting methods. For example, in cases in which an animal is captured in a trap or wounded by an arrow, dogs are used to find game and kill it.

1.4 Gun hunting

Guns are also used to hunt antelopes, monkeys, and birds, accompanied by *loma* and *ntsatsia* imitation calling as in the case of bow-and-arrow hunting.

1.5 Spear/stick and eyes hunting

This hunting is especially for reptiles, such as terrestrial tortoises and vipers (*Bitis nasicornis* and *Bitis gabonica*). The men use spears and sticks to test dense shrubs or places where a fallen tree is covered with many leaves (called *bokwa*) wherein terrestrial tortoises and vipers are often hiding. Sometimes, holes in the ground and other hiding places, called *liyoka/baoka*, are tested as well. Squirrels also announce the presence of other animals, especially snakes and tortoises; in fact, it is said that squirrels will indicate the presence of any other animal. Their announcement is called *liseko/baseko*. However, it is difficult to kill animals with this method, and they often run away.

1.6 Gathering hunting

Some animals are easily hunted because they live in holes, so we consider this kind of hunting as gathering. People look for the holes of birds, especially hornbills, *bokoma* (squirrels, *Epixerus ebii*), *ngaa* (tree pangolin, *Manis tricuspis*), and *lokiyo* (flying squirrels, *Anomalurus derbianus*). Whereas hornbills are hunted mainly from August to September, *bokoma*, *ngaa*, and *lokiyo* do not have a specific hunting period. Squirrels in their holes are sometimes hunted by cutting the tree. All the individual animals (normally 2–6) are then caught at one time.

1.7 Digging land hunting

People hunt by digging land to catch some animals, such as rats and aardvarks (*Orycteropus afer*), and digging in swamps for crocodiles. Because rats and aardvarks make holes in termite mounds, hunters dig in land where there are termite mounds to hunt these creatures. While nets (*iteko*, *bopone*, and *ntombi*) and machetes or sticks are used for hunting rats, nets (*botai*), spears, and bows and arrows are used for hunting aardvarks. People also do digging hunting in the swamp forest to catch crocodiles, which live in holes in the swamps. Digging hunting is not practiced frequently at the research site.

2. FISHING

The second activity practiced at the research site is fishing. Both men and women fish, and periodically, people establish fishing camps in the forest and go there simply to fish. There are 8 types of fishing methods.

2.1 Bailing water (*mpoha nse*)

This kind of fishing is practiced mainly by women in the dry season. They go to the river and make dykes in the ponds. The women then use *litsungu* bags to scoop the water out of these ponds and find the fish. Sometimes *losingi* bags or *lisangi* nets are also used for bailing. This system is called *mpohela* (*ma losingi*

or *lisangi*).

2.2 Net fishing

There are two kinds of nets for fishing: the *lisangi*, a circular net of 2–10 m in circumference and 1.5–10 m in length, and the *bozanga*, 2–100 m long and 2 m wide. The *lisangi* is made locally from threads of *Manniophyton fulvum* (*lokosa*) and sticks from the *bondongondongo* tree (*Cyclocotyla congolensis*). The *bozanga* type is imported from other countries and is made of nylon threads with any kinds of tree species. *Lisangi* nets are left in the water for one night, whereas *bozanga* nets can stay in the water for as long as one month. The good period for net fishing is the rainy season, which is called *ehela* or *lokela* (the excess water empties into the rivers). The *lisangi* net fishing during this period is called *lohela* when people go to the river in the night for fishing.

2.3 Fish hook fishing

Fish hooks (*ilofi/tolofi*) are combined with nylon or fishing threads and always used with bait such as earthworm. Fish hooks can take the fish directly from water or can be left in the water for one night. Many fish hook sticks were observed at the research site.

2.4 Eel-trap fishing

Five types of eel-trap fishing were observed frequently at the research site: *isai/tosai*, *itanda*, *bosonga*, *iyunvua*, and *ikoto*. *Iyunvua* and *ikoto* have come from outside the region during the past several years. While *iyunvua* uses bait and *ikoto* can on occasion, bait is not used with the *isai*, *bosonga*, and *itanda* types.

2.5 Cutting fishing

Machetes are used for cutting the fish. This kind of fishing is called *bokekaki*, a term originating from the Longando verb *n-keka*, which means “to cut.” It is practiced not only in the daytime but also at night along with lights.

2.6 *Bosoi* fishing

With this method, people fish with a pointed tool called a *bosoi*. The *bosoi* is thrown in the water without targeting a particular spot. When the *bosoi* hits a fish, the fisher goes into the water to get it.

2.7 *Busolaki* fishing

Busolaki is a kind of fishing wherein water herbs are shaken onto a bag or a net to look for small fish.

2.8 Bow-and-arrow fishing

Bow and arrows are also used for fishing, mainly for *likoke* (*Tilapia tholloni*), which is a diurnal fish. The archer shoots arrows (*bolelisanga*) into the water if he sees fish.

3. GATHERING

3.1 Gathered Food

Foods items gathered in the forest include caterpillars, insects like Macrotermes (termites), Apidae (bees), and Vespidae (wasps), mushrooms, wild yams, and forest leaves and fruits. There are several species of caterpillars: *isusu/tosusu* (Noctuidae), *boona/beona* (*Pseudantherea discrepans*), *ihumbo/tohumbo* (*Anaphe* sp.), *lihakala/bahakala* (*Saturnia* sp.), *botoa/betoa* (Saturniidae), *lilangatsike/balangatsike* (*Nudaurelia dione*), *liletsike/baletsike* (*Nudaurelia* sp.), *ilanga/tolanga* (*Anaphe infracta*), *bosake/besake* (Nymphalidae), *lokoo/nkoo* (Notodontidae), *lingonju/bangonju* (*Lobobunaea goodi*), *lingongo/bangongo*, *iyawu/taawu*, *ehoyol/bihoyo* (*Lobobunaea phaedusa*), *ikaninga/ikeninga/tokaninga/tokeninga* (*Anthena insignata*), *lohose/mpose* (*Rhynchophorus phoenicis*) and *likindji/bakindji* (*Augosoma centaurus*).

Macrotermes consumed at the research site include *likaalo/bakaalo* and *londonge/ndonge*. *Bakaalo* are gathered from termite mounds by burning the *bohumbo* tree (*Grewia malacocarpa*) and *bolembo* tree (*Desplatsia dewevrei*). When *bolese* (*Tetrapleura tetraptera*) fruits are burned, the smoke has a smell that drives termites away from the mound. Because the *bakaalo* bites, they are taken from the termite mound opening with the use of *lipute/lihute* or *bapute/bahute* tree (*Turraea vogelii*) bark held by a stick from the *kuluokondji* tree (*Scaphopetalum thoneri*). Gathering *londonge/ndonge*, conversely, is easy because they do not bite.

The apidae that produce honey (*mpako*, *buute* or *ngee*) are *lonjue/njue* (*Apis mellifera adansonii*), *elungu/bilungu* (*Trigona* sp.) and *bolo/beloo* (*Trigona gridoi*). The *luutsu/bautsu* (*Dactyfurina standingeri*) is also gathered occasionally, but this insect is very dangerous because it enters the ear. Although the other bees are dangerous as well, people have a strong appetite for honey, so they gather it using fire in a procedure called *mpumbo*.

The Bongando divide mushrooms into four groups referring to the forms: *emokol/bimoko*, softening mushrooms; *lolungola/ndungola*, sponge-like mushrooms; *buuwo/biuwo*, hard mushrooms; and *lisele/basele*, which do not last long and grow on dead trees. Twenty-six species of fungus and two *Auricularia* sp. were identified at the research site as edible mushrooms, as shown in Table 1. Eleven edible forest leaves and twenty-three edible fruits species were identified, as shown in Tables 2 and 3, respectively. Tall or middle-sized trees are also cut for gathering some fruits. Some yams are gathered in the forest as well: *eheki* (*Dioscorea smilacifolia*), *ekuhe* (*Smilax kraussiana*) and *lilungu* (*Dioscorea* sp.). Only the

Table 1. Edible mushrooms gathered in the research site

Family	Local name (singular/plural)
<i>Fungus</i>	loleholeho/ndeholeho
	emokookwa/bimokoyeekwa
	imelamata/tomelamata
	losalaalokanga/nsalaankanga
	ikungu/tokungu
	lolemwambende/ndemwambende
	losoloolo/nsoloolo
	sweswe/sweswe
	lomongo/mongo
	lolungola/ndungola
	lolungolaloome/ndungolayaome
	buuwalooko/biuwalooko
	buuwalotoha/biuwalotoha
	lisekuseku/likelekenji/basekuseku/bakelekenji
	bokoloamboloko/bekoloamboloko
	yoko/yoko
	itotoloyi/totoloyi
	ingwengwe/tongwengwe
	beesesu
	liyeleakongoli/baeleakongoli
buuwootamba/biuwootamba	
zambanyoso/zambanyoso	
buuwalikinda/biuwalikinda	
mbokola/mbokola	
lotsukunulu/ntsukunulu	
nseliko/nseliko	
<i>Auricularia</i> sp.	liselealitoyianvua/baseleatoyianvua
	liselikolo/baseleatokolo

Table 2. Edible forest leaves

Local name (singular/plural)	Scientific name
bohili/behili	<i>Scorodophloeus zenkeri</i>
lokumbokumbo/nkumbokumbo	<i>Leonardoxa romii</i>
bokau/bekau	<i>Ancistrophyllum secundiflorum</i>
londendisongo/ndendeatosongo	<i>Cola bruneeli</i>
londendimange/ndendeatomange	<i>Cola marsupium</i>
bohe/behe	<i>Lonchitis currorii</i>
linyolo/banyolo	<i>Diplazium welwitschii</i>
linyoloalose/banyoloalose	<i>Cyclosorus dentatus</i>
londendealose/londendelaanamiso/ndendealose/ ndendeyaanamiso	<i>Guyonia ciliate</i>
bopanje/boanje/boenje/bepanje/bepenje	<i>Combretum</i> sp.
lohonyongolo/mponyongolo	<i>Erythrococca oleraceae</i>

Table 3. Edible forest fruits

Local name (singular/plural)	Scientific name
losou/nsou	<i>Dacryodes edulis</i>
litohe/batohe	<i>Landolphia owariensis</i>
lohelenge/mpelenga	<i>Dacryodes yangambensis</i>
lisenda/basenda	<i>Saba florida</i>
lopwampumbo/mpwampumbo	<i>Pterygota bequaertii</i>
litoheyokila/batoheokila	<i>Landolphia bruneeli</i>
leele/mbele	<i>Canarium schweinfurthii</i>
bolingo/belingo	<i>Anonidium manii</i>
lokaso/nkaso	<i>Tetrochidium didymostemon</i>
lihunga/bahunga	<i>Synsepalum subcordatum</i>
bolonge/belonge	<i>Chrysophyllum delvoyi</i>
bohanvu/behavvu	<i>Gambeya lacourtiana</i>
londake/ndake	<i>Afromomum laurentii</i>
londakealose/ndakealose	<i>Afromomum</i> sp.
liko/baiko	<i>Cola acuminata</i>
botendo/betendo	<i>Garcinia kola</i>
nkaho/nkaho	<i>Griffonia physocarpa</i>
bondeendende	<i>Cola bruneeli</i>
iyolealisombo/tooletasombo	<i>Afromomum</i> sp.
lotende/ntende	<i>Pancovia laurentii</i>
losemu/nsemu	<i>Chytranthus carneus</i>
liimbo/mbimbo	<i>Treulia africana</i>
imama/tomama	<i>Synsepalum stipulatu</i>

eheki and *ekuhe* have been traditionally eaten by the local people for a long time. For example, *eheki* was introduced to the Bongando people before the 17th century. On the other hand, *lilungu* became a food item in a time of war around 2000 when the local people learned from the custom of the Oriental Province.

3.2 Gathered fruits, leaves and barks for medicinal use

Plants are also gathered for medicinal use. Some people among the Bongando have special knowledge of medicinal plants, which are shown in Table 4.

3.3 Gathering trees for cash income

Some fruits, leaves, and bark of trees are gathered for commercial purposes. The fruits of the *bolokoloko* tree (*Piper guineense*), called *iketsu/tokets*, and of the *bolemba* tree (*Desplatsia dewevrei*), called *iteha/toteha*, and the leaves of the *lilombolombo* tree (*Piper umbellatum*) are gathered and sold for money. The root bark of the *elole* tree (*Rauvofia obscure*) is also gathered for cash income.

3.4 Gathering drinking water from the forest vines

The vines of the *bombende* (*Artabotrys thomsonii*) and *bolengalenga* trees (*Cissampelos dinklagei*) are cut to obtain drinking water. Many *bombende* and *bolengalenga*

Table 4. List of medical plants

Vernacular names	Scientific names	Kind of illness	Gathered part
bosole	<i>Baphia laurifolia</i>	chest ache	bark
bohili	<i>Scorodophloeus zenkeri</i>	malaria	bark
nkaho	<i>Griffonia physocarpa</i>	malaria and back ache	revolving root
ilambasanyi	<i>Gouania longipetala</i>	child malaria	root
ikuka	<i>Alstonia congensis</i>	nose and head aches	root
boongoayopoko	<i>Dipteropeltis poranoides</i>	fracture and luxation	root and leaves
mpute	<i>Dalbergia saxatilis</i>	rheumatism	part of tree
lkaikai	<i>Byrsocarpus viridis</i>	cough	new leaves
boyengo	<i>Canavalia ensiformis</i>	eye ache	leaves
bosehe	<i>Garcinia punctata</i>	malaria and back ache	bark
botohe	<i>Landolphia owariensis</i>	cough	young leaves
kongololisongo	<i>Coffea spathicalyx</i>	malaria and intestine worms	root
kongolokoli	<i>Morinda sp.</i>	malaria and intestine worms	leaves
liteleteleyeesia	<i>Palisota schweinfurthii</i>	fracture, luxation and rheumatism	leaves
bongoli	<i>Parinari excelsa</i>	chest ache	bark
bohiningo	<i>Isolana congolana</i>	chest ache and malaria	bark
longoankoy	<i>Rinorea gracilipes</i>	cough and chest ache	bark
bokako	<i>Costus afer</i>	head ache and cold	sap
bosomboko	<i>Afromomum laurentii</i>	head ache	sap of fruit
yatsuli	<i>Trichilia lambata</i>	stomach ache	bark
ngomboanyama	<i>Oxyanthus speciosus</i>	abscess	new leaves
botonogolo	<i>Harungana madagascariensis</i>	child stomach ache and red skin	bark
bosongu	<i>Maesopsis eminii</i>	production of good milk to suckle child	sap
kelikunjuki	<i>Ptericlinum aquilinum</i>	easy birth and abscess	a part of the tree
bolese	<i>Tetrapleura tetraptera</i>	chest and stomach aches	fruit
bombambo	<i>Musanga smithii</i>	chest and stomach aches	bark
etenge	<i>Ritchiea aprevaliana</i>	abscess	leaves
likondoalilimo	<i>Anchomanes difformis</i>	stomach ache	root
likoso	<i>Englophytum vermoessenii</i>	chest ache and cough	bark
tosaso	<i>Allophylus lastourvillensis</i>	chest ache	leaves and tree part
boseke	<i>Carpolobia glabrescens</i>	stomach ache	root
boleli	<i>Tetrochidium didymostemon</i>	measles and variola	sap
bombongo	<i>Gilbertiodendron dewevrei</i>	cough and chest ache	bark
Beo/ boketo	<i>Massularia acuminata</i>	stomach ache	fruit
iyoloole	<i>Carpolobia alba</i>	diarrhoea	leaves
botendo	<i>Garcinia kola</i>	malaria, chest and back aches	bark
isongoyekondo	<i>Bartiera sp.</i>	malaria	leaves
bohohihohi	<i>Ritchiea fragariodora</i>	hernia and gonorrhoea	revolving root
liyamba	<i>Albizia adianthifolia</i>	injury	bark

trees can be seen in the forest, and people usually use these trees for drinking water.

3.5 Other gathered insects, animals feces, mushrooms, and trees

Certain insects, like water worms; one kind of mushroom; *bokomokomo* larvae called *bokomo/bekomo* (insects living in branches of *Barteria nigritiana*); and some forest leaves and fruits are not edible but are gathered for using as poison or bait for catching fish, animals, and birds.

In terms of forest leaves, *bosole* (*Renealmia africana*) is gathered as bait for catching fish. The fruits of the *bosengealose* tree (*Uapaca heudelotii*), *boleko* tree (*Ongokea gore*), *bopembe* tree (*Anthonotha fragrans*), *ekoo* tree (*Strombosiaopsis tetrandra*), *bolele* tree (*Trachyphrynium branianum*), *liyondje* tree (*Alchornea cordifolia*) and *elole* tree (*Rauvolfia obscure*) are also gathered as bait.

Copal, which is the hard sap of the *bokongo* tree (*Baikiaea robynsii*), *waka* tree (*Guibourtia demensi*) and *bohehele* (*Gilbertiodendron mildbraedii*), is gathered to be burned for light. This copal was used for cash income during the Belgium colonial era.

Several products are gathered to use as poison for catching fish: the fruits of the *boloko* tree (*Blighia welwitschii*), *lileko* tree (*Ciphilis peduncularis*), and *ikana* tree (*Bartiera capitata*); the vine of the *bolemba* tree (*Desplatsia dewevrei*), bark of the *bokungu* tree (*Piptadeniastrum africanum*) and *bosole* tree (*Baphia laurifolia*); and leaves of the *bosehe* tree (*Garcinia punctata*). Sometimes, *boloko* and *ikana* trees are cut to gather the fruits. The vine of the *bolemba* tree is also cut for taking apart.

For *loliki* (poison), some kinds of trees are gathered and mixed. Sometimes the *loliki* or *lolengo* tree (*Parquetina nigrescens*) is mixed with the *iloolole* (*Tabernanthe iboga*) and *eloleoome* or *lomata* trees (*Rauvolfia manii*) to make a good poison for arrows. *Loliki* or *lolengo* is also mixed with parts of the *bosole* and *nkaho* trees (*Griffomia physocarpa*). The poison can be obtained by the mixture of the *loliki* or *lolengo* tree and the *nsamba* tree (*Strychnos icaja*). An important mushroom is *simbokilo*, which is eaten by many animals and thus can be used as good bait. In terms of animals, only the feces of *mpambi* (*Cephalophus natalensis*) are gathered for curing a lack of vitamins, which is called *bopambi*.

4. HOUSING AND OTHER ACTIVITIES

Tools for building houses, especially those in the camps, are found in the forest. The houses are built with sticks, leaves, and/or clay. Sticks from all of the trees in the forest can be used to build a house. The main sticks used are the hard ones like the *biilo* tree (*Diospyros alboflavescens*), *bosehe* tree, *beo* tree (*Massularia acuminata*), *bolonda* tree (*Xylopiya chrysophylla* and *Xylopiya gilbertii*), *bongundju* tree (*Dalium pachyphyllum*), *lokengo* tree (*Klainedoxa gabonensis*), *bolinda* (*Polyathia suavolens*), and *bosange* (*Xylopiya aethiopica*).

For binding sticks and leaves together for these houses, vines from the *longoli*

tree (*Eremospatha haullevilleona*), longonge tree (*Dewevrella cochliostema*) and likau tree (*Ancistrophyllum secundiflorum*) are also used.

Leaves for houses are obtained from the loheto tree (*Sclerosperma manii*), lokongo tree (*Megaphrynium macrostachyum*), lokokolo tree (*Sarcophrynium pri-onogonium*), bombongo tree (*Gilbertiodendron dewevrei*), and liluku tree (*Sterculia bequaertii*). Sometimes, the leaves of the bombongo tree are used on the walls rather than clay.

Many trees are cut for many other types of work, such as making canoes (*ntombi*), drums (*etanga*), paddles (*losingi*), pestles (*botete*), mortars (*lotanda*), bags (*litsungu*), strainers (*ilekwa*), nets (*botai*, *iteko*, or *bopone*), eel-traps (*isail/tosai*, *iyunvua/tuunvua*, *ikoto/tokoto*), threads (*isinga* or *tosinga*), axes (*liswa* or *engoma*), and spear sticks. There are specific trees that correspond to each instrument. For the canoes, the likuku tree (*Cynometra alexandri*), bokolombe tree (*Staudia stipitata*), bokoli tree (*Garcinia smeathmanii*), longoankoy tree (*Rinorea gracilipes*), bolongo tree (*Symphonia globutifera*), bosenge tree (*Uapaca guineensis*), and lihelehele tree (*Albizia ferruginea*) are suitable. For drums, they use the bosulu or bsiyo tree (*Pterocarpus casteelsii*), bosongu tree (*Maesopsis eminii*), lihelehele tree, and beele or boele tree (*Canarium schweinfurthii*). The wood of the bokolombe tree is the most important in making paddles. Pestles are made from the wood of the beo or boketo and biilo or boilo trees. Only lihake trees (*Entandrophragma angolense*, *candollei* and *cylindricum*) are used for making mortar. The lokosa tree is used for making bags, nets and threads. Bags (*etanga*, *losingi*, *botete*, *lotanda* and *litsungu*), strainers, and eel-traps are made from the bokombe tree (*Haumania liebrechtsiana*), longoli tree, lihindo tree (*Eremospatha hookeri*), and bokau tree. Axes and spear sticks require the wood of the bokumbo tree (*Leonardoxa romii*), bohili tree (*Scorodophloeus zenkeri*), esekesekealose tree (*Drypetes cinnabaricana*), bokendju tree (*Aidia congolana*), bokolombe tree, biilo or boilo tree and boseke tree.