



Availability of Non-Timber Forest Products in the habitats of Kindu city and its surroundings (Maniema, DRC)

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ABSTRACT

This survey conducted in Kindu city and its surroundings aims at contributing to the knowledge of Non-Timber Forest Products exploited in the habitats surrounding Kindu city, Nyoka locality, Bilundu and Muyengo villages in order to call on actors for responsible exploitation of these natural resources. In a specific manner, it aims at identifying Non-Timber Forest Products exploited in forests of Kindu and its surroundings and determining their habitats of exploitation. We used the ethnecological approach to collect data. We interviewed permanent operators in Kindu city (Kindu city, Katako village, Shenge village, Lwama district), Bilundu village on Kibombo road, Nyoka and Muyengo villages on Kalima road. We sampled and surveyed at least 25% producers' households at random of the producers. Data collection was conducted through interviews. Therefore, the sampling unit is operators' and consumers' household in the survey sites. Our sample is made of 697 individuals. The results show that the most exploited wild food plant species in Nyoka locality are *Amaranthus viridis* (LINNE) (31%), *Colocasia antiquorum*, var. *esculenta* (25%) and *Xanthosoma sagittifolium* (19%); *Amaranthus viridis* (34%), *Colocasia antiquorum* (19%) and *Xanthosoma sagittifolium* (11%) in Muyengo village; *Dioscorea prehensilis* (30%), *Amaranthus viridis* (15%) and *Pteridium aquilinum* (12%) in Bilundu village. Among wild food plants collected in Kindu city, *Amaranthus viridis* is the most exploited (26%), followed by *Xanthosoma sagittifolium* (16%) and *Colocasia antiquorum* and *Talinum triangulare* (11%). In Nyoka locality, 40% operators collect NTFP, 28% in fallowlands and 19% in fields. In Muyengo village, 38% operators collect NTFP in the forest, 29% in fallowlands and 20% in fields. In Bilundu village, 37% operators collect NTFP in forests, 23% in savannas and 20% in fallows. In Kindu city, 37% operators collect these resources in forests, 23% in savannas and 20% in fallowlands.

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Introduction

In DRC, the market of Non-Timber Forest Products (NTFP) mainly developed during the last decades, in part due to fast increase of the population. (Toirambe. B, 2007).

Three-quarters of Maniema Province is occupied by forest that hosts enormous potentialities for the development of local population. (DSRP,2004). A large part of the population is strongly dependent not only on forest resources (wood, NTFP, poaching) but also on fishing (illicit fishing). To assure their subsistence, a number of households resort to agricultural activities and collection of forest products other than timber (DEBROUX *et al*, 2007). These products include animal and forest plant products.

Therefore, this article suggests to identify in depth Non-Timber Forest Products mostly exploited in Maniema Province in the Democratic Republic of Congo, precisely in Kindu city and its surroundings less studied until today.

For a number of people, natural habitats are considered as a generator of funds in terms of exploitation of Non-Timber Forest Products (NTFP) and play an important role in fight against poverty (Biloso & Lejoly, 2006). This situation is caused more by political or economic changes (civil war,

rebellion, inflation, dysfunctioning of food supply system) and induce an increase of the demand for local forest products (Akitoby, 1997).

The general objective of this survey is to contribute to the knowledge of Non-Timber Forest Products of plant origin, exploited in the habitats surrounding Kindu city, Nyoka locality, Bilundu and Muyengo villages in order to call on actors for responsible exploitation of these natural resources.

In a specific manner, our goals are:

1. To identify Non-Timber Forest Products of plant origin exploited in Kindu city and its surroundings and determine the rhythm of exploitation through a survey;
2. To determine habitats of exploitation of Non-Timber Forest Products of plant origin.

Survey area

This survey was conducted in Kindu city and its surroundings, Maniema Province, in the Democratic Republic of Congo, mainly in Kailo and Kibombo territories.

These parts of the province were chosen because of the relationship between the inhabitants and their forest ecosystems.



Face 1. The card of localization of the survey surroundings.

It is focused on operators and consumers of Non-Timber Forest Products of plant origin and, extends over four sites: Kindu city, Nyoka locality in Kailo territory (19 km away from Kindu), Bilundu village in Kibombo territory (37 km away from Kindu) and Muyengo village in Kailo territory (38 km away from Kindu).

Kindu city is located almost in the middle of the Democratic Republic of Congo. It is bounded by Kailo territory in the North; Kasongo, Kailo and Kibombo territories in the South; Kailo and Pangi territories in the East, Kailo and Kibombo territories in the West.

The topography of the city is the same as the one characterizing the extremity of the Congolese central basin, very little accident with the soil varying between sandy-clay type and clay-sandy type. This region has an agricultural soil that permits growing all sorts of cultures either subsistence or cash farming (Yuma, 2016).

According to city weather service report, Maniema Province is characterized by a hot and humid climate the equatorial type in the North, Sudanese type in the South while going through a transition zone in the center. The average temperature is about 27° C and rainfall amounts to 1650 mm.

The climate is characterized by a rainy season that intervenes two times per year from August to December and from January to mid-May; a dry season that does not exceed 4 months from mid-May to mid-August with fog in the morning and patchy fine rainfall. Season A normally extends from mid-September to January. Season B extends from February to May. (RVA/Mn, 2018).

The primary vegetation of this city was destroyed a long time ago. It included valuable species such as *Militia excelsa*, *Entadrophragma borea* and more others that have currently given way to gramineous plants, vegetables, bushes and shrubs, among wick *Musanga cecropioides*, *Eupatorium odoratum*, *Hyparrhenia sp*, *Pueraria javanica*, *Elaeis sp...*

Hydrography of the city is essentially made of the Congo River and its tributaries on both banks of the River, namely: Kindu, Kange, Mikonde, Luambondo, Muchondo, Mangobo, Kamikunga and Musubu on the right, and Mikelenge, Luandoko, Makopo, and channels on the left. (Yuma, 2016).

Methods

Data collection

We used the ethnoecological approach to collect data on the field. We surveyed on Non-Timber Forest Products in Kindu and its surroundings. The survey consisted on interviewing permanent operators in Kindu city, Katakoo village, Shenge village, Lwama district, Bilundu village on

Kibombo road, Nyoka and the Muyengo villages on Kalima road. We sampled 25% households at random for the interview. The sampling unit is operators' and consumers' household in the survey sites.

Data analysis and treatment

Data were analyzed statistically. This analysis enabled us to get differences that were converted into percentages (%). Other tests were applied for more precision.

We used R and Excel softwares to draw some graphics and histograms and fill in some tables to show results on some variables in our database.

Results

The habitats where NTFP of plant origin are more harvested

Different types of habitats found in the four survey sites are presented in Figure 2 below.

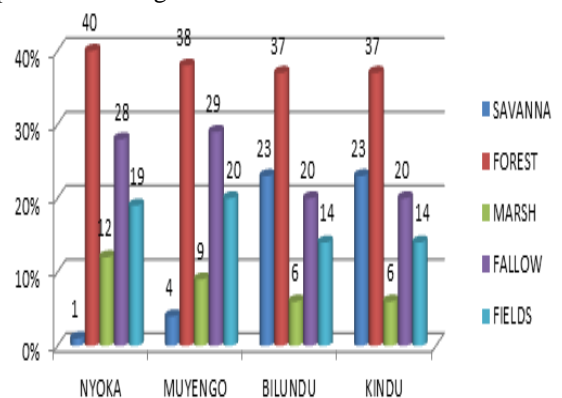


Figure 2. Habitats where Non-Timber Forest Products of plant origin are more harvested Kindu city, Nyoka locality, Muyengo and Bilundu villages

These histograms show that in Nyoka locality, 40% forest operators collect Non-Timber Forest Products in forests, 28% in fallows and 19% in fields; in Muyengo, 38% in forests, 29% in fallows and 20% in fields; in Bilundu village, 37% in forests, 23% in savannas and 20% in fallows; and in Kindu city, 37% in forests, 23% in savannas and 20% in fallows.

This observation makes us affirm that the most exploited habitat in the four sites is the forest.

Groups of Non-Timber Forest Products collected in the habitats surroundings of the survey area

During our survey in the four sites, we found some groups of Non-Timber Forest Products as illustrated in Figure 3.

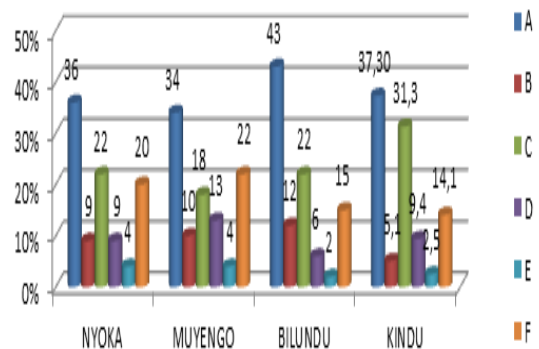


Figure 3. Groups of Non-Timber Forest Products collected in the forests surrounding Kindu city, Nyoka locality, Muyengo and the Bilundu villages.

Legend

A = Wild Food Plants; B = Packing Plants; C = Plants for building; D = medicinal Plants; E = Textile Plants; F = Plants for work of art

The results in this figure show that wild food plants are the most exploited in different habitats of our four sites, that is, 36% for Nyoka, 34% for Muyengo, 43% for Bilundu and 37.3% for Kindu. Plants used for building (houses, huts, ...) rank in second position, that is, 22% for Nyoka, 18% for Muyengo, 22% for Bilundu and 31, 3% for Kindu and those used for work of art in third position, that is, 20% for Nyoka, 22% for Muyengo, 15% for Bilundu and 14, 1% for Kindu.

Most collected Wild Food Plants in the Habitats of Kindu and the surroundings

In the four survey sites, we identified 14 species that are mostly used as wild food plants. Figure 4 shows the most exploited wild food plants in the habitats of the survey sites.

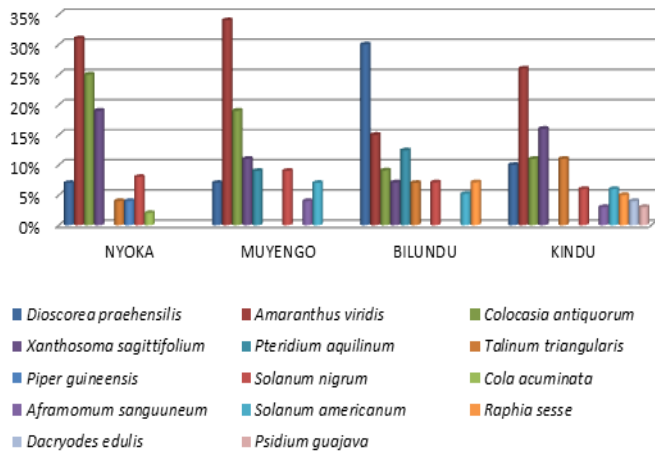


Figure 4. Most exploited wild food plants in the habitats of the survey sites

This figure reveals that the most exploited wild food plant species in the habitats of Nyoka locality are *Amaranthus viridis* (LINNE) (31%) followed by *Colocasia antiquorum*, var. *esculenta* (25%) and *Xanthosoma sagittifolium* (19%); *Amaranthus viridis* (34%), followed of *Colocasia antiquorum* (19%) and *Xanthosoma sagittifolium* (11%) in Muyengo village; *Dioscorea prehensilis* (30%), *Amaranthus viridis* (15%) and *Pteridium aquilinum* (12,4%) in Bilundu village; *Amaranthus viridis* (26%), *Xanthosoma sagittifolium* (16%) and *Colocasia antiquorum* and *Talinum triangularis* (11%) in Kindu city.

Organs used

Elements in Figure 5 give information on the types of organs of wild food plants used.

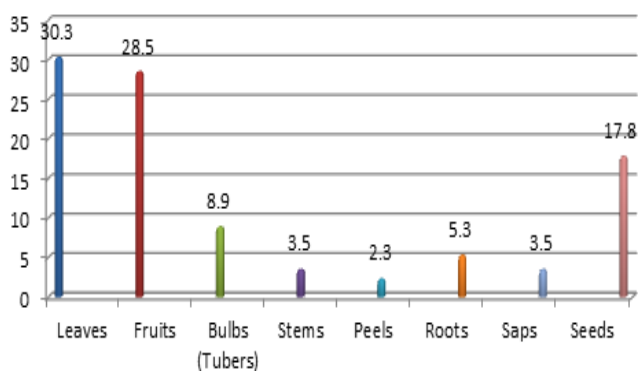


Figure 5. Number of wild food plants species by types of organs used.

From Figure 5, it appears that wild food plants exploited in our four sites are mostly represented by their leaves (30.3%), followed by fruit (28.5%), seeds (17.8%) and bulbs (8.9%). Barks are the least exploited (2.3%).

Packing plant most collected in forests of Kindu and in the surroundings

We found out 5 species that are exploited as packing plants, namely: *Colocasia antiquorum*, *Xanthosoma sagittifolium*, *Sclerosperma mannii*, *Megaphryniumbrachystachyum* and *Maranthochloa purpurea*. Figure 6 shows the most collected packing plants in habitats surrounding these sites.

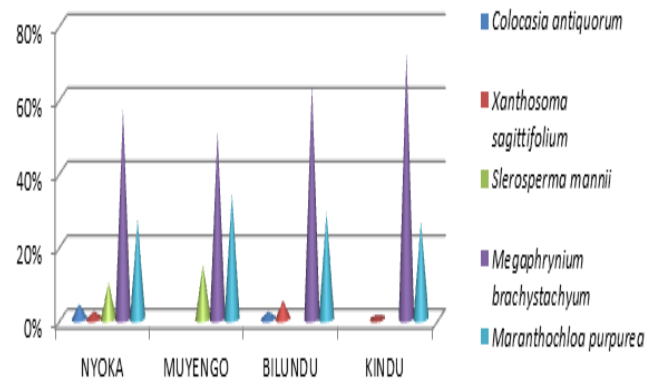


Figure 6. The most collected packing plant species.

In habitats surrounding Nyoka locality, *Megaphrynium brachystachyum* is the most exploited (57%), followed by *Maranthochloa purpurea* (27%), *Sclerosperma mannii* (10%). The other species are less exploited. The most exploited species in Muyengo is *Megaphrynium brachystachyum* (51%), *Maranthochloa purpurea* (34%) and *Sclerosperma mannii* (15%); *Megaphrynium brachystachyum* (64%), *Maranthochloa purpurea* (29%), and *Xanthosoma sagittifolium*(5%) in Bilundu; *Megaphrynium brachystachyum* (72.5%), *Maranthochloa purpurea* (26,6%) and *Xanthosoma sagittifolium* (0.8%) in Kindu.

The most collected plants for building in forests of Kindu and the surroundings

Figure 7. Most collected plants for building in the habitats of our survey sites.

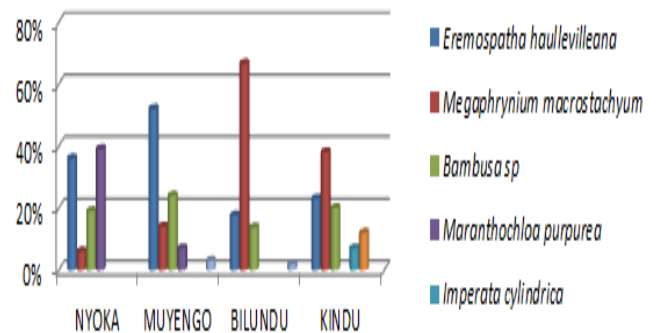


Figure 7. Most collected plants for building in the habitats of our survey sites.

The most exploited plant for building in the habitats of Nyoka locality are: *Maranthochloa purpurea* (39%), *Eremospatha haullevilleana* (36%) and *Bambusa sp* (19%); *Eremospatha haullevilleana* (52%), *Bambusa sp* (24%) and *Megaphrynium brachystachyum* (14%) in Muyengo village;

Megaphrynium brachystachyum (66.6%), *Eremospatha haullevilleana* (17.6%) and *Bambusa sp* (13,7%) in Bilundu village; *Megaphrynium brachystachyum* (38%), followed of *Eremospatha haullevilleana* (23%), of *Bambusa sp* (20%) and of *Sclerosperma mannii* (12%) in Kindu city.

Medicinal plants most collected in the forests of Kindu and the surroundings

Figure 8 illustrates medicinal plants collected in the habitats surrounding our sites of survey.

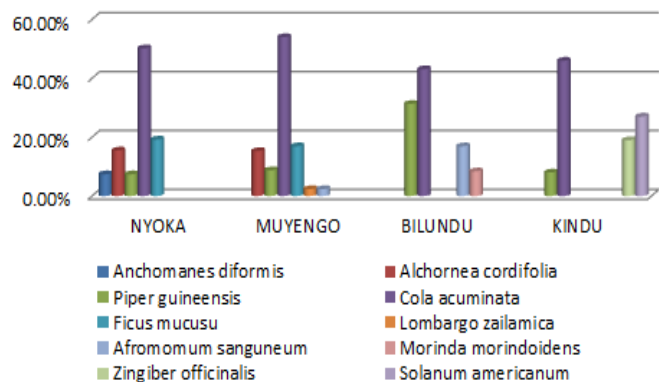


Figure 8. Medicinal plants most collected in the habitats surrounding the four sites of survey

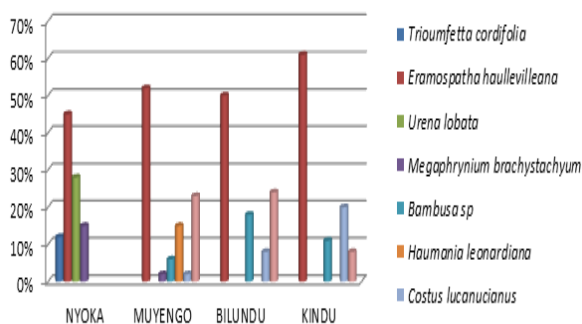
The analysis of Figure 8 shows that *Cola acuminata* (50.2%), *Ficus mucusu* (19.2%) and *Alchornea cordifolia* (15.5%) are the most exploited in Nyoka; *Cola acuminata* (54%), *Ficus mucusu* (16.9%) and *Alchornea cordifolia* (15.3%) in Muyengo; *Cola acuminata* (43.10%), *Piper guineensis* (31.3%) and *Afromomum sanguineum* (16.9%) in Bilundu; *Cola acuminata* (46%), followed of *Solanum americanum* (27%) and of *Zingiber officinalis* (19%) in Kindu city.

Textile plant collected in habitats of our survey sites

Table 1 presents the most collected textile plants in the habitats of our survey sites.

The results show that forest operators prefer *Raffia gillettii* and *Raffia sesse* as textile plants. **Plant used for making works of art**

Figure 9 presents plants used for making works of art in our survey sites.



Face 9. Plant used for making works of art in our survey sites

The analysis of Figure 9 shows that *Eremospatha haullevilleana*(45%), *Urena lobata* (28%) and *Megaphrynium brachystachyum* (15%) are used in Nyoka; *Eremospatha haullevilleana* (52%), *Raffia gillettii* (23%) and *Haumania leonardina* (15%) in Muyengo village; *Eremospatha haullevilleana* (50%), *Raffia gillettii* (24%) and *Bambusa sp* (18%) in in Bilundu; *Eremospatha haullevilleana* (61%), *Costus lucanucianus* (20%) and *Bambusa sp* (11%) in Kindu.

Groups of NTFP that can be exploited without travelling long distances

In the four sites of survey, we also observed that some forest operators travel long distances to collect Non-Timber Forest Plants and others collect them near their dwellings. Figure 10 presents groups NTFP that can be exploited without travelling long distances.

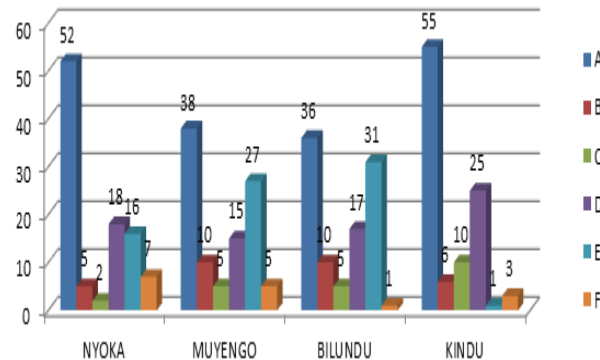


Figure 10. Groups of NTFP that can be exploited without travelling long distances

A = wild food Plants; B = packing Plants; C = Plants for building; D = medicinal Plants; E = textile Plants; F = Plants for making works of art

As Figure 10 shows, those are wild food plants collected without travelling long distances (Nyoka (52%), Muyengo (38%), Bilundu (36%) and Kindu (55%)). The reason for this is that some wild food plants grow near dwellings and many grow in fallows and fields near villages.

For Nyoka locality, after wild food plants rank medicinal plants (18%), followed by textile plants (16%). In Muyengo, textile plants (27%) are followed by wild food plants as for the distance covered, followed by medicinal plants (15%). In Bilundu village, after wild food plants rank textile plants (31%) followed by medicinal plants(17%). And in Kindu city, medicinal plants (25%) are collected near dwellings, ranking second after wild food plants, and plants used for building rank in third position (10%).

Frequency (per week) of exploitation of NTFP of plant origin in Kindu city and its surroundings

Most of poor rural and urban populations live on vital manner of the exploitation of the natural areas. Hence forest operators of our survey sites, frequent habitats in their surroundings every week.

Table 1. Textile plant collected in the forests of Nyoka village

Sites	TEXTILE PLANTS			Number of repetition	Rate (%)
	Scientific names	Vernacular names	Family		
Nyoka	<i>Raphia gillettii</i> and <i>R. sesse</i>	Mpeku	Arecacée	187	100
	Total			187	100
Muyengo	<i>Raphia gillettii</i> and <i>R. sesse</i>	Mpeku	Arecacée	124	100
	Total			124	100
Bilundu	<i>Raphia gillettii</i> and <i>R. sesse</i>	Mpeku	Arecacée	153	100
	Total			153	100
Kindu	<i>Raphia gillettii</i> and <i>R. sesse</i>	Mpeku	Arecacée	233	100
	Total			233	100

In Figure 11, we present the frequency (per week) of exploitation of Non-Timber Forest Plants of plant origin in the habitats of Kindu, Nyoka, Bilundu and Muyengo.

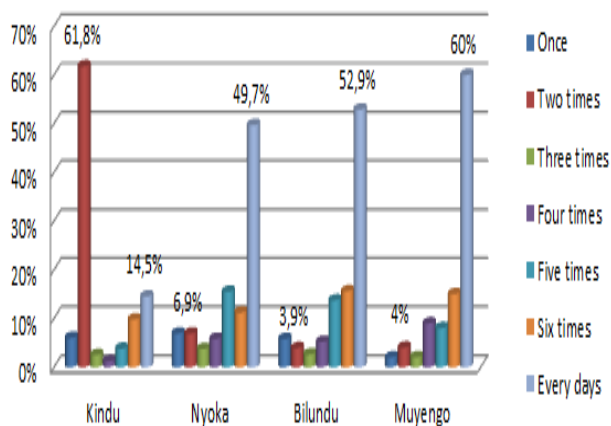


Figure 11. Frequency (per week) of exploitation of NTFP of plant origin in forests of Kindu and its surroundings

These histograms show that, 61.8% forest operators frequent their habitats two times per week in Kindu city and 14.5% frequent them every day. In Nyoka, 49.7% frequent the habitats every day, while 15.5% operators frequent them five times per week and 11.2% six times per week. In Bilundu 52.9% frequent habitats every day, 15.6% frequent six times per week and 13.7% five times per week. And in Muyengo, 60% frequent every day, 15% six times per week and 9% four times per week.

Discussion

In Nyoka village, we identified in total 42 species used as Wild Food Plants (WFP), among which eight (8) are the most exploited. *Amaranthus viridis* (LINNE) is the most exploited, followed by *Colocasia antiquorum. var. esculenta*, and *Xanthosoma sagittifolium*. In the habitats of Muyengo village, 33 species have been inventoried, eight (8) are the most exploited such as *Amaranthus viridis*, *Colocasia antiquorum* and *Xanthosoma sagittifolium*. In Bilundu village, out of 34 species inventoried, *Dioscorea prehensilis*, *Amaranthus viridis* and of *Pteridium aquilinum* are the most exploited. In Kindu city, out of 38 species *Amaranthus viridis* is the most exploited, followed by *Xanthosoma sagittifolium*, *Colocasia antiquorum* and *Talinum triangulare*.

In Central Africa Republic, Georges N'Gasse (2010) found that among Wild Food Plants exploited in the habitats neighboring Bangui capital city, eight species are the most consumed: *Gnetum africanum*, *Gnetum buchhol*, *Dostenia psilumus*, *Irvingia excelsa*, *Raffia sp.*, *Afrotyrax lépido*, *Xylopia aetiopica* and *Megaphrynium macrostactis*.

In Congo Brazzaville, Loubelot (2012) found that among all these NTFP inventoried in the country, the most consumed are: *Gnetum africanum*, *Trilepisium madagascariense* and *Dioscorea liebrechtsiana*.

In his survey on the valorization of Non-Timber Forest Products of Bateke plateau in the surroundings of Kinshasa (DRC), Biloso (2008) found that *Pteridium sp.*, *Dioscorea praehensilis* and *Talinum triangulare* are the most consumed NTFP species in Kinshasa and its surroundings.

In Ubundu territory, among Kumu tribe (Tshopo, DRC), Tshibidi (2012) found that *Megaphrynium macrostachyum*, *Canarium schweinfurthii* and *Tetracarpidium conophorum* are the most consumed species. These findings show that these plants, particularly *M. macrostachyum*, are very important in this population's diet.

In this study, we found wild food plants exploited in our four survey sites are mostly represented by leaves (30.3%), fruits (28.5%), seeds (17.8%) and bulbs (8.9%). Barks are the least exploited (2.3%). On the other hand, in Yahuma, Paluku and al. (2011) found that fruits or pulps are the most consumed organs, followed by leaves eaten as vegetables or brewed, while stems and roots are less used. Termote and al. (2011) found among Turumbu, Mbole and Bali tribes (Tshopo, DRC) that fruit and leaves are the most used organs of WFP.

In this study, we found that *Cola acuminata* that is the most exploited in Nyoka as medicinal plant (50.2%), followed by *Ficus mucusu* (19.2%) and *Alchornea cordifolia* (15.5%); *Cola acuminata* (54%), *Ficus mucusu* (16.9%) and *Alchornea cordifolia* (15.3%) in Muyengo; *Cola acuminata* (43.10%), *Pipe guineensis* (31.3%) and *Aframomum sanguineum* (16.9%) in Bilundu village; *Cola acuminata* (46%), *Solanum americanum* (27%) and *Zingiber officinalis* (19%) in Kindu city.

Malaisse (1997) pointed out 9 species with a medicinal importance in Katanga Province already and Zambezi region, namely: *Aframomum giganteum*, *Cola acuminata*, *Garcinia kola*, *Hymenocardia acida*, *Mondia whitei*, *Morinda morindoides*, *Pipe guineense*, *Cassia alata* and *Rauwolfia vomitoria*.

Conclusion

One of the specific objectives of this survey is to identify NTFP of plant origin exploited in forests of Kindu city and its surroundings.

During data collection, we combined participating observation techniques, structured interviews and interview with household chiefs, focus group and individual survey with operators of different habitats and documentary technique.

The results showed that:

1. Most forest operators (37%) in the four survey sites collect NTFP plant origin in forests, 23% in fallows and 16% in fields. This makes us say the forest is the most exploited habitat in the four sites.
2. In the four survey sites, wild food plants are the most exploited (38%), followed by plants used in building (25%), and plants used for making works of art (17%).
3. In Nyoka, Muyengo and Kindu, the most exploited wild food plant is *Amaranthus viridis*, but *Dioscorea prehensilis* (30%) in Bilundu;
4. In all of the four survey sites, *Megaphrynium brachystachyum* is the most exploited as packing plant;
5. Plants used for building are *Maranthochloa purpurea* (39%) in Nyoka, *Eremospatha haullevilleana* (52%) in Muyengo, *Megaphrynium brachystachyum* in Bilundu and Kindu;
6. *Cola acuminata* is the most exploited medicinal plant in all of the four sites;
7. *Raffia gillettii* and *Raffia sesse* are exploited as textile plants in all of the four sites;
8. *Eremospatha haullevilleana* is exploited as plant used for making works of art in all the sites.





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