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Original article

Behavior of the use category of non-timber forest products in Cabinda, Angola

Comportamiento de la categoría de uso de los productos forestales no madereros en Cabinda, Angola

Comportamento da categoria de uso de produtos florestais não madeireiros em Cabinda, Angola

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ABSTRACT

Non-timber forest products (NTFPs) are resources used by populations, whose knowledge constitutes the means of subsistence of various rural communities. The objective of this work was to evaluate the behavior of the category of use. The work was carried out in the province of Cabinda, from January 2019 to November 2021, where the following questions were asked: open (they allowed collectors to freely present their considerations and information) and closed (they included possible answers that could be selected by the collectors). These questions were applied to the sellers of these products, where a preliminary test was applied to a sample of 30 individuals, in order to adjust the questionnaire and work through the exposed procedure to social studies, with 100%: 120 people (90 women and 30 men). The ethnobotanical indices were also analyzed: Relative Frequency of Citations (FRC), Use Value (VU) and Sorting Priority. The most cited species as use category were: *Glycyrrhiza glabras, Zingiber officinale* and *Pausinystalia macroceras*.

Keywords: Questionnaire; Ethnobotanical indices and non-timber forest products.

RESUMEN

Los productos forestales no madereros (PFNMs) son recursos utilizados por las poblaciones, cuyo conocimiento constituyen el medio de subsistencia de diversas comunidades rurales. El objetivo de este trabajo fue evaluar el comportamiento de la categoría de uso. El trabajo se desarrolló en la provincia de Cabinda, en la fecha comprendida entre enero del año 2019 hasta noviembre de 2021. Se realizaron preguntas abiertas que permitieron a los colectores exponer libremente sus consideraciones e informaciones y cerradas que incluían las posibles respuestas que pudieron ser seleccionadas por los colectores, las cuales se aplicaron a los vendedores de estos productos, donde se aplicó una prueba previa a una muestra preliminar de 30 individuos, con la finalidad de ajustar el cuestionario. Se trabajó a través del procedimiento expuesto para estudios sociales, con el 100 %: 120 personas (90 mujeres y 30 hombres). También se analizó los índices etnobotánicos: Frecuencia Relativa de Citaciones (FRC), Valor de Uso (VU) y Prioridad de Ordenamiento. Las especies más citadas como categoría de uso fueron: *Glycyrrhiza glabras, Zingiber officinale* y *Pausinystalia macroceras*.

Palabras clave: Cuestionario; Índices etnobotánicos y productos forestales no madereros.

RESUMO

Os produtos florestais não madeireiros (NTFPs) são recursos utilizados por populações cujo conhecimento constitui o sustento de várias comunidades rurais. O objetivo deste trabalho era avaliar o comportamento da categoria de uso. O trabalho foi realizado na província de Cabinda, de janeiro de 2019 a novembro de 2021. Perguntas abertas que permitiram aos coletores expressar livremente suas considerações e informações e

perguntas fechadas que incluíam as possíveis respostas que poderiam ser selecionadas pelos coletores foram aplicadas aos vendedores desses produtos, onde um pré-teste foi aplicado a uma amostra preliminar de 30 indivíduos, a fim de ajustar o questionário. Trabalhamos através do procedimento descrito para os estudos sociais, com 100%: 120 pessoas (90 mulheres e 30 homens). Os índices etnobotânicos também foram analisados: Frequência relativa de citação (CRF), Valor de uso (UV) e Prioridade de gerenciamento. As espécies mais citadas como categoria de uso foram: Glycyrrhiza glabras, Zingiber officinale e Pausinystalia macroceras.

Palavras-chave: Questionário; Índices etnobotânicos e produtos florestais não madeireiros.

INTRODUCTION

Non-timber forest products (NTFPs) come from resources available in natural forests, agroforestry systems and plantations, and also include medicinal and food plants, such as: fruits, chestnuts, resins, latex, essential oils, blades, fodder, fungi, fauna and wood for the manufacture of handicrafts (Sarmiento *et al.,* 2017).

NTFPs are resources most used by traditional populations and whose knowledge is of great importance, they constitute the means of subsistence for diverse rural communities and indigenous peoples in the tropics, being also significant elements of the rural and regional economy in various countries. At the same time, they play an important role in the culture and identity of various peoples in all the songs of the planet (Zamora Martínez, 2017).

Kussumua (2021) explains that, in Angola, as in most African countries, the different communities and ethnic groups traditionally have the forest as an important part of their lives, before any other source of subsistence. For this reason, the same author states that it is important to change the vision in the management of NTFPs plants, seeking a balance in achieving monetary gains and the need of conserving resources. Therefore, it is essential to implement actions to achieve sustainability and proper forest management.

In Cabinda there is an inappropriate use of NTFPs by local populations, by selling in different places that are not established by the government: squares and other clandestine areas (Buza *et al*., 2006).

Unfortunately, there is no control of NTFPs by the authorities in the maiombe forest, which means that the state of these species in their habitat is unknown, as there is an increase in their sale.

MATERIALS AND METHODS

Location of the work area

The research was carried out in the province of Cabinda, in the different places, such as: Cabassango, San Pedro, Uneca and Ngoma, Figure 1, on the date between January 2019 and October 2021 (Figure 1).

Figure 1. - Location of area of study

Edaphic characterization

The soils are classified as the differentiated alluvial type on carbonate transported material, with characteristics of a deep, red-yellow horizon, with excellent structure and low fertility. They were also described with a profile A, B, C, when they present transition horizons, deep, with a moderately deep brown to yellowish brown A horizon, with color 10 YR 5/8 to 7.6 YR 6/8. The clay is less than 50 % and the sand fraction acquires high values, which can vary from 30 to 60 %, where fine sand predominates and the apparent density acquires relatively high values, varying between 1.25-1.45 g/cm³, which translates into total porosity values between 60-45 % (FAO, 2008).

The same author explains that as part of the chemical properties, in the upper horizons, the organic contents oscillate between 2.26-3.86 % and a noticeable decrease with depth is observed, slightly acidic pH between 5.5 - 6.6 and its degree of saturation ranges from 45 to 60 %.

Climatic characterization

Figure 2 represents the climatic characteristics of the Cabinda municipality, according to the meteorological station, from 2009 to 2021. The average annual temperatures are 34.58ºC and the average rainfall is 909 mm per year. The driest months are from April to the second half of October and in December, while from January to the first half of April they are rainy and November is the rainiest month, with over 100 mm. In general, it is characterized by a dry climate (Figure 2)

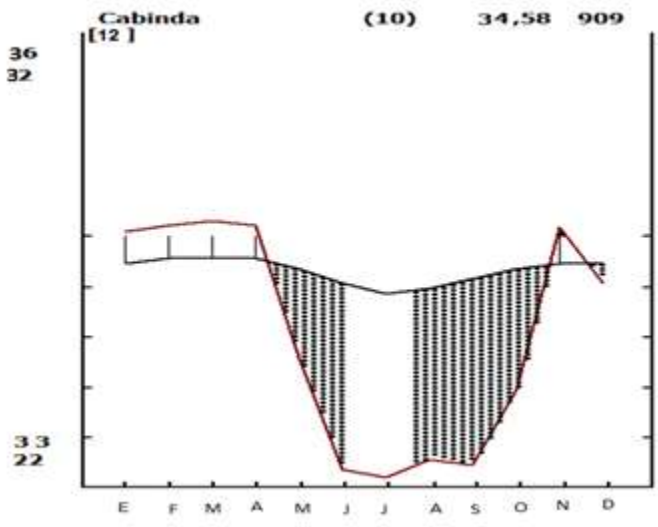

Figure 2. - Climodiagram of the Cabinda Meteorological Station (from 2009 to 2021)

Determination of the use category of NTFPs

To collect this information, a questionnaire was used as a fundamental tool for collectors of NTFPs, to learn about their main uses and benefits, where different questions were asked:

- Open: that collectors can freely expose their considerations and information.
- Closed: includes the possible answers that could be selected by the collectors.

At the same time, the closed questions that were used were: bivalent (they gave two possible answers, which were, obviously, exclusive and antonymous) and with exclusive alternatives (they offered several possible answers but were mutually rejected).

A pre-test was applied to a preliminary sample of 30 individuals, in order to adjust the questionnaire as explained by López-Beltrán *et al*. (2021), which allowed to achieve complementary elements on the problem.

After carrying out the previous test and redesigning the questionnaire, it was applied to the determined sample through the procedure described for social studies.

In it, there are a total of 120 people (90 women and 30 men). 100 % of the people were studied, with the aim of knowing the uses and benefits of the non-timber forest products that exist in the province of Cabinda.

Ethnobotanical analysis

For the analysis of the ethnobotanical indices, the following equations recommended by Tardío and Prado (2008) and López-Beltrán *et al.* (2021) were used:

The Relative Frequency of Citations (FRC): its objective is to identify the species considered useful by the community (Equation 1).

$$FRC= FC/N*100 \quad (1)$$

Where:
FC = number of informants who mentioned the use of the species.
N = total number of informants.

Value of Use (VU): evaluates the relative importance of a species cited by the informants (Equation 2).

$$VU= (\Sigma U) /N \quad (2)$$

Where:

∑U = result of the sum of the number of uses for the given species mentioned by the informant (U).
N = total number of informants (N).

Ordering priority (ROP "Rank Order Priority"): used for the category of medicinal use, in which associated with the FL it presents a new level of agreement, regarding the distribution in the category of use studied, of the knowledge of the species compared to species richness (Equation 3).

$$ROP=FL*RP \quad (3)$$

Where:
FL = fidelity level
RP = relative popularity (calculated by the ratio of the number of informants who cited a given species, by the number of informants who cited the most cited species).

RESULTS AND DISCUSSION

Determination of the use category of plant NTFPs

Table 1 shows the forest formations of the collection, where 70 % of the population recognize the place of collection of the products and 30 % do not, in which 12 families appear, with five species of Fabaceae (Glycyrrhiza *glabra* L.., *Epinephelus tukula* Morgans 1959, *Pterocarpus tinctorius* Welw, *Erythropleum suaveolens* (Guill. & Perr.) Brenan and *Burkea africana* Hook.); three from Anacardiaceae (*Anacardium occidentale* L. *Spondias mombin* L. and *Mangifera indica* L.).

It can also be observed that two species are found: Myristicaceae (*Staudita stepitata* (Warb.) Warb, *Pycnanthus angolensis* (Welw.) Warb and Cucurbitaceae (*Senna occidentalis* (L.) Link and *Momordica charantia* L.); there are also families with one species: Zingibernaceae (*Zingiber officinale* Rosoe 1807); Rubiaceae (Pausinystalia *macroceras* (K. Schum.) Pierre Ex Bille); Chenopodiaceae (*Chenopodium ambrosioides* L.); Combretaceae (*Terminalia superba* Engl. & Diels); Moraceae (*Chlorophora exceisa* (Welw.) Benth); Sapotaceae (*Baillonella toxisperma* Pierre); Myrtaceae (*Psidium guajava* L.); Meliaceae (*Azadirachta indica* A. Juss) (Table 1).

Table 1. - Forest formation of the collection of NTFPs

Species	Family	Forest formation of the collection
***Glycyrrhiza glabra* L.**	Fabaceae	Dense humid forest under Maiombe
***Zingiber officinale* Rose 807**	Zingibernaceae	Dense humid forest under Maiombe
***Pausinystalia macroceras* (K. Schum.) Pierre ex Bille**	Rubiaceae	Savannahs with bushes
***Chenopodium ambrosioides* L.**	Chenopodiaceae	Savannahs with bushes
***Epinephelus tukula* Morgans 1959**	Fabaceae	Dense moist evergreen forest (Maiombe)
***Terminalia superba* Engl. & Diels**	Combretaceae	Dense moist evergreen forest (Maiombe)
***Staudita stepitata* (Warb.) Warb**	Myristicaceae	Dense moist evergreen forest (Maiombe)
***Chlorophora exceasa* (Welw.) Benth.**	Moraceae	Dense moist evergreen forest (Maiombe)
***African Burkea* Hook.**	Fabaceae	Dense humid semi-deciduous forest (under maiombe)
***Pterocarpus tinctorius* Welw.**	Fabaceae	Dense moist evergreen forest (Maiombe)
***Baillonella toxisperma* Pierre**	Sapotaceae	Dense moist evergreen forest (Maiombe)
***Senna occidentalis* (L.) Link**	Cucurbitaceae	Savannahs with bushes
***Spondias mombin* L.**	Anacardiaceae	Savannahs with bushes
***Psidium guajava* L.**	Myrtaceae	Savannahs with bushes
***Mangifera indica* L.**	Anacarrdiaceae	Savannahs with bushes
***Momordica charantia* L.**	Cucurbitaceae	Savannahs with bushes
***Pycnanthus angolensis* (Welw.) Warb**	Myristicaceae	Dense moist evergreen forest (Maiombe)
***Azadirachta indica* A. Juss.**	Meliaceae	Savannahs with bushes
Anacardium occidentale L.	Anacardiaceae	Savannahs with bushes
***Erythropleum suaveolens* (Guill.& Perr.) Brenan**	Fabaceae	Dense moist evergreen forest (Maiombe)

In the study, it was noted that ten species are from the evergreen humid dense forest formation (Maiombe), ten belong to the shrubby savannah formation, and two are from the semi-deciduous humid dense formation (low Maiombe). This indicates that most of the NTFPs come from formations that have excessive exploitation for wood and affect these products.

Similar results coincide with León-Merino *et al*. (2017) when affirming that when forests and savannahs are properly managed, they provide products and services in a sustainable way. However, when this is not done, the rate of deforestation and degradation thereof increases, through indiscriminate logging, degradation of the ecosystem and affectation of the soils.

The natural resource that is most extracted in Angola is forestry. That is in correspondence with Malengue (2019) who states that the existence of greater logging, causes many non-timbers forest products to be little used.

It can be seen in table 2, the purpose of use and medicinal indications of the species, where 88 % of people recognize it and 12 do not, which explains that, among the species, 17 are medicinal, 11 used as fuel and nine belong to the food category, one to condiment, six artisanal and five provide shade. Several medicinal indications are also shown, in which five are used for diarrhea, three based on malaria, one without medicinal indications and the rest have various forms of treatment (Table 2).

Table 2. - Purpose of use and medicinal indications of the species

Species	**Purposes of uses**	**medicinal indications**
Glycyrrhiza glabra	M;	Anti-inflammatory
Zingiber officinale	M; Co	Joints, digestive system
Pausinystalia macroceras	M	Sexual impotence
Chenopodium ambrosioides	M;	Cough, hemorrhoids
Epinephelus tukula	M; S	Beauty
Terminalia superba	M: Fu; S	Hemorrhoids, diarrhea
Staudita stepitata	M; Fu.	Hemorrhoids, diarrhea
Chlorophora excesa	M; Fu.	Dental cavities antibiotic
african burkea	Fu; M	Body aches
Pterocarpus tinctorius	Fu; Art	---------
Baillonella toxisperma	Art; Fu; M;	Toothache
Senna occidentalis	M;	Colic, malaria, like coffee
spondias mombin	F; M	Diarrhea
Psidium guajava	M; Fu; F	Dry diarrhea
Mangifera indica	F; Fu; M	Tummy aches
Momordica charantia	M	Diabetes
Pycnanthus angolensis	Fu; M	Malaria
Azadirachta indica	M;	Tummy aches, malaria
Anacardium occidentale	F; Fu; M	Diabetes, glucose
Erythropleum suaveolens	M; Fu; S	Had

Product acronyms: (F) = food, (Art) = craft, (Fu) = fuel, (M) = medicinal, (Co) = Condiments and (S) = shade.

In the table 3, the way of preparing the products and the used part of the species is observed, where 92 % of people recognize it and 8 % do not. In addition, 15 are consumed as tea, four raw, six in syrup, two in powder, five for bath and four cooked. Moreover, the most used parts of the different species are: roots, leaves, fruits, seeds, stem and bark.

The results show that the medicinal category is the most representative, when relating to Téllez-Velasco (2018), who report that human beings use plant species for the evaluation and treatment of their diseases in all cultures since Antiquity, by bringing the knowledge of their ancestors about medicinal plants.

Generally, the production of medicines is done by residents who learned through the knowledge inherited from their parents and grandmothers, stories that correspond to Sarmiento *et al*. (2017), where they say that the collection of parts of the plants for

medicinal use is done whenever it is needed to meet orders or for consumption by people from the community (Table 3).

Table 3.- Way of preparing the products and used part of the species

Species	Way to prepare	used part
Glycyrrhiza glabra	Tea	Roots, Leaves
Zingiber officinale	Raw, Cooked, Tea	Roots, Fruits, Seeds, Leaves
Pausinystalia macroceras	Tea	Shells, Leaves , Fruits
Chenopodium ambrosioides	Raw, Bath, Syrup	Leaves, Roots, Stem
Epinephelus tukula	Dust	Shells, Leaves , Stem
Terminalia superba	Tea	Shells, Leaves , Seeds
Staudita stepitata	syrup, Tea	Husks, Leaves , Roots
Chlorophora excesa	Syrup Tea	Roots, Husks
african burkea	Bath, tea	Husks, Leaves , Roots
Pterocarpus tinctorius	Dust	Husks, Leaves , Roots, Seeds
Baillonella toxisperma	Syrup	Husks, Leaves , Roots, Seeds
Senna occidentalis	Tea, Stew	Leaves, Seeds, Roots
spondias mombin	Tea _	Leaves, Roots
Psidium guajava	Bath, syrup	Leaves, Fruit, Stem
Mangifera indica	Tea, Stew, Raw	Leaves, Roots, Fruits, Seeds, Stem
Momordica charantia	Tea, Bath, Crude	Seeds, Leaves, Fruits
Pycnanthus angolensis	Tea	Stem, Seeds, Leaves
Azadirachta indica	Tea, Bath, Syrup	Leaves, Seeds, Stem, Roots
Anacardium occidentale	Tea, Raw	Leaves, Peels, Fruits
Erythropleum suaveolens	Tea, Bath, Syrup	Husks, Leaves Roots

The predominant form of preparation was tea, from the leaves and peels of various species such as: *Glycyrrhiza glabra, Zingiber officinale* and *Pausinystalia macroceras* and there are different ways of obtaining: the leaves from *Azadirachta indica* are removed and boiled, then they are cooled off for ten minutes for typhoid treatment. The peel of *Pausinystalia macroceras* is also boiled for treating dysfunction and the stem of *Epinephelus tukula* is left to dry, then it is turned into powder for traditional rituals and beauty treatments.

These results coincide with Tardío and Prado (2008) who explained that the forms of preparation also have great importance in an ethnobotanical survey, in this study, the forms of preparation found were: syrup, bath, tea, macerated powder, raw and cooked.

According to the interviewees, the knowledge of the use of the plants is based mainly from father to son (vertical sense), due to the exchange of information between the neighbors (horizontal sense), mainly when it comes to medicinal species and even by simple observation, when corresponding with Jiménez *et al*. (2018), who talk about the most used part of the plant (roots, leaves, seeds, peel, stems and fruits), in order to help low-income rural and urban communities.

In table 4, the current occurrence of plant species is observed, where 44 % are large, 35 % medium and 21 % small, which of the 21 species: 13 are large (arboreal), six medium (shrubs) and one small (herbaceous) (Table 4).

Table 4. - Current status of plant species

Species	Current status of the species (Small, Large, Medium)
Glycyrrhiza glabra	Stocking (shrub)
Zingiber officinale	Stocking (shrub)
Pausinystalia macroceras	Large (arboreal)
Chenopodium ambrosioides	Stocking (shrub)
Epinephelus tukula	Large (arboreal)
Terminalia superba	Large (arboreal)
Staudita stepitata	Large (arboreal)
Chlorophora excesa	Large (arboreal)
african burkea	Large (arboreal)
Pterocarpus tinctorius	Large (arboreal)
Baillonella toxisperma	Large (arboreal)
Senna occidentalis	Stocking (shrub)
spondias mombin	Large (arboreal)
Psidium guajava	Stocking (shrub)
Mangifera indica	Large (arboreal)
Momordica charantia	Small (herbaceous)
Pycnanthus angolensis	Large (arboreal)
Azadirachta indica	Large (arboreal)
Anacardium occidentale	Large (arboreal)
Erythropleum suaveolens	Large (arboreal)

The results show that the most used NTFPs are the arboreal type, coinciding with Aguirre and Aguirre (2021), who explain that the organs used are flowers, fruits, peels, roots, leaves and seeds available in a certain season of the year.

In rural communities, NTFPs are a form of self-subsistence, which is in correspondence with López-Beltrán *et al*. (2021) that demonstrate the great importance of products for the rural and regional economy, as well as the important role in culture, identity, folklore, local spiritual practices. Besides, NTFPs provide rural communities with vital resources such as medicines, food, shelter and source of income.

Table 5 shows the perception of the plant and times of collection of NTFPs, where 93 % do not recognize their perception but seven do. While 45 % collect it in the rainy season, 55 % do it in the dry season, which shows that 15 species are collected in the rainy and dry season, only three in the dry season and two during the rainy season (Table 5).

Table 5. - Perception of the plant and times of collection of NTFPs

Species	Plant perception	Picking time
Glycyrrhiza glabra	Common	Rainy and dry
Zingiber officinale	Common	Rainy and dry
Pausinystalia macroceras	Limited	Rainy and dry
Chenopodium ambrosioides	Common	Rainy and dry
Epinephelus tukula	Limited	Rainy and dry
Terminalia superba	Abundant	Rainy and dry
Staudita stepitata	Common	Rainy and dry
Chlorophora excesa	Abundant	Rainy and dry
african burkea	Abundant	Rainy and dry
Pterocarpus tinctorius	Abundant	Rainy and dry
Baillonella toxisperma	Abundant	Rainy and dry
Senna occidentalis	Abundant	Dry
spondias mombin	Common	Dry
Psidium guajava	Common	Rainy and dry
Mangifera indica	Abundant	Rainy and dry
Momordica charantia	Abundant	Rainy and dry
Pycnanthus angolensis	Abundant	Rainy
Azadirachta indica	Common	Rainy and dry
Anacardium occidentale	Common	Rainy and dry
Erythropleum suaveolens	Common	Dry

Most of the NTFPs are collected in the rainy and dry season, according to the characteristics of each species in the area. These results coincide with Zamora Martínez (2017), who affirms that the harvest of goods and services is within the limits of productivity of the system, of the capacity of support and of its level of guarantee of the permanent operations in the ecosystems.

These results suggest that *Glycyrrhiza glabra*, *Zingiber officinale Pausinystalia macroceras*, *Azadirachta indica* and *Momordica charantia* are species of high value for the local community, and these results coincide with Aguirre *et al*. (2019) when stating that these products are among the most mentioned in studies carried out in different communities.

Figure 3 shows the relative frequency which allows knowing the management and conservation of the species, from the importance of their uses. That is in correspondence with what was indicated by Sánchez *et al*. (2020), who explained that, with the values achieved, these species provide quality of life for families under various aspects and diversity of use (Figure 3).

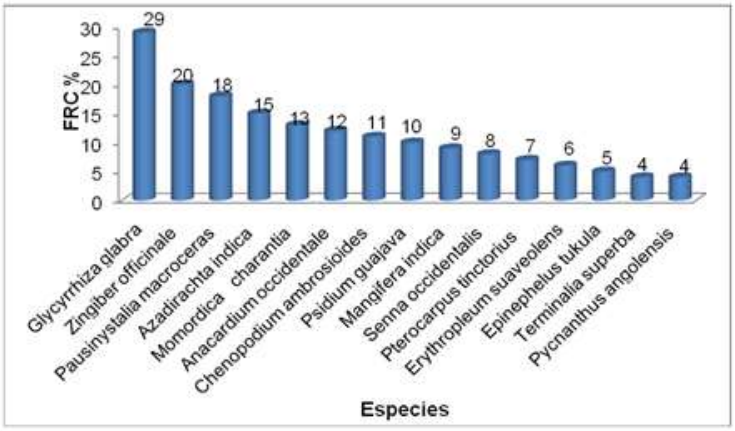

Figure 3. – Relative frequency of the plant species of the NTFPs

Figure 4 shows the use value of the species, where the species with the highest use value are shown: *Pausinystalia macroceras*, *Anacardium occidentale* and *Staudita stepitata.* Since the ethnobotanical study is the first multidisciplinary step, it allows ecophysiological knowledge, to assist in the management and conservation of species from the importance of their uses, according to González *et al*. (2017), which agrees with the values achieved, where these species contribute to improving the quality of life of these families under various aspects and with a diversity of use (Figure 4).

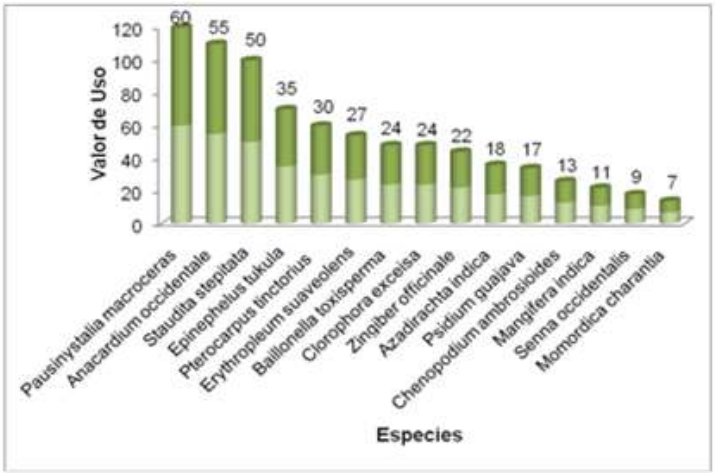

Figure 4. – Use value of plant NTFPs

Figure 5 shows the absolute frequency of the species by category of use, where it is identified that there is a greater predominance of medicinal and fuel, coinciding with these results Téllez-Velasco *et al.* (2018), explaining that the communities have extensive knowledge regarding the use of species, in addition to their relationships and cultural practices they have regarding the care of the forest (Figure 5).

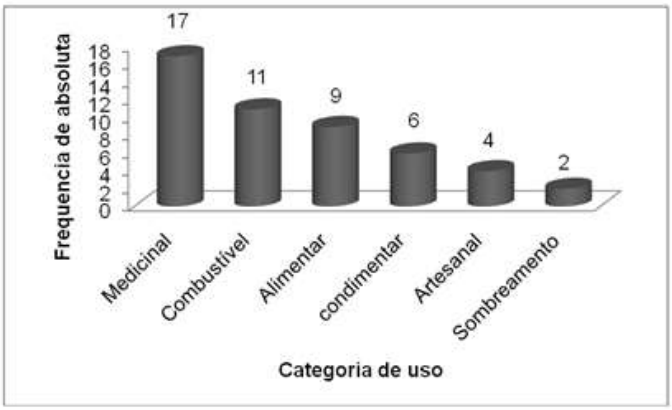

Figure 5. - Absolute frequency of plant species by category of use

Also in correspondence with these results are Jiménez *et al*. (2018), making it clear that the high value of rural communities for NTFP species is due to several factors: the low income of these populations, the distance from the urban area, inefficiency, and the cost of river transportation.

Figure 6 shows the ordering priorities, where the results show that the highest values are concentrated in *Glycyrrhiza glabra* (indicated in Anti-inflammatory treatments), *Pausinystalia macroceras* (treatment of sexual impotence), *Zingiber officinale* (treatment of joints and digestive system) and *Azadirachta indica* that treats cavities, stomach aches and malaria.

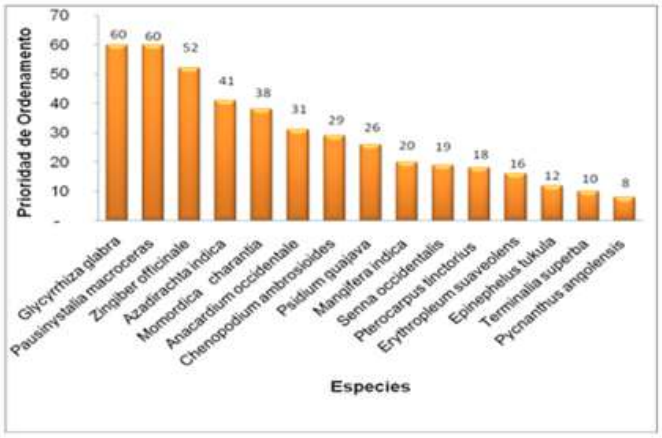

Figure 6. - Ordering priority of the most cited species

These results correspond to what was obtained by León-Merino *et al*. (2017), who affirm that all the wealth of knowledge regarding the therapeutic use of traditional plants by the populations originates in the need for an alternative therapeutic treatment. That, in many cases, is due to low incomes in contrast to the high prices of pharmaceutical medicines, because of the limited access to public health and the great cultural influence.

CONCLUSIONS

The species most cited as a category of use of NTFPs by rural communities were: *Glycyrrhiza glabras, Zingiber officinale* and *Pausinystalia macroceras*.

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