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Research Paper

Use of wild trees and shrubs as fodder and traditional veterinary medicine in Cameroon: ecological impacts and conservation

Souare Konsala^{1,2*}, Nkongmeneck Bernard-Aloys¹, Todou Gilbert¹, Fotso Roger-Corneille³, Fosso Bernard³, Biye Elvire-Hortense¹, Tchobsala⁴

1.University of Yaoundé I, Faculty des Science, PO Box: 812 Yaoundé, Cameroon,

*Corresponding author: ksouare07@gmail.com , Phone: (+237) 96 44 79 65

2.University of Maroua, Higher Institute of the Sahel, PO Box: 46 Maroua, Cameroon

3.Wildlife Conservation Society (WCS), PO Box: 3055 Messa, Yaoundé, Cameroon

4.University of Ngaoundéré, Faculty des Science, PO Box.: 454 Ngaoundéré, Cameroon

Abstract: A study was carried out at the northern periphery of the Mbam and Djerem National Park in Cameroon in order to value the potential of woody species used as fodder and traditional veterinary medicine by agro-pastoralists, and to assess the effects of improper exploitation on the victim plants. Interviews, the monitoring of ruminant animals and macroscopic observations of their faeces were made up in order to appreciate the palatable species. In total, 25 species distributed within 15 families were inventoried. 15 species were essentially used as fodder, 6 species were used to treat animal diseases and 4 species were used both as fodder and traditional veterinary medicines. The collection systems of the products consist of a simple gathering of fruits on the ground, harvesting directly the fruits, pruning branches and a complete felling of the plant. The systems that consist of collecting products by complete barking, total destruction of the root system, pruning or systematic felling of the plant have real ecological impacts on the survival victim plants, and then favour the reduction of the density of the resources. It was found that the damages caused on plants and the palatability are positively correlated (Pearson, $r = 0.82$; $p = 0.05$). It is urgent to elaborate strategies of exploitation which observe the conservation of the phylogenetic resources.

Keywords: Fodder, traditional veterinary medicine, ecological impacts, conservation, Cameroon

Introduction

Phylogenetic resources which are main components of biodiversity are used for different purposes, notably agricultural, medicinal, industrial, environmental, spiritual, cultural and ecological purposes. They are mostly on the basis of human and animal food. Grasses are the basis of ruminants' diet (Breman and Traoré, 1987), but woody plants constitute also a significant portion of animal food (Akpo, 1992; Souare, 2006). They are main source of nitrogen for animals. Shortage of fodder in dry season is a major concern for agropastoralists who live in the regions which are periodically dry. In fact, woody plants represent a valuable source of fodder as supplements in dry season. Many studies give the lists of species and their organs which are consumed by domestic animals and mention the various aspects such as chemical composition (Lampray *et al.*, 1980) and the techniques of plantations of the species (Okafor et Fernandès, 1987). Woody fodders which are mostly planted in South-East of Nigeria are: *Ficus* spp., *Bafia nitida*, *Acacia barberi* and *Newbouldia laevis*. Woody species are also mentioned as source of traditional veterinary medicines. In western Africa, decoction of leaves and roots of *Ximenia americana* is used to treat diarrhea of calves, and decoction of buds of the same species is used for eyedrop (Okafor et Fernandès, 1987). Studies carried out with the farmers and herders of the great regions of livestock in Burundi, Rwanda and Republic Democratic of Congo permitted to make an inventory of 242 species of indigenous trees and shrubs consumed by cattle, sheep and goats (Kanzila, 1994).

In Cameroon, stations are arranged in Wakwa in the Adamawa region and Bambui in the North-West region in order to test and popularize woody fodders, but only few species are recruited, while many species are known by farmers as fodders and veterinary medicines. There are ecological impacts linked to the abusive exploitation of the plant species used by agropastoralists. However, these impacts remain mixed in scientific researches. These ecological clashes are the consequences of ignorance of sustainable management of phylogenetic resources exploited by the farmers. It is quite obvious that woody plants contribute to the maintenance of potential production of the routes, but they are facing a general regression due to the steady decline in rainfall since the sixties, and the extension of cultivated areas (Onana, 1995).

It is urgent to carry out participatory studies in the agropastoral regions, and to make a list of all woody species which are used as fodders and veterinary medicines in order to elaborate strategies for exploitation which observe the conservation of phylogenetic resources.

The general goal of this article is to value the potential of woody species used as fodders and veterinary medicines in Cameroon. It is underpinned by three specific objectives:

- to identify woody species used as fodders and traditional veterinary medicines at the northern periphery of Mbam and Djerem national park;
- to highlight the damages related to the misuse of the plant products;
- to propose solutions for a development of operating strategies which observe the conservation of phylogenetic resources.

Materials and Methods

Study site

The Mbam and Djerem National Park in Cameroon is situated between 5°30' - 6°13' N, and 12°23' - 13°10' E (Figure). The area is characterized by a sudano-guinean climate, average monthly temperature is between 21.6 and 25.8°C and the annual

rainfall between 1 530.2 and 1 843.6 mm. It is situated in a transitional zone made up of semi-deciduous forest, savannas and successional forest at the northern part of the Congo basin rainforest. As such, the zone is very rich in biodiversity. The vegetation is characterized by savannas with main species such as *Daniellia oliveri*, *Terminalia glaucescens*, *Lophira lanceolata*, *Albizia* spp., *Bridelia ferruginea*, *Hymenocardia acida*, *Piliostigma thonningi* and *Annona senegalensis* (Letouzey, 1985). The geological substratum is formed of a series of gneiss and undifferentiated granites. About 74 villages are situated around the Park, with more than 20 680 inhabitants. On the basis of the proximity of the park (5 to 20 km), the population size and the dominant activity, namely livestock, 15 villages were chosen among them. The populations are composed of five main ethnic groups, notably Gbaya, Tikar, Haoussa, Babouté and Foulbé. They practise a small subsistence farming based on the cultivation of maize and cassava.

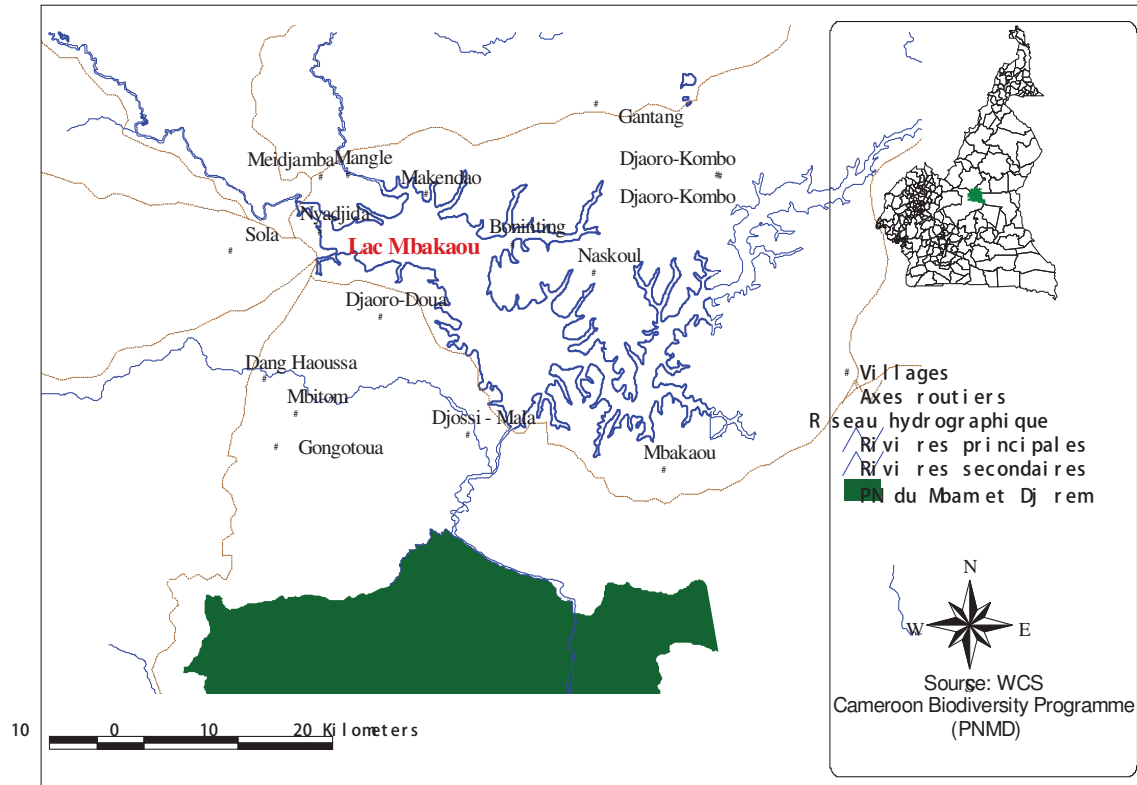


Figure 1: Location of the study site.

Methods

The stratified probability sampling method (Grange et Lebart, 1992) was adopted on a sample of 166 agropastoralists by using semi-structured interviews and interviews of target groups. The number of participants in interviews of target groups varies from 5 to 12 persons concerned by the study (Anonym, 1995). The interviews were focused on the woody species used to feed and treat domestic animals. The collected organs, the collection period and their use had been noted. This participatory approach was completed by the field method which was based on the observations of the eaten plants and the macroscopic examination of faeces (Atger, 1995; Onana et Devineau, 2002) in order to note the species appreciated by animals. The palatability was recorded from 1 to 5 (1 = occasionally consumed species; 2 = weak consumed species; 3 = moderately consumed species; 4 = highly consumed species; 5 = highly sought after species).

Damages caused by animals and agropastoralists on fodder species were coded in three classes: class 1 for species which show little evidence of harvested organs; class 2 for species that the size of damages reaches 50 %; class 3 for the species that the size of damages is greater than 50 % (Onana, 1995).

Data processing and analysis

Species inventoried are accompanied by the notes of use, they are also named according to the international nomenclature and the corresponding families are indicated. Coefficient correlation « r » between the palatable species and the damages caused to the species was calculated by using R software version 2.14.1.

Results

Fodder and taxonomic diversity

At the northern periphery of Mbam and Djerem National Park, 19 species which belong to 11 Families were inventoried as fodders. Leguminosae which represented 36.84 % are the most important. The main species were: *Daniellia oliveri*, *Piliostigma thonningii*, *Piliostigma reticulatum* and *Azelia africana*. The organs consumed by animals are fruits, flowers and leaves. *Daniellia oliveri* is the most palatable species, fruits, flowers and leaves are consumed (Table 1). Species that are mostly palatable are those on which the high damages were observed. Damages are positively correlated to the palatability (Pearson, $r = 0,82$; $p =$

0,05). Palatable organs are directly eaten by animals on the trees when they are not very high. However, the collection of organs can be done by pastors who give them directly to the animals or to make hay which destined to feed animals during times of food shortage.

Table 1. List of woody species used as fodder.

Plant species	Palatability of fruits/flowers	Palatability of leaves	Damages (DP)
<i>Sarcocephalus latifolus</i> syn. <i>Nauclea latifolia</i> (Rubiaceae)	4	-	3
<i>Piliostigma thonningii</i> (Leguminosae-Caesalpinaceae)	5	1	3
<i>Piliostigma reticulatum</i> (Leguminosae-Caesalpinaceae)	5	1	3
<i>Ficus platyphylla</i> (Moraceae)	4	-	2
<i>Stereospermum kunthianum</i> (Bignoniaceae)	-	4	2
<i>Strychnos spinosa</i> (Loganiaceae)	-	2	1
<i>Vitex simplicifolia</i> (Verbenaceae)	-	4	2
<i>Erythrina sigmoidea</i> (Leguminosae-Caesalpinaceae)	-	1	1
<i>Terminalia avicennoides</i> (Combretaceae)	-	1	1
<i>Daniellia oliveri</i> (Leguminosae-Caesalpinaceae)	3	5	3
<i>Cussonia barteri</i> (Araliaceae)	-	3	2
<i>Alchornea cordifolia</i> (Euphorbiaceae)	-	2	1
<i>Ficus polita</i> (Moraceae)	1	3	2
<i>Bridelia ferruginea</i> (Euphorbiaceae)	-	1	1
<i>Pterocarpus lucens</i> (Leguminosae-Papilionaceae)	-	2	1
<i>Pterocarpus erinaceus</i> (Leguminosae-Papilionaceae)	-	2	2
<i>Syzygium guineense</i> var. <i>macrocarpum</i> (Myrtaceae)	-	2	1
<i>Azelia africana</i> (Leguminosae-Caesalpinaceae)	-	3	3
<i>Gardenia</i> spp. (Rubiaceae)	1	3	2

DP: Damages on plants

Rating of palatability: 1 = occasionally consumed species; 2 = weak consumed species; 3 = moderately consumed species; 4 = highly consumed species; 5 = highly sought after species Damages on woody plants DP = 1: Very few traces of collection; 2 = traces of collection near 50 % ; 3 = Traces of collection more than 50 %.

Veterinary medicines and taxonomic diversity

At the northern periphery of Mbam and Djerem National Park, 10 species which belong to 9 Families are useful for the treatment of animal diseases (Table 2). The main diseases treated by the plants are digestive diseases (diarrhea) and skin diseases (dermatoses). The main collected organs are leaves, barks and roots according to the species and the diseases being treated. Roots and barks of *Annona senegalensis* are used to treat digestive diseases of ruminant animals. Barks of *Piliostigma thonningii* are good healing of skin wounds of animals. Leaves of *Cussonia barteri* are used to treat both digestive diseases and skin diseases. Roots of *Terminalia glaucescens* are used to treat both digestive and skin diseases. Among the 10 species used to treat animal diseases, 4 species are fodder species notably *Daniellia oliveri*, *Nauclea latifolia*, *Piliostigma thonningii* and *Cussonia barteri*. Although plant products used in veterinary medicine are not commercialized in the region, the quantity of collected products is sometimes important and causes damages to the target plants.

Table 2. List of woody species used to treat animal diseases.

Plant species	Diseases and used organs	
	Diarrhea	dermatoses
<i>Annona senegalensis</i> (Annonaceae)	roots, barks	-
<i>Daniellia oliveri</i> (Caesalpinaceae)	barks	-
<i>Terminalia glaucescens</i> (Combretaceae)	barks	barks
<i>Sarcocephalus latifolus</i> syn. <i>Nauclea latifolia</i> (Rubiaceae)	roots	-
<i>Hymenocardia acida</i> (Euphorbiaceae)	leaves	-
<i>Vernonia guineense</i> (Asteraceae)	roots	-
<i>Cussonia barteri</i> (Araliaceae)	leaves	leaves
<i>Ceiba pentandra</i> (Bombacaceae)	barks	-
<i>Piliostigma thonningii</i> (Caesalpinaceae)	-	barks
<i>Saba comorensis</i> (Apocynaceae)	-	barks

Discussion

Methods of collection and threats on target plants

Fruits. In many tropical regions, a common practice to harvest fruits consists of felling completely the tree or to prune fruiting branches. Fruits of *Sarcocephalus latifolius*, *Piliostigma thomningii* and *Piliostigma reticulatum* are collected directly on trees in large quantity to make meal for animals. For some species like *Ficus platyphylla*, fruits are collected on the ground after falling. On the other side, *Daniellia oliveri* is sometimes pruned or completely felled in order to collect the fruits. Even in the absence of partial or total destruction of the plant, fruit collection can lead to notable modifications of the structure and the dynamic of plant populations (Guedje, 2002). Several other species at the periphery of the park are destroyed for their edible fruits and are sold in local and national markets (Souare, 2006).

Roots. Roots play important roles in plant stability, absorption and transport of hydromineral elements, and also a role of storage of nutrients. Collection of the roots by agropastoralists can damage the functional system of the plant development. In fact, two methods of collection are noted at the catchment of Mbam and Djerem National Park. The first practice consists of making a hole around the tree in order to collect a large quantity of roots. That method disturbs the hydromineral nutrition of the plant and can be an open way to pathogens, and consequently weakens the plant. The second practice is done on shrubs which are completely snatched in order to collect the roots. The reduction of the population size of the plants is significant while practicing this method. In fact, there is an equilibrium little known in the mechanism between aerial parts and underground parts of the trees. All events affecting aerial parts (defoliation by pests, abrupt removal by storm or a pruning) will have important consequences on roots (Drénou, 1999). All root destruction leads to the decrease of supplying in water and minerals.

Barks. At the northern periphery of Mbam and Djerem National Park, debarking is done in two ways: anarchic debarking (girdling of the stem pourtour) or debarking after felling the stem. These methods of collection were observed on *Garcinia lucida* in southern Cameroon. Anarchic debarking can disturb and paralyze completely the circulation of the sap. The consequences of debarking techniques assessed on *Garcinia lucida* had shown alarming results (Guedje, 2002). Debarking for about 2/3 of stem circumference has a mortality rate ranging between 0 and 25 % according to diameters. When debarking is circular girdling around the stem, the rate of mortality is ranging between 50 and 100 % (Kengue and *al.*, 1998). The scientific world has shown for decades the ecological effects of the abrupt interventions: loss of nutrient reserves of plants, open ways to diseases and pests.

Leaves. Collection leaves for medicine has no notable impact on the biology of the plant. A small quantity of leaves collected has no significant effect on the process of photosynthesis. However, the collection of leaves by breeders needs a total felling of the plant or the pruning of leafy branches. A systematic section of the stem provokes an appearance of a great number of tangled and poorly anchored branches. That can lead to the death of the tree. Whatever the stage of tree development, when it comes to pruning, it is necessary to operate soon when the branches are still young and with small dimensions (Diallo, 1995). Opening a wound results in necrosis and drying of cells. Movement of water is created inside the tissues towards the wound, and when the water resources of the soil are limited or the wound is large compared to the vegetative, the water loss can be fatal. Secondly, on the other hand the introduction of air into the xylem vessels causes embolism which limits the flow of sap (Piot, 1970). Finally, after the injury or pruning of branch, the tissues exposed to the external environment are systematically colonized by phytophagous organisms, wood-destroying organisms or lignicolous organisms. If many of them are harmless, some have a virulent pathogenicity and can lead to stress or kill the host (Chargueraud, 1896). Greater is the cut, more important are the adverse effects (Leroy, 1953).

Resource conservation

During the last century, numerous studies have provided a better understanding of the physiological requirements of woody plants. Operating methods of wild woody plants used for fodder and veterinary medicine have ecological impacts on the resources. The threats are real but mixed in research works. If the use of trees by breeders causes enormous ecological problems today, there are strategies to mitigate the collection of tree organs. In fact, conservation of ecosystem forests begins an efficient education and sensitization of the local populations in order to elaborate participatory approaches of the exploitation of wild plant resources. Programs of communication and training concerning the protection of environment are necessary for the conservation of natural resources in agropastoral areas in Cameroon. The programs should be sponsored by NGOs or the Ministries that are in charge of protection of forests and environment. Training workshops organized for breeders on threats can concern the methods of stems and roots debarking, and the pruning of branches. Technical rational exploitation will permit to avoid trees mortality after brutal pruning. Fruit collection should be limited in order to permit the regeneration of wild population.

Conclusion

Agropastoralists who live at the periphery of Mbam and Djerem National Park in Cameroon use 25 woody species to feed and treat their animals. Damages caused to plants by domestic animals and breeders are positively correlated to the palatability of the species (Pearson, $r = 0,82$; $p = 0,05$). Methods of the collection of products used vary according to level of appreciation and the height of the plant. The systems of massive collection of fruits and systematic felling of trees are main source of population decrease. Debarking of stems or roots and pruning of branches are source of stress and infections, but can lead also to the death of plants. All those systems lead directly or indirectly to the modification of the structure and dynamic of the populations, and then the phylogenetic erosion.

This article is one of the first works which expose the problems linked to the exploitation of woody species used for fodder and traditional veterinary medicines in Cameroon. It is necessary to carry out similar studies in several sites in Cameroon in order to make an inventory of all the woody species used by agropastoralists, and to elaborate strategies of exploitation which observe the conservation of phylogenetic resource.

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