

Medicinal uses and natural availability of three plant species in selected ecosystems in cameroon

Abstract

In many developing countries traditional medicine constitutes a major part of health care because of its local availability and affordability compared to modern medicine. However, little is known about the specific uses and availability of medicinal plants. In this research an exploratory study was conducted to determine the uses of three medicinal plants in Cameroon, and to examine their relative distribution and abundance in specific habitats. From a questionnaire administered to traditional healers, we found that three species of medicinal plants including: *Alstoniaboonei*, *Picralima nitida* and *Sarcocephaluslatifolius* that are commonly used, either singly or in mixtures to treat human diseases such as muscle and joints pains, hyperthermia, hypertension, hepatitis, jaundice and rheumatism. Fresh or dry barks of the tree plants and fresh fruits of *Picralima nitida*, as well as various ethnopharmacological preparations (decoctions, maceration, infusion and powder) are widely commercialized. Findings from our ecological study revealed that *Alstoniaboonei* was represented by 2, or 1 % of total individuals recorded in 0.5 ha, implying 3 individuals and 6 trees/ha. This tree was well represented and was sometime among the dominant species in the forests. *Picralima nitida* was represented by 0.6 % of total trees recorded in 0.5 ha, implying 0.70 tree and 1 tree/ha. This tree was poorly represented and was not a dominant species in its habitats. *Sarcocephaluslatifolius* belonged to a group of 72 plants with a recovery < 5% corresponding to Braun-Blanquet scale 1. Hence, this plant was not densely represented in the Sudano-Guinean and Sahelian savannahs. It is the most harvested species of the three species that has undergone a strong anthropogenic destruction. Therefore these three plants, and especially *Sarcocephaluslatifolius*, need to be protected through a sustainable management of their habitats in Cameroon.

Keywords: natural availability; *alstoniaboonei*; *picralima nitida*; *sarcocephaluslatifolius*; monospecific and polyspecific recipes; disease control; irrational exploitation; conservation strategies

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Introduction

An ethnobotanical survey, realized in Cameroon from 2003 and 2015 has permitted to identify three medicinal plants with traditional monospecific and multispecific uses. These plants are constituted of two Apocynaceae *Alstoniaboonei* and *Picralima nitida* and one Rubiaceae *Sarcocephalus latifolius* Syn. *Nauclea latifolia*. The two Apocynaceae are forests species while *Sarcocephalus latifolius* grows in Guinean, Sudanian and Sahelian savannahs. The increasing harvest of these plants for their medicinal uses has reduced their population densities in their-natural ecosystems. This situation is more frequently observed near strong agglomerations especially in the Northern regions of Cameroon, where various formulations of *Sarcocephalus latifolius* are currently used to treat diverse human diseases. Climate change is another important factor that can affect their perennity. The discovery in natural state of the synthetic Tramadol, a sedative molecule from this African plant has increased its medicinal uses by local people.²⁻⁴ The combination of its barks with those of *Picralima nitida* and of *Alstoniaboonei* by traditional healers has contributed to an increasing in the exploitation of these natural resources. Therefore the present scientific research has provided new insights on the overexploitation of *Sarcocephaluslatifolius* and related plants, for medicinal purposes. The main diseases treated by these three species of plant are: muscle and joints pains, hyperthermia, hypertension, hepatitis, jaundice and rheumatism. The more rich in documented information of the three species are *Alstoniaboonei* and *Sarcocephalus latifolius*.^{1,2} Crude extracts of these plants, either alone or in combination of two or three mixtures, are sold by

travelling healers or hawkers in Cameroon's markets. In the present study our first objective was to document the medicinal uses of these natural plants and the second was to evaluate their relative dominance and abundance in order to establish their availability and population densities in their natural habitats.

Materials and methods

A survey questionnaire was designed, validated and administered to residents of the study areas. Data were collected from 1131 respondents drawn from 58 tribes. The distribution of the respondents included 70 traditional healers and 1,061 other resource persons.⁵ The process used to collect information began by a fieldwork focusing on harvest and identification of the three plants. During this step ethno pharmacological details on the preparation of recipes were described with the help of informants. This description focused on the mode and the time of preparation, the mode of administration, the posology, the duration of treatment, the undesirable or secondary/toxic effects, and the diseases treated. It was followed by the chemical and pharmacological approach based on investigation of previous searches. hence chemistry and pharmacology have also played a great role in the evaluation of natural products.⁶ Confirmation of botanical identification was done in National Herbarium of Cameroon and voucher specimens are deposited in the Institute of Medical Researches and Medicinal Plants Studies.

For *Alstoniaboonei* and *Picralima nitida* which are forest species their abundance and their dominance were assessed in their habitats by a sampling method that was based on the establishment of quadrats

or parcels of 0.1 ha (100m x10m) each. The device in Figure 1 was used for this inventory.

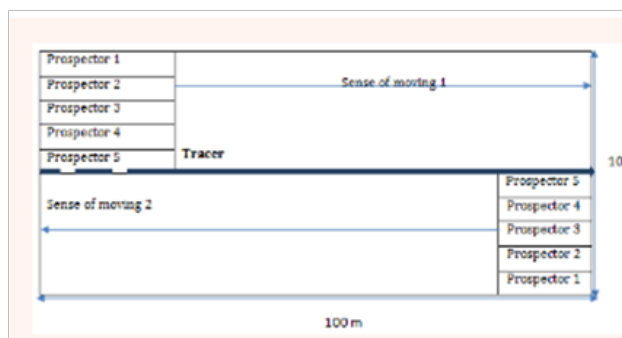


Figure 1 Improved methods for trees assessing and monitoring.

RD: relative density; RA: relative abundance.

A total of 15 quadrats were established in three habitats: 5 for *Alstoniaboonei* in the Littoral and continental humid rain forests zone of transition, 5 also for *Alstoniaboonei* in the Banana's plantations in Littoral humid rain forests and 5 for *Picralima nitida* in the Littoral and continental humid rain forests zone of transition. In these specific habitats each plant is highly harvested for supplying towns' markets with medicinal products. A total surface of 1ha was covered. The following formulas were used to calculate abundance and dominance of these two recorded trees species with circumference at the breast high (CDH) >32cm in each habitat.^{7,8}

Basal surface

$Sb = \pi X(D/2)^2$ with Sb=surface basal and D=diameter. For a given family or species it corresponds to the sum of basal surface of different individuals of this family or species. Abundance of taxa: AT=(number of individuals of a species or of a family)x100/total number of recorded individuals. Dominance of taxa: DT=(basal surface of a species or a family)x100/total basal surface of all recorded individuals.

For *Sarcocephaluslatifolius*, shrub of savannahs, the floristic diversity was evaluated following a sampling based on the establishment of quadrats of 1ha (100mx100m). A total of 5 quadrats were sampled. A total surface of 5 ha was recovered. The method founded on the notion of the characteristic species⁹ was used to study the vegetal community living in the quadrats or the parcels. The list of all the species encountered in the 5 quadrats was established with their abundance-dominance that is an expression of the relative space occupied by the set of individuals of each species space which is at once determined by their number and by their dimension. The usual scale for the evaluation is that of Braun-Blanquet⁹ described in Table 1 below.

$CSi = FSi / \sum i = 1 / FSn$ Specific frequencies SiF, and centesimal frequencies (CF) derived from these data have permitted to obtain an expression of recovery for each species at level of soil.^{11,12} It is equal to proportion (expressed in %) of number of repetitions of the given species divided by a total number of quadrats sampled. The « specific contribution » SiC, which is defined as the rate of the specific frequency SiF and the sum of the specific frequencies of all the species recorded, was calculated according to the following formula:

Where SiC and SiF are the contribution and the specific frequency of the species i and n the total number of species.

Ecological statistical analysis

Diversity assessment was done using Shannon-Weiner and Evenness. Shannon index (H).

$H = - \sum p_i \ln p_i$ measures the incertitude link to the appearance of an individual of a given species taken at random in the sample.

Where p_i is the proportion of individuals of a species i (Relative density of species), and \ln is the natural logarithm. The maximum value of H' is the natural logarithm of the number of species ($\ln S$).

Evenness

(Evenness (E) $E = H / \ln S$ describes the distribution among species, reaching a value of 1 when all species have equal numbers of individuals.

Results

Different uses of the three species

The combined and single medicinal and non-medical uses of the three plants by local people are presented in Table 2.

Presentation of ecological study of the three plant species

Dominance and abundance

Alstoniaboonei

Specific composition of the five quadrats located in Littoral and continental humid rain forests zone of transition: In this feature of vegetation, 125 individual trees were recorded. They belong to 24 families, 51 genera and 66 species. *Alstoniaboonei* was represented by 2.1% of total individuals recorded in 0.5ha, implying 2.625 individuals and 6 trees/ha (Figure 2). This species was least abundant and dominant. The timbers' exploitation repulses this tree towards the versants of mountains difficult to reach. So like others species, the enclosure is favorable for it conservation.

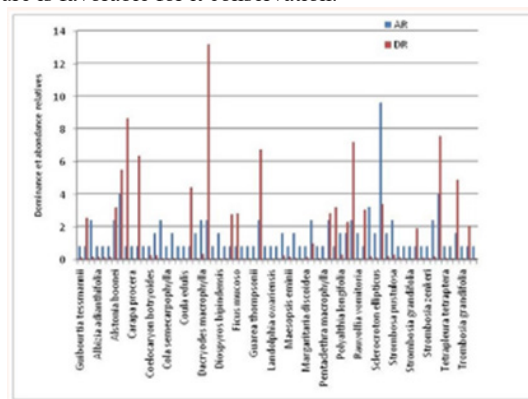


Figure 2 Abundance and dominance of species in *Alstonia boonei* forest habitats.

Specific composition of the five quadrats located in the banana's plantations: This feature of vegetation had 109 recorded trees. These trees belonged to 21 families, 31 genera and 35 species. *Alstoniaboonei* was represented by 2% of total individuals recorded in 0.5 ha, implying 2.5 individuals and 5 trees/ha (Figure 3). This feature is nearly the same in the forest. Banana's farming is a moderate means of useful trees conservation.

omphalocarpoides (0,07), *Sacoglottis gabonensis* (0,13) and *Uapaca guineensis* (0,13). To the lesser extent, other trees as *Cola verticillata* (0,07), *Coula edulis* (0,07), *Lophialata* (0,07), *Dacryodes macrophylla* (0,07), *Ficus mucoso* (0,07), *Garcinia mannii* (0,07), *Guarea thompsonii* (0,07), *Macaranga hurifolia* (0,07), *Maesopsis eminii* (0,07) and *Polyalthia suaveolens* (0,07) are also represented.

Continental humid rain forests

Large trees which dominated the canopy are *Vitex cienkowskii* (0,12), *Tabernaemontana crassa* (0,12), *Lovoa trichyloides* (0,12), *Irvingia gabonensis* (0,12), *Hylodendron gabunense* (0,12), *Funtumia elastica* (0,12) and *Amphimas pterocarpoides* (0,12). Other trees of canopy less representative are: *Azelia pachyloba* (0,07), *Alstonia boonei* (0,07), *Amphimix ferrugineus* (0,07), *Annickia chlorantha* (0,07), *Antiaris welwitschii* (0,07), *Beilschmiedia letouzeyi* (0,07), *Cleistopholus patens* (0,07), *Coelocaryon preussii* (0,07), *Cola semi-carpophylla* (0,07), *Dacryodes macrophylla* (0,07), *Desbordesia glaucescens* (0,07), *Diospyros bipindensis* (0,07), *Distemonanthus benthamianus* (0,07), *Maranthes gabunensis* (0,07), *Musanga cecropioides* (0,07), *Picralima nitida* (0,07), *Piptadeniastrum africanum* (0,07), *Pterygota bequaertii* (0,07), *Pycnanthus angolensis* (0,07), *Santiria trimera* (0,07), *Spondianthus preussii* (0,07), *Staudtia*

kamerunensis (0,07), *Strombosia grandifolia* (0,07), *Terminalia superba* (0,07), *Treculia africana* (0,07), *Uapacaguineensis* (0,07), (0,07), *Xylopia hypolampra* (0,07) and *Zanthoxylum heitzii* (0,07).

Sudano-Zambesian Savannahs of Adamawa. The most numerous species of this site are *Terminalia laxiflora* (0,12), *Asparagus warneckei* (0,12), *Capparis corymbosa* (0,12), *Conyza aegyptica* (0,12), *Diodiascandens* (0,12) and *Eclipta prostrate* (0,12). All other species that include *Sarcocephalus latifolius* with 0,07 as Shannon's index, are less representative.

Interpretations

Table 3 revealed that in the less disturbed littoral rain forests zone of transition the diversity (5,51) and evenness (0,96) were high than in the disturbed Banana's plantations in littoral humid rain forests (5,15) and (0,99). It was more less high in disturbed continental humid rain forests (4,11)). In the Sudano-Zambesian Savannahs of Adamawa the diversity and the evenness are respectfully 5,06 and 0,99. The individuals in these communities are distributed more equitably among these species. The specific density is high in the forest of transition zone (66), following by 48 in the Continental humid rain forests and 35 in banana's plantations of littoral humid rain forests. La density specific is 57 species in the site of Adamawa's savannahs because herbs were took in account. In the banana's plantations there are 35 species that result from the selective conservation.

Table 1 Scale of species recovery of Braun-Blanquet

Percentage of Recovery	Attributed Index
Species just present	+
Recovery < 5%	1
Recovery comprised between 5 – 25%	2
Recovery comprised between 25 – 50%	3
Recovery comprised between 50 – 75%	4
Recovery > 75%	5

Table 2 Combined and single uses of the three plants in Cameroon

Species	Vernacular names	uses	Detailed description of recipes
medical uses			
<i>Alstonia boonei</i> and <i>Picralima nitida</i>	Ewondo, Boulou, Fang: Ekuk Ewondo: Abam	Muscle pains, hypertension	Boil 1 kg of bark of each plant in 7 liters of water. Drink 250 ml of decoction, 2 times daily to treat hypertension and use 5 liters in vapor bath and in bath to treat rheumatism.
<i>Alstonia boonei</i> and <i>Sarcocephalus latifolius</i>	Kaka: Lombo	Muscle and joints pains, rheumatism.	The decoction of 1 kg of bark of each plant or the macerate in 5 liters of water is used in vapor bath and in bath to treat rheumatism.
<i>Alstonia boonies</i> , <i>Picralima nitida</i> and <i>Sarcocephalus latifolius</i>	Bakouedje: Fufuldé, bokoriyi, Gamoyi, Zadeyi	Muscle and joints pains, hypertension, jaundice, hepatitis.	Boil 1 kg of bark of each plant in 10 liters of water. Drink 250 ml 2 times daily to treat hypertension; 250 ml 3 times daily to treat jaundice and hepatitis. Use 5 liters in vapor bath and in bath to treat muscle and joint pains.

Table Continued...

Species	Vernacular names	uses	Detailed description of recipes
<i>Alstonia boonei</i> (Apocynaceae)	Akwaya: Ekuk	Intestinal helminthiasis	1- Decoction of 250g of stem bark in 2 liters. Drink a half glass thrice a day.
	Baya: Gouga	Malaria and repeated convulsions	2- Soak 1kg of stem bark in 3 liters of water. Stir it from time to time until it is hot. Drink 250 ml of extract.
	Bassa: Kotmot	Strangulated hernia	In cases of strong crisis the patient is taking under an <i>Alstonia boonei</i> tree and let him take some latex.
	Bulu, Ewondo, Fang: Ekuk	Expulsion of placenta	
		Rheumatism	The decoction or the macerate is used in vapor bath and in bath to treat rheumatism
		Malaria	Macerate 200 g of the inner bark in 1 liter of water for about 2 hours. Drink 250 ml daily for a week.
	Kaka: Lombo	Asthenia	Mix 10 g of a powdered bark in 20 ml of hot water. Drink the macerate, 2 times daily for a week.
		Cleaning of pus in wound and opened fracture	Soak 1 kg of stem bark in 3 liters of water. Stir it from time to time until it is hot. Use the extract to clean pus in wound and opened fracture.
		Antipyretic	
	Eton :Akuk	Gonorrhea	Infusion of 300 g of stem bark in 2 liters of water. Drink 250ml 3 times daily.
		Agalactocia	
		Snakebite	Wound the stem and apply the latex on and around the site of the bite or infection, three times
		Abscess	
		Children dermatitis	Stroking or touching on inflamed or eruptive parts.
	Bamileke: Ndo Mabeumo	Genital and urinary system affections	1- Mix the latex with sugar cane or pineapple juice or palm oil. Give to drink the mixture to patients.
		Gastro-intestinal affections	2- To complete the treatment, purge the patients with 125 ml of mixture or give to them a urethral or a vaginal injection or seat bath.
		Edema	Apply the pounded leaves in affected parts.
		Antidote	Drink the latex.
<i>Picralima nitida</i> (Apocynaceae)		Rheumatism	Apply the pounded leaves, stem or root barks in affected parts.
		Active purgative	Take 10 to 30ml a mixture of <i>Alstonia boonei</i> and <i>Antostemon aubryanum</i> latex one time
	Maka: Bamborutuk		Decoction of 250g of stem bark in 2 liters. Drink a half glass thrice a day for a week.
		Malaria	Decoction of 250g of seeds in 2 liters. Drink a half glass thrice a day.
	Beti: Abam		Decoction of 500g of fruit in 2 liters. Drink a half glass thrice a day.
		Male sexual impotence	Maceration of 300g of bark in 2 liters. Drink 250ml 3 times daily for a week
	Baka Pygmies: Mototoko	Dysmenorrhea	Crush and boil 300g of fruit. Drink half a glass thrice a day for three days to a week
	Bafia: Keledeng	Jaundice,	
	Ffulde: Bakouedje, Bokoriyi, Gamoyi	Yellow Fever	
	Sanaga: Edindingue	Rheumatism	Pound 100 g of root bark and boil with a half-liter of water. Leave to cool before drinking 250 ml two times daily.
<i>Sarcocephalus latifolius</i> Syn. <i>Nauclea latifolia</i> (Rubiaceae)		Fever or antipyretic	
		Abdominal pain	
		Hepatitis	
		Jaundice	Pound 100g of stem bark and macerate in a half-liter of water. Leave to cool before drinking 250ml of extract 2 times daily.
	Oku : Shi Nkan She	Weakness	
		Hepatitis	

Table Continued...

Species	Vernacular names	uses	Detailed description of recipes
Non-Medical Uses			
<i>Sarcocephalus latifolius</i> Syn. <i>Nauclea latifolia</i> (Rubiaceae)		Edible or eatable	Sweet fruits edible by men and wild animals including buffalo, monkeys and antelopes.
		Colorings	Yellow extract of roots is used to color animals' skin and fibers.
	Gouga: Baka Pygmes	Arrow-poison	The latex is used to prepare arrow poison
	Emien, ekouk : Forestry. name <i>Alstonia</i> , cheesewood, stool wood, pattern wood: English name.	Cash crops' protection	<i>Alstonia boonei</i> is a useful shade tree for coffee, tea, cocoa and banana farms.
<i>Alstonia boonei</i>		Socio-economic value	<i>Alstonia boonei</i> 's bark is commonly sold on local markets in Yaounde, Douala, Limbe, Kumba, for medicinal uses. In Yaounde, the price of bark ranges from 500-2000 FCFA per kilogram depending of the harvesting locality.

Table 3 Summary of the floristic data for parcels in different areas of ecological study

Sites	Number of parcels	Number of trees or herbs per ha	Number of species	Shannon's index (H)	Pielou's evenness (E)	Mean dbh cm	Total Basal Area in cm ²
Banana's Farms in Littoral Humid Rain Forests	5	92	35	5,15	0,98	15,45	17239,09
<i>Alstonia boonei</i>	5	5		0,13	0,13	3,10	37,72
Littoral and continental humid rain forests zone of transition	5	125	66	5,50	0,99	45,23	200739,50
<i>Alstonia boonei</i>	5	6		0,16	0,014	67,62	21536,31
Continental humid Rain Forests	5	112	48	4,11		42,84	161356,55
<i>Picralima nitida</i>	5	1		0,07	0,02	11,54	104,53
Sudano-Zambesian Savannas (Adamawa)	5	71	57	5,06	0,99		
<i>Sarcocephalus latifolius</i>	5	4		0,12	0,02		

Discussion

Alstonia boonei bark extract showed promising results for antimicrobial effects against bacterial including *Bacillus subtilis*, *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Escherichia coli*, and pathogens like *Candida albicans*. The minimum inhibitory concentrations essay is capable of verifying that compounds possessed antibacterial activities. These compounds can give reliable indication of concentration of medicine required for the inhibition of microorganisms. *A. boonei* revealed the presence of important minerals that include calcium, phosphorus, iron, sodium, potassium, and magnesium. Other compounds like alkaloids, tannins, saponins, flavonoids and cardiac glycosides, total phenol, important vitamin, ascorbic acid were also found. *A. boonei* possesses phytochemicals other than phenolics like mineral elements and vitamin C that may be the important elements in the medicinal activities of *A. boonei*.^{13,14} *Alston boonei* and *Picralima nitida* were identified as antimalarial herbal medicine in Cameroon by the European Commission and FAO project.¹⁵ *Sarcocephalus latifolius* (formerly *Nauclea latifolia*) is a small shrub (also known as African fisherman) abundantly distributed throughout sub-Saharan Africa. In traditional medicine, especially in Cameroon, this plant is used in the treatment of various pathologies and symptoms, including epilepsy, malaria, fever and pain.¹⁶

The weak proportions of *Alstonia boonei* and *Picralima nitida* and the low recovery of *Sarcocephalus latifolius* in their respective habitats, reveal that plants may not always be naturally available.

Species status and other ecological characteristics

Despite the fact that the three plants are weakly represented in their habitats, the research of their conserving status in the red list of IUCN reveals that none of them is threatened in the world. But none of them is dominant in its present studied habitat in Cameroon. Their long term exploitation can easily lead to their disappearance. Therefore some conservation strategies need to be implemented to overcome the challenge of overexploitation due to the increase in populations and number of patients who need treatment.¹⁷ The natural habitats degradation leads to rarity of plants. The 5 plots, established in the Littoral rain forest and 5 others in the continental reveal that rain forest are the main habitats of some commonly useful plants in traditional medicine in tropical Africa. The populations continue to exploit this environment. A preservation of the natural resources by the riparian populations seems necessary to promote sustainable management.¹⁸ For *Picralima nitida*, on top of bark, seeds and other parts for commercialization in Cameroon markets and medicinal uses are harvested from wild habitats. *Sarcocephalus latifolius* is widely distributed in tropical humid forests, in undergrowths of dry forests and savannas of occidental and central Africa. It can grow at an altitude of 0 to 200m. It is also widely distributed in the African forests and galleries, especially near rivers and outskirts of the ponds. The optimal climatic conditions of this species are a temperature of 27 degrees and an average rainfall of 2700 m. This species still survive at high temperatures around 35 degrees, but dies at low temperatures around 15 degrees. The root system of this plant is more developed

in shrubbery and in fallow land with a good permeability. There are three types of stems: arborescent, creeping and acaulescent (without visible stem). The color of the roots varies from white to yellow clear depending on whether the soil is sandy or clayey.¹⁹

This study confirms that it necessary to protect these tree species because they contribute to the treatment of many communities in Africa through the action of travelling healers or hawkers in African's markets. Their importance has also been the subject of reflection on many works including thesis for the purposes of conservation.¹⁹

Conservation strategies

The first one is their substitution by an equivalent resource like *Sarcocephalusdidericii* for *S. latifolius* which is a forest tree with an important vegetative morphology.

The second one is the cultivation of each one of these species. However, cultivation may destroy other useful plants and also contribute to environmental degradation. The third one is the use of plant biotechnology to produce callus plants that can synthesize the same chemical constituents like the natural plants. The plant biotechnology strategy is the most important way of perpetuating plants, since it does not create damages to the plants' habitats (Supplementary Figures 1-8).



Supplementary Figure 1-3 Three lots of different herbal medicines from various mixtures of bark, fresh fruits or root preparations, of *Alstonia boonei*, *Picralima nitida* and *Sarcocephalus latifolius*, sold by three hawkers in Yaounde's markets.



Supplementary Figure 4 *Alstonia boonei* tree.

Conclusion

Findings from this research indicated that the three plant species *Alstonia boonei*, *Picralima nitida* and *Sarcocephaluslatifolius* are good sources of medications and are commonly used by the local people to treat various diseases. However, because of their heavy exploitation for medicinal purposes, they are not commonly available in their natural habitats. Therefore the long term exploitation causes a real threat to the survival of these plant species. Hence, care must be taken to implement conservation

strategies toward a good sustainable management of these natural resources. Further research on the isolation, identification, and commercialization of active ingredients from the crude extracts of these three plants will help reduce the demand and alleviate the ecological impact.



Supplementary Figure 5 No sustainable harvest of *Alstonia boonei* barks.



Supplementary Figure 6 No sustainable harvest of *Sarcocephalum latifolius* roots.



Supplementary Figure 7 Fruits of *Picralima nitida*.



Supplementary Figure 8 Measurement of *Coelocarium preussii* (Myristicaceae)'s circumference at the breast high.

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None.

Conflicts of Interest

The authors do not have any personal or financial interests.

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