ETHNOMEDICINAL SURVEY OF PLANTS USED FOR MALARIA TREATMENT BY SUPPORT ZONE COMMUNITIES OF CROSS RIVER NATIONAL PARK, NIGERIA.

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ABSTRACT

There has been a renewed interest in the research of medicinal plants for both preventive and therapeutic purposes even though their use has been in existence since time immemorial for man's good health and wellbeing of both body and soul. This ethnomedicinal study explores plants used in treating malaria and their sustainability in the support zone communities of the Cross River National Park. Data collected using a semi-structured questionnaire interview of thirty key informants, was analyzed descriptively by computing absolute averages, frequencies and percentages. A two-way clustering technique was employed to classify and/or group the plants used using the SPSS programme. The use-value technique was used to determine the relative importance. A total of forty-eight species with mostly trees (65%) were reported to be used. Majority of the remedies used were decoctions (55%) and administered through oral voice (51%). From the clustering, plants used in combination with others or used by the same key informants clustered together signifying their importance. Highest use-value (7.0) was recorded for species used in combination with others. To achieve sustainability, only the amount required and when needed is harvested as well as drying of plant parts. Some species are scarce as a result of poor harvesting methods and habitat destruction. Since a number of the remedies are obtained from the barks through unsustainable harvesting, the probability of survival of individual plants after harvest may be at risk. It is therefore recommended to identify priority species for conservation, encourage local participation in conservation activities and increase collaboration within traditional healers to reduce knowledge loss.

Keywords: preventive, therapeutic, sustainability, clustering, National park

INTRODUCTION

The common adage 'health is wealth' is always in the lips of every living being, and allied to the three necessities of life (that is, air, food and water) is Medicare. With this in mind, people everywhere try to stay healthy and extend the quality and length of their lives. Plants, since time immemorial, have been a basic resource for human health and the basis for traditional medicine systems that have been in existence for thousands of years. All cultures, (Egyptian, Chinese, Indian, Greek, Roman and African) have used and continue to use plants as a source of medicines (Chivian, 2002).

The World Health Organization (WHO) estimates that up to 80% of the world's population, mostly in developing countries, rely mainly on plant-based traditional medicines for their primary health care and that plant products also play an important role in the health care of the rest of the world's population (Bannerman, 1982; WHO, IUCN and WWF, 1993). This is particularly true of the poorer sections of the population in developing countries because natural remedies are not only cheaper than modern medicines, but are often the only medicines available in remote rural regions (Brown, 1992, GTZ, 2001; Maundu, Kariuki and Eyog-Matig, 2004).

Plants products also play an important role in the health care of the remaining 20% of the population in developing countries and for

those in industrialized countries as well. The popularity of medicinal plants today as complementary/alternative medicine is increasing as demands for sources of food supplements, neutraceuticals (foods that act as medicines) and raw materials for the cosmetic industry continue to rise.

In Nigeria, as in other African countries, the use of medicinal plants still plays a major role in the primary healthcare system either as preventive and/or therapeutic remedies. Although the United Nations Millennium Development Goals (MDGs) 5 (to improve maternal health) and 6 (to combat HIV/AIDS, malaria and other diseases) are so specific about our health, all MDGs influence health and health influences them. For example, better health enables children to learn and adults to earn. Gender equality is essential to the achievement of better health. Reducing poverty, hunger and environmental degradation positively influences, but also depends on better health. These goals failed in Nigeria, and Ajiye (2014) and Obinna (2016) identified a number of reasons why the MDGs project failed to include lack of human capacity for implementation, poor access to primary healthcare delivery systems with high cost of healthcare, inadequate and unreliable data systems, inadequate funding and indiscipline with endemic, corruption, sequential healthcare workers' industrial actions, among others.

WHO (2017) reported that, of the 212 million new cases of malaria worldwide in 2015, 90% of such cases were from the African Region. The report also noted that children under 5 are particularly susceptible to malaria illness, infection and death and also malaria infection in pregnancy carries substantial risks for the mother, her foetus and the newborn child. The world malaria report of 2018 also reported that there has been no significant progress in reducing global malaria cases between 2015 – 2017 with sub-Saharan Africa and India topping with almost 80% and Nigeria topping in the sub-Saharan Africa with 25%. WHO (2018) report also noted that of the nearly 80% global malaria deaths in 2017, Nigeria topped the 7 countries that accounted for 53% of the deaths.

Maternal health has also become a critical topic in global development. Malaria infection during pregnancy is a serious health challenge that affects both mother and the neonate. Though the WHO (2017) report observed an increase in the proportion of women and children receiving intermittent preventive treatment in pregnancy (IPTp) and intermittent preventive treatment in infancy (IPTi) respectively in Africa, there is and will always be a difference in the proportion of rural women and children compared to the urban counterparts. Abdulraheem, Oladipo and Amodu (2012) noted that, even though the Nigerian government has established public health centres in both rural and urban areas in the country with the intention of equity and easy access to healthcare, regrettably, the rural populations are seriously underserved when compared with their urban counterparts. With a lot of efforts made through Tropical Disease Research (TDR) and Insecticide treated net (ITN) distribution, malaria still remains an epidemic in Nigeria. WHO (2019) has noted a declining effort to scale-up IPTp in a number of African countries. These remotely situated communities lack adequate health centres and the few available ones lack adequate skilled and motivated staff, drugs and equipment. The local people are faced with challenges of accessing modern medical facilities. They are therefore forced to heavily rely on traditional remedies.

In spite of the important role of medicinal plants in health care, they are faced with ever increasing threats due to unsustainable use and destruction of habitats among other factors (Obasi, 2015). With respect for the vast diversity of flora that our tropical rainforests enjoys, a deep concern of the possibility of some plants becoming scarce or extinct, and

with sense of realization about the invaluable preventive and therapeutic properties of phytodiversity to these common health-related issues, the current study was undertaken. This work is on the ethnomedicinal value of plants commonly used for treating malaria by the communities of the area surveyed. The study specifically sought to: identify and classify medicinal plants used; and determine the relative importance of the species reported.

MATERIALS AND METHODS

The Study Area

The Cross River National Park is made up of two divisions: Okwangwo and Oban. This work was carried out in the Oban division's support zone communities, i.e., villages affected by the creation of the park and thus get incentives from the National Park Service to eliminate or reduce pressure on the park resources. It covers an area of about 3000sqkm lying between latitudes 4º58' and 5º49' North of the equator and longitudes 8º08' and 8º56' East of the Greenwich Meridian (figure 1). It is situated to the south east corner of Nigeria, lying south and east of the loop of the Cross River and contiguous with the Korup National Park in Cameroon and made up of two blocks – Ikpan and Oban.

The climate is tropical humid with distinct wet and dry seasons. The terrain is rugged, rising from 100m in the river valleys to over 1,000m in the mountains. The vegetation is an evergreen moist tropical rainforest. The rugged, less accessible areas have more of primary forest while human activities in the more accessible areas have given rise to secondary regrowth in the buffer zone. The forest is rich in both timber and non-timber species; as such, it is internationally recognized as a biodiversity hotspot with high levels of species richness and endemism. There exists about 1,568 plant species with 77 of them endemic to Nigeria, 75 mammal species, 42 species of snakes (Marguba, 2011).

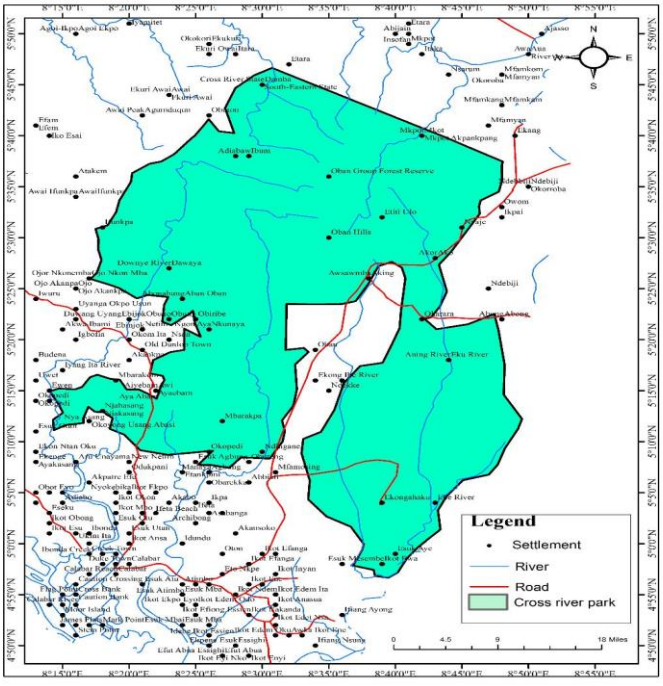

Figure 1: Location of Villages around the Cross River National Park (Oban Division)

Source: GIS unit, Dept of Environmental Management – Kaduna State University

Data Collection

Semi-structured questionnaire interviews, which are suited for collecting ethnobotanical data ((Martin 1995; Cotton, 1996; Giday, 2001; Gazzaneo, de Lucena, and de Albuquerque, 2005; Owuor and Kisangau, 2006; Tewehaymanot and Giday, 2007) with 30 key informants identified by the local people as highly knowledgeable in the efficacy, toxicity, dosage and compounding of plants products were carried out. The key informants were drawn from six villages (Iku, Mbeban, Mkpot 1, New Ndebeji, Ekonganaku and Itaka) that were purposely sampled with regards to their closeness and impact to the park based on the three priority levels (1=maximum, 2=moderate, 3=minimum) which depended on the degree of threat the villages pose to the Park's integrity. Information regarding the plant species and parts used for the purpose, methods of preparation and administration as well as status was gathered.

Data Handling and Analysis

A descriptive statistical method was employed by computing the absolute averages, frequencies and percentages. A two-way clustering technique was employed to classify and/or group the plants used in the preventive and therapeutic cases, using the SPSS programme. The clustering technique used was the hierarchical agglomerative procedure based on unweighted pair-group method with arithmetic averages. The clustering was executed on the resemblance matrices based on Jaccard's index (measure of similarity). Similarity coefficients, which are widely used indices, are indices that are based solely on presence/positive reply (indicated as '1') or absence/negative reply (indicated as '0') data. Jaccard's index is one of the indices that are very useful for calculating the similarity of presence/absence or positive/negative reply data. Since the information employed was which species was used (1) by a particular key informant or was not used (0) in treating or managing malaria, the Jaccard's index was chosen for the analysis. This also involved the construction of dendograms. According to Greg-Smith (1980) and Hoft, Barik and Lykke (1999) cluster analysis attempts to subdivide or partition a set of heterogenous objects into relatively homogenous groups. As such, the objective of cluster analysis in this work was to develop subgroups such that species and key informants within a particular subgroup are more alike than those in a different subgroup. The use value adopted from the proposal of Philips et al (1994), a quantitative method that demonstrates the relative importance of species known locally was also calculated.

$$UV = \frac{\sum U}{n}$$

Where UV = Use value of a species
U = number of citations per species
n = number of informants

This is ideal in evaluating the potential use of a given plant, and the extent of any knowledge about it, as the technique is derived from the perspective of what people consider useful (Albuquerque, Lucena, Monteiro, Florentino and Almeidaet, 2006).

RESULTS AND DISCUSSION

Plant species used in the treatment of malaria

A total of forty-eight medicinal plants were reported for use in the treatment and management of malaria. Analysis of the data based on their habits shows that 31 species

(65%) are trees, 13 species (27%) herbs, 3 species (6%) are shrubs and 1 species (2%) is an epiphyte (See figure 2) with the stem bark being the most used part (See Appendix A).

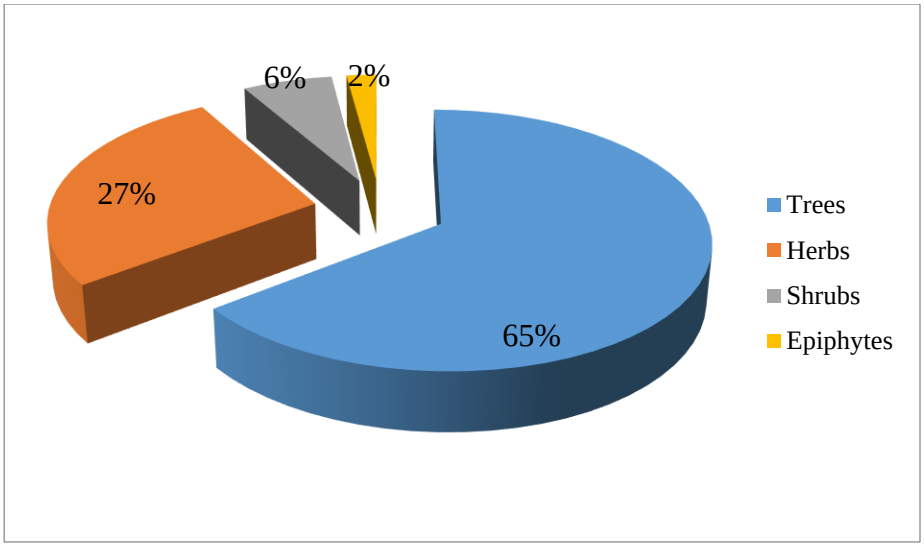

Figure 2: Habit-wise Analysis of the 48 Species
Source: Authors' field survey, 2019

Most of the remedies are prepared as decoctions (55%), tinctures (15.4%), or infusions (9%). Less than 10% are macerated or masticated as presented on table 1. The remedies are administered through oral voice (51%), rectal voice (9%), and both oral and rectal (19.3%) or a combination of all oral, rectal and steam bath (21.8%) (See table 1 and appendix A).

Table 1: Distribution of Methods of Preparing Remedies for Malaria and Routes of Administration

	Routes of administration					
Methods of preparing remedies	**Oral voice**	**Rectal voice**	**Oral, rectal voice +steam bath**	**Oral voice+ rectal voice**	**Oral voice + steam bath**	**Total**
Tincture	12	0	0	0	0	12
Decoctions	9	6	17	10	1	43
Infusions	6	1	0	0	0	7
Mastication	1	0	0	0	0	1
Maceration	5	0	0	0	0	5
Scraping, grinding + tincture	2	0	0	0	0	2
Grinding + tincture	1	0	0	0	0	1
Pounding + tincture	1	0	0	0	0	1

Pounding + decoction	0	0	0	3	0	3
Pounding + infusion	2	0	0	0	0	2
Grinding + decoction	1	0	0	0	0	1
Total	40	1	17	13	1	78

Source: Authors' field survey, 2019.

Although a large number of plants are being harvested for this purpose, there is still the possibility of preference for some plants by a group or groups of users. Using the data on the number of informants who make use of the respective species, a clustering analysis was carried out. The clustering results depicted in the dendrogram (figure 3) exhibit the separation of plants at the sixteenth – cluster level. The tree shows that there are two groups of plants, that is, from *Sida acuta* to *Milicia excelsa* (most used species) and from *Stragytapheta indica* to *Physalis ungulata*. The two cluster solution actually separates *Physalis angulata* from the rest of the species implying that it is the most dissimilar species from all the others. The first group is characterized by plants that are used by over half of the users. This group is made up of five sub-clusters. The first subcluster is *Sida acuta* and *Sida corymbosa* which are cited by the same number of harvesters. The second sub-cluster, which consists of *Gongronema*, *Phyllanthus* and *Vernonia* are grouped together because the species were used by at least fifteen harvesters/users in common. The third sub-cluster which consists of sixteen species (*Mangifera indica* to *Alstonia congensis*) is made up of species that are used by all the informants. These species are used either singly (for example *Harungana madagascariensis* and *Enantia chlorantha*) or in association with others (*Mangifera, Psidium, Cymbopogon, Citrus spp, Carica, Azadirachta, and Ananas)* signifying their importance and why they clustered together (see Appendix A). A review by Alebie, Urga and Worku (2017), reports that some herbal preparations are a mixture of two or more different plant species.

The fourth (*Afromomum melegueta* and *Newbouldis laevis*) and fifth (*Nuclea diderrichi* to *Milicai excelsa*) sub-clusters are used by a common group of people where the two species were used together and by 17 to 22 informants respectively. Similar studies (for example, Adebayo and Krettli, 2011; Gathirwa and Nyang'acha, 2017 and Okello and Kang, 2019) have revealed the potential and use of similar species, e.g. *Azadirachta, Morinda, Milicia, Vernonia* and *Alstonia.*

The second group, comprising of 17 species (*Strachytapheta indica – Physallis ungulata*), is characterized by species that are used by less than one-half the users. This cluster contains the most dissimilar species (*Pysalis angulata*). Though this species is the most dissimilar amongst the species used for preventing and treating malaria, it is grouped with the other species as it records two users using it as other species in this group.

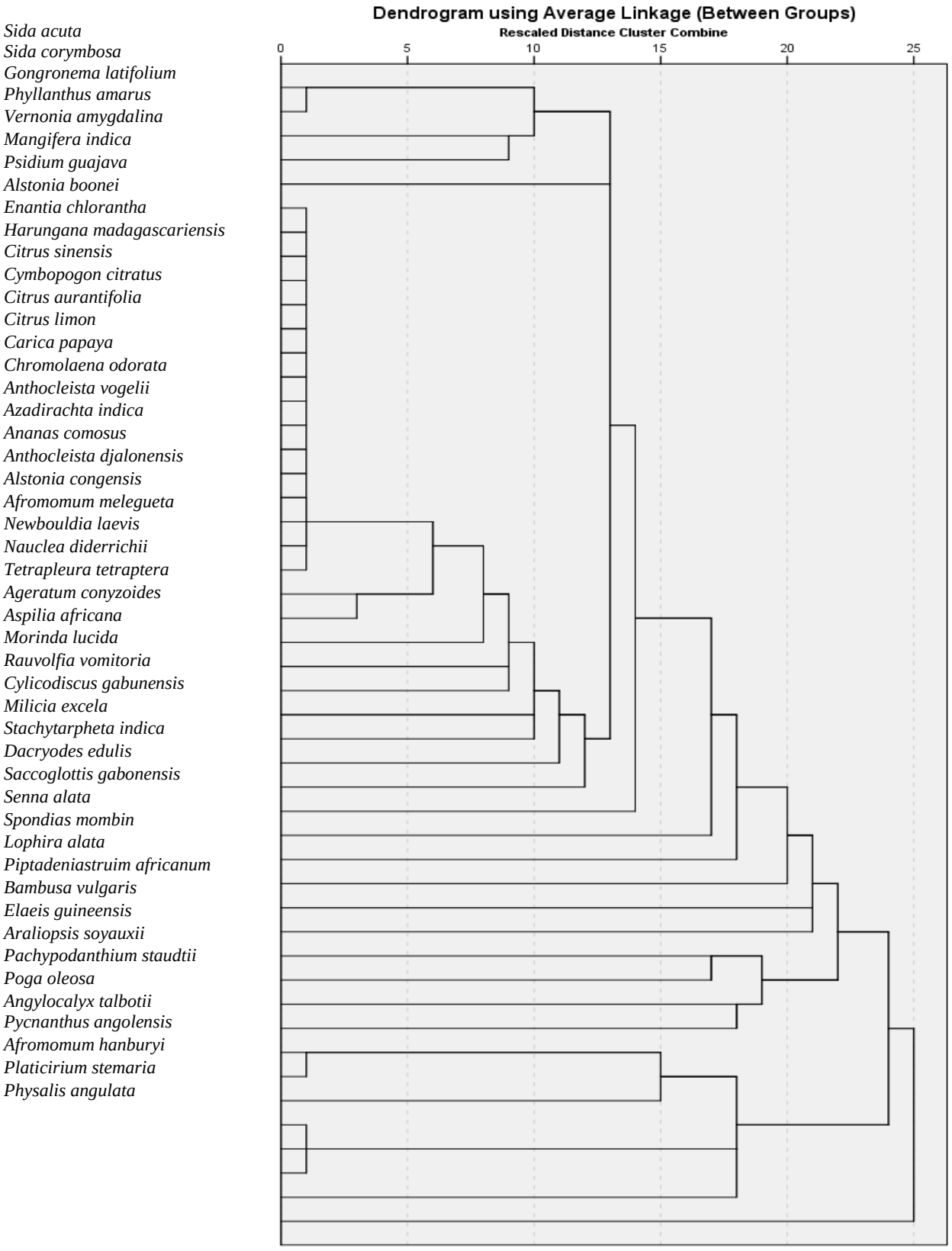

Figure 3: Clustering of 48 plants species used for treating/managing malaria
Source: Authors' field survey, 2019

The other species used by two informants, though not same as those who used *Physalis angulata*, are clustered far from this one because they are used in association with other plants, while *Physalis* is used singly in preparing the remedy.

The study reveals that malaria, which is still a serious health problem in Nigeria and the rest of sub-Saharan Africa, is a specific problem most commonly attended to with 48 species as reported by the informants. All key informants are involved in using one or more plants in the treatment. Most (65%) of the species reported for are used by more than one-half of the key informants. 65% of these species are trees whose remedies are prepared as decoctions (55%) from barks which are often used fresh except for about five species that are used either in dried or fresh form. 33% of the species are used by all the key informants and this is the reason why they cluster close together (figure 3). The species are highly valued by the people of this area. A number of these species (*Alstonia boonei, Alstonia congensis, Anthocleista djalonensis, Anthocleista vogelii, Citrus spp, Enantia chlorantha, Harungana madagascariensis* and *Milicia excelsa*) are commonly used as remedies against malaria in other places (Thomas, Thomas, Bromley and Mbenkum, 1989; Obot and Anwana, 1996; Ita, 1998 and Betti, 2004). The use of plant parts for the same ailment differs also from one area to the other. In this study for example, the roots of *Sida acuta* are used for the treatment. Meanwhile in a similar study by Obute (2005) in south eastern Nigeria, the stems were used for same ailment. Similarly, Igoli, Ogaji, Tor-Anyiin and Igoli (2005) recorded that the leaves of *Anthocleista djalonensis* are used while in the present study the barks are the parts used. The study also reveals that the barks of two uncommon species (*Araliopsis soyauxii* and *Pachypodanthium staudtii*) are used in this area to treat malaria. These species have not really been documented in terms of their ethnomedicinal purposes.

Species with the highest use value are *Mangifera, Psidium, Cymbopogon, Citrus spp, Carica, Azadirachta, and Ananas* (7.0 each), followed by *Enantia chlorantha* (3.33), *Alstonia spp* (2.9 each), *Harungana madagascariensis* (2.37) and *Azadirachta indica* (2.0). Their main importance resides in their use in combination with others in the preparation of treatments and different parts used from a single plant (see Appendix A). More than 60% of the species have the least use-values of 1.0. These are species that a single part is used by a few or all the key informants.

Sustainability and Conservation Challenges

All (100%) informants reported that harvesting of the species is in small quantities and when the need arises though backs of *Enantia, Araliopsis and Pachypodanthium* are dried for commercial purpose. They also reported that to ensure replenishment and availability barks of species (for example, *Enantia, Nauclea, Araliopsis and Pachypodanthium*) are dried. All the informants reported that they do not cultivate species except for those that are originally food crops as they believe that the forest is for them and cultivating may mean inviting illness. This belief is also reported by Musila, Kisangau and Muena (2004) where respondents were of the belief that cultivating medicinal plants was like inviting the spirit of illness into homes. That notwithstanding, species like *Araliopsis soyauxii* and *Pachypodanthium staudtii* are exploited by just a few informants as they reported that the species are scare and difficult to find. The informants explained that most of the trees of these two species have been ring-barked to death coupled with scarcity due to habitat destruction.

CONCLUSION AND RECOMMENDATIONS

Plant diversity is still an indispensable resource for the well being of the people of these communities and provides preventive and therapeutic help to malaria, one of the most health-related issues in the area. Majority of the species are used locally and by people from neighbouring areas and therefore harvested in relatively small quantities. Since a number of the remedies are obtained from the barks, the probability of survival of individual plants after harvest could be at risk. Some plants (for example, *Araliopsis soyauxii* and *Anthocleista* species) may be endangered as a result of the unsustainable harvesting (ring-barking of tree species with low potentials of regeneration) and loss of habitats.

Carrying out similar studies on sustainable harvesting methods, species biomass, primary production and demography of medicinal plants in the tropical rainforest of Nigeria with the view to improving the state of our knowledge on Nigerian medicinal plant resource and hence, the ethnomedicine of Nigeria is eminent. Furthermore, a comprehensive research designed to determine the rates that barks, roots and stems (if possible) can regenerate after harvest is of utmost importance. This will help in a sustainable off take of medicinal plant materials from natural populations. It is therefore, recommended that local participation in the conservation activities in the area be encouraged. It is important to identify priority medicinal plants for conservation especially those that make a direct contribution to human livelihood and health. There is need for increased collaboration with and within traditional healers in order that ideas are exchanged. This will reduce the extent of knowledge loss.

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Appendix A: Citations of Medicinal Plants among the Key Informants

Scientific name of plant	Associated plants	Plant part	Phar	Mod. Adm	No. Inf
Ageratum conyzoides		whl	inf	re	21
Alstonia boonei		Ba	de	or,re	28
Alstonia boonei		Ba	tinct	or	24
Alstonia boonei		wo	tinct	or	28
Alstonia congensis		Ba	de	or,re	28
Alstonia congensis		Ba	tinct	or	24
Alstonia congensis		wo	tinct	or,	28
Alstonia boonei	*Elaeis*	Ba+wo	inf	or	7
Elaeis guineensis	*Alstonia*	Wi	inf	or	7
Alstonia congensis	*Elaeis*	Ba+wo	inf	or	7
Elaeis guineensis	*Alstonia*	Wi	inf	or	7
Ananas comosus	*Citrus,Carica,Cymbopogon,Mangifera,Psidium*	Fr	de	or,re,st-ba	30
Citrus aurantifolia	*Ananas*	Le,Fr	de	or,re,st-ba	30
Citus limon	*Ananas*	Le,Fr	de	or,re,st-ba	30
Citrus sinensis	*Ananas*	Le,Fr	de	or,re,st-ba	30
Carica papaya	*Ananas*	Le,Fr	de	or,re,st-ba	30
Cymbopogon citratus	*Ananas*	Le	de	or,re,st-ba	30
Mangifera indica	*Ananas*	Le+ba	de	or,re,st-ba	30
Psidium guajava	*Ananas*	Le	de	or,re,st-ba	30
Angylocalyx talbotii	*Pycnanthus,Afromomum*	Ba	scr,gr,tinct	or	2
Pycnanthus angolensis	*Afromomum,Angylocalyx*	Ba	scr,gr,tinct	or	2
Afromomum hanburyi	*Angylocalyx,Pycnanthus*	Se	gr,tinct	or	2
Anthocleista djalonensis		Ba	de	or,re	30
Anthocleista vogelii		Ba	de	or,re	30
Araliopsis soyauxii		Ba	inf,tinct	or	5
Aspilia africana		Le	mac	or	20
Azadirachta indica		Le	mac	or	30
Azadirachta indica		Le+wo+ba	tinct	or	30
Bambusa vulgaris	*Cymbopogon*	Le	de	or	5
Cymbopogon citratus	*Bambusa*	Le	de	or	5
Carica papaya		Le	mac+inf	re,ba	16
Chromolaena odorata		Le	mac	or	27
Chromolaena odorata		Le	de	re	15
Cylicodiscus gabunensis		Ba	de	or,re	18
Cylicodiscus gabunensis	*Piptadeniastrum*	Ba	tinct	or	4
Piptadeniastrum africanum	*Cylicodiscus*	Ba	tinct	or	4
Dacryodes edulis		Ba	de	re	12
Enantia chlorantha		Ba	de	or	30
Enantia chlorantha		Ba	tinct	or	30
Enantia chlorantha		wo	tinct	or	21
Enantia chlorantha		Le	de	or,,st-ba	19
Gongronema latifolium		Le	mac	or	17
Harungana madagascariensis		Ba	de	or	27
Harungana madagascariensis		Le	de	or	24
Harungana madagascariensis		Le	po,tinct	or	8
Harungana madagascariensis		Le	mas	or	12
Lophira alata		Ba	de	or	11
Milicia excelca		Ba	de	or	17
Morinda lucida		Ba+Le	de	or	20
Nauclea diderrichii		Ba	tinct	or	17
Nauclea diderrichii		Le	mac	or	16
Nauclea diderrichii		Rt	tinct	or	8
Newbouldia laevis		Le	de	or,re	25
Newbouldia laevis	*Afromomum*	Ba	de	re	23
Afromomum melegueta	*Newbouldia*	Se	gr+de	re	23
Pachypodanthium staudtii		Ba	po,de	or,re	5
Phyllanthus amarus		whl	de	or,re	20
Physalis angulata		whl	de	or,re	2

Platicirium stemaria	*Mangifera,Carica,Citrus spp,Cymbopogon,Ananas, Psidium*	Whl	de	or,re,st-ba	2
Mangifera indica	*Platicirium*	Ba+le	de	or,re,st-ba	2
Carica papaya	*Platicirium*	Fr+le	de	or,re,st-ba	2
Citrus aurantifolia	*Platicirium*	Fr+le	de	or,re,st-ba	2
Citrus limon	*Platicirium*	Fr+le	de	or,re,st-ba	2
Citrus sinensis	*Platicirium*	Fr+le	de	or,re,st-ba	2
Cymbopogon citratus	*Platicirium*	Le	de	or,re,st-ba	2
Ananas comosus	*Platicirium*	Fr	de	or,re,st-ba	2
Psidium guajava	*Platicirium*	Le	de	or,re,st-ba	2
Poga oleosa		Ba+le	po+de	or,re	11
Rauvolfia vomitoria		Le	po+de	or,re	10
Rauvolfia vomitoria		Ba	de	or	14
Saccoglottis gabonensis		Ba	de	re	9
Senna alata		Le	inf	or	7
Sida acuta		Rt	po+inf	or	16
Sida corymbosa		Rt	po+inf	or	16
Spondias mombin		Ba	de	re	7
Stachytarpheta indica		Le	de	or,re	11
Tetrapleura tetraptera		Ba	de	or,re	21
Vernonia amygdalina		Le	de	re	17

Plant Part:Rt= Root; Fr= Fruit; Le= Leaf; Se= seed; Whl = whole plant; Yo-le = Young leaf; Ba = bark; Fl=Flower; Wo= wood; st = stem; Sti-sh = Stipular sheath; **Pharmaceutical form (Phar)**: gr = grinding; mac= maceration (soak); mas= mastication; co =cooking; de= decoction; inf = infusion; po = pounding; scr = scraping; tinct = tincture; **Mode of administration (mod.adm)**: or=oral voice; re = rectal voice; st-ba = steam bath; **Associated plants:** Plants that are used together with other plants for the same prescription; **No Inf**. Number of informants who reported a specific usage (a citation).