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Socio-economic and ethnobotanic characteristics of Plant use in Mount Nlonako, Cameroon

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Abstract
This study aimed to investigate the socio-economic characteristics of plant users in the biodiverse Mount Nlonako forest community in the Littoral region of Cameroon. The study evaluated the socio-cultural and economic characteristics of villagers; identified the different plant resources exploited in and around the forest particularly their medicinal use and the mode of exploitation, preparation and administration and user's knowledge of these plants. Semi-structured questionnaires were administered to 100 people from two purposively selected villages representing 30% of the estimated village population in the study area. The socio-economic characteristics of respondents, the methods of preparation, and methods of harvesting and route of administration of medicinal plants were analyzed using descriptive statistics. Pearson correlation tests were conducted to determine relationships between socio-economic and ethnobotanic variables. The majority of respondents was farmers, married to one or more wives and had some secondary education with an average annual income of less than 100, 000 FCFA. The wide use of medicinal plants, high value attributed to them, informant consensus factor and fidelity level could validate the effectiveness and efficacy of the ethno-botanical practices of the Mount Nlonako communities. 33 plant species were identified belonging to 22 families used to cure 28 diseases. Asteraceae was the most dominant family. Leaves and decoctions taken orally were the plant part and method most used for medicinal preparation and use. 14 species were used as fuel wood, ten for fencing, 15 for timber, 6 for cultural activities and 22 forest products used as food. The collected data may help to avoid the loss of traditional knowledge on the use of medicinal plants in this area. The findings of this study serve as baseline for future ethnobotanic, socio-economic, pharmacological and phytochemical studies of medicinal plants in humid Central African montane forest.

Keywords: Socio-economics, ethnobotany, health, medicinal plants, Non-timber forest products

1. Introduction
Ethnobotany is a field of study that examines the relationship between people and their forests, (Thomas *et al*,. 1989) [86]. It focuses on how local people interact with the natural environement, including how they classify, manage, and use plants available around them. (Getaneh, 2019; Limenih *et al.*, 2015; Netsanet *et al*., 2020) [31, 57, 67]. Ethnobotany can help guide rural development by calculating sustainable yields of forest products. (Thomas *et al.*, 1989) [86]. Around 60 million indigenous people are almost entirely dependent on forests (World Bank, 2006). Forests in Central Africa provide numerous products and services for local and indigenous peoples and for trade globally, including foods, medicines, fuel and revenues ranging from supplementary to the main source of income (Eba'a Atyi *et al.*, 2021; Awono *et al.*, 2016; Ingram, 2014) [23, 8, 45]. Indigenous and local people have evolved locality specific knowledge on medicinal plant use, management and conservation (Teklehaymanot, 2009; Yigezu *et al.*, 2014; IPBES 2019; 2022, Duguma & Mesele, 2019; Netsanet *et al*., 2020) [84, 92, 46, 47, 22, 67]. Many people in Africa use plants for medicinal purposes (Idu *et al.*, 2005; Bussmann, 2006; Teferi *et al.*, 2009) [41, 14, 82] with up to 95% of traditional medicinal preparations being of plant origin (Abebe, 1986) [1]. Cameroon is a country that is rich in biodiversity and has a long history of using forests and plants for various purposes, including medicinal ones. (Nichter, 1992; Ndenecho, 2011; Fonge *et al*., 2012, Ingram 2014; Awono *et al*., 2016) [68, 65, 27, 45, 8]. The traditional medicine industry in Cameroon is not well-structured, which hinders its assimilation into the contemporary healthcare system (Nkongmeneck *et al.*, 2007) [69]. In 2017, Cameroon's progress towards meeting its health targets under the

Sustainable Development Goals was found to be lacking. Specifically, the country had a health service coverage index of 46%, which indicates that many people did not have access to basic health services. Additionally, there were only 0.9 medical doctors per 10,000 people, which suggests that there was a shortage of healthcare professionals in the country. (WHO 2020) [91].

In the last 15 years, many studies have looked to understand how social, economic, cultural, environmental, and geographical factors influence the traditional knowledge about plants for medicinal use. On an individual level, factors such as gender, age, ethnicity, birthplace, and level of education that relate to a person's social and economic status have been recognized as significant (Luoga *et al.*, 2000; Byg, 2004; Byg & Balslev, 2006; Paniagua Zambrana *et al.*, 2007) [59, 15, 16, 71]. Here's one possible rephrased version: "The size of a family, its participation in the market economy, and the quantity of material possessions at the family level have been associated with the level of the household (Byg & Balslev, 2001; 2004; Reyes-García *et al.*, 2007) [15, 75]. At the community level, access to commercial centers, health care, education, electricity, water, land tenure systems, and settlement history have been identified as significant factors (Takasaki *et al.*, 2001; Byg *et al.*, 2007; Vandebroek, 2010) [79, 71, 89].

Gaining insight into customary knowledge is is a crucial factor in improving livelihoods (Reyes-García *et al.*, 2007) [75], and in managing natural resources sustainably (Mackinson & Nottestad, 1998; Berkes *et al.*, 2000; Huntington, 2000) [60, 12, 40], and for the protection of species and ecosystems (Shackeroff & Campbell, 2007) [76]. Local communities have acquired traditional knowledge by living in and adapting to their environment over time. Traditional and indigenous knowledge of plants however is rapidly disappearing (Teferi *et al.*, 2009) [82]. The loss of knowledge is made worse by rapid destruction of natural habitats, the expansion of agriculture, and the overuse of plants for medicinal and other purposes, which endangers most species with extinction (Focho *et al.*, 2009b) [26]. Medicinal plants are a valuable substitute for conventional medicine, particularly for impoverished communities in rural regions who lack access to healthcare services. This is due to the vast number of species available, which provides a diverse range of options. (Shippmann *et al.*, 2002) [77]. According to the World Health Organisation, around 80% of the global population depends mainly on traditional medicine for their primary health care needs. (Cao *et al.*, 2009) [17]. Medicinal plants are a valuable resource for poor rural people as they are affordable and readily available to treat various diseases and health issues. However, the overuse of these plants due to human activities such as deforestation, agricultural expansion, and other anthropogenic pressures is a significant cause of their depletion (Alemayehu *et al.*, 2015) [4]. The economic downturn and poverty that are widespread in many tropical countries, including Cameroon, have led to a rise in the demand for forest resources. This has resulted in significant deforestation caused by human activities, which has deprived local communities of vital sources of sustenance, health, and income. (Kamga *et al*., 2019) [51]. Huai and Pei (2009) [39] suggest that the loss of traditional knowledge of plants and culture can be reversed. However, Idu *et al*. (2011) [42] found that younger people have less traditional knowledge compared to older and middle-aged people. This was also atested by Ghorbani *et al*., (2012) [94]. The authors of a study published in 2012 argue that the breach discussed in their work highlights the challenges associated with transferring knowledge from older to younger generations (Fonge *et al*., 2012) [27]. They emphasize the importance of documenting traditional knowledge of plants, especially medicinal plants, to address this issue. Despite many ethnobotanical investigations in Cameroon, some regions remain understudied despite their high levels of endemism and plant diversity, according to Adjanohoum *et al*. (1996) [3]. Mount Nlonako is an example of an area with high animal endemism, according to Sainge *et al*. (2017) [73] and Herrmann *et al*. (2005) [52]. Although floral endemism is high in this mountainous region in general, plant species in Mount Nlonako have not been well documented, as per Ndenecho (2011) [65], Sainge *et al*., 2017 [73], Cheek & Onana, 2021) [21]. The authors of the papers by Mahmoud *et al*. (2020) [61] and Eba'a Atyi *et al*. (2021) [23] have reported that overexploitation of forest species, anthropogenic deforestation and degradation, and climate change have put biodiversity at risk, particularly for endemic species. There is a possibility that species not yet known to science and of value for local communities may become extinct if no concrete measures are taken, as reported by Zapfack *et al*., (2001). Given the common use of plants, particularly forest plants, in this area, especially for medicinal use (Ndenecho 2011 [65], Cheek & Onana, 2021) [21], this study aims to fill these critical gaps by understanding plant uses and values among people living in and around the Mt Nlonako forest.

2. Methods

2.1. Location of the Mt Nlonako study area

The Cameroon highlands are a chain of isolated volcanic and plutonic mountain peaks that cover an area of approximately 40,877 km², extending from the Gulf of Guinea to the Mandara Mountains (Ayonghe *et al*., 1999) [9]. The highlands are biologically diverse and are home to a variety of flora and fauna. Mount Nlonako is located in the Mungo division of Littoral Region, from 4° 49′- 4° 56' North and from 9° 56' - 10° 01′ East. It encompasses approximately 15,000 hectares and is situated southeast of Nkongsamba and east of Mts Kupe Muanengouba. Its slopes are covered by humid montane forest up to a peak that is approximately 1825 meters high, Mahmoud *et al*., 2020 [61].

Mt Nlonako is a wildlife reserve (WDPA ID: 306631) due to high levels of faunal endemism, although hunting and poaching are common (Fonkwo *et al*,. 2011) [28]. There is no modern healthcare access in the two villages of Ngwa and Badjoki, with the nearest hospital and healthcare centre, and pharmacies located in the town of Nkongsamba (population approx. 104,050 in 2005), respectively approximately 4 and 20 Km by untarred road.

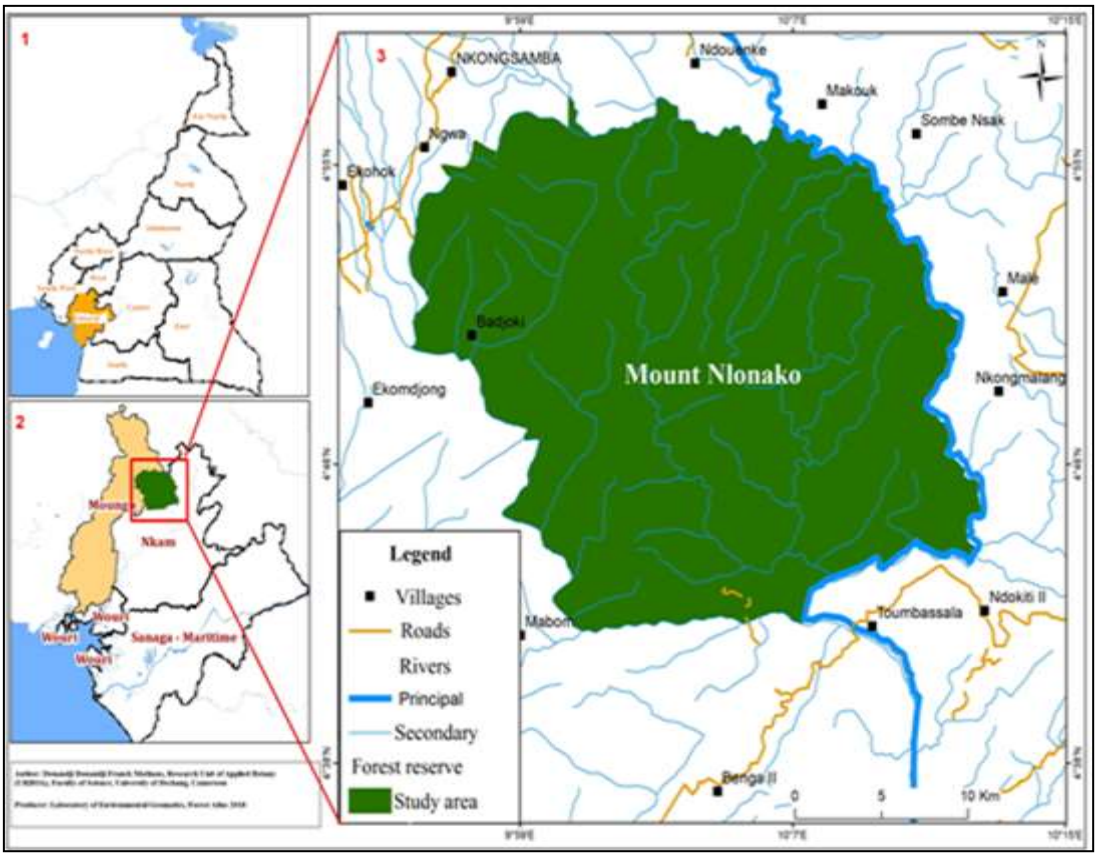

Fig 1: Localization of the Mount Nlonako study area

2.2. Data collection and analysis

Semi-structured questionnaires with open-ended questions were conducted in Mbo and French languages in the period mid-April to mid-May. Self-reported information was collected, their socio-cultural and economic characteristics and ethnobotanical information on species used, types of uses, methods of preparation, methods of harvesting and route of administration of medicinal plants from 100 randomly selected people amongst the local population in two purposively selected villages (35 people in Badjoki and 65 people in Ngwa), located in and around the forest and representing about 30% of the population in these two villages. Concerning the socio-economic characteristics and the indigenous knowledge of the medicinal plants, youths, women, men and traditional healers in the local community were selected randomly. The data was entered and coded in Microsoft® Excel for Windows 2010 and analyzed in Statistical Package for Social Sciences software version 20 (SPSS software V.20) using descriptive and inferential statistics. The socio-economic characteristics of respondents, methods of preparation, methods of harvesting and route of administration of medicinal plants were analyzed using descriptive statistics (Netsanet *et al.*, 2020) [67]. Pearson correlation tests were conducted to determine relationships between socio-economic and ethnobotanic variables. Informant consensus factor (ICF) was used to evaluate the degree of agreement in the use of plants in ailment categories between plant users in the study area i.e. to test the homogeneity of the informant(s) knowledge and reveals intra-cultural and inter-cultural importance and validation (Trotter & Logan, 1986) [87]. The Fidelity level (FL) (the percentage of informants who mentioned the uses of certain plant species to treat a particular ailment in the study area) was analyzed to identify the most preferred species used by the informants for treating certain ailments. Species were identified by participants using local names (Mbo and French languages) with scientific names identified by the research team. Consent to use data and village name was granted by all participants according to the University of Buea and Dschang research guidelines.

3. Results

3.1. Socio-economic and demographic characteristics of Mount Nlonako communities

The majority of respondents (72%) were male and 28% female with 25% between the ages of 15-29 years; 35% between 30-54 years; and 40% 54 years old and above. The majority, (89%) were married while 11% were still single. For those that were married, 80% were monogamous while 20% were polygamous. 19% of the participants attended secondary school followed by 28% attaining primary level; 12% tertiary; and 41% had no formal education. In terms of household size, 41% had children ranging from 1-6 followed by 29% having children ranging between 7 and 10; 15% between 11 and 15 and 5% had children ranging between 16 to 20. The main economic activity was agriculture (71%); followed by agriculture and traditional medicine practitioner (9%); civil servant (6%), hunting (5%), agriculture and other activities (4%); 4% were only traditional medicine practitioners and 1% of the respondents were in other activities. A traditional medical practitioner is (self) defined as a person in a traditional community who practice healing or renders medical services using plants based on traditional knowledge. In total, 84% of them were engaged in agriculture and 13% were traditional medical practitioners. In terms of farm size, 26% of participants had farms ranging between 2 to 3 hectares; 23% had farms ranging from 4 to 5 hectares and less than 2 hectares; 16.48% had 6 to 10 hectares while 11% had farms of 11 hectares or more. The main types of agricultural activity carried out were crop production (65%) and animal

production (9%) with 27% involved in both crop and animal production. For those in crop production, 74% practiced mixed type of cropping, 4% for mono-cropping and 22% both mixed and mono cropping. Of those practicing animal production, 65% used extensive systems and 35% semi-intensive systems of production. The main source of farm labour used is family labour (50%). This explains why some men were married to more than one woman with the sole intention of increasing the family size to provide sufficient labour for their farms. Other farmers used hired labour (48%) and 2% used both family and hired labour. Capital sources for their farming activities were mainly personal savings 37%, bank loan 26%, informal saving groups (njangi) 15% with 12% using both bank loan and personal savings; and 10% family contributions. 10% engage in farming for subsistence use while 62% for both commercial and subsistence purposes. The majority of interviewees (45%) earn between 100,000 and 500,000 FCFA annually from farming from farming activities**,** 27% earn less than 100, 000 FCFA annually; and 28% earns between 500, 000 and 1,000,000 FCFA annually. Belonging to a farming organization or a cooperative is common (54%) as these organizations organize marketing and offer extension officers.

3.2. Ethnobotanic characteristics of Mount Nlonako plant users

The uses of plants found in the study area and their importance were assessed. 80% indicated the use of medicinal plants with the majority aged 54 years and above. Of this 80%, 16.25% users were traditional medicine practitioners. A total of 33 medicinal plants belonging to 22 families were recorded. Asteraceae (7 species; 21.21%) was the most used plant family in the area of study followed by Fabaceae (4 species, 12.12%), Euphorbiaceae (2 species; 6.06%) and Malvaceae (2 species; 6.06%) while other families had 1 species (3.03%) each, shown on table 1. Majority of the plant species recorded were used to treat human ailments as shown in table 2. The most utilized plants were *Eremomastax speciosa* (41 citations) and the oil palm, *Elaeis guineensis* (33 citations). Leaves were mostly used for herbaceous plants, barks and roots for trees while young shoots, latex, and seeds were least used. Malaria, stomach disorders and diarrhea, child birth and gynecological were the main illnesses treated with a variety of plants.

Table 1: Diversity of medicinal plant families in the Mount Nlonako study area

No	Family name	No of Species	Percentage (%)
1	Acanthaceae	1	3.03
2	Anacardiaceae	1	3.03
3	Apocynaceae	1	3.03
4	Araceae	1	3.03
5	Araliaceae	1	3.03
6	Arecaceae	1	3.03
7	Asphodeaceae	1	3.03
8	Asteraceae	7	21.21
9	Caricaceae	1	3.03
10	Cluciaceae	1	3.03
11	Commelinaceae	1	3.03
12	Crassulaceae	1	3.03
13	Dracaenaceae	1	3.03
14	Euphorbiaceae	2	6.06
15	Fabaceae	4	12.12
16	Lauraceae	1	3.03
17	Malvaceae	2	6.06
18	Myristicaceae	1	3.03
19	Myrtaceae	1	3.03
20	Poaceae	1	3.03
21	Rutaceae	1	3.03
22	Zingiberaceae	1	3.03
		33	100

Table 2: Plants with medicinal uses in the Mount Nlonako study area

No	Species and family Names	Parts used	Diseases treated /uses	Preparation and administration	Frequency of citation
1	*Vernonia amygdalina* Del. Cent. (Asteraceae)	Leaves	Menstrual cramps, wounds, high blood pressure	Maceration of leaves is taken orally, macerate leaves and squeeze on the fresh wound	13
2	*Euphorbia desmindi* Keay and Milne-Redhead (Euphorbiaceae)	Bark	Rheumatism	Decoction is taken orally	3
3	*Rauvolfia vomitoria* Afzel. (Apocynaceae)	Bark, leaves	Malaria, stomach ache, gastritis	Decoction is taken orally	20
4	*Piptadeniastrum africanum* (Hook. f) Brenan (Fabaceae)	Bark	General fatigue	Decoction is taken orally	12
5	*Psidium guajava* Linn. (Myrtaceae)	Leaves	Malaria and fever	Concoction with roots of Carica papaya and leaves of Sena alata is taken orally	31
6	*Pycnanthus angolensis* (Welw.) Warb. (Myristicaceae)	Sap	Clean the eyes	Small quantity is put inside each eye and covered, and then the clot is removed	4
7	*Hibiscus sabdariffa* Linn. (Malvaceae)	leaves	Stomach ache	Maceration of the leaves and taken orally	9
8	*Eremomastax speciosa* (Hochst.) Cufod. (Acanthaceae)	Leaves	Irregular menstruation, infertility in women, stomach cramps, pains	Infusion and decoction of the leaves taken orally	41
9	*Senna alata* (Linn.) Roxb. (Fabaceae)	Leaves	Rashes, filariasis	Pound the leaves and apply on the skin	8
10	*Ageratum conyzoides* Linn. (Asteraceae)	All the parts of the plant	Headache, tiredness	Infusion of the plant is taken orally	18
11	*Carica papaya* (Caricaceae)	Whole plant	Hypertension, malaria	Decoction of the plant with other plants and taken orally	17
12	*Citrus aurantifolia* (Rutaceae)	Fruits	Filariasis, kidney problem, rheumatism	Decoction and taken orally	9
13	*Cola nitida* (Malvaceae)	Seeds, leaves, bark	Gastritis, stimulant, chest pains	Eating	17
14	*Commelina benghalensis* L. (Commelinaceae)	Whole plant	Ease child birth, ring worms, typhoid, headache	Decoction taken orally	4
15	*Cymbopogon citratus* (DC.) Stapf. (Poaceae)	leaves	General fatigue and fever	Decoction taken orally	15
16	*Dracaena arborea* (Willd.) Link (Dracaenaceae)	Roots	Tooth ache	Concoction with lime stone taken orally	3

17	*Emilia coccinea* (Sims) G. Don. (Asteraceae)	Leaves	Epilepsy	Burnt and cover with blanket	1
18	*Euphorbia hirta* L. (Euphorbiaceae)	Leaves	Diarrhea, stomach ache, food poisoning	Fresh leaves eaten raw and or oil	4
19	*Aloe vera* (L.) Burm. (Asphodeaceae)	Leaves	Stomach ache, menstrual cramps	Macerate the leaves and take orally	10
20	*Bidens pilosa* L. (Asteraceae)	Whole plant	Headache	Decoction taken orally	13
21	*Mangifera indica* L. (Anacardiaceae)	Bark	Malaria	Concoction with leaves of *Carica papaya* and *Cymbopogon citratus*	4
22	*Persea americana* Mill. (Lauraceae)	Leaves	Malaria	Concoction with *M. indica, C. papaya* taken orally	3
23	*Brassica oleracea* Plenck. (Brassicaceae)	Leaves	Typhoid	Concoction with roots of Eucalyptus and taken orally	2
24	*Desmodium sp* (Fabaceae)	Leaves, stem	Dysentery, piles	Decoction taken orally	4
25	*Garcinia kola* (Cluciaceae)	Bark, seeds, roots	Cough, gastritis, sleeping sickness, stimulant, gastroenteritis, speed lactation	Decoction taken orally	3
26	*Helianthus annuus* Asteraceae	Leaves	Piles	Decoction taken orally	2
27	*Taraxacum officinale* (*Asteraceae*)	Whole plant	Liver disorders, kidney problems, spleen problems	Decoction taken orally	3
28	*Colocasia esculenta* (L.) Schoot (Araceae)	stem	Sores	Pound the stem and apply on the area	2
29	*Conyza sumatrensis* (L.) Cronquist. (Asteraceae)	Leaves	Fungi, eczema, poisoning	Macerate and apply topically, fresh shoots eaten raw	3
30	*Zingiber officinale Roscoe* (Zingiberaceae)	Roots	Cough	Grind and taken with honey orally	6
31	*Kalanchoe crenata* (Andr.) Haw. (Crassulaceae)	Leaves	Ear pain	Squeezing the leaves and dropping the liquid in the ears	4
32	*Polyscias fulva* (Hiern) Harms (Araliaceae)	Bark, leaves	Headache	Decoction taken orally	1
33	*Elaeis guineensis Jacq* (Arecaceae)	Seeds, oil, leaves, palm wine	Constipation, fever, malaria, bone sprain	Chewing with leaves young guava leaves, decoction of guava leaves, pawpaw leaves, and wine taken orally, mixture of the oil with other medicines	34

3.2.1. Plant parts used for medicines
Respondents reported that the leaves (41.25%) were the most used part for traditional medicine, followed by bark (27.50%), roots (17.50%), fruits (8.75%), seeds and sap (2.50%).

3.2.2. Preparation methods
The main method for preparation of traditional medicine is decoction (35%), followed by concoction (21.25%), maceration (15%). Other methods include infusion and squeezing (7.5% each), maceration and squeezing (6.25%), with pounding and exudation the least used (3.75% each).

3.2.3. Administration routes
The medicines are applied through different routes of administration dominated by oral (chewing, eating, drinking and swallowing) 82.50%, followed by dermal (pasting, creaming and washing), 11.25%, through the eye (4%), anus and ear (1.25% each).

3.2.4. Growth form
The species used to treat human ailments were categorized as herbs (51.25%), tree (23.75%), shrub (18.75%) and epiphytes (6.25%).

Eleven categories of ailment were found with high informant consensus factor (0.95) value recorded for disease related to female sterility and gynecology while the lowest factor (0.73) was for skin diseases as shown in table 3. The use of plants was mostly reported by the older participants.

Table 3: Ailment categories and Informant Concensus Factor in the Mount Nlonako study area

No	Category of ailment	Number of taxa (Nt)	Number of use reports (Nur)	ICF
1	Digestive system	13	113	0.89
2	Central nervous system	9	84	0.90
3	Respiratory system	4	25	0.87
4	Skin diseases	6	20	0.73
5	Female sterility/gynecology	4	71	0.95
6	Male sterility/sexual dysfunction	4	32	0.90
7	Malaria/typhoid fever/yellow fever	9	96	0.91
8	Rheumatism	2	9	0.87
9	Piles	2	5	0.75
10	Wounds	2	15	0.92
11	Other problems (ear, tooth, eye)	3	10	0.77

The percentage of informants claiming use of a specific plant for a major ailment, fidelity level (FL) was calculated for the most frequently reported ailments, to evaluate species consensus shown in table 4. *Psidium guajava*, *Elaeis guineensis* and *Eremomastax speciosa* had the highest levels of fidelity (100%) while *Ageratum conyzoides* and *Senna alata* was lowest with 63.3% and 58.3% FL respectively. The highest FL value (100%) was obtained for the internal therapeutic category (irregular menstruation, infertility in women, stomach disorders, pains, malaria and fever).

Table 4: Fidelity level of commonly used medicinal plants in Mount Nlonako study area

No	Family	Scientific name	Uses	Fidelity level (%)
1	Acanthaceae	*Eremomastax speciosa* (Hochst.) Cufod	Irregular menstruation, infertility in women, stomach cramps, pains	100
2	Apocynaceae	*Rauvolfia vomitoria* Afzel.	Malaria, stomach ache, gastritis, yellow fever	78.5
3	Arecaceae	*Elaeis guineensis Jacq*	Stomach disorders, bone sprain, malaria, fever, typhoid	100
4	Asphodeaceae	*Aloe vera* (L.) Burm.	Stomach ache, menstrual cramps	73
5	Asteraceae	*Ageratum conyzoides* Linn.	Headache, tiredness	63.3
6	Asteraceae	*Bidens pilosa* L	Headache	85
7	Asteraceae	*Vernonia amygdalina* Del.	Menstrual cramps, wounds, high blood pressure	85.4
8	Caricaceae	*Carica papaya* L.	Hypertension, malaria	91
9	Fabaceae	*Piptadeniastrum africanum* (Hook.f) Brenan	General fatigue	77.8
10	Fabaceae	*Senna alata* (Linn.) Roxb.	Rashes, filariasis	58.3
11	Malvaceae	*Cola nitida*	Gastritis, stimulant, chest pains	96
12	Malvaceae	*Hibiscus sabdariffa* Linn	Malvaceae	74
13	Myrtaceae	*Psidium guajava* Linn	Malaria and fever	100
14	Poaceae	*Cymbopogon citratus* (DC.) Stapf	General fatigue and fever	97
15	Rutaceae	*Citrus aurantifolia*	Filariasis, kidney problem, rheumatism	86

3.2.5. Plants used as food

Table 5 shows the species of plants consumed as food with cassava, *Manihot esculentus* followed by banana, *Musa sapientum* as the most consumed staple starchy food crops, *Vernonia amygdalina* and *Solanum nigrum* as the most consumed food vegetables.

Table 5: Plant species used for food and vegetables

No	Common names	Local names	Scientific names and families	Cited Frequency
1	Pineapple	'Ejang'	*Ananas comosus* (Bromeliaceae)	5
2	Black fruit	'Mbel'	*Canarium schweinfurthii* (Burseraceae)	16
3	Pawpaw	*	*Carica papaya* (Caricaceae)	13
4	Coffee	'Caffie'	*Coffea arabica* (Rubiaceae)	8
5	Cola nut	'Ebeh'	*Cola nitida* (Malvaceae)	7
6	Ashu cocoyams	'Egin'	*Colocasia spp* (Araceae)	14
7	Plum, Safou	'Essa'	*Dacryodes edulis* (Burseraceae)	17
8	Palm kernel	'Mbi'	*Elaeis guineensis* (Arecaceae)	28
9	Koki beans	'Koun'	*Glycine max* (Fabaceae)	11
10	Potatoe	'Elanhan'	*Ipomea batatas* (Convolvulaceae)	19
11	Mango	'Mangolo'	*Mangifera indica* (Anacardiaceae)	21
12	Cassava	'Gawwi'	*Manihot esculentus* (Euphorbiaceae)	63
13	Plantain	'Etomb'	*Musa paradisiaca* (Musaceae)	43
14	Banana	'Edourou'	*Musa sapientum* (Musaceae)	47
15	Pear	'Pia'	*Persea Americana* (Lauraceae)	26
16	Beans	'Nzolah'	*Phaseolus vulgaris* (Fabaceae)	23
17	Raphia palm	*	*Raphia hookeri* (Arecaceae)	8
18	Tomato	*	*Solanum Lycopersicon* (Solanaceae)	5
19	Njama njama	*	*Solanum nigrum* (Solanaceae)	27
20	Bitter leaf	*	*Vernonia amygdalina* (Asteraceae)	58
21	Cocoyam	'Ecawi'	*Xanthosoma mafafa* (Araceae)	33
22	Maize, corn	'Mbat'	*Zea mays* (Poaceae)	39

3.2.6. Plants species used for fuel wood

Most of the plants used for fuel wood come from the forest, shown in table 6. The most used species was *Raphia indica* and the least used was *Albizia adianthifolia*.

Table 6: Plant species used for fuel wood in the Mount Nlonako study area

No	Family	Species	Cited Frequency
1	Anacardiaceae	*Mangifera indica* L.	34
2	Apocynaceae	*Rauvolfia vomitoria*	20
3	Apocynaceae	*Voacanga africana*	6
4	Arecaceae	*Raphia indica* G. Mann.	64
5	Asteraceae	*Vernonia conferta*	11
6	Burseraceae	*Santeria balsamifera* Oliv.	8
7	Burseraceae	*Dacryodes edulis*	24
8	Burseraceae	*Canarium schwienforthii* Engl	14
9	Fabaceae	*Albizia adianthifolia*	5
10	Fabaceae	*Albizia zygia*	7
11	Lauraceae	*Persea americana* Mill.	19
12	Myrtaceae	*Eucalyptus grandis* W. Hill ex Maiden.	52
13	Myrtaceae	*Psidium guajava* L.	26
14	Ochnaceae	*Lophira alata*	12

3.2.7. Plants species used for fencing

Shown in table 7, *Eucalyptus grandis* and *Albizia adianthifolia* were the most used for fencing and *Terminalia superba* was the least used, with reasons given that the distance from the community to the forest is far making transportation difficult.

Table 7: Plant species used for fencing in the Mount Nlonako study area

No	Family	Species	Cited Frequency
1	Fabaceae	*Albizia adianthifolia*	17
2	Fabaceae	*Albizia zygia*	27
7	Burseraceae	*Canarium schweinfurthii* Engl	5
5	Dracaenaceae	*Dracaena arborea* (Wild.) Link.	26
6	Meliaceae	*Entandrophragma utile*	7
4	Myrtaceae	*Eucalyptus grandis* W. Hill ex Maiden.	33
9	Ochnaceae	*Lophira alata* Banks ex Gaertn.f	3
3	Pinaceae	*Pinus sylvestris* L	14
8	Arecaceae	*Raphia hookeri*	29
10	Combretaceae	*Terminalia superba* Engl & Diels	2

3.2.8. Plants species used as timber

Shown in table 8, these plants are all exploited from the forest and transported by the head to the villages. As the terrain is steep with no access motorable roads, transportation by vehicles is rare.

Table 8: Plant species used as timber in the Mount Nlonako study area

No	Species	Family
1	*Albizia adianthifolia*	Fabaceae
2	*Albizia zygia*	Fabaceae
3	*Bombax buonopozense*	Bombacaceae
4	*Coelocaryon preussii*	Myristicaceae
5	*Diospyros gabunensis*	Ebenaceae
6	*Entandrophragma utile*	Meliaceae
7	*Erythrophleum ivorense*	Fabaceae
8	*Lannea welwitschii*	Anacardiaceae
9	*Lophira alata*	Ochnaceae
10	*Milicia excelsa*	Moraceae
11	*Nauclea diderrichii*	Rubiaceae
12	*Pentaclethra macrophylla*	Fabaceae
13	*Pterocarpus soyauxii*	Fabaceae
14	*Terminalia superba*	Combretaceae
15	*Treculia africana*	Moraceae

3.2.9. Plants species used for cultural purposes

Table 9 shows the plants were used in cultural activities such as traditional weddings, traditional dance and as protection against witchcraft.

Table 9: Plant species with cultural uses in the Mount Nlonako study area

No	Species and family names	Part used	Uses
1	Ageratum conyzoides (Asteraceae)	Leaves	Protection against witchcraft
2	*Kigelia africana* (Bignonaceae)	Stem	Fabrication of local torches used during hunting
3	*Dracaena arborea* (Dracaenaceae)	Leaves	Traditional dance
4	*Pterocarpus soyauxii* (Fabaceae)	Wood (Powder)	Used in traditional wedding and traditional dance
5	*Harungana madagascariensis* (Cluciaseae)	Leaves	Protection against witchcraft
6	*Garcinia lucida* (Cluciaseae)	Bark	Protection against witchcraft

3.2.10. Plant species used for other purposes: Table 10 shows plants species used for other purposes such as ornamentals uses, for sales, carving and broom making.

Table 10: Plant species used for other purposes

No	Species and family	Part used	Uses
1	*Cola lepidota* (Malvaceae)	Seeds	Food, sale
2	*Pseudospondias microcarpa* (Anacardiaceae)	Fruits	Food, sale
3	*Catharanthus roseus* (Apocynaceae)	Whole plant	Ornamental
4	*Elaeis guineensis* (Arecaceae)	Fronds	Fabrication of broom
5	*Dacryodes edulis* (Burseraceae)	Stem	Carving
6	*Ricinodendron heudelotii* (Euphorbiaceae)	Seeds	Food, condiment, sale
7	*Tetrapleura tetraptera* (Fabaceae)	Seeds	Food, condiment, sale
8	*Cola nitida* (Malvaceae)	Seeds	Stimulant, sale
9	*Garcinia kola* (Cluciaceae)	Seeds, bark	Stimulant, sale

Using Pearson correlation test, we observed a significant correlation between household size and farm size at 5% level of significance (p<0.05) at (p= 0.27). This correlation is because as the number of children increases, the surface area of land to cultivate also increases depending on the availability of the land. A positive correlation was also observed between annual income and farm size (r= 0.35, p<0.01). This implies that an increase in farm size will leads to an increase in annual income if and only if farming has taken place for sales. There was also a positive correlation between family size and knowledge of plant use (r=0.24, p<0.01). This is so because in a large family, there is easy transfer of knowledge of plant used for traditional medicine since they live in the same home.

4. Discussion

4.1. Socio-economic and demographic characteristics of Mount Nlonako forest product users

The older people interviewed provided more information on the traditional knowledge of medicinal plants. Many studies revealed that the aged are custodians of traditional knowledge (Dan Guimbo *et al*., 2011; Fonge *et al*., 2012; Ndah *et al*., 2013; Netsanet *et al*., 2020) [21, 27, 66, 67]. The average level of education amongst farmers enables them to solve intricacies or difficulties related to production (agriculture). It is in line with the work of Oluyole, (2005) [70]. However, when people get educated, traditional knowledge about medicinal plants turns to decrease since they will get interest in modern ways and will turn to forget their tradition as it was the case in the study of Tumoro & Maryo, (2016) [88]. The study revealed a positive transfer of knowledge of medicinal plant between members of a large family. This could be because in a family, when a member has good knowledge on plants, it will easily be shared amongst themselves. By doing so, there is reduction in the loss of plant knowledge.

4.2. Ethnobotanic characteristics of the Mount Nlonako forest users

4.2.1. Medicinal plants in the study area

A total of 33 medicinal plant species were identified to treat various human and livestockailments in the study area. Such medicinal plant species diversity depicts the contribution of medicinal plants as well as the traditional health knowledge held by the Mbo ethnic group in assisting the primary health care needs of the people of Nlonako**.** Similar indigenous ethnomedicinal knowledge were reported in different other parts of Cameroon, including the 30 medicinal plant species from Lewoh-lebang village in the South West region (Fonge *et al*., 2012) [27], 39 medicinal plant species among communities of Takamanda in the South West region (Ndah *et al*., 2013) [66]. The similar number of medicinal plants may be due to the fact that, Mount Nlonako is in the same montane forest ecological zone. Local people in the highland forests in Cameroon tend to use the same medicinal plants, indicating indigenous knowledge on medicinal plants, the therapeutic value of these medicinal plants and to a certain extent, their efficacy. The high percentage of the respondent with respect to ethnomedicine was greater than 54 years. This is because they are custodians of traditional knowledge and they know the uses of plants especially medicinal plants than the younger generation. This result is similar to the findings of Idu *et al*., (2011) [42] who reported the prevalence of older generations in the ethnomedicine knowledge of Anambra state Nigeria. This high prevalence of ethnomedicinal knowledge in the older generation could be as a result of rural exodus, according to Helvetas, (2001) [37] there is a population drop with people within the ages of 25-46 moving to the city. The indigenous ethnobotanical knowledge in the region is at risk of disappearing due to the presence of modern health centers, the lack of interest towards traditional medicine by the youths, and the increasing influence of western lifestyle. This has raised concerns about the preservation of this knowledge. For instance, among the Wabane people in Lebialem Division of Cameroon (Focho *et al*., 2009a) [25], the Igede people of Nigeria (Igoli *et al*., 2005) [44], and Waluguru people in East Uluguru Mountains in Tanzania (Mahonge *et al*., 2006) [62], there are fears that this knowledge will be lost.

Regarding the families of medicinal plants, Asteraceae had the highest number of species followed by the Fabaceae, Euphorbiaceae and the Malvaceae. This finding is in line with the work of Fonge *et al*, (2012) [27] who had the Asteraceae and Fabaceae as the most diversified plant family. These findings are also similar to those of Netsanet *et al*., (2020) [67] where the Asteraceae and Fabaceae were represented by the highest number of species. Khan *et al*, (2014) [54], Getaneh & Girma, 2014 [30]; Chekole *et al*., 2015 [19] Bahadura *et al*., (2020) [10] all also report that the highest number of species is in the Asteraceae family. The Asteraceae family's prevalence could be due to a wide range of biologically active compounds and its status as the largest family in the plant kingdom. This is also in line with the findings of Gazzaneo *et al*. (2005) [29], Simbo (2010) [78], and Chijindu *et al*. (2020) [20].

Comparing this study with other studies, Lulekal *et al*., (2008) [58]; Abera, 2014 [2]; Amsalu *et al*., (2018) [7]; Kidane *et al*., 2018 [55]; Tefera & Kim, (2019) [81], had the Fabaceae as the most dominant family species. In contrast to this study, other authors (Tesfaye *et al*., 2009 [85]; Tumoro & Maryo, 2016) [88] found that the Lamiaceae were the most dominant. Also, the Euphorbiaceae (Tamiru & Asalfew, 2016; Jima & Megersa, 2018) [80, 48] were dominant over other families. This could be due to the difference in ecology and montane area.

4.2.2. Growth forms of medicinal plants used to treat human ailments

This study showed that medicinal plants used to treat human ailments consist of herbs (51.25%), trees (23.75%), shrubs (18.75%) and epiphytes (6.25%). This could be because herbs were the most common, exhibit high level of abundance, and are not difficult to access. The finding is in line with Baydoun *et al*., (2015) [11]; Tumoro & Maryo, (2016) [88]; Bahadura *et al*., (2020) [10]; and Netsanet *et al*., (2020) [67] who found that herbs were the primary ingredient in the preparation of healthcare products and served as a therapeutic indication due to their medicinal properties. Similar findings were also reported in other countries which indicated most medicinal plants forms were herbs (Hailemariam *et al*., 2009; Teklay *et al*., 2013; Chekole *et al*., 2015; Amsalu *et al*.,2018; Kidane *et al*.,2018; Ali *et al*., 2020; Hu *et al*., 2020) [36, 83, 19, 7, 55, 5, 38]. Contrary to this, Jiofack *et al*., (2009) [50], found trees were the most dominant growth form used while in those of Yineger & Yewhalaw, (2007) [93] and Lulekal *et al*., (2008) [58], found shrubs were the dominant growth form. Differences in ecology, seasonality, socio-cultural belief, and practices of traditional plant healers of different regions and countries might be the cause of this variation in growth forms of medicinal plants used.

4.2.3. Medicinal plant parts used to treat human ailments

The local population harvest different plant parts for the

preparation of traditional remedies which include; root, leaves, barks; fruits; seeds and sap. This study revealed that the leaves were the most commonly used plant parts in the preparation of indigenous medicines followed by the bark. This result is line with the findings of Netsanet *et al.*, (2020) [67], Tomuro & Maryo, (2016) [88], Gidey, (2001) [33]; Gidey, (2010) [34]; Gidey *et al*., (2011) [35]; Maryo *et al.*, (2015) [63]. Leaves are often the most active part of the plant in terms of metabolites production (Ghorbani, 2005; Baydoun *et al*., 2015) [32, 11]. In some areas of Cameroon, barks were the most used plant parts (Ndah *et al*., 2013; Fonge *et al*., 2012) [66, 27]. This difference could be explained by the fact that in these areas the most common ailments were treated using strong dosage which were obtained by the concoction and decoction of barks of trees and other plant parts. Also, the authors Alemayehu *et al*. (2015) [4] reported that roots were the most commonly used plant parts. The difference in this study could be due to the fact that roots are easily obtained in swampy areas. Additionally, roots may contain high concentrations of active ingredients in traditional medicines since they are easily absorbed by the roots.

4.2.4. Methods of preparation and route of administration of medicinal plants

The local community carried out various methods of preparation of traditional medicines for different types of ailments. The principal methods of remedy preparation form were decoction and concoction. This study is in line with Nkongmeneck *et al*., (2007) [69]; Fonge *et al.*, (2012) [27] and Ndah *et al*, (2013) [66]. Concoction was the most used method in another study in Littoral region (Mohammed & Seyoum, 2013 [64]. The result differ from Yineger & Yewhalaw, (2007) [93], Teklay *et al.*, (2013) [83]; Amsalu *et al.*, (2018) [7]; and Netsanet *et al*., (2020) [67] who found crushing method was the most used method of preparation of traditional medicine and grinding. This could be explained by the fact that in these areas most traditional medicinal plants are nursed in gardens and also due to cultural reasons. The commonly used route of application in this study was the oral route (82.50% (eating, chewing, and swallowing). Works conducted by other authors (Focho *et al*., (2009) [24]; Fonge *et al.*, (2012); Ndah *et al.*, (2013)) [27, 66] in the country, Amenu, (2007) [6] and Lulekal *et al.*, (2008) [58] in other countries showed that oral routes of administration were more eminent.

4.2.5. Ethnobotanical indices

The percentage of respondents claiming the use of a certain plant for the same major ailment was calculated for the most frequently reported ailments. *Eremomastax speciosa, Elaeis guineensis, Psidium guajava* had the highest fidelity level followed by *Rauvolfia vomitoria.* This finding corroborates with that of Ndah *et al.*, (2013) [66] 100% fidelity level for *Elaeis guineensis* followed by *Annikia chlorantha*. However, the finding is not in line with that of Tumoro & Maryo, (2016) [88] who had a high fidelity levels for *Cucumis ficifolius, Datura stramonium,* and six other plants. The differences might be due to the fact that the later was carried out in Ethiopia, in a different socio-ecological context, compared to the other two studies in Cameroon. The high ICF value gives an indication that these diseases are either prevalent in the Mount Nlonako area, may be due to poor living conditions and sanitary conditions of plants used for remedy preparation. Diseases which recorded a single species for its treatment were not taken into consideration.

The elevated informant consensus factor (0.95) value was recorded for disease associated to female sterility/gynecology while the least factor (0.73) was noted for skin diseases. The study's results differ from Tumoro & Maryo's (2016) [88] findings, which showed a high ICF of 0.95 for respiratory, oral, and pharyngeal diseases. The high prevalence of respiratory ailments in their study could be attributed to polluted air resulting from poor sanitary conditions or differences in climatic conditions.

4.2.6. Plant species used for food, fencing, fuel wood and timber in the community

Cassava (*manihot esculentus*) and bitter leaf (*Vernonia amygdalina*) were the most used plant species for food. According to IFAD (2005) [43], cassava is a popular ingredient used in preparing dishes such as garri, bobolo, water fufu, and nkoum nkoum. The high usage of cassava in this region can be attributed to its high productivity and resilience to harsh environmental conditions, as well as the fertility of the soil. In addition, at least 14 plant species were used for fuel, with the majority obtained from the forest by the villagers (about 70%). Furthermore, 15 plant species were used by the villagers for building houses and constructing bridges and pig fences.

The use of fence plants is a common practice in local communities to prevent wild and domestic animals from entering crop fields. This finding is consistent with the study conducted by Fonge *et al*. (2012) [27] in the South West region. Some of these plants are planted around the field as permanent life fences, while others are temporarily harvested and used as barriers. Villagers in the area of study used both barrier systems and life fences. According to Bhattarai *et al*. (2006) [13], these fence plants are also used for windbreak and erosion control. Most of these timber species belong to the Fabaceae family, which explains their constant availability. Fabaceae is one of the largest plant families in the plant kingdom, second only to Asteraceae (Netsanet *et al*., 2020) [67].

5. Conclusions

The majority of the Mount Nlonako forest in the Littoral region of Cameroon depend on agriculture for a living, and on traditional medicinal plants from the forest to treat a wide range of sickness and diseases. Given that majority of small-scale (2-3 hectare), subsistence farmers were middle aged, married with one or more wives and children and had no formal education and earn an average annual income of less than 100, 000 FCFA, distances and with poor infrastructure from the main urban area of Nkongsamba and close proximity to the forest, they can be seen as poor, low-educated, rural and remote forest communities. Given that access to modern healthcare is highly limited, poverty level and peoples proximity to the biodiverse forest, the use of at least 33 medicinal plants species, belonging mainly to the Asteraceae family, was widespread based on the high values of ICF and FL could validate the effectiveness and efficacy of the ethno-botanical practices of the Mount Nlonako forest communities. The dominant growth forms of the plants used for medicines are herbs, whose leaves are preeminent use for remedial preparation. This dominant use has a limited conservation impact. Decoction and concoction are the most common methods of preparation, with remedies mostly taken orally due to the prevalence of internal ailments. The Mount Nlonako forest at the moment has no forest management policies involving the communities. There is the need for environmental education of the communities and their

involvement in the forest management policy formulation and implementations. A good system of resources management should also be established by the creation of community farms and the development of protected forest network. Furthermore, the findings of this study serve as guideline for future ethnobotanic, socio-economic, pharmacological and phytochemical studies of medicinal plants in humid Central African montane forest.

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7. Author Contributions
Douandji Franck and Louis Ndumbe designed the study, Douandji Franck implemented the research, Kamga Borel, Douandji Franck and Verina Ingram analyzed the results, Douandji Franck and Louis Ndumbe wrote, Nguetsop François and Verina Ingram reviewed and edited the manuscript.

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