JOURNAL OF COMPLEMENTARY MEDICINE RESEARCH, 2020
VOL 11, NO. 1
10.5455/jcmr.2020.11.01.08

RESEARCH ARTICLE

Open Access

Ethnomedicinal Importance and Conservation Status of Medicinal Trees among Indigenous Communities in Esperanza, Agusan del Sur, Philippines

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ABSTRACT

This study provides ethnomedicinal information and conservation status of medicinal trees used by the *Manobo* and *Higaonon* indigenous communities of Esperanza, Agusan del Sur, Philippines. Data were obtained through semi-structured interviews, group discussion, and guided field walks with a total of 145 informants comprising of 95 *Manobo* and 50 *Higaonon* people with their traditional medical knowledge. A total of 43 tree species belonging to 36 genera and 22 plant families were recorded as ethnomedicinally important. Family importance value (FIV) was highest in Moraceae (99.33), followed by Lamiaceae (97.33), Rutaceae (96.00), Lauraceae (94.00), and Fabaceae (93.33). Plant parts are used for fracture and dislocation, weakness and fatigue, snakebite, diarrhea, and postpartum care and recovery, respectively. Highest relative frequency of citation (RFC) was cited for both *Cinnamomum mercadoi* S.Vidal and *Ficus concinna* (Miq.) Miq. Assessment of conservation status revealed that most of the medicinal trees with 20 species were not assessed (NA), followed by 15 species as least concern (LC), two species as vulnerable (VU), two species as other threatened species (OTS), two species as data deficient (DD), and one species each as endangered and near threatened, namely *Swietenia mahagoni* (L.) Jacq., and *Calamus megaphyllus* Becc., respectively. Only seven species (16%) are endemic in the Philippines. These findings provide a rationale for future *in-situ* conservation strategies of these important medicinal trees in indigenous ancestral lands for sustainable utilization of these genetic resources as part of the traditional heritage of the *Manobo* and *Higaonon*.

ARTICLE HISTORY

Received January 21, 2020

Accepted February 10, 2020

Published June 20, 2020

KEYWORDS

Ethnobotany; *Higaonon*; indigenous; *Manobo*; medicinal trees; Philippines

INTRODUCTION

The United Nations has recently reported a warning that global biodiversity is unprecedentedly reducing with more than a million species at risk of extinction [1]. Despite the decline, this report further emphasized that lands governed by indigenous communities have significantly lower reduction rates, demonstrating the essential role of indigenous peoples (IPs) as stewards of their natural environment. Around 22% of the world's land surface is recognized as traditional indigenous territories, which coincide with areas harboring 80% of the plant's biodiversity [2]. The knowledge of rural residents is essential for forest conservation [3]. In agroforestry, trees have been increasingly recognized as an option for multifunctional land management, which can also contribute to income, food security and biodiversity conservation, and ecosystem services [4–6].

Regardless of the transformations of many indigenous knowledge systems, practices that help promote forest sustainability have remained intact in the Philippines [7]. The Philippines, as an archipelagic country, has a unique geographical location comprising more than 7,100 islands. The Philippines is considered crucially important to global biodiversity because of its exceptional levels of narrow endemism in both terrestrial and marine

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ecosystems [8–10]. The Philippines is renowned as one of the megadiverse countries around the globe [11] and one of the world's eight biodiversity hottest hotspots [9].

Aside from its megadiverse biodiversity, the Philippines is also acclaimed to be culturally diverse in ethnicity, accounting to 110 different ethnolinguistic groups [12,13] with distinct classification based on identity, language, socio-political systems, and practices [14]. Among the settlements of these indigenous groups, the island of Mindanao is mostly occupied with various indigenous peoples (IPs) [15]. Some of these IPs are the numerous cultural communities of *Manobo* and *Higaonon*, inhabiting several areas only in Mindanao [16]. Both *Manobo* and *Higaonon* continued to be recognized as one of the largest and nomadic groups of indigenous peoples in CARAGA Administrative Region [14,17]. Etymologically, the *Manobo* term was named after the "Mansuba" which means river people, coined from the "man" (people) and the "suba" (river). In contrast, the *Higaonon* term was named after "Higa-gaon-onon" coined from the "higa" (to live or to lay), "gaon" (mountain), and "onon" (people). These tribes have maintained to conserve and protect their ancestral domain to continually sustain their cultural traditions, practices, and values up to this present generation. They are knowledgeable about various medicinal trees used in their communities for economic and therapeutic benefits. Medicinal trees and other trees in the forest have a crucial role in forest structure and ecological balance. Some of these trees are also used for timber production and are then often overused and harvested more frequently than others [18]. The significant role of IPs as key conservation actors is highly anticipated because of their vast knowledge and internal accountability in opportunities for joint intervention with Indigenous Peoples Organization (IPOs) to address biodiversity programs worldwide [19].

It is highly significant to investigate plant sources like medicinal trees and their conservation status used by the Indigenous Cultural Communities/Indigenous Peoples (ICCs/IPs). Hence, this study aims to document ethnomedicinal importance and assess the conservation status of the medicinal trees used by the *Manobo* and *Higaonon* cultural communities in Esperanza, Agusan del Sur, Philippines.

Materials and Methods

Study Area

The fieldwork was conducted in the Municipality of Esperanza, Agusan del Sur. This landlocked municipality is situated at the coordinates 8°41' N and 125°39' E (8.6760, 125.6454). This study purposively covered selected barangays for the reasons of accessibility, availability, and security with Certification of Ancestral Domain Title (CADT) as endorsed by the National Commission on Indigenous Peoples - CARAGA Administrative Region (NCIP-CARAGA) (Fig. 1). These sites are part of the forestland areas of the province, which comprise almost two-thirds (74%) of the total land area [20]. In comparison, alienable and disposable (A&D) areas constitute around one-third (26%) of the total land area [20].

Field Survey

Fieldwork was conducted from March 2018 to April 2019. Prior acquisition of necessary ethics approval, informed consents, resolution, certification, and wildlife gratuitous permit were acquired before the actual interview, field survey, and branch collection in selected barangays of Esperanza, Agusan del Sur, namely Bentahon, Bunaguit, Poblacion and Remedios. Consultation meetings and discussions were conducted together with the two tribal leaders and two tribal healers comprising the two indigenous communities, with the assistance of the municipal IPs consultant in cooperation with the municipal administration to discuss research intent as totally academic. The joint meeting succeeded with rituals for this documentation resulted in mutual agreement and respect. As agreed, the research intent was certified by NCIP-local government unit (LGU) following its by-laws for the welfare and protection of indigenous peoples, and finally approved by NCIP-CARAGA.

A total of 145 indigenous respondents (95 *Manobo* and 50 *Higaonon*), which is more than 10% of the total population of selected barangays, comprising of the tribal council and members were selected through purposive and snowball sampling. A total of 48 females and 97 males with an age range from 18–78 years old and median age being 41 were sampled. Ethnomedicinal data were collected through semi-structured interviews with the key informants and corner meetings with the tribal community after obtaining an accurate translation to the *Manobo* dialect (Minanubu) with the help of the tribal elders. Focus group discussions among respondents were assisted by the respective barangay tribal leaders and the municipal IP representative as consultants to obtain consensus and clarification of their essential points and ideas.

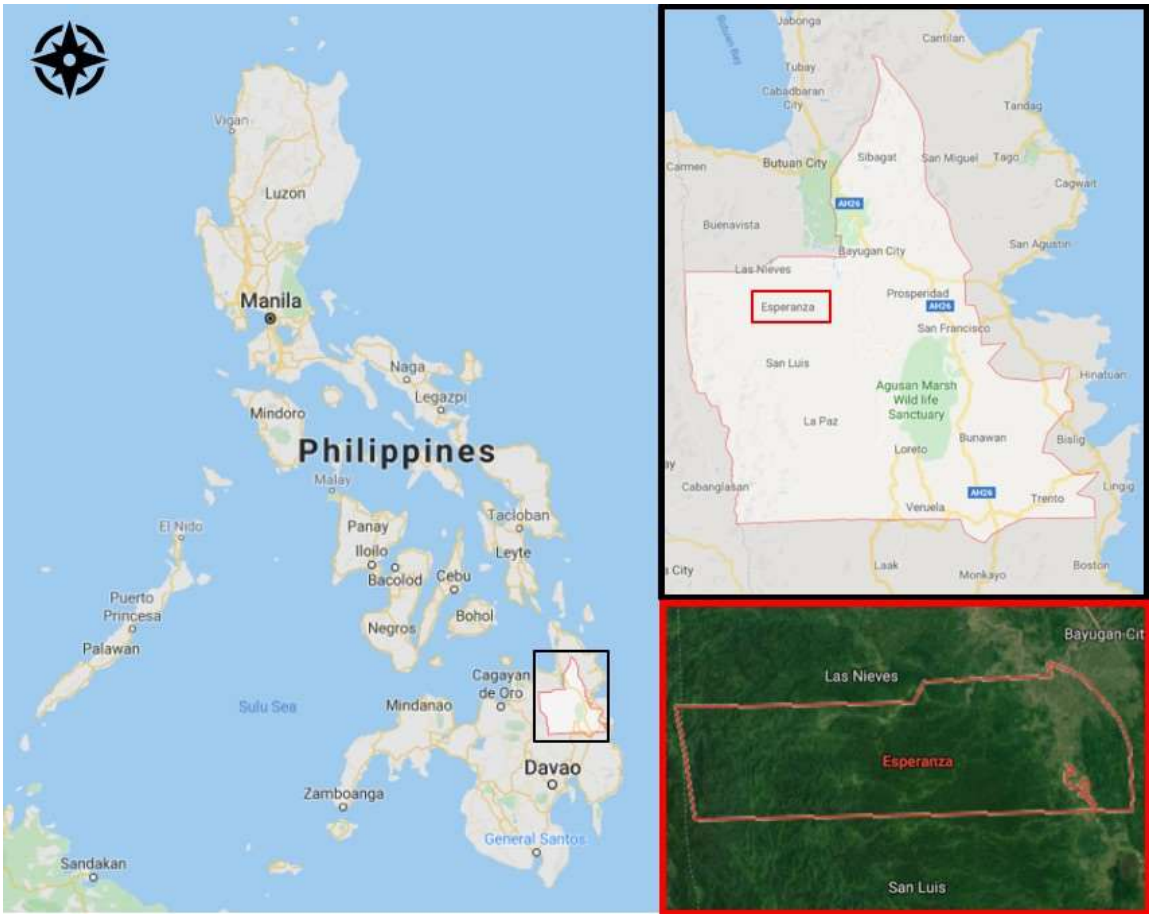

Figure 1: Location map of Esperanza (outlined in red), Agusan del Sur (outlined in black), Philippines (left).

Collection and Identification

Actual species identification of trees was conducted during field walks with the assistance of the forester guide from the City Environment and Natural Resources Office (CENRO) and tribal healer for the record of the vernacular names. At least three branches of each tree were collected and subsequently pressed, poisoned, and mounted as herbarium vouchers. Voucher specimens were deposited in the University of Santo Tomas Herbarium (USTH). Vernacular names of specimens were referred to the *Dictionary of Philippines Plant Names* [21]. Plant identification was verified by Mr. Danilo Tandang, a botanist and researcher at the National Museum of the Philippines. All scientific names were checked for spelling and synonyms, and family classification using *The Plant List* [22], *World Flora Online* [23], the *International Plant Names Index* [24] and *Tropicos* [25]. The occurrence, distribution, and latest species identification were further confirmed in the updated *Co's Digital Flora of the Philippines* [26].

Family Importance Value (FIV)

FIV determines the most important family based on the number of citation reports of the informants [27]. This was calculated using the following formula: FIV = (FC/N) x 100, where FC is the frequency of citation of the plant family, and N is the total number of informants. The FIV also helps characterize families according to the number of medicinal plant species belonging to a particular family as a treatment.

Relative Frequency of Citation (RFC)

RFC, on the other hand, identifies the local importance of each medicinal plant species [28] and is calculated using this formula: RFC = FC/N, where FC is the number of informants who mentioned the plant species while N is the total number of informants. RFC ranges its value from 0 to 1, where most important species have values closer to 1.

Conservation Status and Endemicity

Conservation status of the medicinal plants was enumerated according to the International Union for Conservation of Nature (IUCN) standard [29], and further assessed based on the available data from the Department of Environment and Natural Resources (DENR) Administrative Order No. (DAO) 2017-01 [30] and the updated online flora of *Co's Digital Flora of the Philippines* [26]. The identified medicinal tree species were checked for their occurrence and distribution in the Philippines and other countries to determine their endemicity.

Results

Family Importance Value

Table 1 presents the census of medicinal trees with a total of 43 species belonging to 36 genera and 22 families. Results showed that Moraceae had the highest FIV (99.33), followed by Lamiaceae (97.33), Rutaceae (96.00), Lauraceae (94.00), and Fabaceae (93.33) which are medicinally used for fracture and dislocation, weakness and fatigue, snakebite, diarrhea, and postpartum care and recovery, respectively, based on the frequency of informant citation.

Table 1: List of medicinally important trees, conservation status, endemicity, and medicinal uses among the indigenous groups (alphabetically arranged by family).

No.	Taxon	Voucher no.	Local Name	FIV	RFC	Conservation Status		Endemicity (CDFP)[c]	Part/s Used[d]	Diseases Treated
						IUCN[a]	DENR/ CDFP[b]			
	Anacardiaceae			91.33						
1	*Mangifera indica* L.	USTH 015591	Mangga		0.44	DD		NE	Bk, Fr, Lf	Constipation, cough, diarrhea, stomach troubles
2	*Spondias pinnata* (L.f.) Kurz	USTH 015599	Abihid		0.74	NA		NE	Bk, Lf	Colds, cough, diabetes, fever
	Annonaceae			90.00						
3	*Annona muricata* L.	USTH 015593	Guyabano		0.42	LC		NE	Fr, Lf	Cancer, stomach trouble, urinary tract infection
4	*Cananga odorata* (Lam.) Hook.f. & Thomson	USTH 015577	Anangilan		0.72	NA		NE	Bk, Lf	Colds, cough, insect bites, muscle pain, stomach trouble, ulcer
	Apocynaceae			90.67						
5	*Alstonia macrophylla* Wall. ex G.Don	USTH 015546	Dita		0.77	LC		NE	Bk, Lf	Cough, cuts and wounds, skin diseases, stomach trouble, urinary tract infection
	Arecaceae			88.67						
6	*Areca catechu* L.	USTH 015610	Huling-huling		0.08	NA	LC	NE	Rt	Breast cancer
7	*Calamus megaphyllus* Becc.	USTH 015608	Kapi		0.34	NA	NT	EN	Rz	Arthritis, asthma, diarrhea, hypertension
	Bombacaceae			91.33						
8	*Ceiba pentandra* (L.) Gaertn.	USTH 015535	Doldol		0.28	LC		NE	Bk, Rt	Diabetes, diarrhea, dysentery, rheumatism
	Byttneriaceae			86.00						
9	*Kleinhovia hospita* L.	USTH 015631	Bitan-ag		0.29	LC		NE	Lf	Asthma, cough, skin diseases, tumor

10	*Melochia umbellata* (Houtt.) Stapf	USTH 015649	Banitlong	0.53	NA		NE	Lf	Body ache, rheumatism, burns
	Caricaceae			90.67					
11	*Carica papaya* L.	USTH 015668	Kapayas laki	0.92	DD		NE	Lf	Asthma, cramp and spasm, dengue fever, tonic
	Euphorbiaceae			84.00					
12	*Omalanthus macradenius* Pax & K.Hoffm.	USTH 015633	Banti	0.41	NA		EN	Lf	Skin diseases, stomach trouble
	Fabaceae			93.33					
13	*Gliricidia sepium* (Jacq.) Kunth ex Steud.	USTH 015620	Madre de Cacao	0.31	NA		NE	Bk, Lf	Cuts and wounds, postpartum care and recovery, skin diseases
14	*Ormosia macrodisca* Baker	USTH 015625	Bahay	0.87	LC		NE	Bk, Rt	Fever, high cholesterol, kidney problem, nervous breakdown
	Lamiaceae			97.33					
15	*Gmelina arborea* Roxb. ex Sm.	USTH 015635	Gemelina	0.67	LC		NE	Lf	Body ache, muscle pain, weakness and fatigue
16	*Premna odorata* Blanco	USTH 015559	Abgaw	0.94	NA	LC	NE	Lf	Colds, cough, diarrhea, gas pain and flatulence
17	*Teijsmanniodendron ahernianum* (Merr.) Bakh.	USTH 015603	Kulipapa	0.26	LC		NE	Rt, St	Beriberi, labor and delivery, muscle pain
	Lauraceae			94.00					
18	*Cinnamomum mercadoi* S.Vidal	USTH 015585	Kaningag	1.00	VU	OTS	EN	Bk, Br, Rt	Amoebiasis, cancer, diarrhea, kidney problem, ulcer, urinary tract infection
19	*Litsea cordata* (Jack) Hook.f.	USTH 015580	Loktob	0.61	NA		NE	Bk, Rt	Asthma, cyst, goiter, myoma
20	*Machilus philippinensis* Merr.	USTH 015576	Efficascent	0.16	NA	OTS	NE	St	Cough, weakness and fatigue
	Lythraceae			79.33					
21	*Lagerstroemia speciosa* (L.) Pers.	USTH 015596	Banaba	0.77	NA		NE	Lf	Body ache, fever, kidney problem, ulcer
	Marattiaceae			63.33					

22	*Angiopteris evecta* Sw.	USTH 015658	Amampang	0.25	NA	OTS	NE	Rt	Cramp and spasm, muscle pain, postpartum care and recovery
	Meliaceae		92.00						
23	*Lansium domesticum* Correa	USTH 015565	Lansones	0.21	NA		NE	Bk	Diarrhea, fever, gas pain and flatulence, malaria
24	*Sandoricum koetjape* (Burm.f.) Merr.	USTH 015624	Santol	0.93	LC		NE	Lf	Diarrhea, skin diseases, tonic, toothache
25	*Swietenia mahagoni* (L.) Jacq.	USTH 015671	Mahogany	0.67	EN		NE	Sd	Abdominal pain, delayed menstruation, dysmenorrhea
	Moraceae		99.33						
26	*Ficus botryocarpa* Miq.	USTH 015672	Kabiya	0.11	NA		NE	Rt	Fever, headache
27	*Ficus cassidyana* Elmer	USTH 015551	Tobog tapol	0.82	NA		EN	Bk, Rt	Asthma, diabetes, postpartum care and recovery, respiratory disease complex, stomach trouble, weakness and fatigue
28	*Ficus concinna* (Miq.) Miq.	USTH 015552	Balete	1.00	LC		NE	Bk, Lf, Rt	Arthritis, cancer, cuts and wounds, fracture and dislocation
29	*Ficus fistulosa* Reinw. ex Blume	USTH 015561	Tobog puti	0.80	LC		NE	Bk, Rt	Diabetes, hypertension, respiratory diseases complex, stomach trouble, weakness and fatigue,
30	*Ficus pseudopalma* Blanco	USTH 015636	Lobi-lobi	0.66	NA		EN	Lf, Rt	Atherosclerosis, cramp and spasm, diarrhea, hemorrhage, muscle pain
31	*Ficus septica* Burm.f.	USTH 015623	Lagnob	0.97	LC		NE	Lf, Rt	Cataract, dengue fever, herpes simplex, muscle pain,

32	*Ficus* sp.	USTH 015642	Tuwa-tuwa		0.14	LC	NE	Lf	skin problem, stomach trouble, weakness and fatigue Impotence and sterility, pregnancy
33	*Morus alba* L.	USTH 015549	Tahibo		0.55	LC	NE	Lf	Asthma, colds, cough, cramp and spasm, pneumonia
	Muntingiaceae			65.33					
34	*Muntingia calabura* L.	USTH 015629	Mansanitas		0.34	NA	NE	Lf	Abdominal pain, colds, diarrhea, stomach trouble
	Myristicaceae			68.67					
35	*Myristica agusanensis* Elmer	USTH 015611	Duguang Kahoy		0.39	VU	EN	Bk	Measles, respiratory disease complex
	Myrtaceae			92.67					
36	*Psidium guajava* L.	USTH 015663	Bayabas		0.55	LC	NE	Bk, Lf	Cuts and wounds, dandruff, diarrhea, scabies, skin diseases, ulcer
	Rubiaceae			58.67					
37	*Mussaenda philippica* A.Rich.	USTH 015556	Buyon		0.25	NA	NE	Bk, Lf	Asthma, colds, cough, dysentery, jaundice
	Rutaceae			96.00					
38	*Melicope latifolia* (DC.) T.G.Hartley	USTH 015540	Bagaynga		0.09	NA	NE	Bk	Cough
39	*Melicope triphylla* (Lam.) Merr.	USTH 015660	Dahile		0.17	NA	NE	Lf	Cough, tuberculosis, snakebite
40	*Micromelum minutum* (G.Forst.) Wight & Arn.	USTH 015538	Lunas kahoy		0.99	NA	NE	Lf, Rt, St	Cancer, cuts and wounds, diarrhea, muscle pain, poisoning, skin diseases, snakebite, stomach trouble
	Sparmanniaceae			76.67					
41	*Grewia laevigata* Vahl	USTH 015547	Talimughat		0.57	LC	NE	Bk, Lf, Rt	Cramp and spasm, labor and delivery enhancer, muscle pain, postpartum care and

								recovery, weakness and fatigue
	Urticaceae			82.00				
42	*Leucosyke capitellata* Wedd.	USTH 015542	Anagasi	0.06	NA	NE	Lf	Stomach trouble, vomiting
43	*Oreocnide rubescens* (Blume) Miq.	USTH 015676	Salin-ubod	0.30	LC	NE	Lf	Cough, diarrhea, fever, stomach trouble

[a]IUCN: NA = Not Assessed, DD = Data Deficient, LC = Least Concern, VU = Vulnerable, EN = Endangered.
[b]DENR Administrative Order 2017-11, CDFP: LC = Least Concern, NT = Near Threatened, OTS = Other Threatened Species.
[c]CDFP: EN = Endemic, NE = Not Endemic.
[d]Bk, barks; Br, branches; Fr, fruits; Lf, leaves; Rt, roots; Rz, rhizomes; Sd, seeds; St, stems.

Relative Frequency of Citation

The highest RFC values were recorded for both *Cinnamomum mercadoi* S.Vidal (1.00) and *Ficus concinna* (Miq.) Miq. (1.00) as depicted in Figure 3, followed by *Micromelum minutum* (G.Forst.) Wight & Arn. (0.99), and *Ficus septica* Burm.f. (0.97) as shown in Table 1.

Figure 3: Habit of (A) *Cinnamomum mercadoi* S.Vidal "Kaningag" and (B) *Ficus concinna* (Miq.) Miq. "Balete". (© M.L.G. Dapar)

Conservation Status and Endemicity

The 43 species of medicinal trees identified belong to different size classes. Most of the species are small-sized trees (58%), followed by small to medium-sized trees (19%), medium-sized trees (16%), and medium to large-sized trees (7%). Table 1 and Figure 2 present the conservation status and endemicity of these medicinal trees. The conservation status of these plant resources showed that most of the medicinal trees were not assessed (47%) based on the IUCN [29]. However, the combined data from DENR [30] and CDFP [26] conservation assessment showed that there were 15 species as Least Concern, two species as Vulnerable, two species as Other Threatened Species, two species as Data Deficient, and one species each of Endangered and Near Threatened, namely *Swietenia mahagoni* (L.) Jacq. and *Calamus megaphyllus* Becc., respectively. The distribution of species in terms of endemicity showed only seven species (16%) are endemic in the Philippines. In contrast, most of the species are distributed in other countries (84%) and thought to be introduced or naturalized in the Philippines [26].

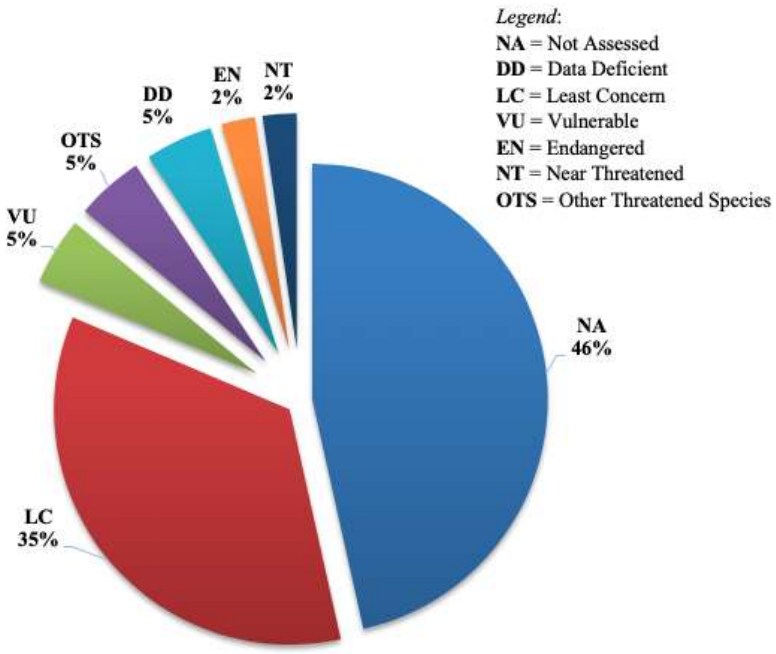

Figure 2: A combined conservation assessment of tree species based on the international data of IUCN, and the national data of DENR and CDFP.

DISCUSSION

Scientific validation of some reported species under the same genus and family could suggest similar pharmacological properties in treatment for various illnesses and health conditions. This ethnomedicinal information could open avenues for future pharmacological investigations and clinical studies.

The Moraceae (fig family) have been proven for their potential biological and pharmacological activities. This family possesses a wide variety of bioactive compounds with biomedicinal properties as formerly investigated on *Ficus racemosa* L. [31], *Ficus carica* L. [32], and *Ficus benjamina* L. [33]. The Lamiaceae (mint family) have several bioactive compounds and essential oils that are used in traditional and modern medicine, food, cosmetics, and pharmaceutical industry [34]. This family is aromatic with various medicinal properties aside from its ornamental uses. It was proven for effective pain modulation as a source of analgesic, which can be found in aromatic spices like mint, oregano, basil, and rosemary [35]. Rutaceae (citrus family) are comprised of aromatic deciduous shrubs and trees that have been used in gastronomy and traditional medicine. This family also has significant economic importance because it contains several edible fruits and essential oils [36]. For instance, secondary metabolites of *Zanthoxylum limonella* (Dennst.) Alston were isolated from the stems, barks, and fruits, which were reported to cure several health problems like stomachache, diarrhea, dental caries, and rheumatism [37]. The phytochemical investigation by Salleh et al. [38] in the genus *Beilschmiedia* Nees revealed the presence of bioactive compounds like essential oils, amides/alkaloids, flavonoids and miscellaneous compounds with a broad spectrum of biological activities. Fabaceae (pea family) represent the third largest family, which also possess numerous secondary metabolites with potential pharmacological and toxicological properties [39]. *Gliricidia sepium* (Jacq.) Kunth ex Steud. is a notable species included here under Fabaceae with reported biological and biochemical properties. Abdulaziz et al. [40] recently investigated the antimicrobial, antioxidant, and the phytochemical components present in *G. sepium*, which has long been cultivated and introduced in the Philippines.

Some *Cinnamomum* species like *C. zeylanicum* Breyne were reported with antimicrobial activity and *C. cassia* (L.) J.Presl with antitumor property possessing several essential oils [41]. These findings supported some ethnomedicinal uses of *C. mercadoi* in this study as a treatment for cancer, diarrhea, and urinary tract infection. Previous investigations of *Ficus* species revealed potency against malignant disease and inflammation. Lansky et al. [42] reviewed ethnopharmacological uses of *Ficus* species as anticancer and anti-inflammatory agents during medieval, ancient, and modern times. This ethnopharmacological review coincided with the medicinal purposes of *F. concinna* among the key informants in treatment for arthritis, cancer, cuts and wounds, fracture, and dislocation. Identified chemical constituents for *M.*

minutum also have potential biological property containing coumarins as potent cytotoxic agents against the T-lymphoblastic leukemia cell line [43]. This result supports the medicinal uses of *M. minutum* in both indigenous communities as a treatment for cancer. The aboriginal claim of *F. septica* as a treatment for dengue fever has also been studied. Huang et al. [44] revealed that the methanol extracts of fruit, heartwood, leaves, and stems from *F. septica* had a promising anti-dengue virus activity against dengue virus types 1 and 2.

Conservation assessment findings of this study justify for future reinforcement of conservation strategies to sustain medicinally important tree species. These significant genetic resources are assets that must be conserved and protected with strict implementation of national and local policies on their conservation and uses. Both *Manobo* and *Higaonon* indigenous communities value the conservation of their natural resources. Regardless of some differences in their cultural traditions and practices, they continually keep peace and practice sustainable use of their forest plant resources. They are recognized as bearers of ancestral knowledge and wisdom concerning biodiversity. Indigenous peoples of Agusan del Sur were previously surveyed with rich medicinal plant knowledge and practices [45–47] with few species scientifically validated for its biochemical and biological activities [48,49], but this is the first time to document on medicinal trees.

Their active participation in programs and initiatives for biodiversity conservation for adequate protection and management of forest reserves would lead to a more comprehensive, robust, and cost-effective biodiversity conservation and management [50].

Both *Manobo* and *Higaonon* tribal communities traditionally practice conservation of their natural resources through the years. However, their long traditions of managing their lands have no titles of their own, resulting in community-based use of properties and rights being passed on through inheritance. In 1995, the Community-Based Forest Management Program was implemented in the country based on the Integrated Social Forestry Program in 1976. This implementation issued Certificates of Ancestral Domain Claim (CADC) to Indigenous Cultural Communities/Indigenous Peoples (ICCs/IPs) and provided security of tenure for 50 years. This issuance legitimized the presence of indigenous communities, like the *Manobo* and *Higaonon* tribes, thus, giving them right over their ancestral domain for occupation, land management, and development. Subsequently, the Indigenous Peoples' Rights Act was passed in 1997. This act put up an absolute Ancestral Domain Title among the ICCS/IPS promoting conservation practice of the *Manobo* and *Higaonon* cultural communities in their natural resources. They continually exercise their rights and practice their customs and traditions of land management and development. As a result, it strengthened their rightful ownership of their land for the future conservation of natural resources, particularly their medicinally essential plants. Besides, the issuance of Certificate of Ancestral Domain Title (CADT) conferred significant economic and cultural benefits for indigenous communities.

Assessment of medicinally important and conservation status of their medicinal plants are very significant. For instance, tree species play a vital role in the balance of ecosystems aside from its commercial uses as a source of timber, food, and medicine. With the traditional ecological and medicinal knowledge of the *Manobo* and *Higaonon* tribes, their integral roles as guardians in their ancestral territories started within their cultural communities.

The assessment by the IUCN and DENR will take more years and meticulous processes, while some of these tree species are becoming extinct through time. Hence, environmental governance should reinforce collaborative initiatives in partnership with the tribal communities as a source of medicinal and ecological perspectives and knowledge of their indigenous trees to improve environmental conservation and management. These findings provided baseline information on medicinal trees as critical genetic resources. Local people and LGU intervention should actively participate in shared management responsibilities for viable conservation strategies and sustainable use of cultural community resources.

It is highly recommended to investigate further the *Manobo* and *Higaonon* ethnomedicinally important trees, which are now classified as vulnerable, threatened, and endangered medicinal tree species. The pharmacological aspect of medicinal tree species could intensify their sustainable conservation priorities.

CONCLUSIONS AND RECOMMENDATIONS

This study evaluated a total of 43 species belonging to 36 genera and 22 families recorded as ethnomedicinally important tree species among the *Manobo* and *Higaonon* indigenous communities in Esperanza, Philippines. Results showed that Moraceae had the highest FIV (99.33), and both *Cinnamomum mercadoi* (Lauraceae) and *Ficus concinna* (Moraceae) had the highest relative frequency of citation (1.00). Results showed that *Manobo* and *Higaonon* indigenous communities of Esperanza, Agusan del Sur is a habitat of endemic, endangered, vulnerable and threatened tree species. These findings provided baseline information on medicinal trees as critical genetic resources. Local people and LGU intervention

should actively participate in shared management responsibilities for viable conservation strategies and sustainable use of the cultural community resources.

ETHICS APPROVAL

All necessary approval, free prior informed consent, permit, and certification was secured from the local government units, provincial government administration of Agusan del Sur, and regional agencies of CARAGA administrative region (Region XIII). DENR-CARAGA wildlife gratuitous permit (no. R13-2019-12) and NCIP-CARAGA certification (no. R13-2019-01) were obtained before the conduct of the study. An ethics approval from USTGS-ERC (protocol no. GS-2019-PN007) was secured. The purpose of the study was discussed to indigenous communities of *Manobo* and *Higaonon* in Esperanza, Agusan del Sur governed by their respective tribal chieftains, following ritual observation as part of cultural immersion.

ACKNOWLEDGMENTS

We are very grateful to the indigenous communities of *Manobo* and *Higaonon*, who participated in our documentation. MLGD would like to thank for his scholarship grant from the Department of Science and Technology - Accelerated Science and Technology Human Resource Development Program - National Science Consortium (DOST-ASTHRDP-NSC) and Alexander von Humboldt Foundation as a Junior Researcher. GJDA thanks the Department of Health - Philippine Institute of Traditional and Alternative Health Care (DOH-PITAHC) for the funding, and Alexander von Humboldt Foundation for a renewed research stay at the University of Bayreuth (Germany) in 2019.

FUNDING

This work was supported by the Department of Health - Philippine Institute of Traditional and Alternative Health Care (DOH-PITAHC).

CONFLICT OF INTEREST

The authors declare that they have no competing interest.

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