

Forest Plant Community and Ethnomedicinal Study towards Biodiversity Conservation of an Ancestral Land in Northern Mindanao

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ABSTRACT

The dependence of many rural communities in the Philippines on herbal medicine represents a long history of human interactions with the environment. The use of plant resources as indigenous sources of cure for a wide variety of ailments has been part of traditional cultures, however, urban development and its sprawl into rural areas has somehow eroded this traditional practice. An assessment of the forest plant community within the vicinity of Lake Danao in the upland area of Naawan, Misamis Oriental was conducted to evaluate the status of biodiversity and ethnomedicinal value of plant resources and determine the community's perceptions toward forest conservation. Standard methods in assessment of plant community structure were adopted. Knowledge, perceptions, and attitude of the respondents towards forest resources and ethnomedicinal plants were obtained through semi-structured interview. Extracts from five species of medicinal plants were tested for antibacterial action against *Escherichia coli* and *Staphylococcus aureus* using the disc diffusion method and using chloramphenicol as positive control. Sixty one species of trees, saplings and herbs belonging to 29 families were recorded in the survey. *Acacia mangium*, *Leukosyke capitellata* and *Nephrolepis hirstula* were the most numerically important plant species. Thirty-three out of 61 species have medicinal value to local residents which are used to treat various disorders. Antimicrobial test showed that *Pavetta indica* (*galawan*) and *Bauhinia sp.* (*alibangbang*) showed greater inhibitory effect against *S. aureus* and *E. coli* than other plants. Local residents generally appreciate the importance of the forest and the value of preserving it for the various services they provide. Traditional knowledge and appreciation of the indigenous value of forest resources can make a significant contribution to sustainable development and biodiversity conservation.

Keywords: *Acacia mangium*, ethnomedicine, Higaonons, indigenous people, Lake Danao.

INTRODUCTION

The use of herbal medicines in Asia represents a long history of human interactions with the environment. The interrelationships between society and nature, and the importance of environmental health to human health have been widely acknowledged. Human health depends highly on the quality of the environment in which people live. Biodiversity loss due to environmental degradation can have indirect effects on human well-being (Alves *et al.*, 2005).

Most rural communities depend on plant resources for herbal medicines, food, forage, construction of dwellings and other needs for survival (Ayyanar *et al.*, 2006; Arances, *et al.* (2006). Many people who suffer from disease believe that a possible cure might be found in traditional medicine (Beaglehole *et al.*, 2000). Low income people such as farmers, residents of small isolated villages, and native communities use folk medicine for the treatment of common infections. The indigenous system of medicine that is based on ethnomedicinal plants and animals has been in existence through time and continues to play a significant role in the health care system of indigenous peoples and in the conservation of biodiversity (Ayinam, 1995). A well-functioning ecosystem, therefore, can help protect human health.

Economic progress and rapid urbanization has spread to rural communities, creating a change in lifestyle and health system. The erosion of traditional medicine culture coupled with the adoption of sedentary lifestyle has had a devastating effect on the self-sufficiency, health status of indigenous peoples (IP's), and on forest conservation. Indigenous peoples living a traditional lifestyle maintain both physical and spiritual ties to the land. Every aspect of their existence, from biodiversity conservation to the accessibility of medicinal plants and animals, is dependent on careful stewardship of local resources. The IPs have an unparalleled knowledge about these resources and how best to manage them (Balick and Cox, 2003). The study on local knowledge of natural resources is becoming increasingly important in defining strategies and actions for conservation of residual forest (Bletter, 2007).

Barangay Lubilan in Naawan, Misamis Oriental (Fig. 1) is one of the mountainous areas in Mindanao, inhabited mostly by the Higaonon tribe. Part of the barangay is Lake Danao which is surrounded by a relatively thick forest (Fig. 2) and is a shared watershed with Bgy. Tula in Alubijid, Misamis Oriental. The Higaonon culture is strong and thriving and the group's claim on the land is locally recognized. But like in many other parts of the country, the forested area is threatened by various forces such as illegal logging. The strongest threat is the reported proliferation of mining activities that are already known to devastate forest ecosystems and the surrounding ecosystems therein.

This study was focused on the forest community in Lubilan with the general objective of generating baseline information on the forest plant community and its ethnomedicinal value. Specifically, plant community structure and conservation status of the species were determined. Antimicrobial tests were done for selected species to validate its medicinal value. A demographic survey and interview were also carried out to characterize the local community in the vicinity and to determine the initiatives, if any, toward conservation of the forest. Results of this study are very important in advocacy work for protection and conservation. Presence of endemic and

METHODOLOGY

The study site

This study was conducted in the vicinity of Lake Danao situated at the boundary between Barangay Lubilan, Naawan and Bgy. Tula, Alubijid, both in the province of Misamis Oriental (Fig. 1). The municipality of Naawan lies on the western part of the province; situated 60 km from Cagayan de Oro City and 24 km from Iligan City. Forestlands occupy a larger area relative to the agricultural lands of the municipality (Fig. 2). Majority of its landscape consists of steep mountains and rolling hills. Lubilan is the innermost upland barangay of Naawan and has perhaps the last remaining thick forest in the municipality. Within the upland area are settlements of many Higaonons and other *lumads*.

Establishment of transects and plots

A 1-ha plot (200m x 500m) was established in the study site, within which three 100m transect lines were positioned at an interval of 100m from the reference point. Along each transect, two 100m² quadrats were established at an interval of 50 m for the inventory of tree species. Within each 100m² plot a 5m x 5m (Area = 25m²) subquadrat was delineated for the inventory of saplings and shrubs. Further inside the 25m² area, 1m x 1m subquadrats were marked for the inventory of the smaller plant forms (e.g., herbs, vines, pteridophytes, bryophytes, and seedlings) (Arances, et al. 2006).

Data collection

Plants inside the quadrats and subquadrats were surveyed with the help of two Higaonon leaders. Plants were identified up to species level using a guidebook by Madulid (2001) and the number of individuals were counted. Numerical indices to describe the plant community structure were determined using the formulas in Odum (1971):

1. Species richness (S) = refers to the number of species in a given area or habitat.
2. Species Importance Value (SIV) = Relative Density + Relative Frequency +
Relative Dominance

The conservation status of the various plants encountered in the survey was determined from the IUCN Red List database (IUCN, 2011). Classification of conservation status is based on the following criteria as defined by the IUCN:

1. Endangered species: actively threatened with extinction, and survival is unlikely without protective measure.
2. Rare species: not under immediate threat of extinction but occurring in such number or in such localized or specialized habitats that species could quickly disappear if the environment worsens. Needs watching.
3. Depleted species: although sufficiently abundant for survival, the species has been nearly depleted as a result of natural causes or human activities.

Antimicrobial test of plant crude extracts

Medicinal plants. Five ethnomedicinal plants were tested for antimicrobial property in the laboratory, namely: *Crinum* sp. (Liryo), *Pavetta indica* (Galawan), *Bauhinia* sp. (Alibangbang), *Cinnamomum mercadoii* (Kalingag) and *Mollugo pentaphylla* (Salukot). The number of plants verified was limited only to five species due to funding limitations. The test substances were prepared in the traditional way of the Higaonons. The plants were sorted, washed, and chopped into smaller pieces. In the case of tree species *Bauhinia* sp., *M. pentaphylla* and *C. mercadoii*, a decoction was prepared by boiling leaves in tap water. For *P. indica* and *Crinum* sp., leaves were grounded until the juice was extracted.

Bacterial strains. Two clinical bacterial strains, namely: *Staphylococcus aureus* and *Escherichia coli* were used in the study. *E. coli* is gram-negative, facultative anaerobic and non-sporulating (Andrews, 1992; <https://en.wikipedia.org>). This microbe is usually acquired through eating unwashed vegetables, unhygienic food preparation, and farm contamination causing diarrhea, gastrointestinal infection, urinary tract infection and sudden kidney failure. *E. coli* is also the bacterium found in the humans and other warm-blooded animals, excreted through feces into land or aquatic environments. *Staphylococcus aureus* is gram-positive, a facultative anaerobic coccus, which appears as grape-like clusters when viewed through a microscope and has large, round, golden-yellow colonies, often inducing hemolysis when grown on blood agar plates (<https://en.wikipedia.org>). *S. aureus* may occur as a commensal on human skin where its infections can spread through contact with pus from an infected wound, or skin-to-skin contact with an infected person by producing hyaluronidase that destroys tissues. *S. aureus* is resistant to many commonly used antibiotics.

Culture medium and antibacterial activity test. Typtone Soy Broth (TSB) medium and MacFarland Standard were used to culture the microorganisms in agar plates following standard protocols in bacterial preparation and analysis (Nita *et al.*, 2002; Andrews, 1992). The disc diffusion method by Drew, *et al.* (1972) was used to screen the antimicrobial activity of the crude extracts. Sterile paper discs (8mm diameter) were soaked in the leaf extract for 2 hours. Broth culture of bacteria (106 CFU/ml) was spread on the surface of gelled sterile TSB agar plates. The paper discs soaked in the plant preparation were placed at different areas on the surface of each plate. The discs were lightly pressed to ensure surface contact with the agar medium, then were incubated at 37⁰C for 24 hours. Chloramphenicol was used as positive control in the test.

Antibacterial activity of the extract is indicated by the growth-free zone of inhibition. Diameter of inhibition zones was measured in millimeter using a transparent ruler. The microbial index was calculated as:

$$\text{Microbial Index (MI)} = \frac{\text{diameter of zone of inhibition} - \text{diameter of the disc}}{\text{diameter of the disc}}$$

A larger zone of inhibition indicates greater antibacterial action, hence, as the value of microbial index increases, the more effective the extracts are against the pathogens (McGregor *et al.*, 1997).

Socio-economic survey and demographic profile

A socio-economic and demographic profile of the community in the vicinity of the forest was compiled through a semi-structured interview. The respondents and informants were 20 years old and above from both indigenous and non-indigenous groups. Data on relevant demographic (age, sex, civil status, birthplace) and socio-economic characteristics (tribe, educational attainment, household type, and property ownership) were obtained. The knowledge, perception, and attitude of the community towards the ethnomedicinal plants were also assessed. Information on the ethnomedicinal uses, mode of preparation and administration, dosage and the diseases treated were gathered from key informants among the Higaonon tribe, including a traditional healer or “arbularyo”.

RESULTS AND DISCUSSION

Species composition

A total of 61 plant species belonging to 29 families were identified around Lake Danao comprising of trees, shrubs, herbs and vines. Table 1 presents the list of the tree species and their calculated importance value. *Acacia mangium* has the highest density and dominance, thus obtained the highest species importance value of 94.70% (Fig. 3) while *Shorea contorta* (*Lauan*) ranks second in importance value. *Shorea guiso*, another species of *lauan*, is present at lower densities than *Shorea contorta*.

Table 1. Tree species and their importance values in the forest around Lake Danao, Lubilan, Naawan, Misamis Oriental.

Tree Species	Relative density	Relative Frequency	Relative Dominance	Species Importance Value
<i>Acacia mangium</i>	19.3	11.11	64.29	94.70
<i>Shorea contorta</i>	17.54	14.81	10.42	42.77
<i>Leukosyke capitellata</i>	15.79	14.81	9.44	40.04
<i>Lithocarpus sp.</i>	14.03	14.81	7.22	36.06
<i>Mollugo pentaphylla</i>	7.02	7.41	1.21	15.64
<i>Amomum sp.</i>	3.51	3.70	1.03	8.24
<i>Mangifera indica</i>	1.75	3.70	0.23	5.68
<i>Shorea guiso</i>	3.51	3.70	0.96	8.17
<i>Artocarpus heterophyllus</i>	1.75	3.70	0.37	5.82
<i>Litsea philippinensis</i>	1.75	3.70	0.26	5.71
<i>Cleistanthus pilosus</i>	3.51	3.70	0.80	8.01
<i>Cratoxylum sp.</i>	1.75	3.70	0.25	5.70
<i>Dillenia philippinensis</i>	3.51	3.70	0.48	7.69
<i>Malastoma sp.</i>	1.75	3.70	0.12	5.57
<i>Syzygium cumini</i>	3.51	3.70	1.08	8.29

At least 39 species of sapling or shrub plants were identified in the area (Table 2). *Leukosyke capitellata* ranks highest in importance value at 48.77% (Fig. 3), and is the densest, most dominant and ubiquitous species (i.e. found in most quadrats) in the area. Other frequently encountered saplings are *Lygodium sp.* and an unidentified shrub called *Kaloot* by local folk.

Calamus multinervis obtained the lowest relative dominance. *Leukosyke capitellata* is the most important shrub species but can also grow into medium-sized tree and ranks third among the tree species (Table 1).

Table 2. Sapling species and their importance values in the forest within the vicinity of Lake Danao in Lubilan, Naawan, Misamis Oriental.

Species	Relative Density	Relative Frequency	Relative Dominance	Species Importance Value
<i>Leukosyke capitellata</i>	13.27	8.2	27.30	48.77
<i>Lygodium sp.</i>	1.02	6.56	18.38	25.96
<i>Dillenia philippinensis</i>	5.11	1.64	17.37	24.12
Kaloot*	7.15	6.56	6.52	20.22
<i>Artocarpus heterophylus</i>	6.13	3.28	4.73	14.13
<i>Amomum sp.</i>	1.02	1.64	1.79	4.45
<i>Cinnamomum mercadoii</i>	1.02	1.64	2.36	5.02
<i>Costus speciosus</i>	3.06	1.64	0.10	4.80
<i>Desmodium quinquepetalum</i>	1.02	4.92	0.25	6.19
<i>Donax comnaeformis</i>	2.04	4.92	0.67	7.63
<i>Fagraea blumei</i>	1.02	1.64	0.05	2.71
<i>Ficus heteropleura</i>	1.02	1.64	0.10	2.76
<i>Ficus sp.</i>	1.02	1.64	0.10	2.76
<i>Grewia sp.</i>	2.04	1.64	0.70	4.38
<i>Gymnostoma rumphiana</i>	2.04	1.64	0.33	4.02
<i>Ardisia sp.</i>	1.02	1.64	0.23	2.89
Lamakan*	2.04	3.28	0.54	5.86
<i>Lithocarpus sp.</i>	1.02	1.64	1.25	3.91
<i>Litsea sp.</i>	1.02	1.64	0.25	2.91
<i>Malastoma sp.</i>	10.21	1.64	0.25	12.10
Mangon-Bangon*	5.11	3.28	3.59	11.97
<i>Mollugo pentaphylla</i>	1.02	1.64	0.52	3.18
<i>Myrica sp.</i>	1.02	1.64	0.25	2.91
Palaypay*	1.02	1.64	0.13	2.79
<i>Pavetta indica</i>	2.04	1.64	0.09	3.77
<i>Phyllanthus virgatus</i>	1.02	3.28	0.96	5.25
Salungan*	1.02	1.64	3.59	6.25
<i>Scleria lithosperma</i>	2.04	1.64	0.23	3.91
<i>Sennata alata</i>	1.02	3.28	0.10	4.40
<i>Shorea guiso</i>	1.02	1.64	0.09	2.75
<i>Shorea negronensis</i>	4.08	3.28	2.48	9.84
Tagubay*	1.02	1.64	0.10	2.76
<i>Villebrumea rubescens</i>	1.02	1.64	0.49	3.15
Bagun*	3.06	1.64	0.70	5.40
<i>Bambusa sp.</i>	2.04	1.64	0.77	4.45
Bangkaw*	3.06	3.28	0.67	7.01
<i>Bauhinia sp.</i>	1.02	3.28	1.79	6.08
<i>Calamus discolor</i>	3.06	1.64	0.99	5.70
<i>Calamus multinervis</i>	2.04	1.64	0.04	3.72

*- Local Names

Table 3 presents the list of herbaceous species and other lower forms of plants occurring in the area. A total of 19 species of herbaceous plants were recorded, with *Nephrolepis hirstula* as the top most important herb (SIV or 79.26%).

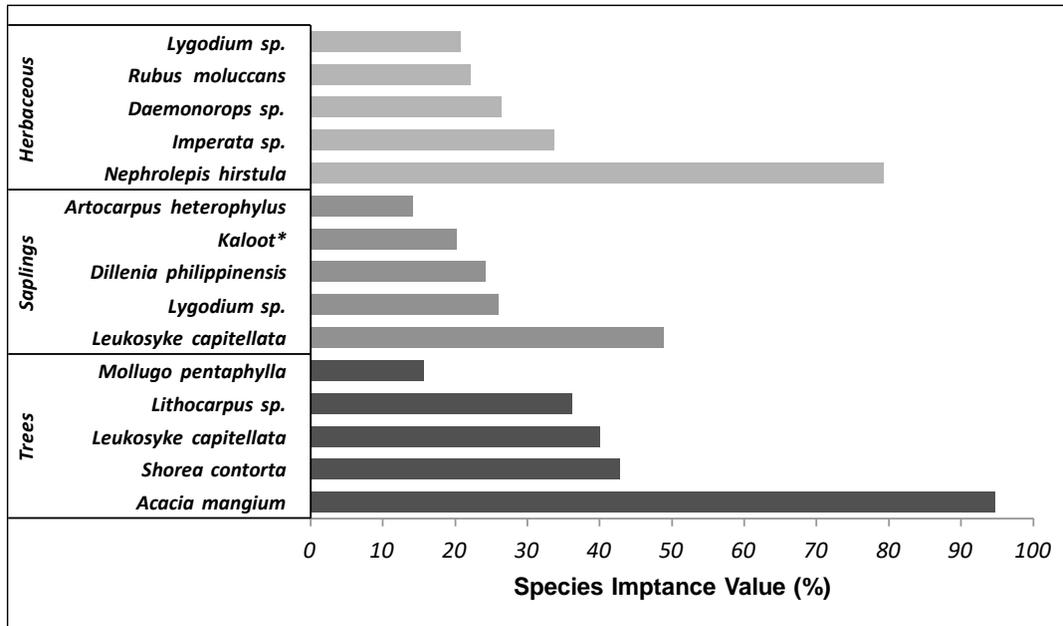


Figure 3. Top five most important trees, saplings, and herbaceous plants in the forest within the vicinity of Lake Danao, Lubilan, Naawan, Misamis Oriental.

The conservation status of plant species found within the study area (Table 4) was identified based on the IUCN database (2011) and the Lexicon of Philippine Trees (Rojo, 1999). Two species of trees are critically endangered, namely: *Shorea guiso* and *Shorea contorta*. Logging (for construction and furniture making) and slash-and-burn agriculture in the area threaten these species. *Dillenia philippinensis* and *C. mercadoii* are vulnerable species. These species are under threat from adverse factors throughout their range and are likely to move to the endangered category in the future. At least eight plant species in the forest are endemic to the Philippines, two of which are critically endangered and one is vulnerable. While conservation status of some species in the area could not be ascertained for lack of available references, the relatively high endemism in the forest of Lubilan sends a strong message to step up conservation efforts in the area. Biodiversity is the nation's natural capital: a highly diverse forest provides, among others, diverse habitats to many plant and animal organisms.

Ethnomedicine and antimicrobial test

Thirty-two of the 61 plant species are known to have medicinal values and are used as immediate and an alternative solution to curing illnesses. Some 13 species of plants are used in treating stomach disorder, 8 species for curing cuts and wounds, and two species for curing animal bite poisoning.

Table 3. Herbaceous plants in the forest within the vicinity of Lake Danao in Lubilan, Naawan, Misamis Oriental.

Species	Relative Density	Relative Frequency	Relative Dominance	Species IV
<i>Nephrolepis hirstula</i>	18.06	16.67	44.53	79.26
<i>Imperata sp.</i>	9.73	8.33	15.59	33.65
<i>Daemonorops sp.</i>	4.17	5.56	16.58	26.31
<i>Rubus moluccans</i>	9.73	11.11	1.26	22.10
<i>Lygodium sp.</i>	6.92	8.33	5.47	20.72
<i>Bauhinia sp.</i>	1.4	2.78	5.79	9.97
Kaulod*	4.17	5.56	1.34	11.07
Pangambungol*	9.73	2.78	0.20	12.71
<i>Scleria lithosperma</i>	2.78	2.78	0.20	5.76
Sigpang*	4.17	5.56	1.26	10.99
<i>Syzygium cumini</i>	2.78	2.78	1.18	6.74
<i>Villebrumearubescens</i>	1.39	5.56	0.87	7.82
<i>Wedilia biflora</i>	2.78	5.56	1.02	9.36
<i>Calamus discolor</i>	2.78	2.78	1.46	7.02
<i>Calophyllum sp.</i>	9.73	2.78	0.12	12.63
<i>Curculigo orchioides</i>	2.78	2.78	0.32	5.88
<i>Diplazium oligosorum</i>	2.78	2.78	1.81	7.37
<i>Ficus septica</i>	2.78	2.78	0.16	5.72
Kanding-Kanding*	1.39	2.78	1.02	5.19

*.- Local Names

Table 4. Conservation status of some plant species in Lubilan, Naawan, Misamis Oriental.

Family	Scientific Name	Local name	Conservation Status
Dilleniaceae	<i>Dilleniaphilippinensis</i>	Kulambog	Endemic, Vulnerable
Dipterocarpaceae	<i>Shorea guiso</i>	Giho	Endemic, Critically endangered
Dipterocarpaceae	<i>Shorea negronensis</i>	Lanagon	Endemic
Dipterocarpaceae	<i>Shorea contorta</i>	Lauan	Endemic, Critically endangered
Euphorbiaceae	<i>Myrica sp.</i>	Hindang	Endemic
Lauraceae	<i>Litsea philippinensis</i>	Bakan	Endemic
Lauraceae	<i>Cinnamomum mercadoii</i>	Kalingag	Vulnerable
Moraceae	<i>Ficus sp.</i>	Baliti	Endemic
Moraceae	<i>Ficus heteropleura</i>	Kalapat	Endemic
Sterculiaceae	<i>Cleistanthus pilosus</i>	Banitlong	Endemic
Casuarinaceae	<i>Gymnostoma rumphiana</i>	Agoho	Endemic

Respondents in household interviews declared that some of the ethnomedicinal plants they use were obtained in the forest while some were grown in their home gardens. *Lagundi* and *helbas* are the most commonly identified herbal cure for various illnesses and diseases such as fever, cough and colds. Other common ethnomedicinal plants utilized by the community are *atay-atay*, *gabun*, *kanila*, *kalingag* and *hagonoy*. *Atay-atay* and *hagonoy* are used for curing wounds while *kanila*, *kalingag* and *gabun* are used for stomach disorders and “panuhot”. Different parts of the plants are used depending on the traditional mode of preparation, including

flowers, leaves, root, stem, whole plant, fruits, seeds, bark, latex, and cones. Each medicinal plant is used either raw or in dried form.

The type of ailment also determines the type of herbal preparations which are administered in different forms: as powder, crushed, paste, decoction (liquid obtained from boiling or the medicinal plants in the solvent), and infusion/homogenization (plant powder/paste mixed with the solvent). Decoctions constitute the most frequent form of preparation, followed by leaf extract directly applied onto the infected skin (Fig. 4). Medicinal plant preparations are applied through different routes of administration, namely, oral (most common), dermal or topical, and nasal routes. Among the *Higaonons* of Lubilan, medicines are prescribed and administered in various ways and dosage is determined by age, sex, and physical appearance of the patient. Children are given smaller doses of the herbal medicine than adult patients, depending on the type of illness and treatment required. The type of disease and degree of severity further determine the frequency of treatments.

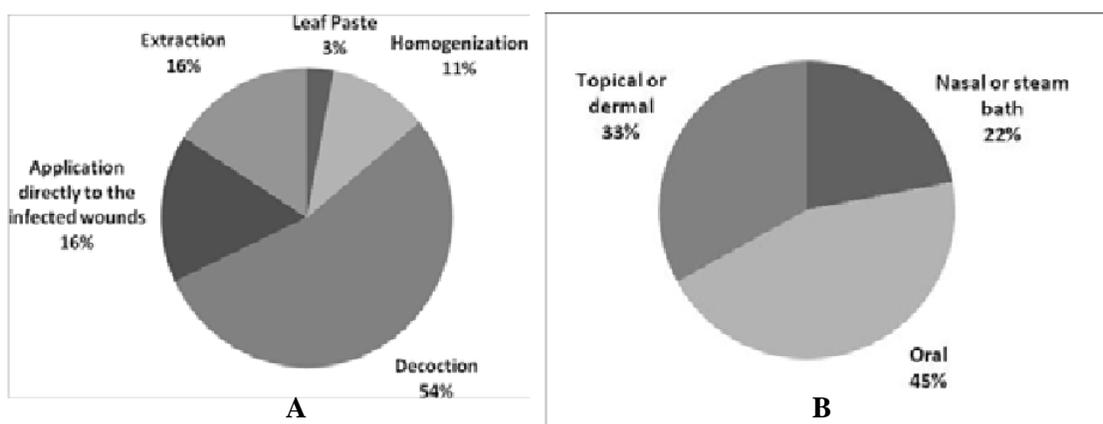


Figure 4. Modes of preparation (A) and administration (B) of medicinal plants by *Higaonons* and other lumads in Lubilan, Naawan, Misamis Oriental.

Various types of plant species were used to treat different health problems of the *Higaonons* and other residents of around Lake Danao. These diseases and illnesses include stomach disorders, cuts and wounds, bleeding, cough, poisoning, relapse, bone fracture, fever, animal bite poisoning and other diseases locally known as “sinda”, and “padug-as”. Stomach disorder, wounds, and cuts are by far the most widespread ailments while bone fracture and kidney trouble are occasional problems. The *Higaonons* use different diagnostic ways and treatment methods depending on the type of ailment. Patients are often diagnosed by interview and visual observation of changes in physical appearance (e.g. eye and skin color, tongue and throat regions), body temperatures and signs of bone fracture.

Results of antimicrobial tests on selected plants confirmed the claims of the respondents that the plants can cure certain illnesses as shown by their microbial indices or MI (Table 5). Plant extracts of *P. indica* was found to be more effective against *S. aureus* than the rhizome of *Crimum sp.* The antibacterial activity of extracts from stem bark and roots of *C. mercadoii* showed little inhibitory effect on the test organisms while greater inhibitory effect was exhibited

by *Bauhinia sp.* against *E. coli*, with zones of inhibition of 9.83mm and 18.50mm, respectively. Antimicrobial effect of the crude extracts, however, is lower than the purified synthetic antibiotic chloramphenicol whose zone of inhibition is much larger on both bacterial strains (Table 5).

Table 5. Microbial indices indicating antimicrobial activity of plant extracts against *E. coli* and *S. aureus*.

Plant Extract	Traditional use	<i>E. coli</i>		<i>S. aureus</i>	
		Ave. zone of inhibition (mm)	MI	Ave. zone of inhibition (mm)	MI
<i>Crinum sp.</i>	Infected wounds	10.67	0.33	10.67	0.33
<i>P. indica</i>	Infected wounds	13.33	0.67	15.67	0.96
<i>Bauhinia sp.</i>	Stomach disorder	18.50	1.31	10.33	0.22
Salokot	Stomach disorder	9.33	0.17	11.67	0.43
<i>C. mercadoii</i>	Antibiotic	9.83	0.23	12.00	0.50
Chloramphenicol	Synthetic antibiotic	26.33	2.29	28.17	2.52

Community perceptions on health and biodiversity

The forest that surrounds Lake Danao in Lubilan, Naawan, Misamis Oriental can be considered a secondary forest as the original growth was razed by a forest fire in 1984. Tree planting within the area and collective protection by the Higaonons under the leadership of the Higaonon Datu, DENR and the people living near the Lake Danao, helped the forest to regenerate. The forest is an important resource to the communities in Lubilan, Naawan – as source of timber for building houses, firewood for domestic uses, drinking water and food. Aside from its economic value, residents are aware of the ecological benefits from the forest, such as protection from natural calamities such as landslides, storms and flooding, and its water retention ability to maintain its aquifers and support agriculture.

During the interviews, most of the respondents (94.51%) believed that the forest is still a good source of ethnomedicinal plants. Ethnomedicine is an essential component of the Higaonon health care system: the plants are their source of medicine and they find them to be effective in treating diseases and illnesses. Communities living in the vicinity of Lake Danao are generally knowledgeable about the importance of forest diversity especially in relation to their health care system. They also appreciate the role of the forest and the multiple benefits they derive from a healthy ecosystem and believe that biodiversity conservation is the only means to achieve resource sustainability. On the other hand, some respondents are not as well aware of the existing laws that protect the forest from all forms of destruction and forest degradation.

CONCLUSIONS AND MANAGEMENT IMPLICATIONS

This study has revealed that the indigenous and non-indigenous communities around Lake Danao in Lubilan, Naawan demonstrate a high level of environmental awareness and can be rallied toward stronger stewardship and conservation. Preserving the indigenous culture, particularly the use of ethnomedicine, and respecting the rights of the Higaonon people to their

ancestral domain, can help protect the forest and the resources therein. Traditional knowledge can make a significant contribution to sustainable development. Many of tribal communities have cultivated and used biological diversity in a sustainable way for thousands of years. Some of their practices have been proven to enhance and promote biodiversity at the local level and help maintain healthy ecosystems.

The Higaonon community and other lumads living around Lake Danao expressed concerns on the expansion of mining activities in some parts of Naawan and Manticao, Misamis Oriental. Spread of mining activities in the watershed areas would threaten not only the forest ecology but also the sustainability of ecological, socio-economic and ethnomedicinal services for forest communities. The local community's medicinal needs are linked to the ethnomedicinal plants found within the forest. Presently certain endemic plant biota in Lubilan are already critically endangered. There is a need to consolidate efforts to protect the forest and conserve its biodiversity and the invaluable traditional health care system of indigenous communities. Furthermore, sporadic violations of forest policies place additional strain on the fragile ecosystem and resources therein.

Concerted efforts by the local government, the DENR, the IPs and other communities in Lubilan are critical in enforcing policy and strategies to conserve forest resources as well as the ethnomedicinal plants therein. Growing of herbal medicine in home gardens is an important alternative way to minimize the dependence of the people on the forest. More research initiatives into biodiversity (e.g. faunal diversity of Lake Danao) regarding the medicinal uses of plants should be carried out for further information on ethnomedicine.

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