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Medicinal plants used by the local communities of Sitio Lomboyan, Barangay Guinabsan, Buenavista, Agusan del Norte, Philippines

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ABSTRACT

The Higaonon tribe is known to coexist with non-Higaonon residents in Sitio Lomboyan, Barangay Guinabsan, Buenavista, Agusan del Norte (ADN), and this interaction may result in sharing of traditional medicinal practices within the locality. This study aimed to determine the medicinal knowledge of residents in Sitio Lomboyan, Barangay Guinabsan, Buenavista, ADN. There are 120 respondents who participated in this study. A semi-structured questionnaire was used to gather information on the different medicinal plants (MP) and practices used by Higaonon and non-Higaonon in the community. A total of 125 species belonging to 52 families were recorded as plants with medicinal importance, where 68 (54.40%) were commonly used by the two groups. The largest number of MP came from the family Fabaceae. Leaves were the most widely used plant part that was prepared through decoction and administered orally. Cough was the most common ailment treated by the MP. Based on the relative frequency of citation (RFC), *Blumea balsamifera* (0.41) and *Origanum vulgare* (0.38) had the highest RFC values. Diarrhea, relapse, stomachache, flatulence, urinary tract infection, fever, high blood pressure, and cough are highly connected to the plant species in the inter-network analysis. Analysis of similarities revealed question: specify extent of similarities bet 2 groups of herbal medicines used by the two groups (R=0.051). The present study provides an in-depth inventory of MP used by Higaonon and non-Higaonon residents in Sitio Lomboyan, Barangay Guinabsan, Buenavista, ADN.

Keywords: *Agusan del Norte, Higaonon, Internetwork Analysis, Relative Frequency of Citation, Analysis of Similarity*

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1 Introduction

Global use of herbal medicine has expanded dramatically in the latter half of the 20th century. The use of herbal remedies in the Philippines is usually perceived as a rural practice, but the knowledge and utilization of herbal medicine in urban areas can also be observed (Catublas, 2016). Medicinal plant studies can have a critical role in highlighting important plant species in a particular region (Amjad et al., 2017; Paraguison et al., 2020). The World Health Organization (WHO) accounted for approximately 60% of the world's population depending on conventional medicine and 80% of the population in developing countries depend almost entirely on traditional medical practices, especially herbal treatment (Paraguison et al., 2020).

There are 422,000 flowering plants found globally (Govaerts, 2001), more than 50,000 are used for medicinal purposes (Schippman et al., 2002). The use of herbal treatment and phytonutrients or nutraceuticals continues to grow rapidly throughout the world with many people now resorting to such products in different national healthcare settings for the treatment of various health problems (Ekor 2014; Paraguison et al.,

Volume 3 | Issue 1 | December 2021
PRINT ISSN: 2408-3623 | ONLINE ISSN: 2408 3631

2020). Herbal medicine keeps some important contributions in the health-care system of local communities as the main source of medicine for the majority of the rural population. It also plays a key role in the development and advancement of modern studies based on hundred years of belief and observations that lead to developing a modern drug (Aburjai et al., 2007). Due to the growing demand for drug discovery and medicinal plant production, the application of traditional herbal medicine has been increasingly rising in recent decades (Paraguison et al., 2020).

Sitio Lomboyan, Barangay Guinabsan, Buenavista Agusan del Norte has a rich and diverse flora as sources of food, healing agents, and other resources. Having unique groups of inhabitants dwelling in the same area, the non-Higaonon and Higaonon (Indigenous) groups are living peacefully together where intermarriage is being practiced. Their intercultural consensus is evident in such a way that the usage of traditional herbal medicine of Higaonon people is already conveyed through this intermarriage or observational learning by non-Higaonon. Intercultural consensus is an agreement in which plants are valued for medicinal use, and similarity of reported uses between cultures that are in contact through such activities as trade, feasting, and intermarriage (Johnson, 2006). Since the traditional practice using medicinal plants that are inherent in local communities is a very important source of information that continually provides the present-day herbal remedies (Balangcod and Balangcod, 2018).

With the shifting trend of society towards the use of plants in the treatment of various diseases and other purposes. This study highlights the relevant plants' species and their local name, plant parts used, treatment process, disease treated, and mode of preparation of the traditional medicinal plants found in Sitio Lomboyan used by the non-Higaonon and Higaonon. Internetwork analysis was also used to show the internetwork relationship of herbal medicines utilized by the non-Higaonon and Higaonon. Plants utilization may be present among different groups in the Philippines however to date, there is a lack of complete medicinal plants documentation or data that can be used to compare the similarities and differences in plant utilization across different groups (Balangcod and Balangcod, 2018).

Nowadays, traditional usage of medicinal plants is fast diminishing because as more plants are lost, so is the information of their value to humanity. Thus, the findings of this research would be of great help to botanists, sociologists, medical practitioners, agriculturists and ecologists in future studies and provide insights on the utilization, management, and conservation of medicinal plants in the area.

2 Materials and Methods

Study area

The study was conducted in Sitio Lomboyan, Barangay Guinabsan, Buenavista Agusan del Norte (Figure 1). It is classified as a rural area that has 381.523 land areas in hectares. Its population as

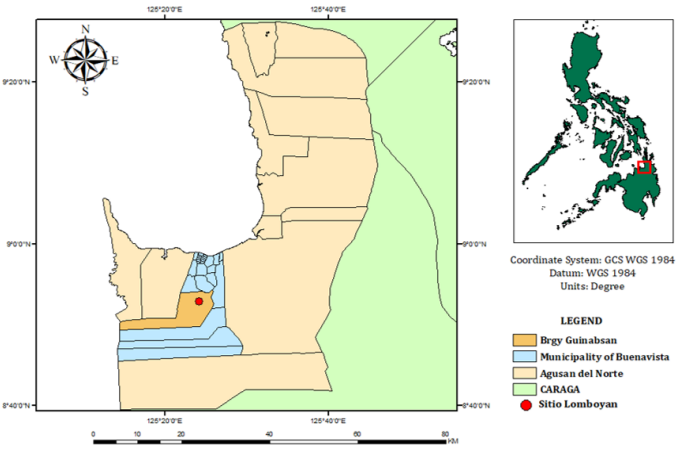

Figure 1. The study site in Sitio Lomboyan, Brgy. Guinabsan, Buenavista, Agusan del Norte, Philippines.

Volume 3 | Issue 1 | December 2021
PRINT ISSN: 2408-3623 | ONLINE ISSN: 2408 3631

determined by the 2019 Census was 571, this data was composed of a mixed community of non-Higaonon (356) and Higaonon (215). It is an area surrounded by mountains and forests with agricultural products like foods such as corn, coconut, banana, and other vegetables and fruits. This place is known for timber production particularly falcata trees.

Data Collection

Medicinal plant data were collected during individual surveys with the informants. Individual informed consent was given before conducting the survey. Different related plant information (plant family, scientific name, local name, plant part used, treatment process, disease treated, and the mode of application) was asked during the interview. Respondents were selected based on their availability, willingness to participate, and accessibility to the area.

The survey was performed using a semi-constructed questionnaire which was checked and validated by a sociologist. The Medicinal data about plants use were collected using a participatory rural appraisal (PRA) method, where the informants also sometimes become the investigator themselves. The PRA involves an interview, informal meetings, open and group discussions with a semi-structured questionnaire translated orally into their dialect. Interviews were conducted using the local language and lasted an average of 15 to 30 minutes depending on the interview conditions.

Ethical consideration

The data collected were handled with critical care by keeping the views, culture and values of the local communities. Respondents were informed that the study was carried out for academic purposes and not for commercial purposes. A Free Prior Informed Consent (FPIC) was secured from the City Mayor's office, Barangay captain, and tribal council before the conduct of the study. Also, individual informed consent was obtained from the respondents before the formal interview. The respondents acknowledged the concept and reached an agreement allowing the researcher to collect data for the study. A local guide also acts as the translator during the conduct of the interview.

Respondents of the study

A total of 120 respondents (60 non-Higaonon and 60 Higaonon) were purposively chosen from Sitio Lomboyan, Barangay Guinabsan, Buenavista, Agusan del Norte. Only 10 % of pure-blood Higaonon participated in the study for the majority of their ancestors get married to non-Higaonon. A total of 75 females and 45 males with an age range between 25-80 years old participated in the study. Some respondents in this study have medical (alternative or modern) backgrounds in which 4 are local healers (1 from Higaonon and 3 from non-Higaonon) and 1 local Higaonon midwife (mananabang).

Species identification

During the interview, some of the plants were observed in situ which involves short field walks with the locals. Some samples were collected and photo-documented for scientific identification especially those rare plants. Collected plants were pressed, dried, identified, and deposited in the herbarium at Caraga State University, Biology science laboratory. Plants were initially identified with the help of the literature and Co's digital flora of the Philippines (Fernando et al., 2004; Merrill, 1903; Pelser et al., 2011). Plant identification was further verified by experts from the Department of Biology, Caraga State University, Butuan City.

Statistical analysis

Data on informant's backgrounds and medicinal plants used by the respondents were entered in Excel spreadsheet software (Microsoft Corporation 2010) and was organized for statistical analysis. Quantitative ethnomedicinal indices were used for data analyses.

Relative Frequency of Citation (RFC)

Relative frequency of citation index shows the local importance of each species. The RFC value was calculated using a formula RFC=FC/N; where FC is the number of informants mentioning the use of species and N is the number of informants participating in the survey (Vitalini et al., 2012). The RFC index varies from 0 to 1, where RFC index with zero value means that there is only one respondent who refers to the plant to be useful while RFC index close to one indicates that all informants in the survey refer to the plants to be useful (Mohomodly et al., 2014).

Inter-network analysis (INA)

INA was applied to traditional medicinal

Volume 3 | Issue 1 | December 2021
PRINT ISSN: 2408-3623 | ONLINE ISSN: 2408 3631

knowledge, although it has been included with its ethnographical properties. In this research, this method was applied to attain more network information between categories of ailments and medicinal plants within the study area (Kim and Song, 2013). The results of the INA were analyzed using Cytoscape (Ver. 4.7.1) software.

Analysis of similarities (ANOSIM)

Analysis of Similarities (ANOSIM) is a robust non-parametric hypothesis testing framework for differences among groups of samples (Somerfield et al., 2021) to test whether there is a significant difference between ethnicity, gender, and age category with respect to species used. The ANOSIM one-way permutation, using the Bray Curtis Similarity Index test to provide a way to test whether there is a significant difference in species cited among two communities. This test resulted in a varied R-values with coefficient interpretation (Table 1).

3 Results and Discussion

Medicinal plants

Plant family, scientific name, local name, plant part used, treatment process, disease treated, and the mode of application are documented in this study. The informants reported 125 plant species that belong to 52 families, which they used for medicinal purposes (Table 2). The most mentioned herbal plant species belongs to the family Fabaceae (26%), Lamiaceae and Asteraceae (20%), Moraceae (12%), Annonaceae and Poaceae (11%) (Figure 2A).

In this survey, ipil-ipil (*Leucaena leucocephala*), asunting (*Cassia alata*), cobra vine (*Cobaea scandens*), consinsik (*Desmodium triflorum*), bahai (*Ormosia calavensis*), hibi-hibi (*Mimosa pudica*), tug-tug (*Plyllantus reticulatus*), sigurilyas (*Psophocarpus tetragonolobus*) and narra (*Pterocarpus indicus*) are the herbal plant recorded under the Fabaceae family. Fabaceae is of great ethnomedicinal importance in indigenous and urban communities throughout the world (Molares and Ladio, 2011). From this botanical group, important chemical constituents that act in the treatment and/or healing of various bodily systems arise (Macêdo et al., 2018).

Plant Parts Used in the Treatment

The plants and their parts such as bark, juice/sap, flower, fruits, leaf, roots, sapling, stem, thorn, and whole plants are essentials in treating specific diseases. In particular, the leaves are the most commonly used for both non-Higaonon and Higaonon followed by the stem, roots, bark, fruits, whole plants, and seeds (Figure 2B). Furthermore, leaves are the most abundant plant parts that are easier to collect and also be generated. This result is comparable to the study of Arquion et al. (2015), that leaves were largely used followed by stems, whole plants, roots, fruits, bark, flowers, and seeds by the people in Prosperidad, Agusan del Sur, Southern Philippines (Arquion et al., 2015).

In accordance with the study of Macêdo et al. (2018), the preponderant use of these plant parts makes these species more vulnerable and may lead to the reduction of its populations, since there is no control over their collection. Lima et al. (2011) and Pinto et al. (2013) stress out that the excessive usage of these resources will affect the survival of the plant and may compromise the conservation of the species.

Preparation process/application using medicinal plants

Non-Higaonon and Higaonon people have several preparation processes of medicinal plants depending on how they apply them. A decoction was found to be the widest preparation process accounted for. Treatment application using a paste, through ingestion, embrocation, steam bath, and insertion are some other popular methods (Figure 2C). Medicinal plants were reported from the respondents mostly to be boiled with water by drinking remedy until the ailments were healed. The rest of the cures were externally applied to the surface of the affected part

Table 1. Ranges and its verbal coefficient interpretation of ANOSIM (Sop et al., 2012).

Range	Verbal Interpretation
0.00 to 0.25	No difference/Similar
0.26 to 0.75	Some Separations/Some Dissimilarities
0.76 to 0.99	Well Separated/Well Dissimilarities
1	Totally Dissimilar

Volume 3 | Issue 1 | December 2021
PRINT ISSN: 2408-3623 | ONLINE ISSN: 2408 3631

Table 2. List of plants recorded utilized by both non- Higaonon and Higaonon in Sitio Lomboyan, Barangay Guinabsan, Buenavista Agusan del Norte.

No.	Plant family	Scientific name	Local name	Part used	Treatment process	Disease treated	Mode of application/treatment
1	Amaryllidaceae	*Allium fistulosum*	Sibuyas	leaf	ingestion	deworming	Incorporated as spices in food
2		*Allium schoenoprasum*	Ganda	leaf	embrocation	cough	Crushed and embrocate
3		*Amaryllis belladonna*	Butsaw	leaf	decoction	cough	Boiled with water and serve as a tea
4		*Allium cepa*	Bombay	fruit	embrocation	fever, cough	Roast the fruit or leaf and while it's warm; rub it in the back or chest.
5	Anacardiaceae	*Mangifera indica*	Mangga	leaf	decoction,	diarrhea	Boiled with water and serve as a tea
6	Annonaceae	*Annona muricata*	Banaba/ Rabana	leaf, roots, fruit, bark	decoction, ingestion,	stomachache, UTI, high blood, cancer, relapse, heart disorder, deworming	Boiled with water and serve as a tea
7		*Annona squamosa*	Atis	leaf	decoction	relapse	Boiled with water and serve as a tea
8		*Cananga odorata*	Anangilan/ Ilang-ilang	leaf, stem	decoction	flu, cough	Boiled with water and serve as a tea
9	Apiaceae	*Hydrocotyle vulgaris*	Yahong-yahong	leaf	decoction	cough, poisoned	Boiled with water and serve as a tea
10	Apocynaceae	*Alstonia scholaris*	Dita	leaf	paste	boil	Crushed and paste in the affected area
11		*Catharanthus roseus*	Kumingtang	roots	decoction	stomachache	Boiled with water and serve as a tea
12	Araceae	*Alocasia macrorrhizos*	Badyang	roots	decoction	toothache	Boiled with water and gargle when its warm
13		*Colocasia esculenta*	Gabi-gabi	leaf	ingestion	deworming	Incorporated in food.
14		*Homalomena philippinensis*	Payaw	leaf	paste	bloat, wound	Crushed and paste in the affected area
15		*Zamioculcas zamiifolia*	Kawelan	stem	decoction	stomachache	Boiled with water and serve as a tea
16	Arecaceae	*Cocos nucifera*	Lubi	roots, fruit	decoction, ingestion,	UTI, high blood pressure, famish	Boiled with water and serve as a tea
17		*Corypha elata*	Buli	thorn	decoction	stomachache	Boiled with water and serve as a tea
18	Araliaceae	*Polyscias guilfoylei*	Kalipay	leaves	paste	wounds	Leaves are crushed until paste texture achieve then apply it in wounds.
19	Asparagaceae	*Agave americana*	Magay	leaf, roots	decoction	relapse, fever	Boiled with water and serve as a tea
20		*Cordyline fruticosa*	Kila	leaf, roots	bath, decoction	flatulence, relapse	Boiled with water, add warm then bath
21	Asteraceae	*Artemisia vulgaris*	Hilbas	leaf, whole plant	embrocation, decoction	asthma, fracture, fever, cough	Whole plant or leaves are obtain and roasted till leaves wilted. While it is warm rub in the chest and other body parts.
22		*Blumea balsamifera*	Sambong	leaves	decoction	cough, fever	Leaves are boiled for a minute, drink or serve while warm.
		Chromolaena odorata	Hagonoy	leaves	paste	boils, wounds	Leaves crushed until paste texture, then apply to affected area.
23		*Acmella uliginosa*	Buya-buya	flower	insertion	toothache	Get small piece of flower then insert to the affected tooth
24		*Ageratum conyzoides*	Gapas	leaf, roots	decoction	flatulence, relapse	Boiled with water and serve as a tea
25		*Bidens pilosa*	Tuway-tuway	leaf	decoction	relapse	Boiled with water and serve as a tea
26		*Mikania cordifolia*	Bekas	leaves	decoction	cough	Boiled with water and serve as a tea
27		*Pseudelephantopus spicatus*	Koko banog	roots, leaf, whole plant	decoction, embrocation	relapse, flu, muscle pain	Boiled with water and serve as tea
28		*Wedelia sp.*	Agonoi	leaves, flower	paste	boils, wounds	Leaves crushed until paste texture, then apply to affected area.
29	Athyriaceae	*Diplazium esculentum*	Pako	leaves	ingestion	headache, fever, boils	Eaten fresh or season it like salad

Volume 3 | Issue 1 | December 2021
PRINT ISSN: 2408-3623 | ONLINE ISSN: 2408 3631

No.	Plant family	Scientific name	Local name	Part used	Treatment process	Disease treated	Mode of application/treatment
30	Basellaceae	*Basella alba*	Alugbati	leaves	ingestion	fever, spasm,	Eaten fresh or season it like salad
31	Bignoniaceae	*Tabebuia avellanedae*	Trumpeta	leaves, bark	paste,	fever, boils	Leaves crushed until paste texture, then apply to affected area.
32	Bixaceae	*Bixa orellana*	Atsuete	leaves, bark, seeds	ingestion, decoction, paste	burns, boils,	Leaves are boiled with water. Set aside to cool. Burns and boil are washed with the solution.
33	Boraginaceae	*Ehretia microphylla*	Alangitngit	leaves	decoction	abdominal pain, constipation	Boiled with water and serve as a tea
34	Caricaceae	*Carica papaya*	Kapayas	leaves, bark, fruit	ingestion, decoction, paste	deworming, wounds, sore throat	Bark are scrape and apply to the open wounds.
35	Convolvulaceae	*Ipomoea batatas*	Kamote	leaves, roots	ingestion	laxative, deworming	Young leaves are eaten as salad
36	Crassulaceae	*Crassula pinnata*	Paso	leaves	paste	burns	Leaves crushed and apply to burn parts
37	Cucurbitaceae	*Cucumis sativus*	Pipino	fruit	ingestion	laxative, deworming	Fruit eaten raw
38		*Momordica charantia*	Paliya	fruit, leaves	ingestion	diabetes	Fruit eaten raw or cooked as viand.
39	Cyperaceae	*Kyllinga monocephala*	Botones	roots	decoction	dengue	Roots are boiled with water. Drink while water is warm.
40		*Scleria scrobiculata*	Gabas	roots	decoction	fever	Roots are boiled with water. Drink while water is warm.
41	Dipterocarpaceae	*Shorea negrosensis*	Lawaan	roots	decoction	fever	Roots are boiled with water. Drink while water is warm.
42	Euphorbiaceae	*Jatropha gossypifolia*	Tuba-tuba	leaves	wrapped	swollen body parts	Leaves are wrapped in the swollen part of the body
43		*Euphorbia hirta*	Tawa-Tawa	whole plant	decoction	dengue, fever	Whole plant are boiled. Drink while water is warm.
44		*Jatropha mcvaughii*	Kasla	leaves	wrapped	swollen body parts	Leaves are wrapped in the swollen part of the body
45		*Jatropha podagrica*	Ginseng	roots, stem	decoction	stomach ache,	Roots are boiled with water. Drink while water is warm. Stem and roots are cut and infused to alcoholic drinks
46	Fabaceae	*Albizia lebbekoides*	Langil	seed	ingestion	deworming, gingivitis	Seeds are eaten directly
47		*Cassia alata*	Asunting	leaf	brush on	facial fungal infection	Crushed and brush on the affected area
48		*Desmodium triflorum*	Consinsik	leaf, roots	decoction	fever, flu, measles, high blood pressure	Boiled with water and serve as a tea
		Derris elliptica	Tubli	roots, leaves	paste	wounds	Leaves crushed until paste texture achieve. Apply to wounded part
		Leucaena leucocephala	Ipil-ipil	seed	ingestion	deworming	Ingest the seed with water
49		*Mimosa pudica*	Hibi-hibi	leaf	decoction	anemic, relapse	Boiled with water and serve as a tea
50		*Ormosia calavensis*	Bahai	leaf, bark, roots, stem	decoction, embrocation	UTI, flatulence, nervous breakdown, paralyzed	Boiled with water and serve as a tea
51		*Psophocarpus tetragonolobus*	Sigurilyas	juice	paste	canker sore	Paste it in the affected area and allow its liquid absorb the affected part.
52		*Pterocarpus indicus*	Narra	bark, juice, leaf	decoction,	UTI, lu-as, dengue	Boiled with water and serve as a tea
53	Flagellariaceae	*Flagellaria indica*	Himag	stem	decoction	fever, stomachache, relapse	Boiled with water and serve as a tea
54	Guttiferae	*Garcinia mangostana*	Mangosteen	leaf	embrocation, decoction	varicose veins, high blood pressure	Crushed and embrocate to the affected area
55	Lamiaceae	*Coleus blumei*	Mayana	leaf	decoction, embrocation, paste	cough, muscle pain, flatulence, fever,boil, high blood pressure,	Crushed and filtrate are taken orally

Volume 3 | Issue 1 | December 2021
PRINT ISSN: 2408-3623 | ONLINE ISSN: 2408 3631

No.	Plant family	Scientific name	Local name	Part used	Treatment process	Disease treated	Mode of application/treatment
56		*Gmelina arborea*	Gemelina	leaf	paste	fracture	Paste the leaf to the affected area
57		*Hyptis capitata*	Kunsaw	leaf	embrocation	muscle pain	Crushed and embrocate to the affected area
58		*Origanum vulgare*	Kalabo	leaf	decoction,	cough, flatulence, fever	Crushed and filtrate are taken orally
59		*Plectranthus hadiensis*	Vicks	leaf	inhalation	flu	Crushed leaf are placed near the nose to inhale the leaf's aroma
60		*Premna odorata*	Abgaw	leaf, roots	decoction,	cough, sore, fever, UTI, flu, flatulence	Boiled with water and serve as tea
61		*Vitex negundo*	Lagundi	leaf	decoction	cough, fever	Boiled with water and serve as tea
62		*Vitex parviflora*	Tugas	roots	decoction	relapse	Boiled with water and serve as tea
63	Lauraceae	*Cinnamomum mercadoi*	Kalingag	bark	decoction	cough, diarrhea	Boiled with water and serve as tea
64		*Persea americana*	Avocado	leaf	decoction	diarrhea, anemia	Boiled with water and serve as tea
65	Malvaceae	*Abelmoschus esculentus*	Okra	fruit	ingestion	irregular digestion, tuberculosis, fever	Incorporate in the cooked food and serve as viand
66		*Theobroma cacao*	Cacao	fruit, roots	paste, decoction, embrocation	boil, sore, wounds, relapse	Paste the fruit cover to the affected area
67		*Colocasia esculenta*	Gabi-gabi	leaf	ingestion	deworming	Incorporated in food.
68		*Durio zibethinus*	Durian	fruit	ingestion	dengue	Ingest the fruit with water
69		*Hibiscus rosa- sinensis*	Gumamela	flower	paste	boils	Crushed and paste in the affected area
70		*Corchorus olitorius*	Saluyot	leaves	ingestion	deworming, anemia	Leave are eaten fresh or cooked like viand.
71	Meliaceae	*Lansium domesticum*	Buwahan	bark	decoction	diarrhea	Boiled with water and serve as tea
72		*Sandoricum koetjape*	Santol	bark, fruit	decoction, ingestion,	stomachache, diarrhea	Boiled with water and serve as tea
73		*Swietenia macrophylla*	Mahugani	seed, leaf, roots	ingestion	stomachache, fever	Ingest the seed with water
74	Menispermaceae	*Anamirta cocculus*	Lagtang	leaf	decoction	flatulence	Crushed and the filtrate are taken orally
75		*Merremia peltata*	Burakan	leaf	embrocation, decoction	stroke, diarrhea, ulcer	Crushed and embrocate to the affected area
76		*Arcangelisia flava*	Alibutra	stem	decoction	fever, sore	Boiled with water and serve as tea
77		*Tinospora crispa*	Panyawan	stem, leaf, roots, ,	embrocation, decoction, insertion,	muscle pain, fever, flatulence, stomachache, toothache, arthritis, numb, diabetes	Crushed and embrocate to the affected area
78	Moraceae	*Artocarpus heterophyllus*	Nangka	roots, bark	decoction	UTI, sore eyes, relapse, diarrhea	Boiled with water and serve as tea
79		*Ficus balete*	Balete	stem, bark	paste, decoction	fracture, sore	Paste the stem in the affected area
80		*Ficus minahassae*	Hagimit	roots	decoction, paste	relapse, fracture	Boiled with water and serve as a tea
81		*Ficus nota*	Tibig	leaves, fruit, stem	decoction	UTI	Boiled with water and serve as a tea
82		*Ficus septica*	Lagnob	leaf, roots, whole plant	decoction, paste	headache, fever, flatulence, stroke, air wave, thiamine deficiency, cough, muscle pain, relapse, ulcer	Boiled with water and serve as a tea
83	Moringaceae	*Moringa oleifera*	Kamunggay	leaf, seed, roots	decoction, vain, paste,	wounds, poisoned, flatulence, fever, high blood, cough, air wave, muscle pain	Crushed and paste in the affected area

Volume 3 | Issue 1 | December 2021
PRINT ISSN: 2408-3623 | ONLINE ISSN: 2408 3631

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84	Muntingiaceae	*Muntingia calabura*	Mansanitas	leaf, fruit	decoction,	diarrhea, relapse	Crushed and the filtrate are taken orally
85	Musaceae	*Musa paradisiaca*	Tundan	fruit	ingestion	diarrhea	Ingest the fruit with water
86		*Musa textilis*	Abaka	juice	paste	wound	Apply in the affected area
87	Myrtaceae	*Eucalyptus globulus*	Yucaliptus	leaf	decoction	cough	Boiled with water and serve as tea
88		*Psidium guajava*	Bayabas	leaf, bark	ingestion, decoction, paste, embrocation	diarrhea, flatulence, wounds, famish, boil, ulcer, stomachache, hyperacidity	Ingest the leaf with water
89		*Syzygium aqueum*	Tambis	leaf	paste	bloat	Crushed and paste in the affected area
90		*Syzygium cumini*	Lomboy	leaf, bark, root	decoction,	diarrhea, vomiting, flatulence, diabetes	Boiled with water and serve as tea
91	Orchidaceae	*Phalaenopsis stuartiana*	Tiger orchid	leaf	paste	cyst, boils	Crushed and paste in the affected area
92	Oxalidaceae	*Averrhoa carambola*	Balimbing	fruit	ingestion	deworming	Fruit are eaten fresh
93	Pandanaceae	*Pandanus amaryllifolius*	Pandan	leaf	decoction	fever, high blood pressure	Crushed and filtrate are taken orally
94	Phyllantaceae	*Phyllanthus fraternus*	Likod- likod	whole plant	decoction	fever	Boiled with water and serve as a tea
95		*Phyllanthus reticulatus*	Tug-tug	leaf	decoction	cough	Boiled with water and serve as a tea
96	Piperaceae	*Peperomia pellucida*	Sinaw-sinaw	whole plant	decoction, paste	UTI, boil, fever,	Boiled with water and serve as a tea
97		*Piper betle*	Buyo	stem, leaf	embrocation, decoction	muscle pain, flatulence, cough, stomachache	Crushed and embrocate to the affected area
98	Poaceae	*Bambusa vulgaris*	Ubod	stem (young part)	ingestion	high blood	Serve as viand
99		*Cymbopogon citratus*	Tangad	whole plant, leaf, root	decoction, paste	high blood pressure, boil, cancer, diarrhea, fracture	Boiled with water and serve as tea
100		*Eleusine indica*	Paragis / Bila- bila	whole plant	decoction	liver cancer, high blood pressure, fever, deworming, cough	Boiled with water and serve as tea
101		*Imperata cylindrica*	Cogon	culm	decoction	UTI	Boiled with water and serve as tea
102		*Saccharum officinarum*	Tubo	stem	decoction, paste	UTI, high blood pressure, relapse, wound	Boiled with water and serve as tea
103		*Saccharum spontaneum*	Bugang	leaf	decoction	vomiting of blood	Boiled with water and serve as tea
104	Polemoniaceae	*Cobaea scandens*	Cobravine	seed	ingestion	snake bite, stomachache	Ingest the seed with water
105	Rubiaceae	*Coffea arabica*	Kape	leaf	decoction	ingestion, diarrhea	Boiled with water and serve as tea
106		*Melanolepis multiglandulosa*	Alom	leaf	paste	cough	Apply around the neck
107	Rutaceae	*Citrofortunella microcarpa*	Agri	fruit	decoction	cough, ringworm	Crushed and filtrate are taken orally
108		*Lunasia amara*	Lunas	bark	decoction	relapse, snake bite	Boiled with water and serve as tea
109	Sapotaceae	*Achras sapota*	Chikos	bark, fruit	decoction	diarrhea, fever	Boiled with water and serve as tea
110		*Atuna racemosa*	Tabon-tabon	root, fruit	decoction,	stomachache, ulcer	Boiled with water and serve as tea
111	Smilacaceae	*Smilax bracteata*	Banag	fruit, roots	decoction	relapse, UTI, nervous breakdown	Crushed and filtrate are taken orally

Volume 3 | Issue 1 | December 2021
PRINT ISSN: 2408-3623 | ONLINE ISSN: 2408 3631

No.	Plant family	Scientific name	Local name	Part used	Treatment process	Disease treated	Mode of application/treatment
112	Solanaceae	*Capsicum frutescens*	Sili	fruit	steam	hemorrhoid	Boiled fruit and drop ice to allow steaming
113		*Datura metel*	Katyubong	leaf	decoction	cough	Boiled with water and serve as tea
114		*Solanum lycopersicum*	Kamatis	fruit	squeeze	toothache	Squeeze the fruit in the affected tooth
115		*Solanum melongena*	Talong	leaf	steam	hemorrhoid	Leaf put on the top of ice cube and put under
116	Thymelaeceae	*Aquilaria malaccensis*	Lapnisan	bark	decoction	cancer	Boiled with water and serve as tea
117	Ulmaceae	*Trema orientalis*	Hanagdung	leaf	paste	wound	Crushed and the filtrate drop in the affected area
118	Urticaceae	*Cypholophus moluccanus*	Handamay	leaf	paste	boils	Crushed and paste in the affected area
119		*Urtica dioica*	Alingatong	roots	decoction	UTI, cancer	Boiled with water and serve as tea
120		*Leucosyke capitellata*	Alangasi	roots, leaves	decoction	head ache, fever	Boiled with water and serve as tea
121	Verbenaceae	*Stachytarpheta jamaicensis*	Elipante	roots	decoction	relapse	Boiled with water and serve as tea
122	Zingiberaceae	*Zingiber officinale*	Luy-a	stem, leaf	decoction	high blood pressure, flatulence, muscle pain, cough	Boiled with water and serve as tea

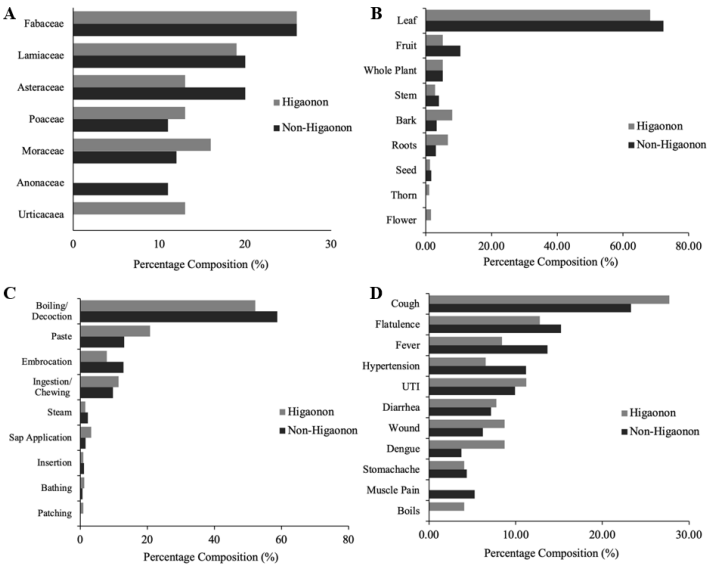

Figure 2. Percentage composition of plant families (A), plant parts used for treatment (B), mode of preparation or application (C), and disease treated of medicinal plants used by Higaonon and non-Higaonons of Sitio Lomboyan, Barangay Guinabsan, Buenavista, Agusan del Norte, Philippines.

of the body. Fresh plant parts were mostly used as medicine and decoction was the usual way of preparing medicinal plants (Arquion et al., 2015).

Decoction consists in treating the chopped vegetal material with a specific volume of water and boiling it. It is generally recommended for roots, rhizomes, bark, stems, hard fruits, seed, and those organs of the plant that have a thicker membrane. Nevertheless, this procedure is also recommended for flowers, leaves, branches, and fruits (Rodino and Butu, 2019).

Disease treated by medicinal plants

In this survey majority of the disease that was

Volume 3 | Issue 1 | December 2021
PRINT ISSN: 2408-3623 | ONLINE ISSN: 2408 3631

mentioned are cough, flatulence, fever, high blood pressure, urinary tract infection (UTI), diarrhea, wound, boils, stomachache, and dengue (Figure 2D).

What is more interesting in the result is that during the COVID-19 pandemic, caused by Coronavirus (CoV) a large family of viruses known to cause illnesses ranging from the common cold to acute respiratory tract infection (Wilder-Smith, 2021). The illnesses have been treated using herbal medicine by the local communities of Sitio Lomboyan, Barangay Guinabsan, Buenavista Agusan del Norte.

Relative frequency of citation

The Relative Frequency of Citation (RFC), distribution, and frequency of usage were also computed. Based on the survey, the non-Higaonon, *Blumea balsamifera*, locally known as sambong, has the highest RFC (0.45) followed by *Origanum vulgare* commonly known as oregano (0.38). This result was comparable to the Higaonons, that *Origanum vulgare* and *Blumea balsamifera* has the highest RFC of (0.37) (Table 3).

Origanum vulgare (oregano) is used as a treatment for cough and fever, abdominal pain, and body pains (Ong and Millow, 2011). Oregano medicine is a relaxant, antibacterial, and can boost the immune system. It is a perennial herb that is commonly grown mostly in the backyards of the non-Higaonon and Higaonon, using this plant as a cure for cough and colds. Many pieces of literature support this medicinal use of oregano for respiratory ailments. The Y'Apayaos, one of the indigenous groups in the province of Cagayan, simply extracted the juice from the leaves and given it as syrup for patients suffering from a cough or cold (Baddu-Verlino and Ouano-Narcitas, 2018).

Another representative species under family Asteraceae is *Blumea balsamifera* (sambong) which has been used as a remedy for cough. Similar studies also pointed out the use of sambong for cough and other ailments such as high blood pressure, headache, renal stones, fever, and rheumatism (Abe and Ohtani, 2013). This plant is also known for treating kidney stones, wounds and cuts, rheumatism, diarrhea, spasms, colds, and coughs and hypertension.

The Y'Apayaos specifically use this medicinal plant, particularly its roots and leaves, for making decoctions to treat fever and flu (Baddu-Verlino and Ouano-Narcitas, 2018).

Interaction Network and Analysis of Similarities

Interaction network analysis (INA) can graphically depict the network relationship of ailments and medicinal plants. Each green node represents either an ailment or plant species recorded from the survey while nodes that are shaded from red to yellow are highly connected regions in the network. Out of 125 species of medicinal plants used by the non-Higaonons and Higaonons, 68 (54.40%) species were found to be commonly used regardless of the ethnolinguistic group. There were 30 (24.00%) and 27 (21.60%) unique species of plants recorded in the non-Higaonon and Higaonon groups, respectively (Figure 3A).

For non-Higaonons, fever was a highly connected ailment to 20 plant species. It is followed by cough (19 species), flatulence (18 species), high blood pressure (16 species), UTI (15 species), relapse (14 species), muscle pain (ten species), and stomachache (ten species). For Higaonons, the node representing cough had the highest connection to 19 species of plants, followed by flatulence (13 species), high blood pressure (13 species), stomachache (11 species), diarrhea (11

Table 3. The rank of utilized plant species with corresponding Relative Frequency of Citation (RFC).

non-Higaonon			Higaonon		
Rank	Species	RFC	Rank	Species	RFC
1	*Blumea balsamifera*	0.45	1	*Blumea balsamifera*	0.37
2	*Origanum vulgare*	0.38		*Origanum vulgare*	0.37
3	*Artemisia vulgaris*	0.37	2	*Artemisia vulgaris*	0.33
	Psidium guajava	0.37		*Moringa oleifera*	0.33
4	*Euphorbia hirta*	0.33	3	*Annona muricata*	0.30
	Moringa oleifera	0.32		*Euphorbia hirta*	0.30
5	*Coleus blumei*	0.27	4	*Coleus blumei*	0.27
				Psidium guajava	0.27
			5	*Jatropha mcvaughii*	0.23

Volume 3 | Issue 1 | December 2021
PRINT ISSN: 2408-3623 | ONLINE ISSN: 2408 3631

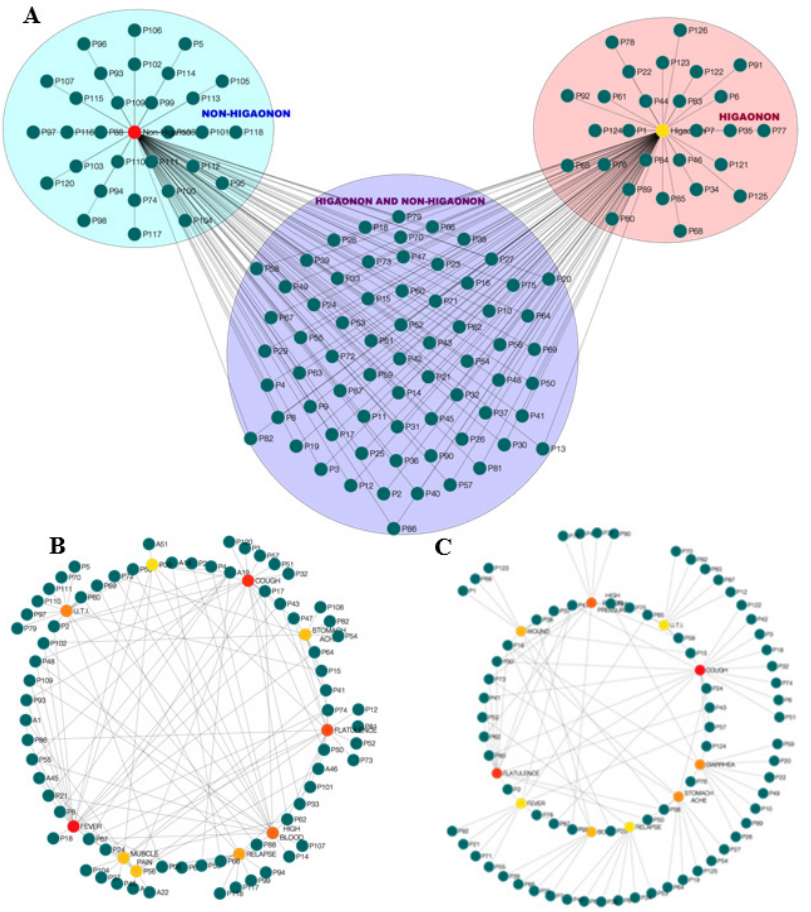

Figure 3. Network relationship of unique and common medicinal plant species (A) and the interrelationship between ailments and medicinal plants of non-Higaonon (B) and Higaonon groups (C).

Ailment coding: A1: air wave; **A2**: anemia; **A3**: anti-rabies; **A4**: arthritis; **A5**: bloat; **A6**: boil; **A7**: cancer; **A8**: canker sore; **A9**: cataract; **A10**: cough; **A11**: dengue; **A12**: deworming; **A13**: diabetes; **A14**: diarrhea; **A15**: facial fungal infection; **A16**: famish; **A17**: fever; **A18**: flatulence; **A19**: flu; **A20**: fracture; **A21**: hangover; **A22**: headache; **A23**: heart disorder; **A24**: hemorrhoid; **A25**: high blood; **A26**: hyperacidity; **A27**: ingestion; **A28**: irregular period; **A29**: lice; **A30**: liver cancer; **A31**: measles; **A32**: muscle pain; **A33**: nervous breakdown; **A34**: numb; **A35**: paralyzed; **A36**: relapse; **A37**: ringworm; **A38**: cysts ; **A39**: skin disease; **A40**: snake bite; **A41**: sore; **A42**: sore eyes; **A43**: spike; **A44**: stomachache; **A45**: stroke; **A46**: thiamine deficiency; **A47**: toothache; **A48**: tuberculosis; **A49**: ulcer; **A50**: UTI; **A51**: varicose veins; **A52**: vomiting; **A53**: vomiting of blood; **A54**: wound **Herbal Plants coding: P1**: *Musa textilis;* **P2**: *Premna odorata;* **P3**: *Citrofortunella microcarpa;* **P4**: *Urtica dioica;* **P5**: *Melanolepis* sp.; **P6**: *Basella alba ;* **P7**: *Ehretia microphylla ;* **P8**: *Cassia alata;* **P9**: *Persea Americana;* **P10**: *Alocasia macrorrhiza;* **P11**: *Ormosia calavensis;* **P12**: *Ficus balete;* **P13**: *Averrhoa carambola ;* **P14**: *Annona muricata;* **P15**: *Psidium guajava ;* **P16**: *Eleusine indica;* **P17**: *Corypha elata;* **P18**: *Merremia peltata;* **P19**: *Kyllinga monocephala;* **P20**: *Lansium domesticum ;* **P21**: *Acmella uliginosa;* **P22**: *Piper betle ;* **P23**: *Theobroma cacao;* **P24**: *Chrysophyllum cainito;* **P25**: *Cobaea scandens;* **P26**: *Scleria scrobiculata;* **P27**: *Durio zibethinus;* **P28**: *Blumea balsamifera;* **P29**: *Ipomoea batatas;* **P30**: *Allium schoenoprasum;* **P31**: *Gmelina arborea;* **P32**: *Jatropha podagrica;* **P33**: *Hibiscus rosa- sinensis;* **P34**: *Ficus minahassae;* **P35**: *Chromolaena odorata;* **P36**: *Cypholophus moluccanus;* **P37**: *Crassula pinnata;* **P38**: *Mimosa pudica ;* **P39**: *Artemisia vulgaris ;* **P40**: *Cananga odorata;* **P41**: *Origanum vulgare;* **P42**: *Plumeria obtuse;* **P43**: *Polyscias guiifoylei ;* **P44**: *Lycopersicon cheesmaniae ;* **P45**: *Moringa oleifera;* **P46**: *Carica papaya ;* **P47**: *Coffea arabica ;* **P48**: *Jatropha mcvaughii;* **P49**: *Datura metel;* **P50**: *Cordyline fruticosa;* **P51**: *Pseudelephantopus spicatus;* **P52**: *Catharanthus roseus;* **P53**: *Desmodium triflorum;* **P54**: *Ficus septica;* **P55**: *Leucosyke capitellata ;* **P56**: *Vitex negundo;* **P57**: *Phyllanthus fraternus ;* **P58**: *Syzgium cumini;* **P59**: *Cocos nucifera ;* **P60**: *Lunasia amara ;* **P61**: *Zingiber officinale ;* **P62**: *Agave Americana;* **P63**: *Swietenia macrophylla;* **P64**: *Mangifera indica;* **P65**: *Muntigia calabura;* **P66**: *Coleus blumei;* **P67**: *Mikania cordifolia;* **P68**: *Artocarpus heterophyllus ;* **P69**: *Pterocarpus indicus;* **P70**: *Abelmoschus esculentus;* **P71**: *Diplazium esculentum;* **P72**: *Tinospora crisoa ;* **P73**: *Homalomena philippinensis;* **P74**: *Allium fistulosum;* **P75**: *Sandroricum koetjape;* **P76**: *Caesalpinia sappan;* **P77**: *Peperomia pellucida;* **P78**: *Psophocarpus tetragonolobus;* **P79**: *Bixa orellana;* **P80**: *Achras sapota;* **P81**: *Tabebuia avellanedae;* **P82**: *Syzygium aqueum;* **P83**: *Cymbopogon citratus;* **P84**: *Euphorbia hirta;* **P85**: *Phaleanopsis stuartiana;* **P86**: *Saccharum offinarum;* **P87**: *Ficus nota;* **P88**: *Eucalyptus globulus;* **P89**: *Bambusa vulgis;* **P90**: *Plectranthus hadiensis;* **P91**: *Hydrocotyle vulgaris;* **P92**: *Arcangelisia flava;* **P93**: *Annona squamosa;* **P94**: *Smilax bracteata;* **P95**: *Saccharum spontaneum;* **P96**: *Imperata cylindrical;* **P97**: *Alstonia scholaris;* **P98**: *Stachytarpheta jamaicensis;* **P99**: *Colocasia esculata;* **P100**: *Ageratum conyzoides;* **P101**: *Flagellaria indica;* **P102**: *Albizia lebbekoides;* **P103**: *Hyptis capitata ;* **P104**: *Anamirta cocculus;* **P105**: *Shorea negrosensis;* **P106**: *Garcinia mangostana ;* **P107**: *Wedelia sp.;* **P108**: *Momordica charantia;* **P109**: *Pandanus amaryllifolius;* **P110**: *Cucumis sativus ;* **P111**: *Corchorus olitorius;* **P112**: *Allium ampeloprasum ;* **P113**: *Capsicum frutescens;* **P114**: *Solanum lycopersicum;* **P115**: *Jatropha gossypifolia;* **P116**: *Vitex parviflora;* **P117**: *Bidens pilosa;* **P118**: *Phyllantus reticulatus;* **P119**: *Musa paradisiaca;* **P120**: *Derris elliptica;* **P121**: *Amaryllis belladonna;* **P122**: *Trema orientalis;* **P123**: *Cinnamomum mercadoi;* **P124**: *Zamioculcas zamiifolia;* **P125**: *Aquilaria malaccensis.*

Volume 3 | Issue 1 | December 2021
PRINT ISSN: 2408-3623 | ONLINE ISSN: 2408 3631

species), wound (ten species), boils (ten species), fever (nine species), UTI (nine species), and relapse (nine species). Some of the plant species were said to cure specific ailments. It is noteworthy that despite the relatively fewer number of plant species recorded from the Higaonons, this ethno-liguistic group had more diverse ailments that can be treated by several plant species (Figure 3B and 3C).

The Analysis of Similarities (ANOSIM) statistic compares the mean of ranked dissimilarities between groups to the mean of ranked dissimilarities within groups. R values that are close to one mean that there are dissimilarities within groups, while R values close to zero means an even distribution of high and low ranks within and between groups. R values below zero means that dissimilarities are higher within groups than between groups (Clarke et al., 2001). ANOSIM between two groups revealed that there are similarities of medicinal plants cited by the two groups (R = 0.051).

Among the plant families, Fabaceae was observed to be the highest percentage composition shared by non-Higaonons and Higaonons, while leaf was commonly used by these groups. Decoction ranked the highest percentage when it comes to the treatment process and cough was the widely treated disease by these medicinal plants. Based on the survey, both groups have sambong (*B. balsamifera*), and oregano (*O. vulgare*) as the highest RFC. In terms of network connection, both groups were similar in connections.

These similarities could be due to the transfer of indigenous information to several generations, regardless of ethnolinguistic group. The two groups share the same knowledge on the usage and other information about the HM, since these groups live together in the same community. Practices on the use of these medicinal plants have been observed in indigenous communities for several decades (Olowa et al., 2012). Fabaceae. Plant parts used for treatment are varied, the majority of which are leaves. The treatment process done used depends on what parts of the plant are being used and what kind of disease to be treated; leaves are the most used plant part as a medicine. Furthermore, decoction from plant leaves remains the most common medicinal plant preparation among them. Cough is the common disease that was noted. The RFC values revealed that sambong (*B. balsamifera* and oregano (*O. vulgare*) are the plants most mentioned used as Herbal Medicines. It is also shown in the Internetwork analysis that diseases such as; diarrhea, relapse, stomachache, flatulence, urinary tract infection, fever, high blood pressure, and cough have the most network connection among the categories for both non-Higaonons and Higaonons. A confirmatory result from ANOSIM shows that there are similarities/no differences between the two groups. Moreover, because the area is far from the city and their access to modern healthcare is limited, most local communities of Sitio Lomboyan, Barangay Guinabsan, Buenavista Agusan del Norte, Philippines still resort to traditional healthcare practices.

However, there is still a need to test the active component of these medicinal plants in terms of their pharmacologic effects, especially the species that were found in the wild and rarely used. Hence, the need for more detailed medicinal plant documentation to help local health care. It also leads to the advancement of alternative medicine programs. This richness of medicinal information's on traditional medicine using plants may be lost unless it is completely passed on to the younger generation or physically recorded as a whole. In line with the government programs and initiatives, recognizing the role of traditional knowledge for potential leads to satisfying the needs of searching for bioactive compounds and future drug discovery, growth, sustainability, and conservation.

4 Conclusions and Recommendations

This study revealed that the medicinal plants used by the local communities of Sitio Lomboyan, Barangay Guinabsan, Buenavista Agusan del Norte, Philippines are rich in plant information on treating different diseases. There are 125 medicinal plants used by Non- Higaonons and Higaonons in Sitio Lomboyan, Barangay Guinabsan, Buenavista, Agusan del Norte, which belong to the family

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Volume 3 | Issue 1 | December 2021
PRINT ISSN: 2408-3623 | ONLINE ISSN: 2408 3631

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Volume 3 | Issue 1 | December 2021
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