Asian Journal of Ethnobiology

| Asian J Ethnobiol | vol. 3 | no. 2 | November 2020 |
| E-ISSN 2580-4510|

Taliwang Grilled Chicken photo by Eslimah

Asian Journal of Ethnobiology

| Asian J Ethnobiol | vol. 3 | no. 2 | November 2020| E-ISSN 2580-4510 |

Published semiannually **PRINTED IN INDONESIA**

E-ISSN: 2580-4510

Asian Journal of Ethnobiology

| Asian J Ethnobiol | vol. 3 | no. 2 | November 2020|

ONLINE
http://smujo.id/aje

e-ISSN
2580-4510

PUBLISHER
Society for Indonesian Biodiversity

CO-PUBLISHER
Universitas Padjadjaran, Sumedang, Indonesia

OFFICE ADDRESS
Department of Biology, Faculty of Mathematics and Natural Sciences, Universitas Padjadjaran. Jl. Raya Bandung-Sumedang Km 21, Jatinangor, Sumedang 45363, West Java, Indonesia. Tel. +62-22-7796412 line 104, Fax. +62-22-7794545, email: aje@smujo.id, asianjethnobiol@gmail.com

PERIOD OF ISSUANCE
May, November

Society for Indonesian Biodiversity

Universitas Padjadjaran Sumedang, Indonesia

Published by Smujo International for The Society for Indonesian Biodiversity and Universitas Padjadjaran Sumedang, Indonesia

GUIDANCE FOR AUTHORS

Aims and Scope *Asian Journal of Ethnobiology* (**Asian J Ethnobiol**) encourages submission of manuscripts dealing with relationships between humans and their biological nature, including ethnobotany, ethnomycology, ethnozymology, ethnozoology, ethnoecology, traditional environmental/ ecological knowledge, ethnometereology, ethnoastronomy, ethnomedicine, ethnopharmacognosy, ethnoveterinary, ethnogastronomy, urban ethnobiology, linguistic ethnobiology, ethical and legal aspects of the biodiversity conservation and other related fields of study within anthropology and biology; as well as impact of economic activity on individuals in community and its social consequences.

Article types The journal seeks original full-length research papers, reviews, and short communication. Manuscript of original research should be written in no more than 8,000 words (including tables and picture), or proportional with articles in this publication number. Review articles will be accommodated, while, short communication should be written at least 2,000 words, except for pre-study.

Submission The journal only accepts online submission through system or email to the editors at **asianjebse@gmail.com**. Submitted manuscripts should be the original works of the author(s). The manuscript must be accompanied by a cover letter containing the article title, the first name and last name of all the authors, a paragraph describing the claimed novelty of the findings versus current knowledge. Submission of a manuscript implies that the submitted work has not been published before (except as part of a thesis or report, or abstract); and is not being considered for publication elsewhere. When a manuscript written by a group, all authors should read and approve the final version of the submitted manuscript and its revision; and agree the submission of manuscripts for this journal. All authors should have made substantial contributions to the concept and design of the research, acquisition of the data and its analysis; drafting of the manuscript and correcting of the revision. All authors must be responsible for the quality, accuracy, and ethics of the work.

Acceptance The only articles written in English (U.S. English) are accepted for publication. Manuscripts will be reviewed by editors and invited reviewers (double blind review) according to their disciplines. Authors will generally be notified of acceptance, rejection, or need for revision within 1 to 2 months of receipt. The manuscript is rejected if the content does not in line with the journal scope, does not meet the standard quality, inappropriate format, complicated grammar, dishonesty (i.e. plagiarism, duplicate publications, fabrication of data, citations manipulation, etc.), or ignoring correspondence in three months. The primary criteria for publication are scientific quality and biodiversity significance. **Uncorrected proofs** will be sent to the corresponding author as *.doc* or *.rtf* files for checking and correcting of typographical errors. To avoid delay in publication, corrected proofs should be returned in 7 days. The accepted papers will be published online in a chronological order at any time, but printed in May and November.

Ethics Author(s) must obedient to the law and/or ethics in treating the object of research and pay attention to the legality of material sources and intellectual property rights.

Copyright If and when the manuscript is accepted for publication, the author(s) still hold the copyright and retain publishing rights without restrictions. Authors or others are allowed to multiply article as long as not for commercial purposes. For the new invention, authors are suggested to manage its patent before published.

Open access The journal is committed to free-open access that does not charge readers or their institutions for access. Readers are entitled to read, download, copy, distribute, print, search, or link to the full texts of articles, as long as not for commercial purposes. The license type is CC-BY-NC-SA.

A charge The journal is committed to free of charge for submission and publication of non-institutional funded research (waiver).

Reprints The sample journal reprint is only available by special request. Additional copies may be purchased when ordering by sending back the uncorrected proofs by email.

Manuscript preparation Manuscript is typed on A4 (210x297 mm^2) paper size, **in a single column**, single space, 10-point (10 pt) Times New Roman font. The margin text is 3 cm from the top, 2 cm from the bottom, and 1.8 cm from the left and right. Smaller lettering size can be applied in presenting table and figure (9 pt). Word processing program or additional software can be used, however, it must be PC compatible and Microsoft Word based (*.doc* or *.rtf*; **not *.docx***). **Scientific names** of species (incl. subspecies, variety, etc.) should be written in italic, except for italic sentence. Scientific name (genera, species, author), and cultivar or strain should be mentioned completely for the first time mentioning it in the body text, especially for taxonomic manuscripts. Name of genera can be shortened after first mentioning, except generating confusion. Name of the author can be eliminated after first mentioning. For example, *Rhizopus oryzae* L. UICC 524, hereinafter can be written as *R. oryzae* UICC 524. Using trivial name should be avoided, otherwise generating confusion. **Biochemical and chemical nomenclature** should follow the order of the IUPAC - IUB. For DNA sequence, it is better used Courier New font. Symbols of standard chemical and abbreviation of chemistry name can be applied for common and clear used, for example, completely written butilic hydroxyl toluene (BHT) to be BHT herein after. **Metric measurement** use IS denomination, usage other system should follow the value of equivalent with the denomination of IS first mentioning. Abbreviations set of, like g, mg, mL, etc. do not follow by dot. Minus index (m^{-2}, L^{-1}, h^{-1}) suggested to be used, except in things like "per-plant" or "per-plot". **Equation of mathematics** does not always can be written down in one column with text, in that case can be written separately. **Number** one to ten are expressed with words, except if it relates to measurement, while values above them written in number, except in early sentence. The fraction should be expressed in decimal. In the text, it should be used "%" rather than "percent". Avoid expressing ideas with complicated sentence and verbiage, and used efficient and effective sentence.

Title of the article should be written in compact, clear, and informative sentence, preferably not more than 20 words. Name of author(s) should be completely written. **Name and institution** address should also be completely written with street name and number (location), postal code, telephone number (O), facsimile number (O), and personal email address. For Indonesian universities, use local name. Manuscript written by a group, author for correspondence along with address is required. First page of the manuscript is used for writing above information.

Abstract should not be more than 200 words. **Keywords** is about five words, covering scientific and local name (if any), research theme, and special methods which used; and sorted from A to Z. All important **abbreviations** must be defined at their first mention. **Running title** is about five words. **Introduction** is about 400-600 words, covering the background and aims of the research. **Materials and Methods** should emphasize on the procedures and data analysis. **Results and Discussion** should be written as a series of connecting sentences, however, for manuscript with long discussion should be divided into subtitles. Thorough discussion represents the causal effect mainly explains for why and how the results of the research were taken place, and do not only re-express the mentioned results in the form of sentences. **Concluding** sentence should be given at the end of the discussion. **Acknowledgments** are expressed in a brief; all sources of institutional, private and corporate financial support for the work must be fully acknowledged, and any potential conflicts of interest are noted.

Figures and Tables of maximum of three pages should be clearly presented. Title of a picture is written down below the picture, while title of a table is written above the table. Colored figures can only be accepted if the information in the manuscript can lose without those images; chart is preferred to use black and white images. Author could consign any picture or photo for the front cover, although it does not print in the manuscript. All images property of others should be mentioned source. **There is no appendix**, all data or data analysis are incorporated into Results and Discussions. For broad data, it can be displayed on the website as a supplement.

References Author-year citations are required. In the text give the authors name followed by the year of publication and arrange from oldest to newest and from A to Z. In citing an article written by two authors, both of them should be mentioned, however, for three and more authors only the first author is mentioned followed by et al., for example: Saharjo and Nurhayati (2006) or (Boonkerd 2003a, b, c; Sugiyarto 2004; El-Bana and Nijs 2005; Balagadde et al. 2008; Webb et al. 2008). Extent citation as shown with word "*cit*" should be avoided. Reference to unpublished data and personal communication should not appear in the list but should be cited in the text only (e.g., Rifai MA 2007, pers. com. (personal communication); Setyawan AD 2007, unpublished data). In the reference list, the references should be listed in an alphabetical order (better, if only 20 for research papers). Names of journals should be abbreviated. Always use the standard abbreviation of a journal's name according to the **ISSN List of Title Word Abbreviations** (www.issn.org/2-22661-LTWA-online.php). The following examples are for guidance.

Journal:

Saharjo BH, Nurhayati AD. 2006. Domination and composition structure change at hemic peat natural regeneration following burning; a case study in Pelalawan, Riau Province. Biodiversitas 7: 154-158.

Book:

Rai MK, Carpinella C. 2006. Naturally Occurring Bioactive Compounds. Elsevier, Amsterdam.

Chapter in book:

Webb CO, Cannon CH, Davies SJ. 2008. Ecological organization, biogeography, and the phylogenetic structure of rainforest tree communities. In: Carson W, Schnitzer S (eds) Tropical Forest Community Ecology. Wiley-Blackwell, New York.

Abstract:

Assaeed AM. 2007. Seed production and dispersal of *Rhazya stricta*. 50th Annual Symposium of the International Association for Vegetation Science, Swansea, UK, 23-27 July 2007.

Proceeding:

Alikodra HS. 2000. Biodiversity for development of local autonomous government. In: Setyawan AD, Sutarno (eds.) Toward Mount Lawu National Park; Proceeding of National Seminary and Workshop on Biodiversity Conservation to Protect and Save Germplasm in Java Island. Universitas Sebelas Maret, Surakarta, 17-20 July 2000. [Indonesian]

Thesis, Dissertation:

Sugiyarto. 2004. Soil Macro-invertebrates Diversity and Inter-Cropping Plants Productivity in Agroforestry System based on Sengon. [Dissertation]. Universitas Brawijaya, Malang. [Indonesian]

Information from internet:

Balagadde FK, Song H, Ozaki J, Collins CH, Barnet M, Arnold FH, Quake SR, You L. 2008. A synthetic *Escherichia coli* predator-prey ecosystem. Mol Syst Biol 4: 187. www.molecularsystemsbiology.com. DOI:10.1038/msb.2008.24

THIS PAGE INTENTIONALLY LEFT BLANK

ASIAN JOURNAL OF ETHNOBIOLOGY
Volume 3, Number 2, November 2020
Pages: 41-50

E-ISSN: 2580-4537
DOI: 10.13057/asianjethnobiol/y030201

Ritual plants used by the Manobo tribe of Surigao del Sur, Philippines

JAKE KEITH ADRIAN M. JAMERA[1], MUHMIN MICHAEL E. MANTING[1], MARK LLOYD G. DAPAR[2,♥]

[1]Department of Biological Sciences, College of Science and Mathematics, Mindanao State University-Iligan Institute of Technology, 9200 Iligan City, Lanao del Norte, Philippines

[2]The Graduate School and Research Center for the Natural and Applied Sciences, University of Santo Tomas, España Boulevard, 1015 Manila, Philippines. ♥email: marklloyd.dapar.gs@ust.edu.ph

Manuscript received: 11 August 2020. Revision accepted: 12 September 2020.

Abstract. *Jamera JKAM, Manting MME, Dapar MLG. 2020. Ritual plants used by the Manobo tribe of Surigao del Sur, Philippines. Asian J Ethnobiol 3: 41-50.* Manobo tribe is culturally rich in traditional practices, medicinal uses, diversity, and traditional knowledge based on their community plant resources. They dwell in hinterlands and mountainous regions in the southern part of the Philippines and live an intricate life dependent on agriculture and forest plants. Traditional ecological knowledge and beliefs of indigenous peoples play an essential role in biodiversity conservation. This study seeks to investigate the use of ritual plants of the Manobo tribe in Hinapuyan, Carmen and Cabangahan, Cantilan, Surigao del Sur, and to identify the availability of ritual plants being used. Plant information with the local name, plant parts used, methods of preparation, ritual uses, and the Cultural Importance Index (CI) were quantified. This study documented a total of 12 traditional rituals associated with ritual plants. The five identified plant species are used in tribal rituals belonging to four different families: Arecaceae, Piperaceae, Poaceae, and Solanaceae. Arecaceae includes two species, while one species represents each of the families. Ritual plants with the highest CI were *Areca catechu* L., *Piper betle* L., and *Nicotiana tabacum* L. Manobo ritual plants have a symbolic meaning and rational function. This study is the first documentation of ritual plants presenting traditional ecological knowledge and cultural beliefs that must be saved to maintain biological diversity. The tribe cultivated some ritual plants and their wild plant collection in the village yard. These ritual plants are conserved and protected by the Manobo community. More investigations are recommended on the ritual plants used among diverse ethnolinguistic groups in the Philippines and other countries.

Keywords: Beliefs and Practices, cultural importance index, ethnobotany, Manobo, ritual plants

INTRODUCTION

Plants are used in many ways by various cultural communities generally for healthcare practices and medicinal uses in the Philippines (Dapar and Demayo 2017; Dapar et al. 2018; Abdulaziz et al. 2019; Añides et al. 2019; Dela Peña et al. 2019; Nadayag et al. 2019; Uy et al. 2019). Apart from medicinal uses and therapy, plants are also utilized in rituals or magical purposes (Abbink 1995; Quiroz et al. 2016). Ritual serves as a traditional practice, which marks the cultural identity of a particular indigenous group through prayers and worship to their deities, gods, and goddesses for protection, thanksgiving, and betterment of human life. Rituals are part of worshipping gods and goddesses on various occasions, from birth to mourning death (Sharma and Pegu 2011). Ritual plants have symbolic meaning and rational functions in diverse ethnicity, religions, and beliefs of people and indigenous groups (Hariyadi and Ticktin 2012; Iskandar and Iskandar 2017; Erawan et al. 2018).

In the Philippines, the largest indigenous groups of the Manobo tribe practice rituals as an integral part of their culture. Ritual observations are the significant practice of Manobo culture in asking permission and approval from their deities in any activities in their ancestral lands and indigenous territories (Dapar et al. 2020b, 2020c). Agusan Manobo healers practice ritual prayers to increase the healing potential of their herbal medicines and some other purposes (Dapar et al. 2020b). Agusan Manobo often passes their traditional system to the next generation through verbal communication (Dapar et al. 2020b; 2020c). Manobo tribe is one of the largest indigenous groups of people on the island of Mindanao, Philippines, including the tribe of Surigao Manobo in the province of Surigao. The word *Manobo* came from "mansuba," meaning man, and "suba," meaning river (Felix 2004), which means river people (Dapar et al. 2020a). Manobo settlers occupied Mindanao's mountain regions and hinterlands in the northernmost part along rivers, valleys, and swamps. Manobo people are concentrated in Agusan, Bukidnon, Cotabato, Davao, Misamis Oriental, and Surigao del Sur (De Jong 2010).

Most indigenous peoples (IPs) use plants for their culture, especially in performing rituals. Indigenous Cultural Communities/Indigenous Peoples (ICCs/IPs) performing rituals typically use plants associated with their beliefs and practices. Various plant parts or whole plants can be used for rituals and ceremonies. Conservation strategies are efficient with the combined information in consideration and understanding of ritual practices of tribal communities (Geng et al., 2017). Ritual beliefs of the indigenous people are essential information in understanding the local community practices and conservation of biodiversity. Some of the problems that the indigenous people face nowadays are the biodiversity crisis and the possible loss of indigenous knowledge (Dapar et al.

2020d, 2020e). Unlike the numerous healers from previous generations, few plant experts (tribal healers) remained among the Manobo communities. Hence, this situation calls to save indigenous knowledge and traditional culture to increase awareness on the conservation of indigenous ritual plants.

With this realization, this study seeks information about ritual plants used by the Surigao Manobo for a specific cultural purpose and traditional rite of passage from childhood to adulthood, social preparations, and other occasions.

MATERIALS AND METHODS

Study area

The fieldwork was conducted in the selected barangays (villages), namely Hinapuyan in Carmen and Cabangahan in Cantilan of Surigao del Sur, as shown in Figure 1. Carmen is a fifth-class municipality in the province of Surigao del Sur with coordinates 9° 12'6.48" N, 125° 58'50.16" E. It is politically subdivided into nine barangays which include barangay Hinapuyan. Cantilan is another municipality of Surigao del Sur, considered the "Cradle of Towns" in the province located in the coordinates 9° 16'58.08" N, 125° 56'31.92" E.

Field survey

This study was initiated by securing free prior informed consent of the Manobo community before conducting a field survey. Key informants were interviewed together with the Manobo healers and tribal chieftain. Data were collected through a questionnaire using Bradacs (2008) from Hinapuyan, Carmen, and Cabangahan, Cantilan in Surigao del Sur. The obtained information was compared and cross-linked to ascertain their validity and integrity. Photographs of plants were taken for identification with taxonomic keys and verified using the updated Co's Digital Flora of the Philippines (Pelser et al. 2011 onwards).

Data analysis

Cultural Importance Index (CI) was applied to determine the cultural significance of plant species in each locality. It is calculated using this formula CI = (ΣUR)/N, as the summation of the use report (UR) in every use category mentioned for a species in the locality divided by the number of participants (N) in that locality (Tardío and Pardo-de-Santayana 2008).

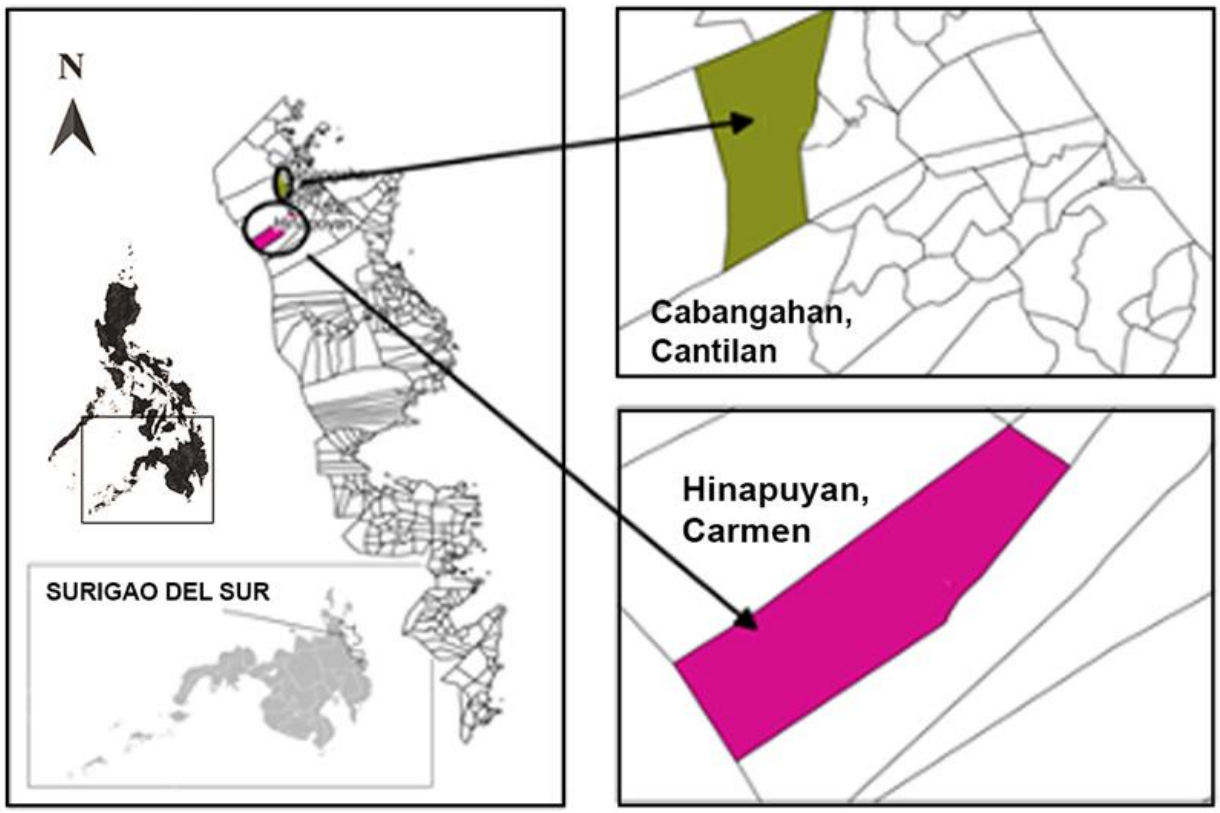

Figure 1. Location map of Bayugan City (middle and right, outlined in red), Agusan del Sur (left, outlined in black), Philippines

RESULTS AND DISCUSSION

Manobo rituals plants

A total of five plant species were used in 12 Manobo rituals belonging to four different families, namely Arecaceae, Piperaceae, Poaceae, and Solanaceae (Table 1). Results showed that three species have the highest CI values of 1.0, namely *Areca catechu* L., *Piper betle* L., and *Nicotiana tabacum* L.; and followed by *Cocos nucifera* L. (0.92) and *Oryza sativa* L. (0.50). Plant information with its local name, plant part used, preparation method, ritual uses, and Cultural Importance Index (CI) were presented. Manobo terms and rituals are summarized in Table 2.

Table 3 presents the different rituals corresponding to the plant families and the number of ritual plants. Ritual for the sick "Binuyahan" depending on how critically ill the person is together with three other rituals known as "Panawagtawag" ritual for harvest, "Pagmaan" ritual for building a house, and "Tagun-un" ritual for baptism. These rituals need three plant families: Arecaceae, Piperaceae, and Solanaceae. The ritual for repentance "Tampoda," the ritual for the wedding "Kumbiti," the ritual for forgiveness "Boneh," the ritual for the full-moon festival "Kahimonan," the ritual for birth "Limpasan," and ritual practice for burial "Uyagdok" utilize of four plant families, namely Arecaceae, Piperaceae, Poaceae, and Solanaceae.

Table 1. Ritual plants used by Manobo tribe in Hinapuyan, Carmen and Cabangahan, Cantilan Surigao del Sur, Philippines

Family and scientific name	Common name	Manobo name	Plant part used	Method of preparation	Habit of growth	Availability of the plant	Source of collection	Cultural importance value
Arecaceae								
Areca catechu L.	Nut Palm; Bujo	Mama/ Bunga	Fruit	Wrapped together with "bujo" leaves	Palm	Rare	Wild	1.00
Cocos nucifera L.	Coconut	Lubi	Young Leaves	Obtained directly	Palm	Common	Cultivated or Wild	0.92
Piperaceae								
Piper betle L.	Betel	Bujo	Leaves	Wrapped together with "mama" fruit	Vine	Rare	Wild	1.00
Poaceae								
Oryza sativa L.	Rice	Bugas	Fruit or Seed	Cooked or uncooked	Grass	Common	Cultivated	0.50
Solanaceae								
Nicotiana tabacum L.	Tobacco	Tabako	Leaves	Dried	Herb	Rare	Wild	1.00

Table 2. Definition of local terms

Manobo terms and rituals	Meaning of terms and rituals
Baylan	Manobo tribe healer
Boneh	Ritual for forgiveness
Gilamat	Deceived by the illusion or charmed by the spirits
Kahimonan	Manobo term for their full-moon festival
Kumbiti	Ritual term for wedding
Lala	Extremely severe sickness
Limpasan	Ritual term for birth
Mahal	Severe sickness
Mamaid	Ritual for asking permission to enter the forest
Pagmaan	Ritual term for house building
Pamebag	Ritual for barrier
Panawagtawag	Ritual term for thanksgiving for the harvest
Tagun-un	Ritual for baptism
Tampoda	Ritual term for repentance
Uyagdok	Ritual term for burial

Table 3. Different rituals and ritual plants used

Ritual description	Local ritual name	Family	Scientific name
Ritual for healing	*Binuyahan*	Arecaceae	*Areca catechu* L., *Cocos nucifera* L.
		Piperaceae	*Piper betle* L.
		Solanaceae	*Nicotiana tabacum* L.
Ritual for repentance	*Tampoda*	Arecaceae	*Areca catechu* L., *Cocos nucifera* L.
		Piperaceae	*Piper betle* L.
		Solanaceae	*Nicotiana tabacum* L.
		Poaceae	*Oryza sativa* L.
Ritual for wedding	*Kumbiti*	Arecaceae	*Areca catechu* L., *Cocos nucifera* L.
		Piperaceae	*Piper betle* L.
		Solanaceae	*Nicotiana tabacum* L.
		Poaceae	*Oryza sativa* L.
Asking permission to enter the forest	*Mamaid*	Arecaceae	*Areca catechu* L., *Cocos nucifera* L.
		Piperaceae	*Piper betle* L.
		Solanaceae	*Nicotiana tabacum* L.
		Poaceae	*Oryza sativa* L.
Thanksgiving for the harvest	*Panawagtawag*	Arecaceae	*Areca catechu* L., *Cocos nucifera* L.
		Piperaceae	*Piper betle* L.
		Solanaceae	*Nicotiana tabacum* L.
House building	*Pagmaan*	Arecaceae	*Areca catechu* L., *Cocos nucifera* L.
		Piperaceae	*Piper betle* L.
		Solanaceae	*Nicotiana tabacum* L.
		Poaceae	*Oryza sativa* L.
Ritual for barrier	*Pamebag*	Arecaceae	*Areca catechu* L.
		Piperaceae	*Piper betle* L.
		Solanaceae	*Nicotiana tabacum* L.
Ritual for baptism	*Tagun-un*	Arecaceae	*Areca catechu* L., *Cocos nucifera* L.
		Piperaceae	*Piper betle* L.
		Solanaceae	*Nicotiana tabacum* L.
Ritual for forgiveness	*Boneh*	Arecaceae	*Areca catechu* L., *Cocos nucifera* L.
		Piperaceae	*Piper betle* L.
		Solanaceae	*Nicotiana tabacum* L.
		Poaceae	*Oryza sativa* L.
Full moon festival	*Kahimunan*	Arecaceae	*Areca catechu* L., *Cocos nucifera* L.
		Piperaceae	*Piper betle* L.
		Solanaceae	*Nicotiana tabacum* L.
		Poaceae	*Oryza sativa* L.
Ritual for birth	*Limpasan*	Arecaceae	*Areca catechu* L., *Cocos nucifera* L.
		Piperaceae	*Piper betle* L.
		Solanaceae	*Nicotiana tabacum* L.
Ritual for burial	*Uyagdok*	Arecaceae	*Areca catechu* L., *Cocos nucifera* L.
		Piperaceae	*Piper betle* L.
		Solanaceae	*Nicotiana tabacum* L.

12 Manobo tribe rituals in Surigao del Sur, Philippines

Based on ritual observation among the Manobo tribe in the province, this cultural practice is strongly associated with their traditional knowledge and beliefs of their god, deities, and spirits. All foods prepared during rituals are cooked, shared, and eaten by members of the tribe. Ritual foods will be separated like a part of a chicken and a bowl of *Oryza sativa*, including the ritual plants *A. catechu* and *P. betle* to be taken home. These cultural practices and tribal activities are based on supernaturalism (Figure 2 A-O). These rituals are often practiced on specific occasions and purposes as follows:

Ritual for healing Binuyahan

Binuyahan is culturally practiced for a sick person (Figure 2A–D). This ritual is categorized on how critically ill a person is into the following categories:

If the illness is mild "barato," the tribal healer will prepare the ripe fruit of *A. catechu* wrapped together with *P. betle* leaves, dried leaves of *N. tabacum*, and a bottle of local wine placed on a small platform. Then it will be followed by the shedding of blood from a red native chicken "sunoy." Then, the healer begins to pray.

If the illness is severe, they will do the "mahal," the ritual outside the sick person's house. The Manobo healer "baylan" will prepare the ripe fruit of *A. catechu* "mama" wrapped together with *P. betle* "bujo" leaves, dried leaves of *N. tabacum* "tabako," and with a bottle of local wine "vino kulafu." These are all placed on a small platform decorated with an arc form of young leaves of *C. nucifera* L. "lubi." Then, the prayer of the healer begins.

If the illness is such severe "lala," the tribal healer will prepare the ripe fruit of *A. catechu* wrapped together with *P. betle* leaves, dried leaves of *N. tabacum*, and a bottle of local wine placed on a small platform. The healer begins the prayer of the ritual, and while doing so, he will prepare a bowl that contains the *A. catechu* and *P. betle* then to be shed by the blood of a pig "baboy" (any color) placed above the head of the sick person. The ill person will be observed on the following day if they become better; therefore, it is an effect of enchantment. Otherwise, there is none.

If the illness is really severe, the "mawala sa kalibutan" or "gilamat" ritual is held inside the sick person's house. The healer will prepare the ripe fruit of *A. catechu* wrapped together with *P. betle* leaves and dried leaves of *N. tabacum*, placed on a small platform. When the ritual begins, the healer lays down beside the sick person and sings a Manobo ritual song, "tud-om," until the ill person falls asleep. The healer will sleep with the ill person and bring back the spirit or body parts through dreams or vision. The healing process will be successful if the healer can get around any parts of the ill person's body; otherwise, the sick person will die.

Ritual for repentance Tampoda

This ritual for repentance is being held outside the victim's house (Figure 2E). The healer will prepare the ripe fruit of *A. catechu* wrapped together with *P. betle* leaves and dried leaves of *N. tabacum*, and uncooked rice *Oryza sativa* L. "bugas." This preparation is placed on a small platform decorated with an arc form of young leaves of *C. nucifera* and a minimum of 100 kg of the white pig as provided by the one who committed the crime. If a white pig is unavailable, the perpetrator will still search for a wild boar "baboy halas" or a wild chicken "katihan" instead. When all these are prepared, the plaintiff family of the member will stab the offered animal several times to forgive the perpetrator.

Ritual for wedding Kumbiti

Along with this ritual is the culture and tradition of the Manobo tribe in asking permission of a man to the parents of the woman he wants to marry, given that his courtship lasted for five years (Figure 2F). If the parents agree, they will prepare the ripe fruit of *A. catechu* wrapped together with *P. betle* leaves and dried leaves of *N. tabacum*, and a cooked rice *O. sativa*. These are placed on a small platform decorated with an arc form of young leaves of *C. nucifera*. The ethnic communities will be invited, and they will prepare five pigs to be sacrificed as ritual offerings to their deities. At the end of the ritual, the couple will squeeze the rice with their hands and eat it.

Asking permission to enter the forest Mamaid

Mamaid is a ritual to ask permission to enter the forest (Figure 2G). This ritual is being held inside or within the house. The ritual starts by preparing a white plate containing the ripe fruit of *A. catechu* wrapped together with *P. betle* leaves, *N. tabacum*, uncooked rice *O. sativa*, and other offerings like money (coins) or candies. The healer starts praying, and the three ritual plants are being poured by the blood of a native chicken (any color). This ritual is performed to ensure the security of the person while entering the forest and to return home safely.

Thanksgiving for the harvest Panawagtawag

This ritual has three stages: before cleaning the area or field, before planting, and before harvesting (Figure 2H). The ceremony is held outside and starts by placing the ripe fruit of *A. catechu* wrapped together with *P. betle* leaves, dried leaves of *N. tabacum*, and a bottle of local wine on a small platform decorated with an arc form of young leaves of *C. nucifera*. This ritual is observed to safeguard the person or family while cleaning the area, to have bountiful crops before planting, and to give thanks for the good harvest and a successful season.

House building ritual Pagmaan

During the ritual, the healer will invoke prayers and offering to the mythical creatures and ask the gods to leave because people will reside in the area (Figure 2I). The healer prepared the ritual plants like the ripe fruit of *A. catechu* wrapped together with *P. betle* leaves, dried leaves of *N. tabacum*, and a bottle of local wine on a small platform decorated with an arc form of young leaves of *C. nucifera*. The ritual is performed as an offering to the mythical creatures to exchange the place and safety.

Ritual for barrier Pamebag

This ritual is performed to hinder any illness or lousy spirit from coming in for peoples' safety (Figure 2J). It is believed that the offering serves as a wall or barrier for the community healthcare system. The healer, including the tribal community, prepares the ritual plants such as the ripe fruit of *A. catechu* wrapped together with *P. betle* leaves, dried leaves of *N. tabacum*, and uncooked *O. sativa* and with a bottle of local wine along with the food offerings across the road.

Ritual for baptism Tagun-un

Tagun-un is a ritual for the baptism of a child (Figure 2K). This ritual will be held inside the house. The healer prepared the ritual plants like the ripe fruit of *A. catechu* wrapped together with *P. betle* leaves, dried leaves of *N. tabacum*, and a bottle of local wine on a small platform decorated with an arc form of young leaves of *C. nucifera*. During the ritual, the healer starts praying that the child will live a healthy life, guided by their gods to do good and avoid evil.

Ritual for forgiveness Boneh

Boneh is a ritual for forgiveness (Figure 2L). This ritual will be held outside the house. The Manobo healer will

prepare the ripe fruit of *A. catechu* wrapped together with *P. betle* leaves, uncooked *O. sativa*, and dried leaves of *N. tabacum*. These are placed in a small platform decorated with an arc form of young leaves of *C. nucifera* and a minimum of 100 kilograms (white pig) given by the one who committed the crime. Also, the one who committed the crime will provide anything that the victim wants, and when all these are ready, the ritual starts, the family of the member will stab the offered animal many times. Through this, the one who committed the crime will be forgiven.

Ritual for full-moon festival Kahimonan

All tribal communities are invited to celebrate the full-moon festival (Figure 2M). The healer prepares the ripe fruit of *A. catechu* wrapped together with *P. betle* leaves and dried leaves of *N. tabacum*, and uncooked *O. sativa* placed in a small platform decorated with an arc form of young leaves of *C. nucifera*. The healer starts praying, and the four ritual plants are to be shed with the blood of a pig (any color). After the ritual, the celebration begins with the music of drums "gembe" and the singing of their ritual song "tud-om." Everybody will dance until morning. This ritual is done every month or during harvest time.

Ritual for birth Limpasan

Limpasan is a ritual for birth (Figure 2N). This ritual will be held inside the house. The healer prepared the ritual plants like the ripe fruit of *A. catechu* wrapped together with *P. betle* L. leaves and dried leaves of *N. tabacum* on a small platform decorated with an arc form of young leaves of *C. nucifera*. The healer starts the ritual with a chicken (any color) sacrificed, and blood will be shed near the mother's stomach. It is believed that the violence committed by the parents will be cleansed.

Ritual for burial Uyagdok

Uyagdok is a ritual for burial that will be held outside the house (Figure 2O). The ritual plants are prepared by the healer like the ripe fruit of *A. catechu* wrapped together with *P. betle* leaves, dried leaves of *Nicotiana tabacum*, and with a bottle of local wine and candles (any color) on a small platform decorated with an arc form of young leaves of *C. nucifera*. The healer starts praying, and the four ritual plants are to be shed with the blood of a native chicken (red) and try to call out a mythical creature, "abyan," to guide the spirit of the dead to their journey. The dead body will be buried at their burial ground within the ethnic community, and the healer will lead prayers.

Characteristics of ritual plants

Arecaceae family is represented with two species, while other families are composed of only one species. The CI index accounts for the number of informants and uses and the plant species' worth (Tardio and Pardo-de-Santayana 2008), making it a proficient tool to show which plant species have high-frequency usage. The plant families with high-frequency use were the Arecaceae, Piperaceae, and Solanaceae.

Figure 2 presents the habit of the ritual plants of the Manobo tribe. It shows that the tree and herb have the highest percentage (37%), followed by the vine (26%). According to Dapar et al. (2020a), the Manobo tribe depends mainly on plants because they believe that using plants in their rituals will strengthen their belief and aid their relationship with the environment. It becomes their way of giving back to nature by conserving their community plant resources.

The availability of the plants is categorized into two as common or rare depending on the commonality or abundance of species in the area (Figure 3). Two ritual plants were identified as 'common' (60%) in the area, such as *Cocos nucifera* and *Oryza sativa*. Identified rare plants (40%) were *Areca catechu*, *Piper betle*, and *Nicotiana tabacum*, as these plants can be obtained in the wild and mountain areas distant from their barangays (villages).

Figure 4 shows the percentage of plant parts used by the Manobo tribe in their rituals. Two fruits are being used (40%) from *A. catechu* and *O. sativa*, while three leaves (60%) are being used from *P. betle*, *N. tabacum*, and *C. nucifera* (young ones). Of all the plant parts used for rituals, the leaves are the most important and frequently utilized since leaves are easily accessible than other plant parts. The tribe believes that leaves are more valuable than any other part of the plant, essential for plant survival. Most of the Manobo ritual plants are obtained from the wild having three species (60%), followed by a cultivated species (20%), and a species obtained in both (20%), as shown in Figure 5. The source of Manobo ritual plants is primarily wild, just like their medicinal plants, as documented by Dapar et al. (2020a).

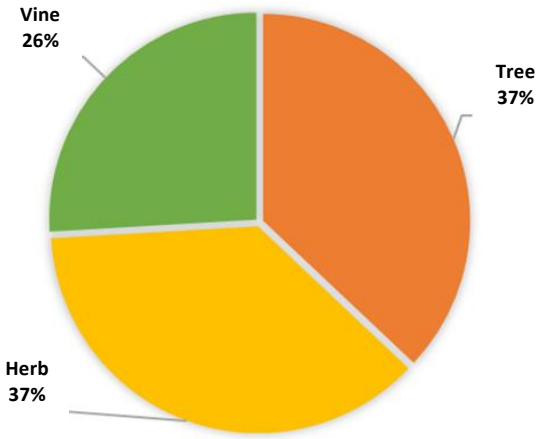

Figure 2. Percentage of the habit of the ritual plants

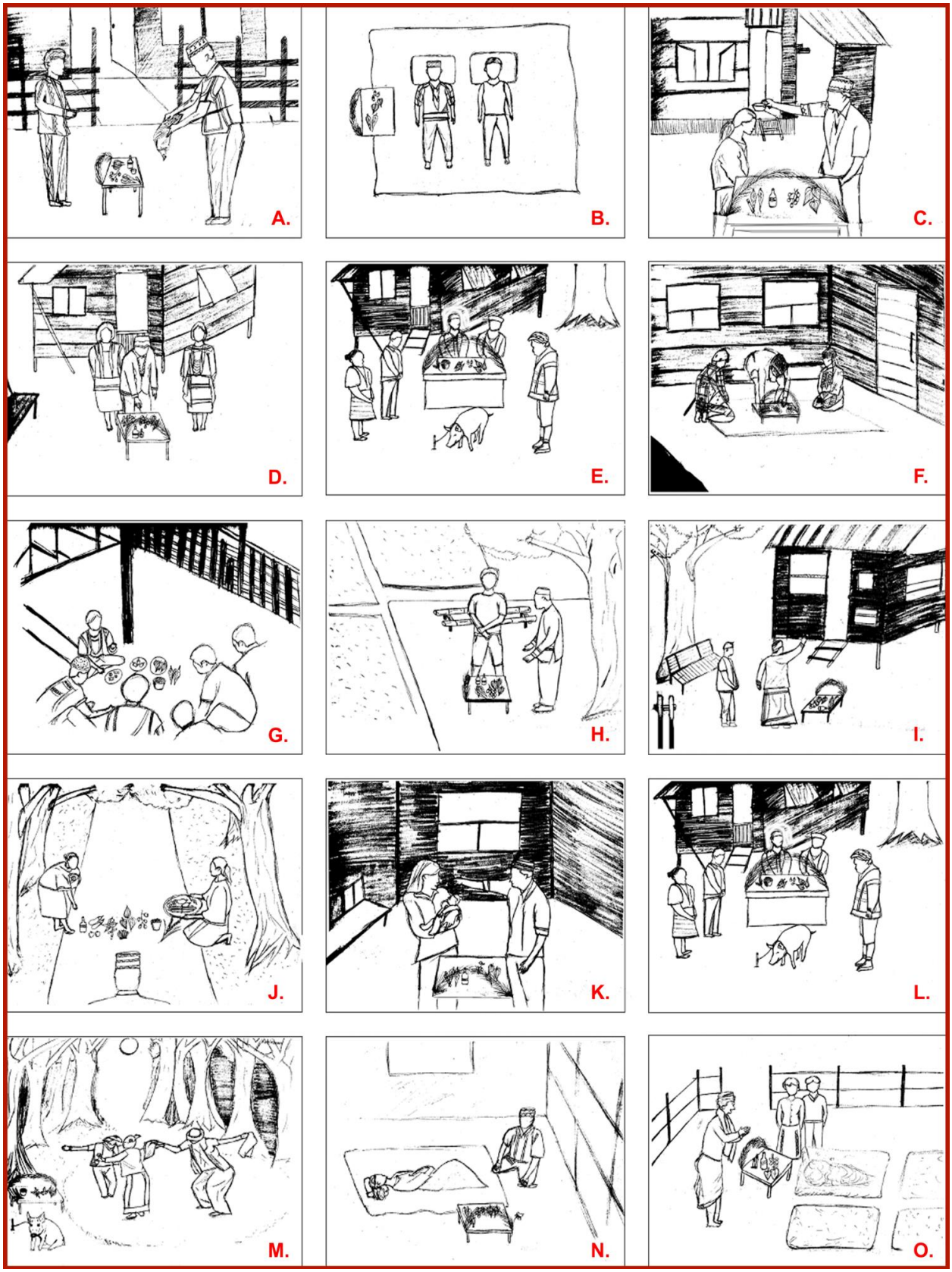

Figure 2. The 12 rituals of the Manobo tribe in Surigao del Sur, Philippines. "Binuyahan" ritual for healing: if the illness is mild "barato" (A); if the disease is highly severe "gilamat" (B); if the disease is severe "lala" (C) or "mahal" (D). Other rituals: for repentance "tampoda" (E); for the wedding "kumbiti" (F); for asking permission to enter the forest "mamaid" (G); for thanksgiving of harvest "panawagtawag" (H); for building house "pagmaan" (I); for barrier "pamebag" (J); for baptism "tagun-un" (K); for forgiveness "boneh" (L); for the full-moon festival "kahimonan" (M); for birth "limpasan" (N); and for burial "uyagdok" (O). Illustration by JKAM Jamera

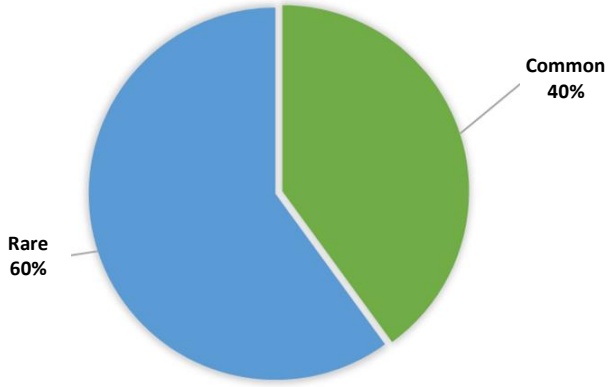

Figure 3. Percentage of the availability of the ritual plants

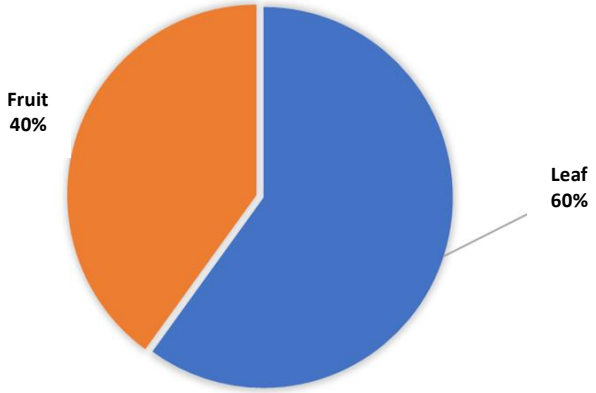

Figure 4. Percentage of plant part used in ritual

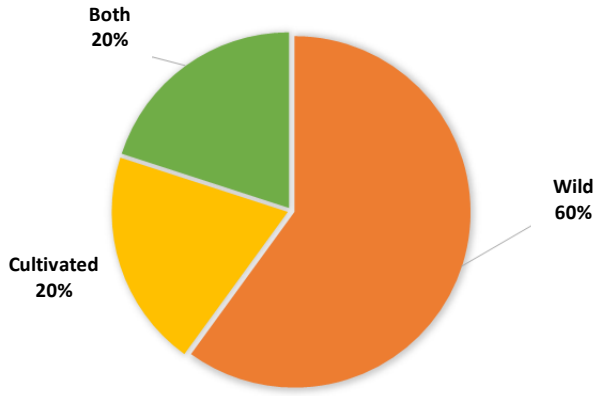

Figure 5. Percentage of plant part used in ritual

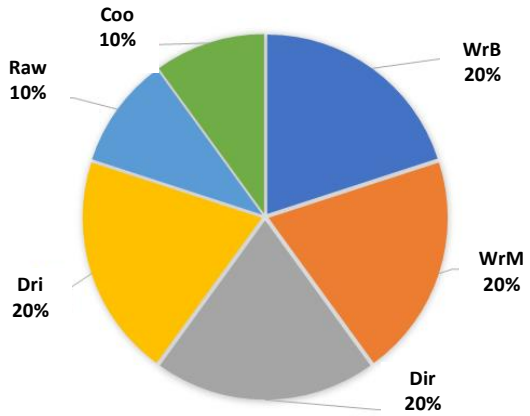

Figure 6. Percentage of the method of preparation practiced by the Manobo tribe in their rituals. Coo, cooked; Raw, uncooked; Dri, dried; Dir, directly obtained; WrB wrapped together with *bujo* leaves, and WrM wrapped together with "mama" fruit

Figure 6 presents the percentage of the method of preparation practiced by Manobo based on their documented 12 rituals using most of the same plant species. Frequency showed that modes of preparation are distributed equally in percentage (20%) such as dried, directly obtained, wrapped together with *P. betle* leaves and *A. catechu* fruit, while either cooked or raw encompass the remaining 20%.

Discussion

All ritual plants were surveyed equally among the Manobo healers tasked to perform their rituals. Ritual plants are essential elements to ritual practices of the Manobo culture. For instance, ritual plants commonly used in both localities were *Areca catechu* L. "mama," *Nicotiana tabacum* L. "tabako," and *Piper betle* L. "bujo." The *A. catechu* is usually wrapped with *P. betle* and mixed a small amount of a pulverized shell "apog," that is believed in strengthening their teeth when Areca nut is being chewed.

Traditionally, chewing of areca nut is conventional in the eastern part of the world. The trend is observed commonly in Madagascar, South Asia, Southeast Asia, and the Solomon Islands (Irwanto and Irsyam 2020). *A. catechu* seed is traditionally chewed with betel leaf, *P. betle*, and lime. This cultural practice is evident in the study of Dapar et al. (2020b) in documenting the Manobo tribe of Agusan del Sur depicting the actual ritual of asking permission to enter the forest "Mamaid." In Central or Southern Mindanao, betel chewing is a ritualistic custom among the Maranao, Maguindanao, Bagobo, and Tausug groups (Valdez 2004). Indigenous rituals and cultural practices were often observed in remote and forested areas where the tribe is closely linked with their ancestral past (Molintas 2004).

Nowadays, traditional knowledge is gradually decreasing due to rapid urbanization, acculturation, and man's independence in the modern health care system (Dapar et al. 2020b, 2020c). However, the ritual and folk system still prevails in the rural communities. In their belief system, plants and humans have their spirit that should be taken good care of and value their presence in the environment.

Comparatively, the Surigao Manobo tribes from two villages, namely barangay Cabangahan and barangay Hinapuyan of Surigao del Sur, differ in their local ritual

terms used. For instance, the ritual term "Panawagtag" in Hinapuyan is different in Cabangahan as they use the term "Uyagdok." However, "Uyagdok" is used as a burial ritual in Hinapuyan. The term "Binuyahan" is a ritual for healing in Hinapuyan but is called "Pasayloa" in Cabangahan. The processes and methods of their rituals are most likely the same but only differ in the applied local terms.

From the present study, it can be deduced that the Manobo tribe continues to rely on their traditional knowledge and ritual culture learned from their ancestors. However, modern society already highly influenced the Manobo tribes of surveyed barangays, including their educational system, healthcare system, and language used. Into the bargain, the Manobo pass their knowledge and culture to the next generation through oral tradition (Dapar et al. 2020c), like wearing their cultural costumes and even use of their native language in their territory. Documentation of ritual practices and benefits of plant species with biocultural importance among indigenous communities is essential for preserving culture and tradition. The indigenous knowledge, conservation practices, ecological understanding, and resource management are vital for future environmental management (UNESCO 2019). They serve critical roles in protecting their culture and indigenous territories (Dapar et al. 2020d, 2020e).

Manobo people believe that deities reside in their indigenous forests and live in their ancestral territories. This cultural belief is marked on the minds of the tribe with obedience and respect to avoid harm and destruction in their livelihoods and living. They continually conserve their plants for their regard for social, cultural, and religious purposes. The Manobo rituals, festivals, and other cultural practices are directly associated with their surroundings preserved religiously. The stigma of getting punished by their deities and forest spirits is instilled in their customs and tradition to obey and respect their gods and deities through prayers and making sacrifices and offerings.

Like other tribes, tribal folklore is directed in magico-religious beliefs and taboos (Sharma and Pegu 2011). The continuation of the ritual practices has significant potential for natural resources conservation (Geng et al., 2017). Ritual plants are exciting studies in Philippines ethnobotany, which are an integral part of the culture and relationship of the people and plants (Dapar and Alejandro 2020). Therefore, this study documented the ritual practices and ritual-plant uses among the Manobo tribe of Surigao del Sur and its importance in the cultural knowledge on traditional ritual practices. Further documentation on ritual plants and practices of indigenous peoples should be further conducted to understand ritual plant knowledge, particularly its distribution and comparison within and among ethnic groups in the Philippines and other countries.

ACKNOWLEDGEMENTS

We are very thankful to the Manobo tribe in Surigao del Sur for their free Prior Informed Consent (PIC) and for generously sharing information on our documentation. The first author thanks RB Cerbito, FL Tejano, JCN Jamera, and SM Daitol for their assistance and support. The second author acknowledges LF Olowa and JJ Manubag for sharing their knowledge and expertise. The third author thanks the scholarship grant of the Department of Science and Technology - Accelerated Science and Technology Human Resource Development Program - National Science Consortium (DOST-ASTHRDP-NSC).

REFERENCES

Abdulaziz AA, Dapar MLG, Manting MME, Torres AJ, Aranas AT, Mindo RAR, Cabrido CK, Demayo CG. 2019. Qualitative evaluation of the antimicrobial, antioxidant, and medicinally important phytochemical constituents of the ethanolic extracts of the leaves of *Gliricidia sepium* (Jacq.). Pharmacophore 10: 72-83.

Abbink J. 1995. Medicinal and ritual plants of the Ethiopian Southwest: An account of recent research. Indigenous Knowledge and Development Monitor 3 (2): 6-8.

Añides JA, Dapar MLG, Aranas AT, Mindo RAR, Manting MME, Torres MAJ, Demayo CG. 2019. Phytochemical, antioxidant, and antimicrobial properties of the white variety of 'Sibujing' (*Allium ampeloprasum*). Pharmacophore 10: 1-12.

Pelser PB, Barcelona JF, Nickrent DL (eds). 2011 onwards. Co's Digital Flora of the Philippines. www.philippineplants.org.

Dapar MLG, Alejandro GJD. 2020. Ethnobotanical studies on indigenous communities in the Philippines: current status, challenges, recommendations, and future perspectives. J Complement Med Res 11 (1): 432–446. DOI: 10.5455/jcmr.2020.11.01.51.

Dapar MLG, Demayo CG. 2017. Folk medical uses of Lunas *Lunasia amara* Blanco by the Manobo people, traditional healers, and residents of Agusan del Sur, Philippines. Sci Int (Lahore) 29 (4): 823-826.

Dapar MLG, Demayo CGD, Senarath WTPSK. 2018. Antimicrobial and cellular metabolic inhibitory properties of the ethanolic extract from the bark of 'Lunas-Bagon' (*Lunasia* sp.). Int J Pharm Sci Res 9: 88–97. DOI: 10.13040/IJPSR.0975-8232.9(1).88–97.

Dapar MLG, Demayo CG, Meve U, Liede-Schumann S, Alejandro GJD. 2020a. Molecular confirmation, constituents, and cytotoxicity evaluation of two medicinal *Piper* species used by the *Manobo* tribe of Agusan del Sur. Philippines. Phytochem Lett 36: 24–31. DOI: 10.1016/j.phytol. 2020.01.017.

Dapar MLG, Alejandro GJD, Meve U, Liede-Schumann S. 2020b. Quantitative ethnopharmacological documentation and molecular confirmation of medicinal plants used by the *Manobo* tribe of Agusan del Sur, Philippines. J Ethnobiol Ethnomed 16: 14. DOI: 10.1186/s13002-020-00363-7.

Dapar MLG, Meve U, Liede-Schumann S, Alejandro GJD. 2020c. Ethnomedicinal plants used to treat cuts and wounds by the Agusan Manobo of Sibagat, Agusan del Sur, Philippines. Ethnobot Res App 19: 1-18. DOI: 10.32859/era.19.31.1-18.

Dapar MLG, Alejandro GJD, Meve U, Liede-Schumann S. 2020d. Ethnomedicinal importance and conservation status of medicinal trees among indigenous communities in Esperanza, Agusan del Sur, Philippines. J Complement Med Res 11 (1): 59-71. DOI: 10.5455/jcmr.2020.11.01.08.

Dapar MLG, Meve U, Liede-Schumann S, Alejandro GJD. 2020e. Ethnomedicinal appraisal and conservation status of medicinal plants among the Manobo tribe of Bayugan City, Philippines. Biodiversitas 21(8):3843–3856. DOI: 10.13057/biodiv/d210854.

Dela Peña JF, Dapar MLG, Aranas AT, Mindo RAR, Cabrido CK, Torres MAJ, Manting MME, Demayo CG. 2019. Assessment of antimicrobial, antioxidant, and cytotoxic properties of the ethanolic extract from *Dracontomelon dao* (Blanco) Merr. & Rolfe. Pharmacophore 10: 18-29.

De Jong R. 2010. The last tribes of Mindanao, the Manobo, river people of Cotabato. Things Asian. http://thingsasian.com/story/last-tribes-mindanao-manobo-river-peoplecotabato.

Erawan TS, Alillah AN, Iskandar J. 2018. Ethnobotany of traditional rituals in the Karangwangi Village, Cianjur District, West Java,

Indonesia. Asian J Ethnobiol. 1 (2): 53-60. DOI: 10.13057/asianjethnobiol/y010201.

Felix MLE. 2004. Exploring the indigenous local governance of Manobo tribes in Mindanao. Phil J Pub Adm. 48: 125.

Galeano G. 2000. Forest use at the pacific coast of Chocó, Colombia: A quantitative approach. Econ Bot 54: 358-376. DOI: 10.1007/BF02864787.

Geng Y, Hu G, Ranjitkar S, Shi Y, Zhang Y, Wang Y. 2017. The implications of ritual practices and ritual plant uses on nature conservation: a case study among the Naxi in Yunnan Province, Southwest China. J Ethnobiol Ethnomed 13: 58. DOI: 10.1186/s13002-017-0186-3.

Hariyadi B, Ticktin T. 2012. Uras: medicinal and ritual plants of Serampas, Jambi Indonesia. Ethnobot Res App 10: 133-149. 10.17348/era.10.0.133-149.

Irwanto RR, Irsyam ASD. 2020. *Areca catechu* L. Arecaceae. In: Franco F. (eds) Ethnobotany of the mountain regions of Southeast Asia. Ethnobotany of Mountain Regions. Springer, Cham. DOI: 10.1007/978-3-030-14116-5_58-1 .

Iskandar J, Iskandar BS. 2017. Various plants of traditional rituals: ethnobotanical research among The Baduy community. Biosaintifika 9 (1): 114-125. DOI: 10.15294/biosaintifika.v9i1.8117.

Nadayag J, Dapar MLG, Aranas AT, Mindo RAR, Cabrido CK, Manting MME, Torres AJ, Demayo CG. 2019. Qualitative assessment of the antimicrobial, antioxidant, and phytochemical properties of the ethanolic extracts of the inner bark of *Atuna racemosa*. Pharmacophore 10: 52-59.

Pardo-de-Santayana M, Tardío J, Blanco E, Carvalho AM, Lastra JJ, Miguel ES, Morales R. 2007. Traditional knowledge of wild edible plants used in the northwest of the Iberian Peninsula (Spain and Portugal): a comparative study. J Ethnobiol Ethnomed. 3: 27. DOI: 10.1186/1746-4269-3-27.

Quiroz D, Sosef M, van Ande Tinde. 2016. Why ritual plant use has ethnopharmacological relevance. J Ethnopharmacol 188:48-56. https://doi.org/10.1016/j.jep.2016.05.006.

Sharma UK, Pegu S. 2011. Ethnobotany of religious and supernatural beliefs of the Missing tribes of Assam with special reference to the 'Dobur Uie.' J Ethnobiol Ethnomed 7: 16. DOI: 10.1186/1746-4269-7-16.

Tardío J, Pardo-de-Santayana M. 2008. Cultural importance indices: a comparative analysis based on the useful wild plants of Southern Cantabria (Northern Spain). Econ Bot 62: 24–39. DOI: 10.1007/s12231-007-9004-5.

UNESCO. 2019. Indigenous knowledge and biodiversity. https://en.unesco.org/links/biodiversity.

Uy IA, Dapar MLG, Aranas AT, Mindo RAR, Manting MME, Torres MAJ, Demayo CG. 2019. Qualitative assessment of the antimicrobial, antioxidant, phytochemical properties of the ethanolic extracts of the roots of *Cocos nucifera* L. Pharmacophore 10: 63–75.

Valdez CO. 2004. Betel chewing in the Philippines. http://www.lasieexotique.com/page/LasieExotique-mag_betel.html.

ASIAN JOURNAL OF ETHNOBIOLOGY
Volume 3, Number 2, November 2020
Pages: 51-61

E-ISSN: 2580-4537
DOI: 10.13057/asianjethnobiol/y030202

Review: A relation between ethnobotany and bioprospecting of edible flower Butterfly Pea (*Clitoria ternatea*) in Indonesia

WHISNU FEBRY AFRIANTO[1,♥], FADILA TAMNGE[2], LAELI NUR HASANAH[3]

[1]Ecosystem and Biodiversity (Ecosbio). Jl. Merapi 02/01, Datengan, Grogol, Kediri 64151, East Java, Indonesia, ♥email: whisnu.afrianto@apps.ipb.ac.id
[2]Departement of Animal Husbandry, Universitas Khairun. Jl. Raya Gambesi, Kampus II Unkhair, Ternate, North Maluku, Indonesia
[3]Departement of Nutrition, Faculty of Science and Technology, Universitas PGRI Yogyakarta. Jl. IKIP PGRI I Sonosewu No.117, Bantul 55184, Yogyakarta, Indonesia

Manuscript received: 11 April 2020. Revision accepted: 13 October 2020.

Abstract. *Afrianto WF, Tamnge F, Hasanah LN. 2020. Review: A relation between ethnobotany and bioprospecting of edible flower Butterfly Pea (*Clitoria ternatea*) in Indonesia. Asian J Ethnobiol 3: 51-61. Clitoria ternatea* L., known as "*bunga telang*" in Indonesia, is an important medicinal plant to Fabaceae, an ornamental perennial climber. It has widely distributed throughout Africa, Asia, Australia, North and South America, Pacific (Northwestern, South-Central, and Southwestern). This review aims to study the relation between ethnobotany and bioprospecting of *C. ternatea.* The literature study revealed that Indonesian communities use flowers as part of *C. ternatea* as an eye medicine, boils disease, an ornamental plant, and a symbol in traditional ceremonies. Leaf, flower, seed, and root of this species have bioprospecting for medicine, agriculture, and food and beverage. Ethnobiology exploration of *C. ternatea* in Indonesia is an initial step to observe the bioprospecting potential. Then, further research can continue to produce commercial products that will provide an economic impact and motivate communities to take part in conservation actions. The present study assesses the minor works on bioecology, ethnobotany, bioprospecting, and market potential. We hope that the study's output can spur further research and industry approach.

Keywords: Bioprospecting, *Clitoria ternatea*, ethnobotany, Fabaceae, medicinal plant

INTRODUCTION

Clitoria ternatea L. is known as "*bunga telang*" in Indonesia. This wild plant belongs to the plant of the Fabaceae family (Karel et al. 2018). The origin of *C. ternatea* is still debatable, but some studies mentioned that *C. ternatea* is a native plant of Ternate, Indonesia Archipelago (Jain et al. 2003; Gupta et al. 2010; Oguis et al. 2019). The etymology of this species is postulated to be from the Ternate Island in the Indonesian archipelago. It is based on the specific description of Linnaeus produced (Oguis et al., 2019). Furthermore, according to Staples (1992), *C. ternatea* originated from the Pacific Ocean or the South China Sea, but it is from around the Indian Ocean. Currently, *C. ternatea* has widely distributed throughout Africa, Asia, Australia, North and South America, Pacific (Northwestern, South-Central, and Southwestern) (Al-Snafi 2016).

Clitoria ternatea is an ornamental perennial climber in other plants or in-wall of home gardens, which lives in various types of soil and has a pH of 5.5-8.9 (Sutedi 2013; Chen et al. 2018). It can adapt to heavy cracking clay soil areas (Hall 1985). *C. ternatea* is a self-pollination plant, and it spreads through seed (Chen et al. 2018). *C. ternatea* occurs in plentiful sunlight and is partially shaded (Jamil et al., 2018). Dry stressing can inhibit population growth, fresh weight, germination, shoot, and root length (Bharti and Kumari 2017). This medicinal plant can be found in high rainfall areas and prolonged dry season areas (Gomez and Kalamani 2003). The germination is 1-2 weeks, and the flowering is 3-4 weeks (Jamil et al. 2018).

The height of *C. ternatea* is up to 6 m with soft twigs. The description steam of *C. ternatea* is adpressed pubescent, glabrescent, and slender. *C. ternatea* has imparipinnate leaves consisting of 5-7 elliptic to lanceolate leaflets with a length of 1-6.7 cm and wide of 0.3-4 cm. The petiole length is 1-3 cm; the rachis is 1-6 cm, petiolules 1-3 mm, and leaflets 4-10 mm. The flower characteristics are axillary, paired, or solitary, with pedicels length of 6-9 mm, and striking blue and white color. The color of the seeds is black and brown, with a length of 4.5-7 mm, wide of 3-4 mm, and thick of 2-2.5 mm. The calyx is pubescent with tube 8-12 mm, under one-third of their length with the upper pair, acuminate or acute. The corolla is standard white, often margined with completely blue or blue. The pod is flat with a length of 6-12.5 cm and wide 0.7-1.2 cm; on each pod, there are 6-8 seeds. The color of the seeds is black and brown, with a length of 4.5-7 mm, wide of 3-4 mm, and thick of 2-2.5 mm (Gillett et al. 1971).

Leaves and flowers have flavonols compounds (Kazuma et al. 2003a,b). The other non-proteinaceous components were found in the roots of *C. ternatea*. For instance, taraxerol, novel norneolignans, and clitorienolactones A-C were found in the roots (Vasisht et al., 2016). *C. ternatea* has cyclotides (proteinaceous components) and is the only family member within the

Fabaceae (Gilding et al., 2015). The edible flowers had antioxidant activity and antimicrobial potential as a medicinal plant for several diseases (Petrova et al. 2016; Dhiman et al. 2017; Wang et al. 2017).

Ethnobotany of *C. ternatea* has been documented as the drug "Sankhupushpi" of Ayurveda (Mukherjee et al., 2008). Ayurveda means the science about life; it contains the traditional medicinal knowledge in India from between 2500 and 500 B.C (Mukherjee and Wahile 2006). The seeds and roots are used for alterative, laxative, and a 'tonic of the nerves' (Mukherjee et al., 2008). On the other hand, the data of ethnobotany in Indonesia is still limited. In Indonesia, *C. ternatea* is used as a medicinal plant or for traditional ceremonies and is known locally only.

Bioprospecting is an exploration of new natural resources of economic and social value. The pharmaceutical industry is one of the massive industries conducting it. However, other sectors, such as agriculture, construction, manufacturing, engineering, and others, also explore bioprospecting (Beattie et al., 2005). To find a novel of biological and chemical resources was conducted by exploration in nature or from traditional knowledge. Thus, the ethnobotany of species is crucial as foundation information for bioprospecting. Based on that, benefits from species can be used wider and optimal. This current literature review aims to study the relation between ethnobotany and bioprospecting of *C. ternatea.* The data documented of ethnobotany and bioprospecting from *C. ternatea* is to develop conservation action and optimize utilization

ETHNOBOTANY OF *CLITORIA TERNATEA*

Numerous ethnobotany research of *C. ternatea* is preliminary and requires a more thorough investigation. In Indonesia, research areas are still limited, such as East Java, Bali, West Nusa Tenggara, West Kalimantan, and Central Sulawesi. In Java, for instance, the data was only found in Madura. Ethnobotany knowledge of *C. ternatea* was depicted in Table 1.

The exploration of the ethnobotany of *C. ternatea* in Tamao Village did not reveal clear information about the utilization (Haryanti et al., 2015). However, based on literature, Dayak Tamambaloh in Embaloh Hulu is still keeping their local wisdom (Sulistiyowati 2016). In general, the Dayak Tamambaloh Community finds beneficial plants from forests, house yards, gardens, river beaches, hills, and fields (Rike et al., 2018; Supiandi and Leliavia 2019).

Table 1. List of ethnobotany research of *Clitoria ternatea* in Indonesia

Location	Part	Utilization	References
Tamao Village, Embaloh Hulu District, West Kalimantan	Flowers	Medicine, traditional ceremony, and ornamental	Haryanti et al. (2015)
Five of *Pakraman* Villages, Bali (*Pakraman* Jatiluwih Tabanan, *Pakraman* Sukawati Gianyar, *Pakraman* Penglipuran Bangli, *Pakraman* Tenganan Karangasem, and *Pakraman* Banyuning Buleleng)	Flowers	Traditional ceremony (*Panca Yadnya*)	Surata et al. (2015)
Lenteng District, Guluk-Guluk District, and Bluto District in Sumenep Regency.	Flowers	Eye disease medicine	Destryana and Ismawati (2019)
The Hindu Community of Jagaraga Village, West Lombok Regency, West Nusa Tenggara	Flowers	Eye disease medicine	Eni et al. (2019)
Togian Tribe, Tojo Una-Una, Central Sulawesi	Flowers and roots	Boils and fever medicine	Tabeo et al. (2019)
The Adjacent Area of Lake Buyan-Tamblingan, Bali	Flowers	Eye disease medicine	Oktavia et al. (2019)
Mincidan Village, Klungkung, Bali	Flowers	Eye disease medicine, ‘nunas’ tirta ceremony, and ornamental	Defiani and Kriswiyanti (2019)
Madura Sumenep Communities	Flowers	Clean and clear baby's eyes	Ismawati and Destryana (2019)

The ethnobotany from some areas in Indonesia used the flowers for many purposes. Flower of *C. ternatea* is utilized as the medicine for eye diseases by the Sumenep-Madura community (Ismawati and Destryana 2019), the adjacent area of Lake Buyan-Tamblingan, Bali (Oktavia et al. 2019), the community around the area model of KPH Kapuas Upstream (Haryanti et al. 2015), as well as the Hindu Community of Jagaraga Village, West Lombok Regency, West Nusa Tenggara (Eni et al. 2019). Ethnobotany knowledge of *C. ternatea* for eyes medicine has been proven through research. The phenol 0.026% from the extracts of *C. ternatea* flower revealed inhibition of 0.87mm as an antibacterial of *Staphylococcus aureus*, a bacterium that causes eyes diseases (Hutajulu et al. 2008). Through ultrafiltration (UF), the extracts of *C. ternatea* in water extract sterilization can be used to eye drops ingredients (Anthika et al., 2015). Furthermore, the extracts of *C. ternatea* can dissolve Calcium (Ca) and Natrium (Na) compiler cataract model in the concentration of 2.5% (Kusrini et al. 2017).

Togian tribal communities in Malenge Island, Talatako District, Tojo Una-Una, Central Sulawesi used *C. ternatea* for boils medicine (Tabeo et al. 2019). Boils are also caused by *S. aureus*. The antibiotic of S. aureus can be produced from ultrasound-assisted aqueous leaf and petal extract, ethanolic leaf, and callus extract of *C. ternatea* (Shahid et al. 2009; Anthika et al. 2015). In addition, *C. tertanea* also has an antipyretic activity that can reduce fever (Devi et al., 2003).

The various ceremonies which belong to the *Panca Yadnya* ceremony need part of plants for the ceremony, and *C. ternatea* is one of them (Surata et al. 2015; Defiani and Kriswiyanti 2019). Hindu Bali's people use leaves, flowers, and fruits as a medium of offering (*sesajen*) and praying (*persembahyangan*) (Sardiana and Dinata 2010). Furthermore, they classified into several uses such as *canang* (offering to God), *kewangen* (scenting God's name), and *bhasma* (the symbol of Siwa's purity) (Surata et al., 2015).

C. ternatea is also used as an ornamental plant. Since *C. ternatea* has an attractive color for making aesthetic scenery to home and garden and ornamental crop adding value (Karel et al. 2018). For example, Mincidan Village in Bali uses plant floral diversity to promote ecotourism (Defiani and Kriswiyanti 2019).

BIOPROSPECTING

Bioprospecting includes cultural information, biodiversity information, and processing and handling technology. Bioprospecting is the effort to search genes and natural compounds of biodiversity for product development (Pushpangadan et al. 2018). The economic benefits from *C. ternatea* include food and beverage, forage, phytochemicals, biopesticides, bioinsecticides, colorants, and medicines. In this part, we reviewed the evidence, based on scientific and research, the difference with the ethnobotany that only focused on Indonesia's studies. In bioprospecting, we explored the current research progress of *C. ternatea* from Indonesia. Thus, we can elaborate on evidence-based scientific and ethnobotany from Indonesia.

Phytochemicals

Leaf of *C. ternatea* contains compounds such as 3-rutinoside, beta-sitosterol, 3 monoglucoside, 3-o-rhamnosyl-glucoside, 3-neohesperidoside, kaempferol-3-o-rhamnosyl essential oils (Tiwari and Gupta 1959; Morita et al. 1977; Mukherjee et al. 2008; Manjula et al. 2013; Thakur et al. 2018). The seed contains oleic, linoleic, stearic, beta-sitosterol, polypeptide, linolenic acids, a water-soluble mucilage, delphinidin 3, 3', 5'-tri-o-glucoside, palmitic, finotin, oligosaccharides, p-hydroxycinnamic acid (4), anthoxanthin glucoside, flavonol-3-glycoside, ethyl α-d-galactopyranoside, adenosine, 3,5,7,4-tetrahydroxyflavone, 3-rhamnoglucoside, hexacosanol,-sitosterol (5),-sitosterol (Grindley et al. 1954; Kulshrestha and Khare 1967; Kulshrestha and Khare 1968; Joshi et al. 1981; Revilleza et al. 1990; Macedo and Xavier-Filho 1992; Husain and Devi 1998; Kelemu et al. 2004). Root has been reported containing alanine, aminobutyric acid, aspartic acid, arginine, flavonoids, glycine, histidine, leucine, methyleneglutamic acid, ornithine, saponins, phenols, taraxerone, taraxerol, valine (Banerjee and Chakravarti 1964; Rajagopalan 1964; Kumar et al. 2008; Swain et al. 2012; Manjula et al. 2013). The flower has ternatins, flavonoids, alkaloids, tannins, resins. (Kazuma et al. 2003 a,b; Kazuma et al. 2004; Manjula et al. 2013).

Food and beverage use

The flower of *C. ternatea* is used as a natural coloring for food and beverage. The bright blue color is the advantage characteristic of colors. The color is produced from anthocyanin in ternatins (Srivastava and Pande 1977; Zussiva et al. 2012). It is the pigment of the flavonoid group, which is soluble in water (Zussiva et al., 2012). For a natural dye of food and beverage, *C. ternatea* showed the best result in the anthocyanin with the treatment of the 10% addition maltodextrin concentration (Hariadi et al. 2018). The compound's content is stable and could withstand high temperatures (Azima et al., 2017; Angriani 2019). Coloring extracts flower was used to an ice lolly with the same quality with blue diamonds of Cl 42090 (Hartono and Angelia 2013). It can also be coloring for several traditional foods such as *putu*, *onde-onde*, *bandang*, *barangko*, *getuk lindri*, *cendol*, candy, sticky rice *tapai*, and others (Saati et al. 2018; Angriani 2019; Febrianti 2019; Permana 2019; Palimbong and Pariama 2020; Shofi and Putri 2020). The flower extracts with 0.25% and 1% concentration were more stable when used in the paracetamol syrup preparations (Pratimasari and Lindawati 2018). Furthermore, *C. ternatea* was used for coloring goat milk yogurt, and it showed effects on the levels of pressure (color) (Dewi et al. 2019).

Blue tea from *C. ternatea* began to be known in Indonesia. It possesses antioxidant properties for healthy beverages because it reduces oxidative stress (Srichalkul 2018; Lakshan et al. 2019). Moreover, drinking C. ternatea can reduce postprandial glucose and insulin concentration

concomitant (Chusak et al. 2018a). Processing of *C. ternatea* is conducted through drying, either using sunlight or an oven. Drying is one of the most critical steps in processing *C. ternatea* tea. The aims are to prolong shelf life, prevent microorganism growth, reduce weight to press storage and transport costs, and minimize enzymatic degradation (Fernandes et al. 2018). Drying is conducted at 08.00-12.00; then, it is continued on the next day. By doing so, the beneficial compounds of *C. ternatea* are not damaged by sunlight (Mulangsari 2019). *C. ternatea* tea is made with five flower petals (1.0 g) dissolved in 250 ml boiling water. Consuming *C. ternatea* tea routinely is good for the thin phlegm in asthmatics (Kusuma 2019) and can improve human health due to its non-caffeinated contents (Panda 2018).

Starch digestibility of cooked rice with a rice cooker was reduced by the incorporation of 1.25% and 2.5% (w/v) of *C. ternatea* flower extracted and 2.5% (w/v) with a microwave oven (Chusak et al. 2019). Flower extracts of *C. ternatea* caused a reduction in hydrolysis index, predicted glycemic index of flour, and glucose released at 0.5%, 1%, and 2% (w/v). In comparison, 5%, 10%, and 20% (w/w) decreased the rate of starch digestion of the wheat bread. The pancreatic α-amylase activity can be inhibited by 1% and 2% (w/v) by using a substrate of all flours (Chusak et al. 2018b). In addition, flower extracts of *C. ternatea* inhibited the food damage and disease of *Pseudomonas aeruginosa* (the extracted ethanol flower concentration of 10% to 100%) and *Bacillus cereus* (the extracted ethanol flower concentration of 30% to 100%.) (Riyanto et al. 2019). These bacteria have been reported as the food poisoning cases in several foods such as rice and noodles in Indonesia's market, particularly in food streets (Ruriani and Nurhayati 2010; Amanati 2014; Ekantini et al. 2017). This makes *C. ternatea* use a bioactive potential for food preservation (Kamila et al., 2009).

Agricultural applications

Anthelmintic

C. ternatea has Anthelmintic activity reported killing *Meloidogyne incognita* (Hasan and Jain 1985; Kumari and Devi 2013). The high effectivity to inhibition of hatching of the egg can be used to minimize the damage of *M. incognita* to fruits and leaves of mulberry. *M. incognita* has been reported decreasing in pepper production in Bangka and West Kalimantan (Sukanaya 2001). In soybean, *M. incognita* can make lost yield up to 30%-90% (Suryanti et al., 2017). *M. incognita* is also a critical plant disease on *kenaf* (*Hibiscus cannabinus*) production in the nursery and tomato development area (Budi et al. 2006; Pradana et al. 2016; Irmawatie et al. 2019).

Antibacterial and antifungal

The purification of *C. ternatea* seed produces a small protein called Finotin (Kelemu et al. 2004). Finotin has been reported to significantly kill the bacteria of *Xanthomonas axonopodis*, which attacks beans. *X. axonopodis* is a disease that causes severe damage in soybean crops and economic loss in citrus crops in Indonesia (Das 2003; Khaeruni et al. 2007; Khaeruni et al. 2008).

As a fungicide, a protein that was designed as a Ct protein from the isolation of *C. ternatea* seed caused the death of some fungus, such as *Alternaria* sp., *Aspergillus flavus*, *Cladosporium* sp., *Curvularia* sp., *Rhizopus* sp., and *Sclerotium* sp. (Ajesh and Sreejith 2014). Finotin from *C. ternatea* seed could inhibit *Bipolaris oryzae*, *Pyricularia grisea* from rice, *Colletotrichum gloeosporioides*, and *Lasiodiplodia theobromae* from *Stylosanthes* spp; *Colletotrichum lindemuthianum*, *Fusarium solani* from common bean, and *Rhizoctonia solani* from *Brachiaria* spp (Kelemu et al. 2004). Furthermore, *Fusarium oxysporum* that causes moler disease on Shallot from Indonesia can be killed by the crude aqueous leaf extracts of 50% (Das and Chatterjee 2014) and flower extracts at 5% concentration (Suganda and Adhi 2017). Research by Suganda and Adhi (2017) is preliminary for plant antifungals since the focus is mainly on human pathogens rather than plant pathogens.

Insecticidal

Cyclotide sequences have insecticidal activity against *Helicoverpa armigera*, the cotton budworm (Poth et al., 2011). *H. amigera* makes cotton fruit undeveloped and fallen because of broaching buds, flowers, and bolls, especially in central areas of cotton production in Indonesia such as Central Java, East Java, South Sulawesi, Southeast Sulawesi, East Nusa Tenggara, West Nusa Tenggara, and Bali (Diyasti et al. 2016). 1-2% (vol/vol) of the oil-based formulation of the *C. ternatea* mixture was used for integrated pest management (IPM) to control *Helicoverpa* spp in Australian cotton. Furthermore, 1% w/w finotin application to *Zabrotes subfasciatus* and 5% w/w to *Acanthoscelides obtectus* resulted in a maximum level of 100% larva mortality (Mensah et al. 2015).

Forage for livestock

To obtain high quality and nutrition, *C. ternatea* is harvested at 45 days (Mahala et al., 2012). *C. ternatea* has high productivity up to 17-25 tons/ha (Abdelhamid and Gabr 1993). A high carotenoid content positively impacts bovine livestock fertility and egg yolk color (Barro and Ribeiro 1983). *C. ternatea* also has a better potential nutritive value than alfalfa and clover (Abreu et al., 2014).

Clitoria ternatea escalates diets and sound quality for ruminants due to its nutritional contents (Gomez and Kalamani 2003; Avalos et al. 2004; Juma et al. 2006; Shamnad 2019). As a forage, *C. ternate* increases the weight of beef cattle and cows, 0.7 and 0.36 kg/day, respectively (Sutedi 2013). In addition, the weight loss of cows during shipment from Timor to Java can be minimized up to 5-7% when generally it is 12-15% (Nunik 2009).

Barros et al. (1991) discovered a better dietary N of goats given *C. ternatea* as forage. Guinea Grass-*Clitoria* mixed hay can be a potential forage to sheep because it increases digestible dry matter intake up to 61% (Sandoval et al. 2009). Besides that, the use of *C. ternatea* to sheep also provides a positive effect on wool growth and live weight gain (Schlink 1998). The two cuts of *C. ternatea*

have better acid and neutral detergent fiber, acid detergent lignin cellulose, crude protein and fiber, hemicellulose than berseem hay (Abdelhamid and Gabr 1993).

A decrease of 10% *of C. ternatea* for boilers diet showed better growth (Marin et al., 2003). A comparison between *C. ternatea* and *Brachiaria humidicola* showed that C. ternatea has higher protein content and metabolizes energy, but the fiber content was lower than *B. Humidicola*. Nevertheless, 15% *C. ternatea* substitution decreased growth and consumption in chicken (Monforte et al. 2002).

Muir and Massaete (1996) found that the crude protein content of dietary components used during experiments in rabbits was 16 %. It is because *C. ternatea* has protein up to 18-25%, which complies with the nutritional needs of rabbits (Sutedi 2013). Nevertheless, Elamin et al. (2011) suggested that sweet potato is better used for rabbits than *C. ternatea* based on performance and blood constituents.

Soil fertility

The high nodule maintenance and the non-structural carbohydrate mobilization make *C. ternatea* adapt quickly to stress after the shoot removal (De Souza et al. 1996). *C. ternatea* increases Nitrogen, Phosphor, Potassium, and Magnesium and impacts soil acidification and nutrient solubilization (Njunie et al. 2004; Alderete-Chavez et al. 2011). Environmental conditions affect nodulation growth. The optimum nodulation growth is on moderate temperatures, such as at 06.00 (27-32°C), 14.00 (36-42°C) and 18.00 (27-30°C) and with the light intensity in summer (11.4-17.1 Wm-2) and winter (11.4 Wm-2), as well as the optimum duration of 11-14 hours (Habish and Mahdi 1979). On the other hand, an optimum soil pH was 6.3 in the four strains of *C. ternatea* (Zoroug and Munns 1980a). Phosphor is an essential nutrient for nodulation growth (Zoroug and Munns 1980b). Unfortunately, we currently do not find the *C. ternatea* to improve soil fertility in Indonesia. This can be an opportunity to discover the utilization of *C. ternatea* to improve soil fertility in Indonesia. It is because *C. ternatea* grows horizontally and makes tightly covered. This growth characteristic brings several benefits, such as preventing erosion, maintaining soil moisture, and improving soil fertility from leaves (Suarna 2005).

Medicinal properties

Antimicrobial

Cliotides T1-T2 in flower, seed, and root of *C. ternatea* can be used as an antimicrobial against *Pseudomonas aeruginosa*, *Klebsiella pneumonia*, and *Escherichia coli* (Nguyen et al. 2011). Fourth, novel cyclotide sequences have been identified, and noted that *C. ternatea* was one of the prosperous cyclotide-producing medicinal plants (Nguyen et al. 2016). Ethanolic and aqueous leaf and callus extracts can inhibit human diseases bacteria, such as *Bacillus cereus*, *B. subtilis*, *Enterococcus faecalis*, *Staphylococcus aureus*, *S. epidermidis*, *Streptococcus pyogenes*, and *S. viridans* (Shahid et al. 2009); *Micrococcus luteus* (Ajesh and Sreejith 2014); *Salmonella typhi* and *Proteus Vulgaris* (Anand et al. 2011). Moreover, as an antifungal, 14.3 kDa seed protein inhibited *Aspergillus fumigatus*, *A. niger*, *Candida albicans*, *C. parapsilosis*, *Cryptococcus neoformans*, *C. albidus*, and *C. laurentii* (Ajesh and Sreejith 2014). Leaf extracts successfully inhibited *Aspergillus niger* (Kamila et al. 2009). In ethnobotany, communities mostly use *C. ternatea* for diseases caused by microbes, such as eye disease and boils caused by *S. aureus*. There are numerous benefits from *C. ternatea* as an antimicrobial that Indonesian communities have not explored.

Antidiabetic

In Indonesia, it has 10,681,400 cases of diabetes in adults (International Diabetes Federation 2020). Currently, *C. ternatea* leaf extracts have shown potential for an antidiabetic medicine (Daisy and Rajathi 2009; Suganya et al. 2014; Talpae et al. 2014; Chusak et al. 2018b; Kavitha 2018). Leaf extracts of *C. ternatea* decrease blood glucose, HbA1c, other biochemical parameters and increase serum insulin level (Kavitha 2018). After five hours of oral administration, the mix of Punica granatum and the dried flower powder resulted in an antihyperglycemic effect. This is affected by flavonoids and alkaloids (Borikar et al., 2018). The root extract in experimental rat models, *C. ternatea*, prevented pancreatic tissue in juvenile diabetic and the possible complications related to brain hippocampal area CA3 (Mathada et al. 2012).

Anti-inflammatory activity, antipyretic activity, and analgesic

Leaf and flower extracts of *C. ternatea* have been identified as having an inflammatory activity (Devi et al., 2003; Bathia et al., 2013; Suganya et al., 2014; Singh et al., 2018). Petroleum ether extract and ethanol resulted in the analgesic activity that ethanol-treated extract showed up to 2 hours of long-lasting effect (Bathia et al. 2013). Flavonoids were important for anti-inflammatory, analgesic, and antipyretic activities in *C. ternatea* (Devi et al., 2003). The methanol extract of *C. ternatea* root at 200, 300, and 400 mg/kg body weight doses. The yeast-provoked raised the temperature dose-dependent and decreased the temperature body to normal (Parimaladevi et al. 2004). Drugs (narcotics or non-narcotics) treat inflammatory and pain conditions, which are very costly and have adverse effects. Natural drugs, especially from *C. ternatea*, can be an option for providing cheaper and feasible drugs.

Antioxidant activity

The root extracts of *C. ternatea* have antioxidant activity based on some research both in white flowers and blue flowers (Patil and Patil 2011; Jadhav et al. 2013). Flower extracts of *C. ternatea* have been reported to have antioxidant activity (Kamkaen and Wilkinson 2009; Jayachitra and Padma 2012; Jadhav et al. 2013; Zingare et al. 2013; Azima et al. 2014; Iamsaard et al. 2014; Phrueksanan et al. 2014; Azima et al. 2017; Havananda and Luengwilai 2019; Lakshan et al. 2019). Biological synthesized MgO-NPs of flower extracts of *C. ternatea* showed high antioxidant activity (Sushma et al. 2016). The white flower produces higher enzyme antioxidants than the blue flower (Jayachitra and Padma 2012). Antioxidant

activity in *C. ternatea* prevents lipid peroxidation in erythrocytes, protein oxidation, and free radical-induced hemolysis (Phrueksanan et al., 2014). *C. ternatea* has enzyme and non-enzyme antioxidants rather than the other plants, such as *Eclipta prostrata* (Rao et al. 2009), *Syzygium cumini*, and *Ardisia colorata* (Azima et al. 2017). In addition, Antioxidant activity in *C. ternatea* is potent to be cosmetic properties (Kamkaen and Wilkinson 2009). Currently, the need for natural anti-rising is rising since synthetic antioxidants bring side effects such as allergies, asthma, inflammation, headache, loss of consciousness, and disorders of the eyes and stomach (Sharrmila et al., 2016). *C. ternatea* has the potential to be used as a natural antioxidant.

Nootropic activity

Nootropic activity, anxiolytic, anticonvulsant, antistress activity, and antidepressants have been found in the extracts of *C. ternatea* (Jain et al., 2003; Talpate et al. 2014). Root extracts of *C. ternatea* increase acetylcholine in the hippocampus to enhance memory and learning (Rai et al. 2001; Rai et al. 2002). An increase of rat brain acetylcholine and acetylcholinesterase activity was produced from the alcoholic extracts root of *C. ternatea* at 300 mg/kg doses (Taranalli and Cheeramkuzhy 2000). In addition, *C. ternatea* also raises episodic memory and cellularity and declines autophagy. However, several studies have reported only in experimental animals (rats). This progress is proved that *C. ternatea* has the potential for improvement in human cognitive performance.

AN RELATION BETWEEN ETHNOBOTANY AND BIOPROSPECTING

There are three critical stimuli to interfere with the community's attitudes, i.e. (i) natural stimulus, (ii) helpful stimulus, and (iii) religious stimulus (Zuhud et al. 2007). The stimuli are a powerful driver of the community's attitude and behavior for realizing conservation actions. Firstly, the natural stimulus is a sustainable resource that needs to be based on bioecology characters. This plant is a wildflower. Even though people also cultivate in the home garden (Eni et al. 2019). Farmers can increase their income and conserve agro-biodiversity through their home gardens (Mohri et al., 2013; Sutoro 2017).

Secondly, the valuable stimulus is the values of human-being needs for economic, medicine, biological/ecological, and the other benefits. It can be identified by biological/ecological utilization, medicinal uses, economic sectors, and social culture aspects (Deryanti et al., 2007; Zakiyyah et al., 2016). Exploration knowledge is an initial step to optimize the potential of *C. ternatea*. The study of ethnobotany can be used to analyze the bioprospecting of *C. ternatea*. Then, further research can continue to produce commercial products to increase income for the community. For example, the information from the ethnobotany of *C. ternatea* in Indonesia describes it as a medicinal plant, some processed products such as herbal tea (dried *C. ternatea*), coloring powder, and eye drops. Species are endangered or rare because people use natural resources to utilize knowledge or exploit. So, when the valuable stimulus can be optimized, it will empower the community to be part of conservation action. Optimizing bioprospecting can generate income and support the conservation project (Skirycz et al., 2016).

Thirdly, a religious stimulus is noble values, especially the rewards from God, spiritual values, universal religious values, merit, happiness, cultural/traditional wisdom, inner satisfaction, and many more. For instance, a local concept of traditional medicine called "Usada Taru Pramana" in Bali. In the idea, *C. ternatea* is regarded as a medicinal plant for the eye (Cahyaningsih et al. 2019). Bali communities admit *Usada* or *Aushadhi* in Sanskrit as guidance for plant medicine (Sutomo and Iryadi 2019). It is related to the Hindu-Bali's belief, *Tri Hita Karana*. *Tri Hita Karana* is the philosophy of harmony relation between human beings and God (*parhyangan*), harmony with other people (*pawongan*), and connection with nature (*palemahan*) (Wirawan and Pendit 2017) (Figure 2). *Parhyangan* is a value/mindset element that can be described in the existence of the Hindu temple. According to Suarmini (2011), *Parhyangan* associated with social subsystems is realized by conducting ceremonies on certain days. In these ceremonies, *C. ternatea* is usually used as one of the elements. *Pawongan* is associated with a social subsystem, where the community has to maintain harmony and togetherness. *Palemahan* is related to the mindset/value realized in preserving, such as a village, village forest, and nature. Rather than exploiting nature, *Palemahan* intends to think that nature is an equitable partner.

Based on the three critical stimuli to the effect of community's attitudes, the relation between ethnobotany, bioprospecting, society, and conservation was shown in Figure 3. We modified the circle of regard by adding ethnobotany as a part of values. Since Indonesia is rich in ethnobotany knowledge that can be a source of natural products. In exploration (ethnobotany), species are still known locally and limited. Thus, comprehensive research by government research institutes or private industries is needed for scientifically proven. The result of the study is products that can be promoted to more comprehensive customers. The products can be used as commercial products. Finally, the study should provide an economic impact on the communities and motivate communities to conserve them.

FUTURE OUTLOOK OF MARKET OVERVIEW

According to the Indonesian Agriculture Ministry Decree Number 511/Kpts/PD.310/9/2020, *C. ternatea* on kinds of plant commodities fostered by Directorate General of Plantation, Directorate General of Food Crops, and the Directorate General of Horticulture (Indonesian Agriculture Ministry 2020) However, in the market overview, the production of *C. ternatea* products are still not optimal. However, herbal medicine is rising gradually with the "back to nature" trend worldwide (Fernandes et

al., 2019). In 2019, the traditional medicine industrial sector grew above 6% or above the national economic growth. Industries absorbed herbal medicine of 63% total market, then exports by 14%, and for household consumption 23% in 2007 (Indonesian Agriculture Ministry 2007). In Indonesia, most herbal medicine consumers are economically categorized as the low-middle class (Andriati and Wahjudi 2016).

A qualitative study with descriptive analysis was used to survey the three most significant marketplaces in Indonesia, e.g., Bukalapak (www.bukalapak.com), Tokopedia (www.tokopedia.com), and Shopee (www.shopee.co.id). It aimed to know the diversity of *C. ternatea* in the Indonesian marketplace. We observed the products sold from 100 procedures in each marketplace (Figure 4). Result explicate that *C. ternatea* was mostly sold as a dried flower tea (Tokopedia of 65%, Bukalapak of 53%, and Shopee of 74%) and a commercial seed/seedling (Tokopedia of 22%, Bukalapak 41%, and Shopee 22%). This result is identical with ethnobotany information which said that the flower of *C. ternatea* is used the most. Less than 10% of *C. ternatea* was used for beverages. Also, there was a product of eye drops (1%). The same percentage of 1% was used for fresh leaf, flower, and coloring powder. Thus, according to this data, the utilization of *C. ternatea* has still not developed optimally.

The current development of technology eliminates the gap between producers and consumers. Through e-commerce, for instance, it is easier for the farmers to enlarge their market access, increase the sale, and reduce transaction costs (Chang and Just 2009; Mishra et al. 2009; Zapata et al. 2016; Fecke et al. 2018). In January 2020, the total of internet users in Indonesia reached + 175.4 M, and this number increased by +17% between 2019 and 2020. That makes Indonesia the top five most significant internet users, with people spending 7 hours 59 minutes longer than globally (Kemp 2020). This condition leads to a shift of consumers' behavior from conventional to digital in their daily activities.

Most producers are small-medium enterprises that use home gardens or limited land and partnership farmers with social enterprises to sell and process their products—for example, empowering farmers through the partnership that Agradaya dan Javara has done. Javara claims to have a partnership with more than 5000 farmers throughout Indonesia and is visioning "to preserve Indonesia's biodiversity and brings community-based, organic products to broader markets" (Javara 2020). On the other hand, Agradaya has a partnership with more than 300 farmers in Yogyakarta and East Java and brings a mission of "collaboration for sustainable agriculture" (Agradaya 2019).

C. ternatea is also grown for urban farming since it can live in various habitat types. For instance, Konekroot is rooftop farming that has hydroponic, aquaponics, and organic agriculture (Konektoot 2019). They sell processing *C. ternatea* for dried tea or seed/seedling. They also use *C. ternatea* for garnish of food. Besides that, Kebun Kumara, a social enterprise located in Jakarta, grows *C. ternatea* in its urban space for agriculture. Like Konekroot, Kebun Kumar also sells seed/seedling of *C. ternatea* (Kebun Kumara 2019).

In conclusion, the ethnobotany of *C. ternatea* can be knowledge resources for bioprospecting in several utilizations, such as food and beverage, agriculture, and medicine. Through innovation, technology, and research,, the potential of *C. ternatea* can be explored to provide high-quality products under tremendous opportunities. We hope that the study will impact communities' economics and escalate their motivation to conserve *C. ternatea*.

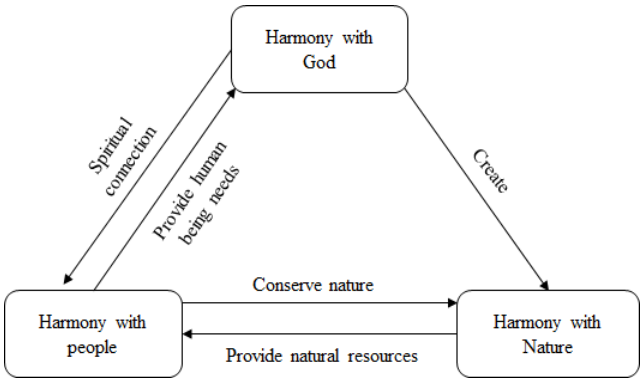

Figure 2. The ancient Balinese philosophy of Tri Hita Karana (Nias Press in Zen et al. 2019)

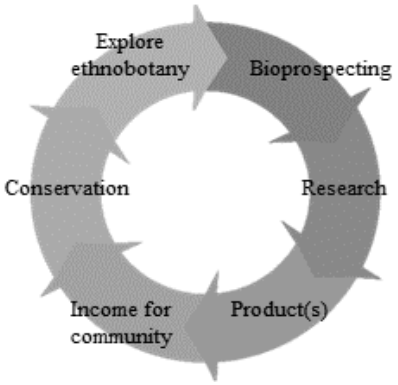

Figure 3. Ideal relation between ethnobotany, bioprospecting, community, and conservation

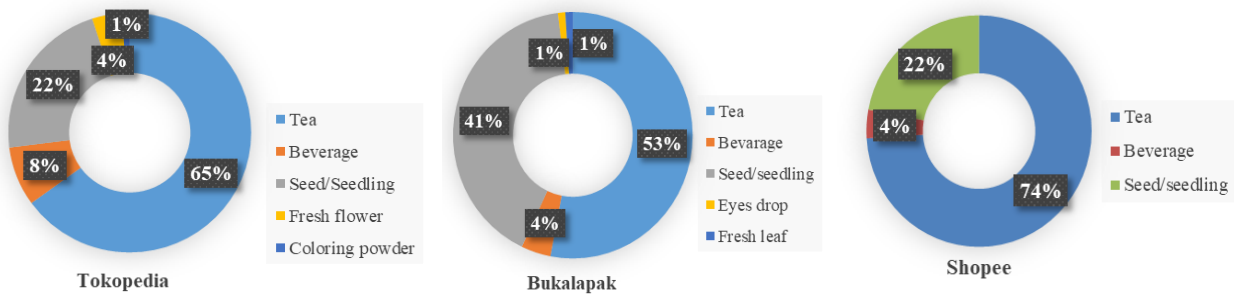

Figure 4. The diversity of products of *C. ternatea* in Indonesia's e-commerce; source: Tokopedia (www.tokopedia.com), Bukalapak (www.bukalapak.com), and Shopee (www.shopee.co.id)

REFERENCES

Abdelhamid AM, Gabr AA. 1993. The evaluation of new fodder sources (*Clitoria* and *Pillipesara*) under Egyptian conditions. Arch Anim Nutr 44: 85-93. DOI: 10.1080/17450399309386060.

Abreu MLC, Vieira RAM, Rocha NS, Araujo RP, Gloria LS, Fernandes AM, de Lacerda PD, Junior AG. 2014. *Clitoria ternatea* l. as a potential high quality forage legume. Asian Australas J Anim Sci 27 (2): 169-178. DOI: 10.5713/ajas.2013.13343.

Agradaya. 2019. About Agradaya. Retriveved from https: //www.agradaya.id/

Ajesh K, Sreejith K. 2014. A novel antifungal protein with lysozyme-like activity from seeds of *Clitoria ternatea*. Appl Biochem Biotechnol 173: 682-693. DOI: 10.1007/s12010-014-0880-8.

Al-Snafi AE. 2016. Pharmacological importance of *Clitoria ternatea*-A review. IOSR J Pharm 6 (3): 68-83.

Alderete-Chevez A, Guerra-Santos JJ, Cruz-Lander NDL, Brito R, Guevera E, Gelbert R, Nunez E, Endanu E, Amador-del Angel LE. 2011. Evaluation of *Clitoria ternatea* L. in relation to fertility in tropical soils. J Appl Sci 11 (6): 1044-1048. DOI: 10.3923/jas.2011.1044.1048.

Amanati L. 2014. *Staphylococcus Aureus* and *Bacillus Cereus* bacteria test on instant noodle products at the market. Ber Litbang Industri 3 (2): 73-80.

Anand SP, Doss A, Nandagopalan V. 2011. Antibacterial studies on leaves of *Clitoria ternatea* Linn.-a high potential medicinal plant. Intl J Appl Biol Pharm Technol 2 (3): 453-456.

Andriati, Wahjudi RMT. 2016. Society's acceptance level of herb as alternative to modern medicine for lower, middle, and upper-class groups. Masyarakat, Kebud dan Polit 29 (3): 133-145. DOI: 10.20473/mkp.V29I32016.133-145.

Angriani L. 2019. The potential of extract butterfly pea flower (*Clitoria ternatea* L.) as a local natural dye for various food industries. Canrea J 2 (1): 32-37.

Anthika B, Kusumacahyo SP, Sutanto H. 2015. Ultrasonic approach in *Clitoria ternatea* (butterfly pea) extraction in water extract sterilization by ultrafiltration for eye drop active ingredients. Procedia Chem 16: 237-244. DOI: 10.1016/j.proche.2015.12.046.

Avalos JSV, Cardenas JAB, Ceja JVR, Guerrero JJB. 2004. Agrotechnics and use of *Clitoria ternatea* in beef and milk production systems. Téc Pecu Méx 42 (1): 79-96.

Azima S AM, Noriham A, Manshoor N. 2017. Phenolics, antioxidants, and color properties of aqueous pigmented plant extracts: *Ardisia colorata* var. *elliptica*, *Clitoria ternatea*, *Garcinia mangostana*, and *Syzygium cumini*. J Funct Foods 38: 232-241. DOI: 10.1016/j.jff.2017.09.018.

Azima SAM, Noriham A, Manshoor N. 2014. Anthocyanin content in relation to the antioxidant activity and colour properties of *Garcinia mangostana* peel, *Syzygium cumini*, and *Clitoria ternatea* extracts. Intl Food Res J 21 (6): 2369-2375.

Banerjee SK, Chakravarti RN. 1964. Taraxerone from *Clitoria ternatea* Linn. Bull Calcutta Sch Trop Med 12: 23.

Barro C, Ribeiro A. 1983. The study of *Clitoria ternatea* L. hay as a forage alternative in tropical countries. Evolution of the chemical composition at four different growth stages. J Sci Food Agric 34: 780-782. DOI: 10.1002/jsfa.2740340803.

Barros NN, Freire LCL, Lopes EA, Johnson WL. 1991. Comparative study of digestibility of forage legume with sheep and goats. 1: in vivo digestibility of cunha hay. Pesq Agropec Bras 26: 1209-1213.

Bathia M, Chahal J, Gupta S. 2013. Analgesic and anti-inflammatory activities of *Clitoria ternatea* Linn. leaves extract on rat model. Intl J Pharm Sci Res 5 (2): 600-660.

Beattie AJ, Barthlott W. Elisabetsky E, Farrel R, Kheng CT, Rosenthal JP, Simpson D, Leakey RRB, Wolfson M, Laird S. 2005. New products and industries from biodiversity. Ecosystems and Human Well-Being. In: Hassan R, Scholes R, Ash N (eds). Millennium Ecosystem Assessment. Island Pr., Washington DC.

Bharti S, Kumari D. 2017. Drought stress response in *Clitoria ternatea* L. Intl J Informative & Futuristic Res 4 (10): 7932-7940.

Borikar SP, Kallewar NG, Mahapatra DK, Dumore NG. 2018. Dried flower powder combination of *Clitoria ternatea* and *Punica granatum* demonstrated analogous anti-hyperglycemic potential as compared with standard drug metformin: In vivo study in Sprague Dawley rats. J Appl Pharm Sci 8 (11): 75-79. DOI: 10.7324/JAPS.2018.81111.

Budi US, Basuki N, Sudjindro. 2006. The resistance character inheritance of root-knot nematode (*Meloidogyne incognita*) in kenaf (*Hibiscus cannabinus* L.). Zuriat 17 (1): 60-65. DOI: 10.24198/zuriat.v17i1.6755.

Bukalapak. 2020. Telang. Retriveved from www.bukalapak.com

Cahyaningsih E, Shandi PEK, Santoso P. 2019. Phytochemical screening and antioxidant activity of telang flower extract (*Clitoria ternatea* L.) using uv-vis spectrophotometry. J Ilm Medicam 5 (1): 51-57. DOI: 10.36733/medicamento.v5i1.851.

Chang HH, Just DR. 2009. Internet access and farm household income-empirical evidence using a semi-parametric assessment in Taiwan. J Agric Econ 60 (2): 348-366. DOI: 10.1111/j.1477-9552.2008.00189.x.

Chen LH, Chen IC, Chen PY, Huang PH. 2018. Application of butterfly pea flower extract in mask development. Sci Pharm 86 (53): 1-9. DOI: 10.3390/scipharm86040053.

Chusak C, Henry C, Chantarasinlapin P, Techasukthavorn V, Adisakwattana S. 2018b. Influence of *Clitoria ternatea* flower extract on the in vitro enzymatic digestibility of starch and its application in bread. Foods 7 (7): 102. DOI: 10.3390/foods7070102.

Chusak C, Thilavech T, Henry CJ, Adisakwattana S. 2018a. Acute effect of *Clitoria ternatea* flower beverage on glycemic response and antioxidant capacity in healthy subjects: a randomized crossover trial. BMC Compl Altern Med 18 (1): 1-11. DOI: 10.1186/s12906-017-2075-7.

Chusak C, Ying JAY, Zhien JL, Pasukamonset P, Henry CJ, Ngamukote S, Adisakwattana S. 2019. Impact of *Clitoria ternatea* (butterfly pea) flower on in vitro starch digestibility, texture, and sensory attributes of cooked rice using domestic cooking methods. Food Chem 295: 646-652. DOI: 10.1016/j.foodchem.2019.05.157.

Daisy P, Rajathi M. 2009. Hypoglycemic Effects of *Clitoria ternatea* Linn. (Fabaceae) in Alloxan-induced Diabetes in Rats. Trop J Pharm Res 8 (5): 393-398. DOI: 10.4314/tjpr.v8i5.48082.

Das AK. 2003. Citrus canker-A review. J Appl Hort 5 (1): 52-60. DOI: 10.37855/jah.2003.v05i01.15.

Das N, Chatterjee P. 2014. Antifungal effect of *Clitoria ternatea* leaf extract on seeds of *Pisum sativum* in relation to the activities of some enzymes. Intl J Res Ayurveda Pharm 5: 99-101. DOI: 10.7897/2277-4343.05120.

De Souza ES, Burity HA, Olivera J, Figueiredo MVB, de Lyra MDCCP. 1996. N2-fixation and growth of the calopogonium (*Calopogonium mucunoides* devs.) and of the clitoria (*Clitoria ternatea* L.) after successive cuts. Rev Bras Zootec 25 (6): 1036-1048.

Defiani MR, Kriswiyanti E. 2019. Floral diversity in Mincidan Village, Klungkung, Bali to support ecotourism. Simbiosis 7 (1): 14– 21. DOI: 10.24843/JSIMBIOSIS.2019.v07.i01.p04.

Deryanti T, Zuhud EAM, Soekmadi R. 2007. Conservation of nutmeg (*Myristica fragrans* Houtt) an analysis of three stimulus amar (natural, use, willing) pro-conservation cases in Bogor Regency. Media Konserv 19 (1): 47-56.

Destryana RA, Ismawati. 2019. Ethnobotany and the use of wild plants as traditional medicine by the Madura Communities (study case in

Lenteng, Guluk-guluk, and Bluto Districts). J Food Technol Agroindustry 1 (2): 1-8.
Devi BP, Boominathan R, Mandal SC. 2003. Anti-inflammatory, analgesic, and antipyretic properties of *Clitoria ternatea* root. Fitoterapia 74: 345-349. DOI: 10.1016/S0367-326X(03)00057-1.
Dewi, AP, Setyawardani T, Sumarmono J. 2019. The Effect of Butterfly Pea (*Clitoria ternatea*) Addition on Syneresis and Levels of Pleasure of Goat Milk Yoghurt. ANGON: J Anim Sci Technol 1 (2): 145-151.
Dhiman MR, Kumar S, Parkash C, Kumar R, Moudgil S, Sharma S. 2017. Determination of phytochemical and antioxidant activities in edible flowers. Intl J Hortic 7 (4): 26-32. DOI: 10.5376/ijh.2017.07.0004.
Diyasti F, Santoso T, Kusumah YM. 2016. Morphology, biology, and molecular characteristics of three isolates of *Helicoverpa armigera* Nucleopolyhedrovirus (*HearNPV*) against cotton bollworm, *Helicoverpa armigera* Hubner (Lepidoptera: Noctuidae). Indones J Entomol 13 (3): 117-126. DOI: 10.5994/jei.13.3.117.
Ekantini PRRI, Mega KT, Prasojo P. 2017. Identification of *Bacillus Cereusbacteria* on wets noodle in Kebonpolo Market of Magelang. J Farm Sains Praktis 3 (1): 1-5.
Elamin KM, Elkhairey MA, Ahmed HB, Musa AM, Bakhiet AO. 2011. Effect of different feeds on performance and some blood constituents of local rabits. Res J Vet Sci 4 (2): 37-42. DOI: 10.3923/rjvs.2011.37.42.
Eni NNS, Sukenti K, Muspiah A, Rohyani IS. 2019. Ethnobotany study of medicinal plants in the Hindu Community of Jagaraga Village, West Lombok Regency, West Nusa Tenggara. Biotropika J Trop Biol 7 (3): 121-128. DOI: 10.21776/ub.biotropika.2019.007.03.5.
Febrianti BA. 2019. Utilization of anthocyanin pigments from several plants as a natural color in the making of getuk lindri. [Dissertation]. UIN Raden Intan, Lampung. [Indonesian].
Fecke W, Danne M, Musshoff, O. 2018. E-commerce in agriculture-The case of crop protection product purchases in a discrete choice experiment. Comput Electron Agric 151: 126-135. DOI: 10.1016/j.compag.2018.05.032.
Fernandes L, Casal S, Pereira JA, Saraiva JA, Ramalhosa E. 2019. An overview on the market of edible flowers. Food Rev Int: 1-18.
Fernandes L, Saraiva JA, Pereira JA, Casal S, Ramalhosa E. 2018. Post-harvest technologies applied to edible flowers: a review. Food Rev Intl 36 (3): 1-23. DOI: 10.1080/87559129.2019.1639727.
Gilding EK, Jackson MA, Poth AG, Heriques ST, Prentis PJ, Mahatmo T, Craik DJ. 2015. Gene coevolution and regulation lock cyclic plant defense peptides to their targets. New Phytologist 210 (2): 717-730. DOI: 10.1111/nph.13789.
Gillett JB, Polhill RM, Verdcourt B. 1971. Flora of Tropical East Africa, Leguminosae. Crown Agents for Overseas Governments and Administrations, London.
Gomez SM, Kalamani A. 2003. Butterfly pea (*Clitoria ternatea*): a nutritive multipurpose forage legume for tropics-an overview. Pak J Nutr 2 (6): 374-379. DOI: 10.3923/pjn.2003.374.379.
Grindley DN, Burden EHWJ, Akour AA. 1954. The seed oils of *Clitoria ternatea* and of Entada phaseoloides. J Sci Food Agric 5 (6): 278-280. DOI: 10.1002/jsfa.2740050605.
Gupta GK, Jagbir Chahal J, Bhatia M. 2010. *Clitoria ternatea* (L.): old and new aspects. J Pharm Res 3 (11): 2610-2614.
Habish HA, Mahdi AA. 1979. Nodulation of Legumes in the Sudan. East African Agric For J 44 (3): 229-236. DOI: 10.1080/00128325.1979.11663013.
Hall TJ. 1985. Adaptation and agronomy of *Clitoria ternatea* L. in Northern Australia. Trop Grassland 19 (4): 156-163.
Hariadi H, Sunyoto M, Nurhadi B, Karuniawan A. 2018. Comparison of phytochemical characteristics pigment extract (Antosianin) sweet purple potatoes powder (*Ipomoea batatas* L.) and clitoria flower (*Clitoria ternatea*) as natural dye powder. J Pharma Phytochem 7 (4): 3420-3429.
Hartono, Angelia M. 2013. Utilization of extract butterfly pea flowers (*Clitoria ternatea* L.) as natural colorant of ice lolly. J Biol: 1-15.
Haryanti ES, Diba F, Wahdina. 2015. Ethnobotany of useful plant society around the Area Model KPH Kapuas Upstream (case study Tamao Village, District Embaloh Hulu West Kalimantan). J Hutan Lestari 3 (3): 434-445.
Hasan N, Jain RK. 1985. Preliminary assessment of the response of *Clitoria ternatea* lines to the root-knot nematode, *Meloidogyne Incognita*. Nematologica 31: 236-238. DOI: 10.1163/187529285X00319.
Havananda T, Luengwilai K. 2019. Variation in floral antioxidant activities and phytochemical properties among butterfly pea (*Clitoria ternatea* L.) germplasm. Genet Resour Crop Evol 66: 645-658. DOI: 10.1007/s10722-018-00738-6.
Husain S, Devi KS. 1998. Fatty acid composition of three plant species: *Clitoria ternatea*, *Mandulea suberosa* and *Ruta chalapensis*. J Oil Technol Assoc India 30: 162-164.
Hutajulu TF, Sari R, Djumarman. 2008. Identification of phenol and delphinidin in the telangs flower (*Clitoria ternatea* L.) and its effectivity to *Staphylococcus aureus* as eyes bacterial disease. J Agro-Based Ind 25 (2): 35-44.
Iamsaard S, Burawat J, Kanla P, Arun S, Sukhorum W, Sripanidkulchai B, Uabundit N, Wattathorn J, Hipkaeo W, Fongmoon D, Kondo H. 2014. Antioxidant activity and protective effect of *Clitoria ternatea* flower extract on testicular damage induced by ketoconazole in rats. J Zhejiang Univ-Sci B 15 (6): 548-555. DOI: 10.1631/jzus.B1300299.
Indonesian Agriculture Ministry. 2007. Prospect and Directions of Agribusiness Development for Medicinal Plant. Indonesian Agency for Agricultural Research and Development, Bogor.
Indonesian Agriculture Ministry. 2020. Plant commodities fostered by the Directorate General of Plantation, Directorate General of Food Crops, and the Directorate General of Horticulture. Indonesian Agriculture Ministry, Jakarta.
International Diabetes Federation. 2020. IDF Western Pacific members. Retriveved from https: //www.idf.org/our-network/regions-members/western-pacific/members/104-indonesia.html
Irmawatie L, Robana RR, Nuraidah N. 2019. Resistance of seven tomato varieties to root-knot nematodes (*Meloidogyne* spp.) Agrotech. Res. J. 3 (2): 61-68. DOI: 10.20961/agrotechresj.v3i2.30392.
Ismawati, Destryana RA. 2019. Inventory of wild plant type of traditional medicine Madura Sumenep Communities. Simbiosis 7 (2): 37-43. DOI: 10.24843/JSIMBIOSIS.2019.v07.i02.p04.
Jadhav V, Deshmukh S, Mahadkar S. 2013. Evaluation of the antioxidant potential of *Clitoria ternatea* L. Intl J Pharm Pharm Sci 5 (2): 595-599.
Jain NN, Ohal CC, Shroff SK, Bhutada RH, Somani RS, Kasture VS, Kasture SB. 2003. *Clitoria ternatea* and the CNS. Pharmacol Biochem Behav 75 (3): 529-536. DOI: 10.1016/S0091-3057(03)00130-8.
Jamil N, Zairi MNM, Nasim NAM, Pa'ee F. 2018. Influences of Environmental Conditions to Phytoconstituents in *Clitoria ternatea* (Butterfly Pea Flower)-A Review. J Sci Technol 10 (2): 208-228. DOI: 10.30880/jst.2018.10.02.029.
Javara. 2020. About Javara. Retriveved from https: //javara.co.id/
Jayachitra A, Padma PR. 2012. Antioxidant potential of *Clitoria ternatea* leaf extract in vitro. Intl J Pharm Bio Sci 3 (4): 753-763.
Jayani DH. 2019. How Many People Use the Internet?Retrieved from https: //databoks.katadata.co.id/datapublish/2019/09/09/berapa-pengguna-internet-di-indonesia.
Joshi SS, Shrivastava RK, Shrivastava DK. 1981. Chemical examination of *Clitoria ternatea* seeds. J Am Oil Chem Soc 58 (6): 714.DOI: 10.1007/BF02899459.
Juma HK, Abdulrazak SA, Muinga RW, Ambula MK. 2006. Evaluation of *Clitoria*, *Gliricidia*, and *Mucuna* as nitrogen supplements to Napier grass basal diet in relation to performance of lactating Jersey cows. Livest Sci 103: 23-29. DOI: 10.1016/j.livsci.2005.12.006.
Kamila L, Mnsor SM, Ramanathan S, Sasidharan S. 2009. Antimicrobial activity of *Clitoria ternatea* (L.) extracts. Pharm online 1: 731-738
Kamkaen N, Wilkinson JM. 2009. The antioxidant activity of *Clitoria ternatea* flower petal extracts and eye gel. Phytother Res 23: 1624-1625. DOI: 10.1002/ptr.2832.
Karel A, Kumar H, Chowdhary B. 2018. *Clitoria ternatea* L. a miraculous plant. Intl J Curr Microbiol Appl Sci 7 (9): 1-4. DOI: 10.20546/ijcmas.2018.709.079.
Kavitha R. 2018. Biochemical studies on the effect of ethanolic extracts of *Trichosanthes dioica* and *Clitoria ternatea* in streptozotocin-induced diabetic male Wistar rats. Intl J Pharm Sci Res 9 (11): 4682-4689.
Kazuma K, Kogawa K, Noda N, Kato N, Suzuki M. 2004. Identification of delphinidin 3-O-(6-O-malonyl)--glucoside-3-O--glucoside, a postulated intermediate in the biosynthesis of ternatin C5 in the blue petals of *Clitoria ternatea* (butterfly pea). Chem Biodivers 1: 1762-1770. DOI: 10.1002/cbdv.200490132.
Kazuma K, Noda N, Suzuki M. 2003b. Flavonoid composition related to petal color in different lines of *Clitoria ternatea*. Phytochem 64: 1133-1139. DOI: 10.1016/S0031-9422(03)00504-1.
Kazuma K, Noda N. Suzuki M. 2003a. *Malonylated flavonol* glycosides from the petals of *Clitoria ternatea*. Phytochem 62: 229-237. DOI: 10.1016/S0031-9422(02)00486-7.
Kebun Kumara. 2019. About us. Retriveved from https: //www.kebunkumara.id/
Kelemu S, Cardona C, Segura G. 2004. Antimicrobial and insecticidal protein isolated from seeds of *Clitoria ternatea*, tropical forage legume. Plant Physiol Biochem 42: 867-873. DOI: 10.1016/j.plaphy.2004.10.013.
Kemp S. 2020. Digital 2020: Global Digital Overview. In Global Digital Insights. Retrieved from https: //datareportal.com/reports/digital-2020-global-digital-overview.
Khaeruni A, Tjahjono B, Suswanto A, Sinaga MS. 2007. Rapid detection of bacterial pustule disease on soybean employing PCR technique

with specific primers. Hayati J Biosci 14 (2): 76-80. DOI: 10.4308/hjb.14.2.76.

Khaeruni A, Tjahjono B, Suswanto A, Sinaga MS. 2008. Virulence of some *Xanthomonas axonopodis* pv. glycines Isolates from Edamame on three soybean varieties. J. Hama dan Penyakit Tumbuhan Trop 8 (1): 39-46. DOI: 10.23960/j.hptt.1839-46.

Konekroot. 2019. The importance of urban food. Retriveved from https: //konekroot.com/

Kulshrestha DK, Khare MP, 1967. Chemical investigation of the seeds of *Clitoria ternatea*. Curr Sci 36: 124-125.

Kulshrestha DK, Khare MP. 1968. Chemical study of *Clitoria ternatea* seeds. Chemische Berichte 101: 2096-2105. DOI: 10.1002/cber.19681010627.

Kumar V, Mukherjee K, Kumar S, Mal M, Mukherjee PK. 2008. Validation of HPTLC method for the analysis of taraxerol in *Clitoria ternatea*. Phytochem Anal 19: 244-250. DOI: 10.1002/pca.1042.

Kumari NV. Devi ML. 2013. Effect of some indigenous plant extracts on the inhibition of egg hatching of nematode *Meloidogyne incognita* Chitwood infesting mulberry. Hort Flor Res Spec 2: 35-39.

Kusrini E, Tristantini D, Izza N. 2017. Activity test of telang flower extract (*Clitoria ternatea* L.) as an anti-cataract agent. J Jamu Indones 2 (1): 30-36. DOI: 10.29244/jji.v2i1.28.

Kusuma AD. 2019. The potential of telang flower tea (*Clitoria ternatea*) as a medicinal herbal of phlegm thinner through a mucosity test. Resenologi 4 (2): 13-19. DOI: 10.47028/j.risenologi.2019.42.53.

Lakshan SAT, Jayanath NY, Abeysekera WPKM, Abeysekera WKSM. 2019. A commercial potential blue pea (*Clitoria ternatea* L.) flower extract incorporated beverage having functional properties. Evid-Based Compl Altern Med 2019 (3): 1-13. DOI: 10.1155/2019/2916914.

Macedo MLR, Xavier-Filho J. 1992. Purification and partial characterisation of trypsin inhibitors from seeds of *Clitoria ternatea*. J Sci Food Agric 58 (1): 55-58. DOI: 10.1002/jsfa.2740580110.

Mahala AG, Amasiab SO, Yousif MA, Elsadig A. 2012. Effect of plant age on dm yield and nutritive value of some leguminous plants (*Cyamopsis tetragonoloba*, *Lablab purpureus* and Clitoria (*Clitoria ternatea)*. Intl Res J Agric Sci Soil Sci 2 (12): 502-508.

Manjula P, Mohan CH, Sreekanth D, Keerthi B, Devi BP. 2013. Phytochemical analysis of *Clitoria ternatea* Linn., a valuable medicinal plant. J Indian Bot Soc 92 (3&4): 173-178.

Marin A, Carias D, Maria CA, Hevia P. 2003. Nutritive value of leaves of *Musa paradisiaca* and *Clitoria ternatea* as diluents in diets for broilers. Interciencia 28: 5156.

Mathada RV, Jevoor PS, Ravishankar R. 2012. Effect of C*litoria ternatea* linn plant root extract on the hippocampal area Ca 3 and pancreas of juvenile diabetic rats-A preliminary investigation. Spatulla DD 2 (1): 9-16. DOI: 10.5455/spatula.20120119052120.

Mensah R, Leach D, Young A, Watts N, Glennie P. 2015. Development of *Clitoria ternatea* as a biopesticide for cotton pest management: assessment of product effect on *Helicoverpa* spp. and their natural enemies. Entomol Exp Appl 154: 131-145. DOI: 10.1111/eea.12263.

Mishra AK, Williams RP, Detre JD. 2009. Internet access and internet purchasing patterns of farm households. Agricultural and Resource Econ Rev 38 (2): 240-257. DOI: 10.1017/S1068280500003233.

Mohri H, Lahoti S, Saito O, Mahalingam A, Gunatilleke N, Irham, Hoang VT, Hitinayake G, Takeuchi K, Herath S. 2013. Assessment of ecosystem services in home garden systems in Indonesia, Sri Lanka, and Vietnam. Ecosyst Serv 5: 124-136. DOI: 10.1016/j.ecoser.2013.07.006.

Monforte J, Carías D, Cioccia AM, Hevia P. 2002. Nutritional value of *Clitoria ternatea* and *Brachiaria humidicola* meals in broiler feeding. Interciencia 27: 33-38.

Morita N, Arisawa M, Nagase M, Hsu H, Chen Y. 1977. Studies on the constituents of Formosan Leguminosae. I.: The constituents in the leaves of *Clitoria ternatea* L. Yakugaku Zasshi 97 (6): 649-653. DOI: 10.1248/yakushi1947.97.6_649.

Muir JP, Massaete ES. 1996. Seasonal growth in rabbits fed wheat and maize bran with tropical forages. Livest Res Rural Dev 8 (1).

Mukherjee PK, Kumar V, Kumar NS, Heinrich M. 2008. The Ayurvedic medicine *Clitoria ternatea*—From traditional use to scientific assessment. J Ethnopharmacol 120 (3): 291-301. DOI: 10.1016/j.jep.2008.09.009.

Mukherjee PK, Wahile A. 2006. Integrated approaches towards drug development from Ayurveda and other Indian systems of medicines. J Ethnopharmacol 103: 25-35. DOI: 10.1016/j.jep.2005.09.024.

Mulangsari DAK. 2019. Training to make dried telang flowers as tea brewing in Putra Baiti Jannati Orphanage. Abdimas Unwahas 4 (2): 93-96.

Nguyen GKT, Zhang S, Ngan TKN, Phuong QTN, Chiu MS, Hardjojo A Tam JP. 2011. Discovery and characterization of novel cyclotides originated from chimeric precursors consisting of albumin-1 chain and cyclotide domains in the Fabaceae family. J Biol Chem 286, 24275-24287. DOI: 10.1074/jbc.M111.229922.

Nguyen KN, Nguyen GK, Nguyen PQ, Ang KH, Dedon PC, Tam JP. 2016. Immunostimulating and gram-negative-specific antibacterial cyclotides from the butterfly pea (*Clitoria ternatea*). FEBS J 283: 2067-2090. DOI: 10.1111/febs.13720.

Njunie MN, Wagger, MG, and Luna-Orea P. 2004. Residue decomposition and nutrient release dynamics from two tropical forage legumes in a Kenyan environment. Agron J 96: 1073-1081. DOI: 10.2134/agronj2004.1073.

Nunik J. 2009. Butterfly pea (*Clitoria ternatea*) as an herbaceous legume alternative for the integrated farming system of cattle and maize in Timor Island. Wartazoa 19 (1): 43-51.

Oguis GK, Gilding EK, Jackson MA, Craik DJ. 2019. Butterfly pea (*Clitoria ternatea*), a cyclotide-bearing plant with applications in agriculture and medicine. Front Plant Sci 10: 1-23. DOI: 10.3389/fpls.2019.00645.

Oktavia GAE, Darma IDP, Sujarwo W. 2019. Ethnobotanical study of medicinal plants in the Area Around Buyan-Tamblingan. Bul Kebun Raya 20 (1): 1-16.

Palimbong S, Pariama AS. 2020. Potential of telang flower extract (*Clitoria ternatea* Linn) as a colorant on sticky rice tapai products. J Sains dan Kesehat 2 (3): 228-235.

Panda S. 2018. A mini-review on non-caffeinated blue tea. Intl J Innov Res Eng Multidiscip Phys Sci 6 (4): 710-713.

Parimaladevi B, Boominathan R, Mandal SC. 2004. Evaluation of antipyretic potential of *Clitoria ternatea* L. extracts in rats. Phytomedicine 11: 323-326. DOI: 10.1078/0944711041495191.

Patil AP, Patil VR. 2011. Comparative evaluation of in vitro antioxidant activity of root of blue and white flowered varieties of *Clitoria ternatea* Linn. Intl J Pharmacol 7 (4): 485-491. DOI: 10.3923/ijp.2011.485.491.

Permana MAW. 2019. The development of natural dye from butterfly pea candy products [Dissertation]. Universitas Pendidikan Indonesia, Bandung. [Indonesian].

Petrova I, Petkova N, Inanov I. 2016. Five edible flowers-valuable sources of antioxidants in human nutrition. Intl J Pharmacogn Phytochem Res 8 (4): 604-610.

Phrueksanan W, Yibchok-anun S, Adisakwattana. 2014. Protection of *Clitoria ternatea* flower petal extract against free radical-induced hemolysis and oxidative damage in canine erythrocytes. Res Vet Sci 97 (2): 357-363. DOI: 10.1016/j.rvsc.2014.08.010. DOI: 10.1073/pnas.1103660108.

Poth AG, Colgrave ML, Lyons RE, Daly NL, and Craik DJ. 2011. Discovery of an unusual biosynthetic origin for circular proteins in legumes. Proc Natl Acad Sci USA 108: 10127-10132.

Pradana AP, Munif A, Supramana. 2016. Endophytic bacteria from the root of several plants as biocontrol agents of the root-knot nematode *Meloidogyne incognita* on tomato. J Fitopatol Indones 12 (3): 75-82. DOI: 10.14692/jfi.12.3.75.

Pratimasari D, Lindawati NY. 2018. The optimization of butterfly pea (*Clitoria ternatea*) as a natural dye for paracetamol syrup. J Fitopatol Indones J Ilm Manuntung 4 (2): 89-97. DOI: 10.51352/jim.v4i2.187.

Pushpangadan P, George V, Ijlnu TP, Chithra A. 2018. Biodiversity, bioprospecting, traditional knowledge, sustainable development, and value-added products: A review. J Tradit Med Clin Natur 7 (1): 1-7. DOI: 10.4172/2573-4555.1000256.

Rai K, Murthy K, Karanth K, Nalini K, Rao M, Srinivasan K. 2002. *Clitoria ternatea* root extract enhances acetylcholine content in rat hippocampus. Fitoterapia 73 (7-8): 685-689. DOI: 10.1016/S0367-326X(02)00249-6.

Rai KS, Murthy KD, Karanth KS, Nalini K, Rao MS, Srinivasan KK. 2001. *Clitoria ternatea* (Linn) root extract treatment during the growth spurt period enhances learning and memory in rats. Indian J Physiol Pharmacol 45 (3): 305-313.

Rajagopalan N.1964. Free amino acids and amides in legume root nodules. Curr Sci 33: 454-456.

Rao DB, Kiran CR, Madhavi Y, Rao PK, Rao TR. 2009. Evaluation of the antioxidant potential of *Clitoria ternatea* L. and *Eclipta prostrata* L. Indian J Biochem Biophys 46: 247-252.

Revilleza MJR, Mendoza EMT, Raymundo LC. 1990. Oligosaccharides in several Philippine indigenous food legumes: Determination, localization, and removal. Plant Foods Hum Nutr 40 (1): 83-93. DOI: 10.1007/BF02193782.

Rike N, Nita ST, Sungkalang C. 2018. Ethnobotany of plant food in Dayak tamambaloh community, west Kalimantan, Indonesia. Intl J Acad Res Dev 3 (3): 267-273.

Riyanto EF, Nurjanah AN, Suharti SNI. 2019. Inhibition of ethanol extract of butterfly pea flower (*Clitoria ternatea* L.) against food-destroying bacteria. J Kesehat Bakti Tunas Husada J Ilmu-ilmu

Keperawatan, Anal Kesehat dan Farm 19 (2): 218-225. DOI: 10.36465/jkbth.v19i2.500.
Ruriani E, Nurhayati. 2010. Investigation of *Bacillus cereus* and *Salmonella* in fried rice sold by street vendor around campus. Agrotek 4 (1): 68-75.
Saati EA, Mulandari RD, Wachid M, Winarsih S. 2018. The utilization of telang flower as healthy-natural food coloring on dawet drink. the 4th International Symposium on Applied Chemistry 2018. Banteng, 1-2 November 2018. [Indonesian]. DOI: 10.1063/1.5064356.
Sandoval B, Valencia E, Rodriguez AA, Randel PF. 2009. Voluntary intake and digestibility of guineagrass (*Panicum maximum*, Jacq.)-clitoria (*Clitoria ternatea* L Dne.) hay and rhodesgrass (*Chloris gayana*, Kunth) cv. Callide hay fed to sheep. J Agr UPR 93 (1-2): 41-50.
Sardiana IK, Dinata KK. 2010. The study of the plants use in spiritual activities (upakara) by Balinese Hindu. J Bumi Lestari 10 (1): 123-127.
Schlink AC. 1998. Nutritional value of *Clitoria ternatea* for sheep in the dry tropics. Proc Aust Soc Anim Prod 22: 361.
Shahid M, Shahzad A, Anis M. 2009. Antibacterial potential of the extracts derived from leaves and in vitro raised calli of medicinal plants *Pterocarpus marsupium* Roxb., *Clitoria ternatea* L., and *Sans Aveiro Cylindrica* Bojer, Ex Hook. Orient Pharm Exp Med 9: 174-181. DOI: 10.3742/OPEM.2009.9.2.174.
Shamnad J. 2019. Mineral and nutritional potential of *Clitoria ternatea* L. variants as forage. J Trop Agric 57 (2): 163-166.
Sharmila G, Nikitha VS, Ilaiyarasi S, Dhivya K, Rajasekar V, Kumar N.M, Muthukumaran K, Muthukumaran C. 2016. Ultrasound-assisted extraction of total phenolics from *Cassia auriculata* leaves and evaluation of its antioxidant activities. Ind Crops Prod 84: 13-21. DOI: 10.1016/j.indcrop.2016.01.010.
Shofi M, Putri MP. 2020. Training on making cendol starch using blue natural dyes extracted from telang flower essence. J Commun Serv Empower 1 (1): 25-30. DOI: 0.22219/jcse.v1i1.11514.
Shopee. 2020. Telang. Retriveved from www.shopee.co.id
Singh NK, Garabadu D, Sharma P, Shrivasta SK, Mishra P. 2018. Anti-allergy and anti-tussive activity of *Clitoria ternatea* L. in experimental animals. J Ethnopharmacol 224: 15-26. DOI: 10.1016/j.jep.2018.05.026.
Skirycz A, Kierszniowska S, Meret M, Willmitzer L, Tzotzos G. 2016. Medicinal Bioprospecting of the Amazon Rainforest: A modern Eldorado?. Trends Biotechnol 34 (10): 782-790. DOI: 10.1016/j.tibtech.2016.03.006.
Srichalkul B. 2018. Ultrasonication extraction, bioactivity, antioxidant activity, total flavonoid, total phenolic, and antioxidant of *Clitoria Ternatea* Linn flower extract for an anti-aging drink. Pharmacogn Mag 14 (56): 322-327. DOI: 10.4103/pm.pm_206_17.
Srivastava BK, Pande ES. 1977. Anthocyanins from the flower of *Clitoria ternatea*. Planta Med 32: 138-140. DOI: 10.1055/s-0028-1097573.
Staples IB. 1992. "*Clitoria ternatea* L," in Plant Resources of Southeast Asia. Pudoc Scientific Pub, Wageningen.
Suarmini NW. 2011. The role of Pakraman Village in strengthening socio-cultural resilience through the knowledge concept of "Tri Hita Karana" J Sos Hum 4 (1): 1-12. DOI: 10.12962/j24433527.v4i1.635.
Suarna IW. 2005. Butterfly pea (*Clitoria ternatea*) as a forage and cover crops. In: Subandriyo, Diwyanto K, Inounu I, Prawiradiputra BR, Setiadi B, Nurhayati, Priyanti A, (eds). Lokakarya Nasional Tanaman Pakan Ternak. Bogor, 16 September 2005. [Indonesian].
Suganda T, Adhi SR. 2017. Preliminary study on the fungicidal effect of butterfly pea flower (*Clitoria ternatea* L.) against *Fusarium oxysporum* f.sp. *cepae*, the causal agent of moler diseases on shallot. J Agrikultura 28 (3): 136-140. DOI: 10.24198/agrikultura.v28i3.15746.
Suganya G, Sampath KP, Dheeba B, Sivakumar R. 2014. In vitro antidiabetic, the antioxidant and anti-inflammatory activity of *Clitoria ternatea* L. Intl J Pharm Pharm Sci 6: 342-347.
Sukanaya W. 2001. Resistance of soybean high yielding varieties against root-knot nematode (*Meloidogyne incognita*). J Perlindungan Tanam Indones 7 (1): 42-48.
Sulistiyowati N. 2016. The Traditional Knowledge of the Dayak Tamambaloh Tribe In Wildlife Hunting In Embaloh Hulu District, Kapuas Hulu Regency, West Kalimantan. [Hon. Thesis]. Universitas Gadjah Mada, Yogyakarta. [Indonesia].
Supiandi MI, Leliavia. 2019. Analysis of natural disasters knowledge in the Dayak Tamambaloh Tribe. J Biosilampari 1 (2): 45-50. DOI: 10.31540/biosilampari.v1i2.212.
Surata IK, Gata IW, Sudiana IM. 2015. Ethnobotany study of Balinese Hindu ceremonial plants as an effort to preserve traditional knowledge. J Kaji Bali 5 (2): 265-284.
Suryanti, Hadisutrisno B, Mulaydi, Widada J. 2017. Interaction of *Meloidogyne incognita* and *Fusarium solani* on pepper yellowing disease. J Perlindungan Tanam Indones 21 (2): 127-134. DOI: 10.22146/jpti.29760.
Sushma NJ, Prathyusha D, Swathi G, Madhavi T, Raju BDP, Mallikarjuna K, Kim HS. 2016. Facile approach to synthesize magnesium oxide nanoparticles by using *Clitoria ternatea*—characterization and in vitro antioxidant studies. Appl Nanosci 6: 437-444. DOI: 10.1007/s13204-015-0455-1.
Sutedi E. 2013. Potential of butterfly pea (*Clitoria ternatea*) as a forage. Wartazoa 23 (2): 51-62. DOI: 10.14334/wartazoa.v23i2.715.
Sutomo, Iryadi R. 2019. Conservation of traditional medicinal plants "Usada Bali". Bul Udayana Mengabdi 18 (9): 58-63. DOI: 10.24843/BUM.2019.v18.i04.p11.
Sutoro. 2017. Utilization and conservation of food crop genetic diversity in home gardens. Iptek Tanam Pangan 12 (2): 105-112.
Swain SS, Rout KK, Chand PK. 2012. Production of triterpenoid anti-cancer compound taraxerol in agrobacterium-transformed root cultures of butterfly pea (*Clitoria ternatea* L.). Appl Biochem Biotechnol 168 (3): 487-503. DOI: 10.1007/s12010-012-9791-8.
Tabeo DF, Ibrahim N, Nugrahani AW. 2019. Ethnobotany of the Togian Tribe on Malenge Island, Talatako District, Tojo Una-una Regency, Central Sulawesi. Biocelebes 13 (1): 31-37.
Talpae KA, Bhosale UA, Zambare MR, Somani R. 2014. Antihyperglycemic and antioxidant activity of *Clitoria ternatea* Linn. on streptozotocin-induced diabetic rats. Ayu J 34 (4): 433-439. DOI: 10.4103/0974-8520.127730.
Taranalli AD, Cheeramkuzhy TC. 2000. Influence of *Clitoria Ternatea* extracts on memory and central cholinergic activity in rats. Pharm Biol 38 (1): 51-56. DOI: 10.1076/1388-0209(200001)3811-BFT051.
Thakur AV, Ambwani S, Ambwani TK, Ahmad AH, Rawat DS. 2018. Evaluation of phytochemicals in the leaf extract of *Clitoria ternatea* Willd. through GC-MS analysis. Trop Plant Res 5 (2): 200-206. DOI: 10.22271/tpr.2018.v5.i2.025.
Tiwari RD, Gupta RK. 1959. Chemical examination of the leaves of *Clitoria ternatea*. J Indian Chem Soc 36: 243-246.
Tokopedia. 2020. Telang. Retriveved from www.tokopedia.com
Vasisht K, Dhobi M, Khullar S, Mandal SK, Karan M. 2016. Norneolignans from the roots of *Clitoria ternatea* L. Tetrahedron Lett 57: 1758-1762. DOI: 10.1016/j.tetlet.2016.03.024.
Wang F, Miao M, Xia H, Yang L, Wang S, Sun G. 2017. Antioxidant activities of aqueous extracts from 12 Chinese edible flowers in vitro and in vivo. Food Nut Res 61 (1): 1-9. DOI: 10.1080/16546628.2017.1265324.
Wirawan IGNPD, Pendit IMR. 2017. The application of *Tri Hita Karana* in the harmonization of conservation and culture in the tourist attractions in the Bali Botanic Garden. JUMPA 4 (1): 18-32.
Zakiyyah, Zuhud EAM, Sumardjo. 2016. Community's attitudes and conservation a case stimulus of vegetable fern in Desa Gunung Bunder II, District of Pamijahan, Bogor. J Nat Resour Environ Manag 6 (1): 71-76. DOI: 10.19081/jpsl.6.1.71.
Zapata SD, Massa OI, Carpio CE, Lamie RD. 2016. Does e-commerce help farmers' markets? measuring the impact of market maker. J Food Distrib Res 47 (2): 1-18.
Zaroug MG, Munns DN. 1980b. Effects of phosphorus and sulfur nutrition on soluble sugars and growth in *Clitoria ternatea* L. Plant Soil 55: 243-250. DOI: 10.1007/BF02181804.
Zaroug, MG, Munns DN. 1980a. Screening strains of Rhizobium for the tropical legumes *Clitoria ternatea* and *Vigna trilobata* in soils of different pH. Trop Grasslands 14: 28-33.
Zen IS, Purwanto Y, Titisari PW, Hendrayani Y, Ariffin SAIBS. 2019. Take stock of Bali island as the potential of biosphere reserve site. The 2018 International Conference on Biosphere Reserve: The Role of Stakeholders in Mainstreaming Natural Resources Related to Agenda 2030 (Sustainable Development Goals). Palembang, South Sumatera, 23 July 2018. [Indonesian].
Zingare ML, Zingare PL, Dubey AK, Ansari MA. 2013. *Clitoria ternatea* (*aparajita*): a review of the antioxidant, antidiabetic and hepatoprotective potentials. Intl J Pharm Biol Sci 3 (1): 203-2013.
Zuhud EAM, Sofyan K, Prassetyo LB, Kartodihardjo H. 2007. Community's attitudes and conservation: an analysis of kedawung (*Parkia timoriana* (DC.) Merr.), stimulus of medicinal plant for the community, case in Meru Betiri National Park. Media Konserv 7: 22-32.
Zussiva AM, Laurent BK, Budiyati S. 2012. Extraction and analysis of blue dye (Anthocyanin) from butterfly pea (*Clitoria ternatea*) as a natural dye. J Teknol Kim Ind 1 (1): 356-365.

ASIAN JOURNAL OF ETHNOBIOLOGY
Volume 3, Number 2, November 2020 E-ISSN: 2580-4537
Pages: 62-69 DOI: 10.13057/asianjethnobiol/y030203

Students' perceptions on the snake in Northwestern Bangladesh

M. FIROJ JAMAN, MD. FAZLE RABBE♥, MD. MAHABUB ALAM, ASHIKUR RAHMAN SHOME, MD. AFZAL HOSSAIN, MOHAMMAD ABDUR RAZZAQUE SARKER

Department of Zoology, University of Dhaka. Dhaka 1000, Bangladesh. Tel./fax.: +88-1515608961, ♥email: fazlerabbedu@gmail.com, mfjaman4@gmail.com

Manuscript received:11 September 2020. Revision accepted: 24 October 2020.

Abstract. *Jaman MF, Rabbe MF, Alam MM, Shome AR, Hossain MA, Sarker MAR. 2020. Students' perceptions on the snake in Northwestern Bangladesh. Asian J Ethnobiol 21: 62-69.* Human-snake interaction has an ancestral history with different outcomes at different times. This study was done to assess the student's perceptions of snakes and current superstitions practiced in some areas of northwestern Bangladesh. We interviewed 348 students from 7 educational institutions under 3 districts from January 2019 to April 2019. We asked dichotomous (yes-no) question to know perceptions about snakes and variation among superstitions of the students. We found significant variation in responses concerning the demographic status of the respondents. Religion and education were the most influencing factors affecting the results of students' perceptions. Among the total respondents, 329 (94.5%) had seen snakes, 182 (52.3%) considered snakes as a notorious animal, 224 (64.4%) considered snakes as an economically harmful animal, 155 (44.5%) think killing snakes giving a good feeling, 313 (90%) believe that snakes attack humans, 321 (92.2%) students have seen others killing snakes, and 127 (36.5%) had killed snakes themselves. Of the five superstitions, "snake can drink milk" was the topmost statement believed by 293 (84.2%) students. Due to these negative attitudes and misconceptions, we assume that snakes are regularly killed, and there is a potential risk for the population to decline.

Keywords: Perceptions, northwestern Bangladesh, misconceptions, student, superstitions

INTRODUCTION

Bangladesh is a small country with diverse cultures and is rich in wildlife resources (Nishat et al., 2002). Reptiles occupy a significant position among them, and approximately 170 species of snakes are known to be present here (Khan 2008; Hasan et al. 2014; IUCN Bangladesh 2015; Khan 2015, 2018). Among them, in total, 100 species of snakes (67% species are non-venomous and 33% venomous) are assessed by the IUCN Red List Bangladesh (2015). Eight species are placed in the threatened categories.

The northwestern districts of Bangladesh are enriched with mainly agricultural and plain lands, rivers, canals, and some areas are covered with deciduous forests (Khan 2008; Khan 2015). A recent survey (Rabbe 2018) has shown that most snakes in this region face numerous anthropogenic threats. Among them, habitat destruction and fragmentation, road accidents, and killing by local people without any definite valid reason have posed severe threats to snakes leading to a drastic decline in their natural population (Hasan et al. 2014). In addition, human-snake conflicts due to snakebite incidences have placed them in a vulnerable position. Mondal et al.'s (2011) study in Rangpur medical college (a hospital in northwestern Bangladesh) showed that 5.71% of patients are killed due to snakebite.

People in various cultures are afraid of snakes, provoking a pronunciation and persecution that hampers conservation efforts for this group of reptiles (Babalola et al. 2020). Traditional practices to prevent snakebites and treat snakebite probably kill snakes (Rahman et al., 2010), consequently leading to a decline in the natural population of snakes in the northwestern region. Snake phobia probably is the main reason for school children for killing snakes. Every year during the rainy season, snakebite incidences increase since the houses are made of homestead bush, making an ideal place for snakes (Rahman et al. 2010; Guidelines for the Management of Snakebite in Bangladesh 2018). Unfortunately, people in Bangladesh generally treat every snake as venomous, probably due to the lack of proper knowledge about snakes. The study of Rabbe (2018) showed that younger people of the north-western region are intended to kill snakes just for fun, resulting in young individuals being more prone to snakebite. Faiz et al. (1999) also suggested that children in Bangladesh are at high risk of snakebite envenoming. Snakes and snakebite in Bangladesh have mythological fragrances leading to higher mortality (Global Snakebite Initiative 2020). Superstitions have dominated the mind of people; consequently, they go to *Ojha* (a person who traditionally treats snakebites and shows snakes for entertainment in markets and villages) for snakebite treatment (Alam et al., 2015). Among the superstitions, the jewel of the snakes' head, snakes dancing by whistle, and milk sucking of snake from cow are the most popular (Kabir 2018).

Snakes also bite humans and cattle when entering the home yard, leading to increased conflict with humans and risks to human life (Alves et al. 2012a, b). Moreover, traditional folk stories promote negative attitudes spreading fear and dislike among people in the community (Alves et

al., 2014). Negative perceptions are often dangerous for both people and snakes since it influences people to make irrational decisions that often cause snake deaths or an increased risk of snakebite, resulting in the low interest in the conservation of snakes (Alves et al. 2012b). The ethnobiological approach may be one way to investigate and establish relationships between the locals and provide scientific knowledge among the school children for conservation strategies of snakes (Baptista and El-Hani 2009).

Considering the above scenario and from an ethnozoological point of view, the present study is the first to investigate the perceptions and knowledge of students about snakes in the northwestern region of Bangladesh. This research examines students' perceptions and attitudes towards snakes and assesses superstitious practices.

MATERIALS AND METHODS

Problems, strategy, and variable assignment

Before starting the survey, we assessed superstitions practiced by the local people and set up our questionnaire accordingly. We divided the questionnaire into two segments-perceptions and superstitions (Table 1). We sorted the information in a series of questions and all questions were bi-category variables expressed as vi (i = 1, 2, ….7) and si (i = 1, 2, ...5) in table 1. For perceptions, we collected responses by asking simply complex questions, i.e., the first perception variable (v1) is about seeing snakes, while the last variable (v7) is about killing snakes. The demographic background of the respondents, such as age, gender, education, religion, and social media usage, was also collected.

Sampling protocol and data collection

We conducted this study from January 2019 to April 2019 in seven institutions of five Upazilas under the Rajshahi institutions of Bangladesh's Rajshahi, Rangpur, and Natore districts (Table 2). Before selecting the Upazilas, we discussed with university students (University of Dhaka) from these districts and gathered information about attitudes, superstitions, snakebites, snake mortality, and other related information. Later, we selected the areas of the Upazilas through personally communicating with deliberate snake rescuers, wildlife biologists, and news reporters who worked in those areas. We also considered social media (Facebook) information for selecting the survey areas. For example, a popular Facebook group of Bangladesh named 'Deep Ecology and Snake Rescue Organization' continuously updates information about snakebites, snake rescue, and snake killing incidences. We selected institutions where students come from the areas of interest to conduct the survey (Table 2). The questionnaire was entirely close-ended, and 348 students were randomly sampled in this study. We surveyed students aged 14 to 20 and from 9th grade to Higher Secondary level. Students were informed about the aims and objectives of the questionnaire survey to encourage them to participate in the research.

147 (42.2%) were males among all survey respondents, and 201 (57.8%) were females. As for the age proportions, 157 (45.1%) were low aged (14-16 years), and 191 (54.9%) were high aged (17-20 years). With regard to religion, 308 (88.5%) were Muslims, 37 (10.6%) were Sonatons, 3 (0.9%) were Christians. The education level of the interviewees varied; 128 (36.8%) were secondary level (SSC) students, and 220 (63.2%) were higher secondary level (HSC) students. Among the respondents, 97 (27.9%) had access to social media, whereas 251 (72.1%) had no access.

Table 1. Variables with their denotations and code used afterward in the article

Category	Information (variable denotation)	Code
Demography	Age	14-16years = 1,17-20years = 2
	Sex	Female = 1, Male = 2
	Religion	Islam = 1, Sonaton = 2, Christian = 3
	Education	9th grade to Secondary School (SSC)= 1, Higher secondary (HSC)= 2
	Internet	No = 1, Yes = 2
Perceptions	Snake seen by the respondent (v1)	No = 1, Yes = 2
	Snake is considered a notorious animal by the respondent (v2)	No = 1, Yes = 2
	Snake harm their eco condition by preying on their domestic animals and by snakebite incidence (v3)	No = 1, Yes = 2
	Respondent thinks killing snake gives a good feeling (v4)	No = 1, Yes = 2
	Respondent thinks snakes attack humans (v5)	No = 1, Yes = 2
	Respondent has seen the killing of a snake by other people (v6)	No = 1, Yes = 2
	Respondent killed a snake themselves (v7)	No = 1, Yes = 2
Superstitions	Snake bear snakestone (*Moni*) on the head (s1)	No = 1, Yes = 2
	Snake can dance hearing the sound of flute played by snake charmer *Ojha* (s2)	No = 1, Yes = 2
	Snake can drink milk (s3)	No = 1, Yes = 2
	Snake takes revenge (if humans hurt one snake, another individual of the pair takes revenge) (s4)	No = 1, Yes = 2
	Snakes have hair (*Dari*) on their skin (s5)	No = 1, Yes = 2

Table 2. Institutions and locations where the survey was conducted

District	Upazila	Institution's name	Sample size
Rajshahi	Tanore	Koel High School	60
	Godagari	Premtoli Degree College	57
Natore	Singra	Satpukuria Dimukhi High School	52
		Kalam Degree College	38
Rangpur	Kaunia	Kaunia College	60
		Vayarhat Piaria Fajil Madrasah	40
	Mithapukur	Shukurer Hat High School	41

Data evaluation and analysis

The main focus of this survey will result in two significant findings; i) the killing of snakes is dependent on demographic and perception-related variables; ii) demographic responses are about superstitions and believing superstitions are correlated with each other. All demographic and perceptions responses (v1 to v6) are independent variables except v7, a dependent variable. We used multiple regression models to calculate the impact of independent variables on the dependent variable. The relations of perceptions, superstitions, and demography of the respondents were analyzed in a bivariate logistic model. Mutual correlation of superstitions and their impacts were analyzed using Kendall's tau-b coefficient.

RESULTS AND DISCUSSION

Perceptions towards snakes

Following the dichotomous method, we asked questions from simple to complex. Almost all the respondents (n= 329, 94.5%) have seen snakes in their areas. This response significantly varied in sex, religion, and education (Table 3). The percentage of seeing snakes was higher for female students (97%), Sonaton followers (97.3%), and higher educated students (97.3%). The second question was whether the respondent considers a snake a notorious animal. This question was asked to know their primary attitudes towards the snake. Among the respondents, 182 (52.3%) were positive and considered snakes a notorious animal, and the response varied significantly only for religion (Table 3). Most of the students who follow the Sonaton religion do not consider snakes notorious animals. Instead, they are regarded as animals of religious importance. Sonaton followers believe the markings on the hood of cobras hailed from the god Vishnu (Wake 1873). We interviewed local Sonaton people and found that serpents are imagined as heavenly animals with the capacity to bless and curse. Snakes are also associated with women's fertility, healing, and familial prosperity; hence they are widely worshipped to obtain these blessings. The work of Alves et al. (2012a; 2014) showed that students have a widespread perception considering most snake species as being tarnished and poisonous, regardless of whether or not the particular snake possesses this characteristic. This is the same perception of a considerable part of the students interviewed, who affirmed they did not distinguish between venomous and non-venomous species. Considering snakes as aggressive and dangerous animals is a serious fact to consider when implementing conservation plans since it stimulates snake killing, regardless of whether or not they are poisonous (Alves et al., 2014).

The next question was about the impact of snakes on their daily life. We asked respondents if snakes do economic damage, like eating their domestic animals (especially chicken), snakebites to human and domestic animals, etc. We found that 224 (64.4%) respondents considered snakes an economically harmful animal and experienced some damage from it. This response varied significantly by the respondent's religion (p= 0.003).

We wanted to know the psychological perception of snake killing or seeing the killing of snakes. Snake killing by themself or seeing them killed by others may give psychological pleasure, and we asked about it to the students. In total, 155 (44.5%) respondents responded positively, but their responses varied significantly in age, religion, and education (Table 3). Muslims believe snake killing is religiously good, and the respondents practice this belief. Our result reflects that Muslim students who are low aged and educated at lower levels were more favorable to this response (v4) (Table 3).

'Snakes attack humans' is a widespread belief to all people, and we asked students to record their responses about it. We received almost 90% positive responses corresponding to this question, and this response was significant considering age, religion, education, and internet use (Table 3). The next question pair was 'respondents have seen the killing of the snake' and 'respondent killed by themself.' Among the respondents, 321 (92.2%) students had seen others had killed snakes, and 127 (36.5%) killed themselves. The first response varied significantly with age and educational status, while the second response varied substantially with sex, religion, and internet use (Table 3). Pandey et al. (2020) suggested that people kill snakes when they encounter them. The study also reported that school students' snake-killing attitudes are acute when they face snakes indoors or outdoors, such as in the yard or backyard and on roads. Ethnozoological research revealed that this perception contributes to negative behavior regarding these animals (Alves et al., 2014). The study showed that students assuming eventual encounters with snakes, almost half of the students (n= 53, 49%) responded in such a way that indicates that they would kill the animal. The study also found that female students were more prone to kill snakes than males, which does not match our results (15.4%

female killed snakes). This was probably due to their fear of snakes. Usually, females are more fearful of snakes than males (Prokop et al., 2009). However, Alves et al. (2014) and Pandey et al. (2020) researched students' attitudes toward snakes. They verified that many students showed positive attitudes about snakes' ecology and economy. This study also reported similar results from the students, such as 'students believed snakes are useful to the ecosystem' and 'snakes are necessary for producing antivenom.' This study mostly received these positive responses from highly educated Sonaton followers and internet users. Indeed, more fantastic core excellent knowledge and awareness about snakes and their ecological and utilitarian roles decrease the fear and negative attitudes toward snakes (Pandey et al. 2020). Frequent exposure of people with scientific and environmental educational activities about venomous snakes and their ecological roles seems to have been influential for the higher tolerance to snakes (Gramza and Temple 2010; Pandey et al. 2020).

Impact of factors on killing snakes by the respondents

Different demographic statuses had other effects on students' perceptions of snakes, as seen in Table 4. To better understand the effects of all factors on a particular variable (dependent), such as demographic variables, other related independent variables need to be considered

The regression analysis showed that sex, religion, v1, v4, and v6 significantly impacted the dependent variable (Table 4). The odds ratio for the dependent variable is (1.684-1) = 0.684 times higher for male students, (0.788-1) = -0.269 times higher for Sonaton students (1.349-1) = 0.349 times higher for students who had seen snakes (v1), (1.216-1) = 0.216 times higher for students who think killing snake gives a good feeling (v4), and (1.197-1) = 0.197 times higher for students who had seen killing snake by others (v6), keeping all other predictors at a fixed level (Table 4). This result suggested that male respondents and followers of Islam and the Christian religion are more likely to kill snakes. Besides, students who had positive responses towards some independent variables, for example, v1, v4, and v6, are proportionally positive in their attitude toward killing snakes. Generally, animal phobia is higher among females and younger individuals (Fredrikson et al. 1996). Previous research by Prokop et al. (2009) also showed that most respondents (n= 66; 61.1%) were fearful of snakes, and fear of snakes was higher in females than in male students. A similar result was reported for female respondents for other animals such as spiders and bats (Prokop and Tunnicliffe 2008). Being less fearful, male students are more interested in killing snakes that match this study also. Different cultures and religions consider snakes deadly venomous, resulting in fear of snakes (Molander et al., 2012). Our study also found that students other than the Sonaton religion intended to kill a snake. Sonaton people believe that snakes (especially Cobra) are a deity. Hence, they usually do not kill any snakes. People following other religions possess false ideas about snakes and think killing them is religiously good.

Table 3. Student's perceptions towards snakes about the different demographic status of the respondents

Perceptions variables	Yes percentage, χ^2, and p-value	Demographic variables										
		Age		Sex		Religion			Education		Internet	
		14-16	17-20	Male	Female	Islam	Sonaton	Christian	SSC	HSC	Yes	No
v1	Yes	93.6	95.3	91.2	97.0	94.8	97.3	33.3	89.8	97.3	96.9	93.6
	χ^2	0.459		5.646			22.360		8.652		1.46	
	p	0.498		0.017			0.000		0.003		0.227	
v2	Yes	50.3	53.9	47.6	55.7	54.5	29.7	100	53.1	51.8	48.5	53.8
	χ^2	0.450		2.234			10.914		0.055		0.797	
	p	0.502		0.135			0.004		0.814		0.372	
v3	Yes	65.6	63.4	60.5	67.2	66.9	40.5	100	65.6	63.6	57.7	66.9
	χ^2	0.191		1.622			11.669		0.140		2.582	
	p	0.662		0.203			0.003		0.709		0.108	
v4	Yes	50.3	39.8	49	41.3	47.1	18.9	100	55.5	38.2	40.2	46.2
	χ^2	3.866		2.031			14.371		9.789		1.023	
	p	0.049		0.154			0.001		0.002		0.312	
v5	Yes	93.0	85.3	89.1	88.6	90.6	73	100	93.8	85.9	83.5	90.8
	χ^2	5.072		0.027			10.678		4.999		3.779	
	p	0.024		0.870			0.005		0.025		0.052	
v6	Yes	88.5	95.3	90.5	93.5	92.5	89.2	100	87.5	95	91.8	92.4
	χ^2	5.491		1.108			0.770		6.360		0.045	
	p	0.019		0.292			0.680		0.012		0.832	
v7	Yes	33.1	39.3	65.3	15.4	39.3	13.5	33.3	38.3	35.5	57.7	28.3
	χ^2	1.404		91.160			9.480		0.279		26.173	
	p	0.236		0.000			0.009		0.597		0.000	

Table 4. Estimates of regression parameters with standard error (SE), p-value, and odds ratio (OR) were obtained from the logistic regression model

Variables	Category	Estimates	SE	p-value	OR
Age	(Intercept)	0.520	0.132	<0.001	1.683
	14-16	-	-	-	-
	17-20	0.051	0.056	0.369	1.052
Sex	Female	-	-	-	-
	Male	0.521	0.055	<0.001	1.684
Religion	Islam	-	-	-	-
	Sonaton	-0.238	0.070	<0.001	0.788
	Christian	0.043	0.235	0.854	1.044
Education	SSC	-	-	-	-
	HSC	-0.020	0.059	0.741	0.981
Internet	No	-	-	-	-
	Yes	-0.018	0.061	0.772	0.982
v1	No	-	-	-	-
	Yes	0.299	0.098	0.003	1.349
v2	No	-	-	-	-
	Yes	0.011	0.046	0.805	1.012
v3	No	-	-	-	-
	Yes	0.022	0.048	0.641	1.023
v4	No	-	-	-	-
	Yes	0.195	0.047	<0.001	1.216
v5	No	-	-	-	-
	Yes	0.093	0.070	0.184	1.098
v6	No	-	-	-	-
	Yes	0.180	0.079	0.024	1.197

Table 5. Kendall's tau-b coefficient results of superstitions about snakes with a p-value in the first parenthesis

Superstitions	s2	s3	s4	s5
s1	0.494 (<0.001)	0.304 (<0.001)	0.246 (<0.001)	0.122 (0.024)
s2		0.272 (<0.001)	0.332 (<0.001)	0.076 (0.156)
s3			0.280 (<0.001)	-0.007 (0.902)
s4				0.085 (0.115)

Superstitions about snakes

The student possesses many superstitions about snakes traditionally and a belief in one superstitious related to believing others. These traditional misbeliefs or misconceptions towards snakes are likely to cause snakebites (Pandey et al. 2020). Alves et al. (2012b) showed that myths and tales unrelated to religion contribute to the persecution of snakes in the Brazilian semiarid region. Besides, cinemas showing traditional snakebite treatments through magic potions, snakestones, or alcohol influence believing firmly in superstitions (Henderson and Dujon 1973).

Table 5 shows the correlation of superstitions variables that have 10 variable pairs. The dual-trail verification at the significance level $p<0.001$, the correlativity between s1 and s2 demonstrates the maximum of 0.494, indicating a reasonably considerable overlap in believing the two superstitions. This means students consider 'snake bear snake stone' (s1) is significantly correlated with 'snake can dance hearing the sound of the flute played by snake charmer *Ojha*' (s2). The second maximum is 0.332 between s2 and s4, implying that the higher belief of s2, the higher the chance of believing s4. All superstitions variables are significantly correlated with other superstitions variables at $p<0.001$, except for s5 (Table 5).

Snake bear snakestone (*Moni*) on the head (s1)

About half (n= 179, 52%) of the respondents believe snake bears snakestone (s1). The response for this superstition significantly varied among sex and internet usage of the students (Table 6). The result showed that female students believed s1 more than males, and respondents who do not use the internet are inclined to believe s1.

People believe snakes make snakestone with magical properties, and snakes can bear it on their heads. People also believe that snakestones can heal snake bites and act as anti-venom. However, experimental studies showed that snakestones are unreliable for snakebite treatment (Chippaux et al., 2007). This indigenous first-aid treatment has been practiced in Asia, Africa, and Latin America (Baldwin 1995). This stone is considered valuable as a diamond, and getting it in one's lifetime is deemed good fortune. All these misconceptions are provided by *Ojha*, as well as the influence of mythical cinemas telecasted on different TV channels.

Snake can dance hearing the sound of flute played by *Ojha* (s2)

More than half (n= 191, 55%) of the respondents believed snakes could hear the flute's sound and, consequently, dance with the tune. Responses to this superstition varied significantly with all demographic variables except religion (Table 6). The result showed that low-aged, female respondents, less educated, and do not use the internet are prone to believe s2. This is one of the prevalent superstitions about snakes in Bangladesh (Kabir 2018). When the *Ojha* plays the flute showing his particular movements, the snake follows those signals, observing the flute or other activities to sense a threat. Sometimes snakes pretend to bite for protection, but actually, these are dry bites.

Snake can drink milk (s3)

Of the 348 respondents, 293 (84.2%) believed that snakes could drink milk as their food. This is the highest believed superstition among students, and the response significantly varied among sexes and internet usage of the students (Table 6). Female respondents (88.6%) believed this superstition more than males, and 87.3% of the respondents who do not use the internet believed this superstition.

Table 6. Superstitionspracticed by respondents about snakes about the different demographic status

Superstitions variables	Yes, percentage, χ^2, and p-value	Demographic variables										
		Age		Sex		Religion			Education		Internet	
		14-16	17-20	Male	Female	Islam	Sonaton	Christian	SSC	HSC	Yes	No
s1	Yes	56.1	47.6	40.1	59.7	51.3	54.1	33.3	56.3	48.6	35.1	57.8
	χ^2	2.438		13.012			0.497		1.878		14.454	
	P	0.118		0.000			0.780		0.171		0.000	
s2	Yes	63.1	48.2	44.9	62.2	55.5	51.4	33.3	65.6	48.6	32	63.7
	$\chi2$	7.715		10.252			0.799		9.432		28.548	
	P	0.005		0.001			0.671		0.002		0.000	
s3	Yes	82.8	85.3	78.2	88.6	84.4	83.8	66.7	89.1	81.4	76.3	87.3
	$\chi2$	0.417		6.803			0.709		3.604		6.318	
	P	0.518		0.009			0.702		0.058		0.012	
s4	Yes	54.1	57.1	51.7	58.7	55.8	59.5	0.0	57.8	54.5	47.4	59
	$\chi2$	0.299		1.689			3.987		0.350		3.778	
	P	0.584		0.194			0.136		0.554		0.052	
	Yes	10.8	19.9	19	13.4	16.6	10.8	0.0	12.5	17.7	21.6	13.5
s5	$\chi2$	5.324		2.012			1.388		1.662		3.453	
	P	0.021		0.156			0.500		0.197		0.063	

Respondents shared this traditional belief. People claim that snakes come to barns at night to drink milk from the cows. But, the myth is false and can easily be explained. Barns often attract rats, which are the primary food source of many snakes. Snakes come to predate rats, and if a farmer sees snakes around the barn on a day when milk production is low, he may believe this myth. Additionally, *Ojha* propagates the belief that snakes drink milk. Drinking milk is a religious belief established by the Hindus (Sonaton) as they use milk to shower *Shibmurti*(incarnate) during *Nagpuja* (a religious ritual). The myth of the *Naga* refers to heavenly snakes with numerous heads believed in both Hinduism and Buddhism (Wake 1873). However, when the snake is quite thirsty, it can be seen drinking any readily easily available liquid food, including milk. Pathak and Metgud (2017) study found that 76.25% (n= 305) of respondents offer milk to snakes brought by local snake charmers on the *Nag Panchami* festival.

Snake can take revenge if hurt (s4)

Among 348 respondents, 194 (55.7%) answered "yes" to the question that snakes can take revenge if hurt by anyone. The response was higher for tall, aged, female, Sonaton, less educated, and not using the internet but not significant with any demographic status (Table 6). People believe that snakes live in pairs, and if a man wounds one, the other can go for the same man and take revenge. These mottoes are practiced by people, especially in Bengali and Hindi mythical cinemas. Snakes cannot identify the same person; it is more likely to see snakes in pairs during the breeding season or if the habitat is suitable enough to support many snakes (Stanley 2008).

Snake has hair (*Dari*) on its skin (s5)

Only 55 students believe snakes have hair (*Dari*) on their skin (s5). This response varied significantly between the two age groups; 19.9% of high-aged students thought that snake has hair on its skin, whereas only 10.8% low aged students believed this superstition. Snakes molt for growth, and some parts of the skin may be attached to the skin while molting. People of the study areas considered it hair (*Dari*), and *Ojha* keeps the molted skins to show people when they entertain them.

In conclusion, people usually think all snakes are venomous and fatal. Furthermore, they bear and practice many preconceptions, misconceptions, and misbeliefs about snakes. As a consequence, many people are frequently involved in killing snakes as well as destroying their habitats. Our study proves that many students perceive snakes as harmful and dangerous animals, and most students show antipathy. These perceptions encourage negative attitudes, especially related to the attempts to kill snakes whenever one is found. These negative attitudes can be a potential threat to snakes. This might be due to the lack of knowledge about these animals and conservation awareness. We found many unaware people who do not know about the role of snakes in the ecosystem, and we consider this one of the main reasons for killing snakes. The same situations occur in Bangladesh and different locations worldwide, making snakes among the most disliked animals (Opler 1945; Molander et al. 2012; Alves et al. 2014). Meanwhile, many students responded to positive aspects of snakes, highlighting their ecological and economic importance. This positive perception, in turn, may help for the conservation of snakes. Therefore, students, teachers, and local people should be encouraged to come forward to conserve snakes. Makashvili et al. (2014) showed that effective teaching and education with other approaches help reduce snake fear.

The severe increase in human population pressure and agricultural development in the northwestern Bangladesh region. As a result, further research and investigation of people's perceptions of snakes are needed to ensure that a threat category is not triggered in the future for the decline of the snake population. The benefit of wildlife, especially snakes, is increasingly recognized worldwide (Babalola et

al. 2020). Therefore, dissemination of public information and education about snakes, their value, and the consequences of human activities on local biodiversity are required (Alves et al. 2012b; Trombulak et al. 2004). This is because education can play a crucial role in informing people about organisms and the environment, which can help to develop more responsible attitudes towards animals (Kellert 1996). Snakes naturally prey on large amounts of insects and rodents, thus controlling their population and thus translating into economic benefits for the national economy (Zug 1993; Adeola 1992). All these facts suggest that conservation strategies for snakes should consider the interactions and perceptions of the local population towards this animal group. We addressed the respondents' major misbeliefs, misconceptions, preconceptions, and traditional beliefs. Therefore, our study has undoubtedly increased awareness among the respondents that may help develop responsible attitudes and behaviors, thus promoting the cessation of snake killing.

ACKNOWLEDGEMENTS

The work was funded by the University Grants Commission (UGC) from 2017-2018. We are grateful to the UGC. We express gratitude to Prof. Humayun Reza Khan, Chairman of the Department of Zoology, the University of Dhaka, for his full cooperation and permission in providing all facilities for research work in the Wildlife laboratory of the department. We are thankful to the authority of educational institutions for their permission to conduct this survey and consultations. We thank Dr. Michael A. Huffman, Associate Professor of Primate Research Institute, Kyoto University, Japan, for critically scrutinizing the manuscript and improving the writing.

REFERENCES

Adeola MO. 1992. Importance of wild animals and their parts in the culture, religious festivals, and traditional medicine, of Nigeria. Environ Conserv 19: 125-134. 10.1017/S0376892900030605.

Alam AS, Islam AM, Jesmin H. 2015. Snake bite as a public health problem: Bangladesh perspective. Birdem Med J 5: 24-29. 10.3329/birdem.v5i1.28370.

Alves RRN, Filho GAP, Vieira KS, Souto WMS, Mendonças LET, Montenegro PFGP, Almeida WO, Vieira WLS. 2012a. A zoological catalogue of hunted reptiles in the semiarid region of Brazil. J Ethnobiol Ethnomed 8:27. DOI: 10.1186/1746-4269-8-27.

Alves RRN, Silva VN, Trovão DM, Oliveira JV, Mourão JS, Dias TLP, Alves AGC, Lucena RFP, Barboza RRD, Montenegro PFGP, Vieira WLS, Souto WMS. 2014. Students' attitudes toward and knowledge about snakes in the semiarid region of Northeastern Brazil. J Ethnobiol Ethnomed 10: 30. DOI: 10.1186/1746-4269-10-30.

Alves RRN, Vieira KS, Santana GG, Vieira WLS, Almeida WO, Souto WMS, Montenegro PFGP, Pezzuti JCB. 2012b. A review on human attitudes towards reptiles in Brazil. Environ Monit Assess 184: 6877-6901. DOI: 10.1007/s10661-011-2465-0.

Babalola O, Jegede HO, Ogunro B. 2020. Perceptions, attitudes, and outcomes of human-snake encounters: A retrospective study of an online discussion community in Nigeria. Asian J Ethnobiol 3: 1-9.DOI: 10.13057/asianjethnobiol/y030101

Baldwin M. 1995. The snake stone experiments: An early modern medical debate. Isis 86: 394-418. DOI: 10.1086/357237.

Baptista GCS, El-Hani CN. 2009. The contribution of ethnobiology to the construction of a dialogue between ways of knowing: A case study in a Brazilian public high school. Sci Educ 18: 503-520. DOI: 10.1007/s11191-008-9173-3.

Chippaux JP, Diédhiou I, Stock, R. 2007. Study of the action of black stone (also known as snakestone or serpent stone) on experimental envenomation. Sante (Montrouge, France) 17: 127-131.

Faiz MA, Hussain M, Rahman M, Das JC, Box S, Mollah AS, Younus EB, Hoq AJMM. 1999. Non-poisonous snake bite in Chittagong Medical College Hospital, Chittagong Bangladesh. Bangladesh Med J 28: 3-5.

Fredrikson M, Annas P, Fischer H, Wik G. 1996. Gender and age differences in the prevalence of specific fears and phobias. Behav Res Ther 34: 33-39. DOI: 10.1016/0005-7967(95)00048-3.

Global Snakebite Initiative. 2020. Snapshot: Bangladesh: A summary of the snakebite situation in Bangladesh. http://www.snakebiteinitiative.org/?page_id = 611.

Gramza A, Temple S. 2010. Effect of education programs on the knowledge and attitudes about snakes in San Isidro de Upala, Costa Rica. Jo Kansas Herpetol 33: 12-18.

Guidelines for the Management of Snakebite in Bangladesh. 2018. Directorate General of Health Services Ministry of Health & Family Welfare Dhaka, Bangladesh. https://dghs.gov.bd/images/docs/Guideline/NCDC_guidelines_01_08_18.pdf

Hasan MK, Khan MMH, Feeroz MM. 2014. Amphibians and Reptiles of Bangladesh-A Field Guide. Arannayk Foundation, Dhaka, Bangladesh.

Henderson BM, Dujon EB. 1973. Snake bites in children. J Pediatr Surg 8: 729-733. DOI: 10.1016/0022-3468(73)90414-4.

IUCN Bangladesh. 2015. Red Book of Threatened Amphibians and Reptiles of Bangladesh. IUCN-Bangladesh, Dhaka, Bangladesh.

Kabir A. 2018. Biography of a snake charmer in Saidpur, Bangladesh. MOJ Biol Med 3: 151-152.

Kellert SR.1996. The Value of Life: Biological Diversity and Human Society. Island Press,Washington, DC.

Khan MAR. 2015. Wildlife of Bangladesh-A Checklist and Guide. Dhaka, Chayabithi.

Khan MMH. 2008. Protected Areas of Bangladesh-A Guide to Wildlife. Nishorgo Program, Bangladesh Forest Department, Dhaka, Bangladesh.

Khan MMH. 2018. A Photographic Guide to Wildlife of Bangladesh. Arannayk Foundation, Dhaka, Bangladesh.

Makashvili M, Kaishauri N, Azmaiparashvili T. 2014. The role of knowledge in overcoming snake fear. Procedia Soc Behav Sci 152: 184-187. DOI: 10.1016/j.sbspro.2014.09.178.

Molander M, Saslis-Lagoudakis CH, Jäger AK, Rønsted N. 2012. Cross-cultural comparison of medicinal floras used against snakebites. J Ethnopharmacol 139: 863-872. DOI: 10.1016/j.jep.2011.12.032.

Mondal RN, Rani M, Mohammad M, Islam MM, Islam MS, Saha AC, Hossain MZ, Haque MA, Faiz MA. 2011. Pattern of poisonous snake bite in Rangpur Medical College. RCMCJ 1: 13-18.

Nishat A, Huq SM, Imrul, Barua, Shuvashis P, Reza AHM, Khan MAS. 2002. Bioecological Zones of Bangladesh. IUCN Bangladesh Country Office, Bangladesh.

Opler ME. 1945. Japanese folk belief concerning the snake. Southwest J Anthropol 1: 249-259. DOI: 10.1086/soutjanth.1.2.3628761.

Pandey DP, Chaudhary B, Subedi PG, Piya RC, Devkota NR. 2020. School students' perceptions on snakes, their uses, and snakebite in Nepal: Implications for snake conservation and snakebite prevention. Adv Clin Toxicol 5: 1-20. DOI: 10.23880/ACT-16000180.

Pathak I, Metgud C. 2017. Knowledge, attitude, and practice regarding snakes and snake bite among rural adults of Belagavi, Karnataka. Int J Commun Med Public Health 4: 4527-4531. DOI: 10.18203/2394-6040.ijcmph20175324.

Prokop P, Ozel M, Usak M. 2009. Cross-cultural comparison of student attitudes toward snakes. Soc Anim 17: 224-240. DOI: 10.1163/156853009X445398.

Prokop P, Tunnicliffe SD. 2008. Disgusting" animals: primary school children's attitudes and myths of bats and spiders. Eurasia J Math Sci Technol Educ 4: 87-97. DOI: 10.12973/ejmste/75309.

Rabbe MF. 2018. Species Diversity, Distribution and Conservation Issues of Herpetofauna in Northwestern Region of Bangladesh. [Dissertation]. Department of Zoology, University of Dhaka, Dhaka, Bangladesh.

Rahman R, Faiz MA, Selim S, Rahman B, Basher A, Jones A, d'Este C, Hossain M, Islam Z, Ahmed H, Milton AH. 2010. Annual incidence of snake bite in rural Bangladesh. PLoS Negl Trop Dis 4: 860. DOI: 10.1371/journal.pntd.0000860.

Stanley JW. 2008. Snakes: Objects of religion, fear, and myth. J Integr Biol 2: 42-58.

Trombulak SC, Omland KS, Robinson JA, Lusk JJ, Fleischner TL, Brown G, Domroese M. 2004. Principles of conservation biology: Recommended guidelines for conservation literacy from the education committee of the society for conservation biology. Conserv Biol 18: 1180-1190. DOI: 10.1111/j.1523-1739.2004.01851.x.

Wake CS. 1873. The origin of serpent-worship. J Anthropol Inst Great Britain Ireland 2: 373-390. DOI: 10.2307/2841458.

Zug GR. 1993.Herpetology: An Introductory Biology of Amphibians and Reptiles. Academic Press, New York. DOI: 10.2307/1447112.

ASIAN JOURNAL OF ETHNOBIOLOGY
Volume 3, Number 2, November 2020
Pages: 70-87

E-ISSN: 2580-4537
DOI: 10.13057/asianjethnobiol/y030204

Evaluation of ethnobotanical knowledge in Komkar-Adi Biocultural Landscape of Eastern Himalayan Region of India

MOMANG TARAM[1,♥], DIPANKAR BORAH[1,2,♥], PURANJOY MIPUN[3], VIJAY TARAM[4], ABHAYA PRASAD DAS[1]

[1]Department of Botany, Rajiv Gandhi University. Rono Hills, Doimukh 791112, Arunachal Pradesh, India
[♥]email: dipankar.borah@goalparacollege.ac.in
[2]Department of Botany, Goalpara College. Goalpara 783101, Assam, India
[3]Department of Botany, BN College. Dhubri 783323, Assam, India
[4]Forum for Siang Dialogue. Pasighat, East Siang District 791102, Arunachal Pradesh, India

Manuscript received: 28 September 2020. Revision accepted: 25 October 2020.

Abstract. *Taram M, Borah D, Mipun P, Taram V, Das A.P. 2020. Evaluation of ethnobotanical knowledge in Komkar-Adi Biocultural Landscape of Eastern Himalayan Region of India. Biodiversitas 21: 70-87.* The present study was aimed to document the traditional ethnobotanical knowledge in Komkar-Adi Biocultural Landscape of Upper Siang District in Arunachal Pradesh (Eastern Himalaya), India. Data was collected from three villages of Geku circle, Upper Siang District, between 2016-2019, covering more than 50% of the households using semi-structured questionnaires, personal interviews, focused group discussions, and transect walk with the core respondents. A total of 301 taxa falling in 203 genera and 85 families are recorded from the Komkar-Adi Biocultural Landscape (KABL), invariably used as food, medicine, and cultural material are directly and indirectly linked with livelihood security, community survival, protection, and preservation of the traditional culture and nature. Use value (UV) of all the reported species ranges between 0.017 and 0.051. 48 ethnomedicinal plant species were recorded, including herbs, shrubs, and trees, to cure 35 different ailments. Comparison of three other indices CI, RFC, and RI, indicating species ranking based on each index and the three fundamental values of the study, viz. FC, UR, and NU for each species were also calculated. *Urtica dioica, Solanum spirale, Paris polyphylla, Curcuma longa, Clerodendrum colebrookeanum,* and *Begonia silletensis* are essential for treating different ailments by the community.

Keywords: Conservation ethics, ethnobotany, Komkar-Adi, quantitative approach, traditional knowledge

INTRODUCTION

The Himalayas, also referred to as 'the abode of snow,' is the youngest and the tallest mountain ranges in the world, running over 2400 km from Afghanistan to India (Arunachal Pradesh-Myanmar border), covering Pakistan, India, Nepal, Bhutan, and Tibet Autonomous Region of China, providing shelter to diverse human cultures, floras, and faunas in its different parts (Das and Bera 2018). Due to a wide range of variations in altitude, aspect, and elements of overall climate, a widely diverse niche of vegetation is developed in its eastern part (E. Nepal to Arunachal Pradesh) and has become one of the essential biodiversity-rich areas in the world. These parts of the Indian Himalayas constitute many particular vegetation types depending upon the diverse combination of climatic and edaphic factors. The area covers the Northeastern states of India, namely, Arunachal Pradesh, Darjeeling part of West Bengal, and Sikkim. In terms of biodiversity, Arunachal Pradesh is the most diverse and most affluent in India, harboring about 50% of the country's flora, of which 4% are endemics (Borah et al. 2019).

Arunachal Pradesh hosts as many as 26 major tribes and 110 sub-tribes (Taram et al., 2018). Of them, the Adi, resident of the Siang valley, is one of the numerically more significant tribes comprising 26.9% of the total tribal population of the state (Krithika et al., 2008). They have several sub-groups, living in different restricted small pockets of the Siang belt and are recognized as Ashing, Bokar, Bori, Karko, Komkar, Milang, Minyong, Simong, Padam, Pangi, and Pasi (Boko and Narsimhan 2015). These sub-groups share similarities in almost every aspect; the only difference is their dialect.

People of the Komkar sub-group reside in a small group of villages at Rasing, Sijer, and Buksang of Komkar-Adi Biocultural Landscape under the Geku Circle in upper Siang District of the state. The major festivals of the Komkar people are *Solung*, *Aran* (*Unying*), and *Etor*, which are similar to other sub-groups. '*Etor'* is celebrated in May, related to community fencing of the village boundaries. A special war dance, '*Taapu,'* is also performed, re-enacting the action of war, its glory details, and the triumphant cries of the warriors. The headgear worn for dancing is '*leb-ro'* made of black fibers from the leaf-sheath of *Arenga obtusifolia* (*Tasat*), a white coma of *Beaumontia grandiflora* dried stem pith of *Brassaiopsis glomerular* by the Komkar. Other sub-groups use different plant species for this purpose too. Hence, it is linked to the locally available species where a particular group lives long. However, apart from these, their customs remain the same, and all of them have inextricable links to the forest

resources for their regular sustenance and to meet their day-to-day needs.

Most of the available ethnobotanical publications have recorded primarily qualitative information/data, and such data were not verified through statistical analysis. Recently, many workers have applied quantitative methods in ethnobotany to assess the reliability of the information (Mipun et al., 2019). The concept of quantitative ethnobotany is relatively new, and the term itself was coined only in 1987 by Prance and his co-workers (Prance 1991). The technique is to directly analyze contemporary plants using data and understand how important these plants are to ethnic and indigenous cultures (Phillips and Gentry 1993). Such studies could advance the traditional approach by incorporating appropriate quantitative research methods in ethnobotanical data collection, processing, and interpretation (Hoft et al. 1999; Ong & Kim 2014; Teklehaymanot and Giday 2010). Quantitative ethnobotanical studies so far have been able to measure the various uses of the plants as food, veterinary medicine, remedies for human disease, and other economic values (Pieroni 2001; Upadhyay et al. 2011; Kim and Song 2013).

The ethnobotanical information is gathered by conducting surveys among the Adi-Komkar community; an appropriate quantitative method is applied to analyze the data that will help understand the importance of such data in the life/society of the people and will assist in framing appropriate strategies to manage the scientific base properly. It also attempts to document the traditional ethnobotanical knowledge of the Komkar people, a subgroup of the Adi community, which, it is expected, will record some new uses of known useful plants or the plants that were not recorded earlier ethnobotanically

MATERIALS AND METHODS

Study area

The study was conducted from 2016 to 2019 in Komkar-Adi Biocultural Landscape (three villages Rasing, Sijer, and Buksang) falling under the Geku Circle of Upper Siang District of Arunachal Pradesh. These villages are inhabited by the Komkar sub-group of the Adi tribe. The Adi's are known for their rich traditional knowledge in the whole state, as this tribe is widespread throughout a long belt of this Himalayan state. Each sub-group has adapted to their environment differently, using different plants for their requirements. Hence, it is urgent to document their traditional knowledge to safeguard their tribal heritage. Only three villages were selected because the population of Komkar people is not that high. Even today, they strictly adhere to their traditional cultures and customs, thereby offering the most harmonious society to study their traditional knowledge. The area is bounded east by Simong and Maryang, west by Karko and Pangkang, north by Yingkong, and in the south by Geku and Dite-dime villages.

The central coordinates of Komkar's inhabiting area are 28.464334° N and 95.091789° E with an elevation of c. 298 m a.m.s.l. The region enjoys a humid subtropical climate with wet summer and mild winter seasons, and the temperature ranges between 29.5°C and 17.7°C. The average annual rainfall is 2,972.7 mm. The vegetation type of the area is chiefly Subtropical; the dominant trees of the site are *Ostodes paniculata*, *Artocarpus heterophyllus*, *Rhus chinensis*, *Toxicodendron hookeri*, *Pterospermum acerifolium*, *Castanopsis indica*, *Erythrina stricta*, etc. Adi-Komkar people are primarily dependent on forests for most of their requirements (nutritional, cultural, and medicinal), whereas their primary occupation is agriculture (both humid and wetland cultivation). They mostly follow the old traditional faith and belief system often referred to as '*Donyi Polo.'*

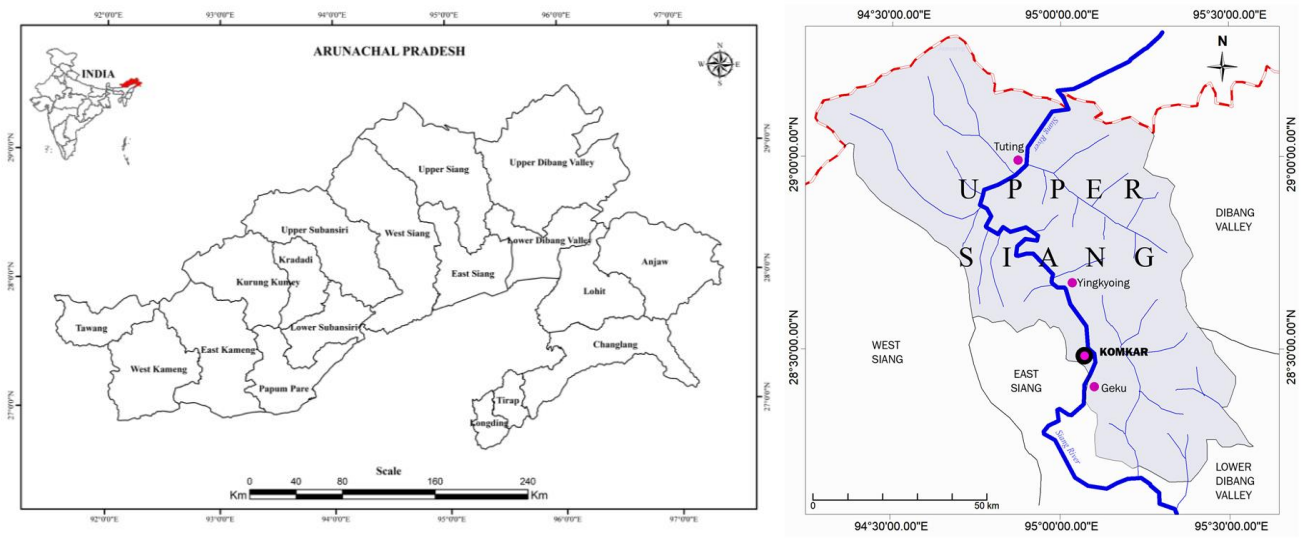

Figure 1. Location of Komkar-Adi Biocultural Landscape, Upper Siang District of Arunachal Pradesh, India

Data collection

A total of 41 respondents were interviewed from different households, falling into both the gender and different age-class categories [15-35 years, 35-60 years, and above 60 years]. The respondents were selected on their livelihood pattern and those who frequently access the forests, village heads, traditional healers, and aged people. Data was collected from the sample households through interviews using various participatory rural appraisal tools like semi-structured questionnaires, personal interviews, group discussions, and transect walks with the core respondents for field validation. The mandatory Prior Information Consents (PIC) were taken from the village/ community heads. Voucher specimens were later identified using different literature (Kanjilal et al. 1934-1940; Hooker 1872-1897; Hajra et al. 1996; Giri et al. 2008; Chowdhery et al. 2009) and matched at ARUN and ASSAM Herbaria. The specimens will be deposited in the Herbarium of Arunachal University (HAU), Department of Botany, Rajiv Gandhi University, Rono Hills, Doimukh, Arunachal Pradesh for future references.

Data analysis

Data collected was analyzed using three quantitative indices following Sharma et al. (2012) and Pardo-de-santayana (2003) and are (i) Use value (UV), (ii) Relative Frequency of Citation (RFC), (iii) Relative Importance Index (RI) and (iv) Cultural Importance Index (CI).

UV is calculated using the following formula:

$$UV = U/n$$

Where U is the number of use reports cited by every respondent for a given species and n is the total number of respondents interviewed. The UV is high when there are many valuable reports for a given species, which implies that the taxa are essential. When there are few reports related to its use, the UV decreases.

Relative Frequency of Citation (RFC) is calculated using the following formula:

$$RFC=FCs/N$$

Where FC is the Frequency of Citation and N is the number of informants participating in the survey. This index ranges from 0-1; when the RFC index is 0, nobody refers to the plant as necessary, and 1 indicates that all informants in the survey refer to the plant as required.

Relative Importance Index (RI) is calculated using the following formula:

$$\text{Ris} = [RFCs\ (max) + RNUs(max)]/2$$

Where RFCs is the relative frequency of citation over the maximum and RNUs is the close number of use categories over the top, viz., it is obtained by dividing the number of uses of the species (NUs) by the maximum value in all the species of the species, [RNUs (max) = NUs/Max (NU)]. The value ranges from 0-1; when the RI index is 0, nobody mentions any use of the value. When the RI index is 1, the plant was the most frequently mentioned as useful in the maximum number of use categories.

Cultural Importance Index (CI) is calculated using the following formula:

$$CIs = \sum_{u=ui}^{U_{NC}} \sum_{i=il}^{iN} UR_{Ui/N}$$

For example, in the case of Artemisia indica, 25 informants out of 50 reported this species as useful in the general category, and there is no other use category. Hence, $CI_{A.\ indica} = 25/50 = 0.5$

RESULTS AND DISCUSSION

Results

A total of 301 taxa falling in 203 genera and 85 families are used by the people of Komkar-Adi Biocultural Landscape (Table S1). Of which 93.36% (281) are angiosperms, pteridophytes 3.98% (12) and Fungi 2.66% (8). 235 taxa were native to the region, whereas 57 are exotics (POWO 2019).

Among the plant-parts used, fruits showed the highest frequency of uses (23.75 %), followed by leaves (19.35 %), tender shoots (11.43 %), whole plants (7.91 %), seeds (6.15 %), flowers (3.51 %), rhizome (3.22 %), fronds (2.93 %), stem (2.93 %), sporocarp (2.34 %), bark (2.05 %), culms (1.75 %), inflorescence (1.46 %), petiole (1.46 %), rootstocks (1.46 %), twigs (1.46 %), stem pith (1.17 %), tubers (1.17 %), endosperm (0.87 %), mid veins (0.87 %), corms (0.58 %), bulbils (0.29 %), calyx (0.29 %), leaf sheath (0.29 %), lignotuber (0.29 %), resin (0.29 %), roots (0.29 %) and sap (0.29 %).

Dividing into use categories, it was found that the majority of the plants fall under food (54.13%) followed by medicine (15.94%), rituals beliefs and customs (11.11%), household materials (4.84%), fishing (2.56%), hunting (2.56%), masticatory (2.56%), construction (2.27%), fodder (1.7%) and fencing (0.85%).

Considering the habit groups, the tree was the most dominant with 72 spp. (23.92 %), followed by annual herbs (58 spp., 19.26%), shrubs (45 taxa, 14.95%), perennial herb (40 spp., 13.28%), Geophytic herbs (17 spp., 5.64%), a shrubby climber (12 spp., 3.98%), liana (11 spp., 3.65%), an herbaceous climber (10 spp., 3.32%), fungal fruit body (8 spp., 2.65%), bamboo (7 spp., 2.32%), epiphytes (7 spp., 2.32%), suffrutescents (5 spp., 1.66%), palm (4 spp., 1.32%), geophytic climbers (3 spp., 0.99%), root parasite and stem parasite with one species each (0.33%). The surrounding vegetation was forest-dominated, which might have provided facilities to test more tree species. However, in open areas, along the forest margins, besides marshlands, around the settlements, etc., herbaceous plants are dominant, so, are coming easily into view and contact people and are mostly used.

Use value (UV) of all the reported species ranges between 0.017 and 0.051 (Table S1). The plants with the highest UV indicate species considered most important by

the Adi people for their repeated treatment use. And those species are conserved locally by following cultivation practices in their respective home gardens and community lands due to their high harvesting pressure. A total of 48 ethnomedicinal plant species, including herbs, shrubs, and trees, are used to cure 35 different ailments. *Solanum spirale* is considered the most important as it predominates in the landscape and is mentioned by a higher number of informants (FC=52). Table 1 shows a comparison between three different indices CI, RFC, and RI, indicating species ranking based on each index and the three fundamental values of the study, viz. FC, UR, and NU for each species.

Table 1. Evaluation of plant species used in medicinal practices of the analyzed areas using CI, RFC, and RI quantitative indices

Botanical name	Basic values			Indices		
	FC	UR	NU	CI	RFC	RI
Agapetes macrantha var. *grandiflora*	15	15	1	0.26	0.26	0.27
Ageratum conyzoides	30	50	3	0.86	0.52	0.66
Ageratum houstonianum	15	22	2	0.38	0.26	0.39
Arenga obtusifolia	16	25	2	0.43	0.28	0.40
Artemesia indica	23	30	2	0.52	0.40	0.47
Bambusa tulda	33	48	4	0.83	0.57	0.82
Begonia aborensis	17	31	2	0.53	0.29	0.41
Begonia griffithiana	17	27	2	0.47	0.29	0.41
Begonia silletensis	36	55	2	0.95	0.62	0.60
Blumea balsimifera	28	32	2	0.55	0.48	0.52
Brachystemma calycinum	22	22	1	0.38	0.38	0.34
Bryophyllum pinnatum	25	40	2	0.69	0.43	0.49
Centella Asiatica	32	51	3	0.88	0.55	0.68
Chromolaena odorata	22	30	2	0.51	0.37	0.46
Clerodendron colebrookeanum	51	55	2	0.95	0.88	0.74
Curcuma caesia	20	33	2	0.57	0.34	0.44
Curcuma longa	45	55	2	0.95	0.78	0.68
Cyclosorus parasiticus	25	25	1	0.43	0.43	0.37
Dendrocalamus hamiltonii	36	52	3	0.90	0.62	0.72
Dendrocnide sinuata	37	51	2	0.88	0.64	0.61
Euphorbia royleana	34	49	2	0.84	0.59	0.58
Garcinia pedunculata	32	49	2	0.84	0.55	0.56
Hedyotis scandens	30	47	2	0.81	0.52	0.54
Houttuynia cordata	41	55	3	0.95	0.71	0.77
Kaempferia galanga	18	18	1	0.31	0.31	0.30
Melotheria heterophylla	28	45	3	0.78	0.48	0.64
Mikania micrantha	19	33	2	0.57	0.33	0.43
Morus macroura	22	30	2	0.52	0.38	0.46
Neprolepsis cordifolia	17	17	1	0.29	0.29	0.29
Nicotiana tabacum	40	45	2	0.78	0.69	0.63
Oryza sativa	26	37	2	0.64	0.45	0.50
Oxalis corniculata	20	20	1	0.34	0.34	0.32
Paederia foetida	36	54	2	0.93	0.62	0.60
Paris polyphylla	50	55	3	0.95	0.86	0.86
Photos scandens	31	33	2	0.57	0.53	0.55
Phrynium pubinerve	27	38	2	0.66	0.47	0.51
Psidium guajava	19	27	2	0.47	0.33	0.43
Pueraria Montana	13	21	2	0.36	0.22	0.38
Rhus chinensis	49	50	2	0.86	0.84	0.72
Ricinus communis	40	53	3	0.91	0.69	0.76
Setaria italica	10	16	2	0.28	0.17	0.35
Solanum spirale	52	53	2	0.91	0.90	0.75
Solanum viarum	35	52	2	0.90	0.60	0.59
Solanum violaceum	39	43	2	0.74	0.67	0.63
Urtica dioica	49	57	4	0.98	0.84	0.97
Urtica parviflora	15	15	1	0.26	0.26	0.27
Zanthoxylum armatum	36	46	2	0.79	0.62	0.60
Zingiber officinale	29	39	2	0.67	0.50	0.53
Zingiber sianginensis	28	35	3	0.60	0.48	0.64

According to the CI index, Urtica dioica is the most culturally significant, with a value of 0.98. Along with 49 citations (FC) and 57 use reports (UR). It is followed by *Paris polyphylla* with the CI of 0.94 (FC=50 and UR=55), *Houttuynia cordata* (CI=0.94, FC=51 and UR=55), *Curcuma longa* (CI=0.94, FC=45 and UR=55), *Clerodendrum colebrookeanum* (CI=0.94, FC=51 and UR=55) and *Begonia silletensis* (CI=0.94, FC=36 and UR=55). The highest RI value (0.97) of *Urtica dioica* signifies greater importance to its multiple uses, and the species was mentioned in a higher number of use categories (NU=4). The result found that *Urtica dioica, Solanum spirale, Paris polyphylla, Curcuma longa, Clerodendrum colebrookeanum*, and *Begonia silletensis* are largely used by the community in the treatment of human and animal diseases.

Discussion

The plants reported in this study is far more than the earlier studies conducted on the Adi tribe, residing in different regions of the Arunachal Pradesh by Tag et al. (2008); Srivastava and Adi community (2009); Yumnam et al. (2011); Boko et al. (2014); Kumar et al. (2015); Murtem and Chaudhry (2016); Bhuyan et al. (2017); Ayam et al. (2017); Jeyaprakash et al. (2017).

The dependence of these people on ethnobotanical resources may be due to their well-known health benefits or feeling the mere pleasure of gathering, recreation, and enjoying exquisite natural flavors (Pardo-de-Santayana et al., 2007). Their vast traditional knowledge of wild edible plants used by the community is time-tested, eco-friendly, and supportive of livelihood. Traditional knowledge of their ancestors regarding the food habits and the location of their settlements in biodiversity-rich remote Himalayan corners always provided natural resources for their survival. Also, the scarcity of cultivable land forced them to lead a lifestyle where they partially practiced agriculture and depended on available bioresources in their surroundings. It has been observed that among the 301 plants, more than half were used as different types. Some plants are commonly consumed by every household and have one or more types of uses, such as *Asystasiella neesiana*, *Deeringia amaranthoides*, *Dioscorea alata*, *Fagopyrum esculentum*, *Piper pedicellatum*, *Zanthoxylum oxyphyllum*, *Clerodendrum glandulosam*, *Arenga obtusifolia*, *Calamus Erectus*, and *Houttuynia cordata*. These essential plants represent the core of wild food plants for the people of Komkar-Adi Biocultural Landscape. This is because of the frequent distribution and easy availability in the region. The use of such fantastic resources for providing additional needs has also paved its way into the semi-domestication of some plants in their backyards and kitchen gardens. It includes *Fagopyrum esculentum*, *Piper pedicellatum*, *Clerodendrum colebrookeanum*, *Asystasiella neesiana*, *Deeringia amaranthoides*, *Arenga obtusifolia*, and *Houttuynia cordata.*

Ethno-medicines also play a vital role in the rugged terrains, where advanced medical facilities are not yet to be available. Their ethnomedicinal knowledge speaks of their medical history and common ailments. In the present study, 32% of the medicinal plants are reported to treat gastrointestinal disorders, nearly one-fourth of the total plants used by the whole of the Adi tribe (Kagyung et al., 2010). A total of 31 plant species has been recorded to treat a variety of disorders which is higher than the plants used by the Minyong sub-tribe as reported by Baruah et al. (2013) and far more than the total species recorded by Danggen et al. (2018), Gibji et al. (2012) for the Adi tribe of Eastern Himalaya. This study also recorded 9 species of ethnoveterinary knowledge used by the local healers.

A comparison with all the available literature related to the ethnobotanical resources of the Adi tribe (Mibang et al. 2003, Singh et al. 2007a, Singh et al. 2007b, Rethy et al. 2010, Khongsai et al. 2011, Nimasow et al. 2012, Payum et al. 2014, Chetry et al. 2018, Nanda et al. 2018) revealed that 19 plants (*Agapetes macrantha var. Grandiflora*, *Arenga obtusifolia*, *Begonia aborensis*, *Begonia acetosella*, *Begonia silletensis*, *Blumea balsamifera*, *Brachystemma calycinum*, *Dendrocnide sinuata*, *Kaempferia galanga*, *Morus macroura*, *Nephrolepis cordifolia*, *Oryza sativa*, *Phrynium pubinerve*, *Rhus Chinensis*, *Setaria italica*, *Solanum violaceum*, *Solena heterophylla*, *Urtica ardens*, and *Urtica dioica*) are a new record for ethnomedicinal uses by the tribe. Four species (*Ageratum conyzoides*, *Ageratum houstonianum*, *Bryophyllum pinnatum*, and *Solanum spirale*) are new records for medicinal uses against different ailments. Another two species (*Euphorbia royleana* and *Nicotiana tabacum*) are reported as new for ethnoveterinary user benefits. Calculating the quantitative indices found *Urtica dioica, Solanum spirale, Paris polyphylla, Curcuma longa, Clerodendrum colebrookeanum*, and *Begonia silletensis* are the most important plant species used by the Komkar Adi in the treatment of various ailments. More work needs to be done on those particular plants with higher values to validate their traditional medicinal uses and check their bioactive constituents for further drug development. This type of study could open a new path for future pharmacological research, serving as a reference for dealing with the rich ethnobotanical knowledge of diverse ethnolinguistic indigenous groups.

It is also observed that exotic elements such as *Bidens pilosa*, *Chromolaena odorata*, *Ageratum conyzoides*, *Nasturtium microphyllum*, *Erigeron Canadensis*, *etc.* have gradually entered into the traditional knowledge livelihood system of the Komkar-Adi, as food and medicine.

Hunting and fishing have played a vital role in the lifestyle of tribal people. Apart from their protein needs, it has always been a favorite pastime for youths. Since time memorial, they have been using innovative techniques and traps. A total of 18 plants is recorded here used in their traditional ways of fishing and hunting, either as baits, as poison, adhesive, etc., which is half the number of species reported by Yumnam and Tripathi (2013) for the entire *Adi* community.

Some plants or groups are sometimes given particular importance due to their long history of extensive use. Bamboos are part and parcel of the life of Adi people and are used in innumerable ways. Sharma and Borthakur (2008) reported different benefits of 15 species of bamboos by the whole *Adi* community, twice the number (8 spp.)

reported in the present study. Similarly, for the wild or local species of *Allium*, as many as 9 species are known to occur in the region (Devi et al. 2014), and the Adi-Komkar community is using only 2 of them.

Traditional knowledge also became important in their art of living. Different phenophases of some plants are found to use as biological indicators. For example, flowering and fruiting of many plants embark seasons, acting as biological indicators. The Adi people are primarily agricultural. *Capparis multiflora* and *Melastoma malabathricum* blooms in April, and that flag-off the time to broadcast paddy seeds. Similarly, the blooming of Erythrina stricta indicates the time for cultivating different types of beans in the region. The shift in the phenology of such plants primarily due to climatic imbalance causes damage to their livelihood crops.

The Adi people are primarily followers of Donyi-Polo (the Sun and Moon), where they keep faith in Nature like God. Hence, Nature and its associated myths play a vital part in their rural lifestyle. Since time immemorial, the Komkar-Adi have lived in complete harmony with plants while harvesting their daily minimum requirements from the forest for their survival. The example of the erection of gates along the village boundary with the long and spreading fronds of *Cyathea gigantea* for controlling the spread of infectious diseases is one such example. They firmly believe that the tree fern possesses divine power that ensures the community's security, health, and prosperity. Such plants are not frequently harvested except for ritual purposes. This idea underlies the conservation ethics of the communities associated with many plant species, including the tree-ferns, due to their close association with nature.

ACKNOWLEDGEMENTS

The authors are thankful to Rajiv Gandhi University for providing the necessary facilities. They are also grateful to the local traditional knowledge holders of the community for sharing their valuable knowledge system. Invaluable help rendered by Omeng Minno, Ojar Taku, and Bosong Taram during the field survey, Hui Tag for his helpful comments, and Jambey Tsering for the map is sincerely acknowledged and appreciated.

REFERENCES

Ayam VS, Nyitan J. 2017. Plants that Influences the Socio-cultural of Adis of Arunachal Pradesh. Intl J Res 5: 16-19. DOI: 10.20431/2349-0365.0506004

Baruah S, Borthakur SK, Gogoi P, Ahmed M. 2013. Ethnomedicinal plants used by Adi-Minyong tribe of Arunachal Pradesh, eastern Himalayas. Indian J Nat Prod Res 4: 278-282.

Bhuyan LR, Pangu Y, Tam N. 2017. Ethnobotanical studies on Khamba and Adi tribes of Tuting area, Upper Siang District, Arunachal Pradesh. Bull Arunachal For Res 32: 27-40.

Boko N, Narsimhan D. 2014. Rapid survey of plants used by Adi tribe of Bosing Banggo, East Siang District, Arunachal Pradesh, India. Pleione 8: 271-282.

Boko N, Narsimhan D. 2015. House of Adi Tribe of Arunachal Pradesh: Construction materials and the use of space. Intl J Innov Res Adv Stud 2: 1-6.

Borah D, Das AP, Tangjang S, Wangpan T. 2019. Flowering Plant Diversity in the Alpine Regions of Eastern Himalaya. In Jayanta Kumar Patra, Gitishree Das, Sanjeet Kumar, Hrudayanath Thatoi (eds.) Ethnopharmacology and Biodiversity of Medicinal Plants. Apple Academic Press, Palm Bay, Florida, USA. DOI: 10.1201/9780429398193-8.

Chetry LB, Bharali MK, Basar K, Taye K, Taka T, Tsering J, Wangpan T. 2018. Medicinal Plants used against gastrointestinal disorders among the Adi Tribe of Eastern Himalaya. NeBIO 9: 93-10.

Chowdhery HJ, Giri GS, Pramanik A. 2009. Materials for the Flora of Arunachal Pradesh. Vol. III. Botanical Survey of India, Calcutta.

Danggen O, Mello J, Ering K, Hussain A, Saikia V. 2018. Ethnomedicinal Plant Knowledge among the Adi Tribe of Yingkiong and Mariyang Valley, Upper Siang District, Arunachal Pradesh, India. Intl J Pure Appl Biosci 6: 1504-1511. DOI: 10.18782/2320-7051.5432.

Das AP, Bera S. 2018. Preface. In: Das AP, Bera S. (eds.), Plant Diversity in the Himalaya Hotspot Region 1. Bishen Singh Mahendra Pal Singh, Dehradun.

Devi A, Rakhsit K, Sarania B, Adi, Apatani, Monpa, Nyishi Community. 2014. Ethnobotanical notes on Allium species of Arunachal Pradesh, India. Indian J Trad Knowl 13: 606-612.

Gibji N, Ringu N, Dai NO. 2012. Ethnomedicinal knowledge among the Adi tribes of Lower Dibang Valley District of Arunachal Pradesh, India. Intl Res J Pharm 3: 223-229.

Giri GS, Pramanik A, Chowdhery HJ. 2008. Materials for the Flora of Arunachal Pradesh. Vol. II. Botanical Survey of India, Kolkata.

Hajra PK, Verma DM, Giri GS. 1996. Materials for the Flora of Arunachal Pradesh. Vol. I. Botanical Survey of India, Calcutta.

Höft M, Barik SK, Lykke AM. 1999. Quantitative ethnobotany: Applications of multivariate and statistical analyses in ethnobotany. People and Plants Working Paper 6, UNESCO, Paris.

Hooker JD. 1872-1897. The Flora of British India I-VII L. Reeve and Company, London

Jeyaprakash K, Lego YJ, Payum T, Rathinavel S, Jayakumar K. 2017. Diversity of Medicinal Plants used by Adi Community in and around the area of D' Ering Wildlife Sanctuary, Arunachal Pradesh, India. World Sci News 65: 135-159.

Kagyung R, Gajurel PR, Rethy P, Singh B. 2010. Ethnomedicinal plants used for gastrointestinal diseases by Adi tribes of Dehang-Debang Biosphere Reserve in Arunachal Pradesh. Indian J Trad Knowl 9: 496-501.

Kanjilal UN, Das A, Kanjilal PC, Purkayastha C, Dey RN, Bor NL. 1934-1940. Flora of Assam 1-5. Government of Assam, Shillong.

Khongsai M, Saikia SP, Kayang H. 2011. Ethno-medicinal plants used by different tribes of Arunachal Pradesh. Indian J Trad Knowl 10: 541-546.

Kim H, Song MJ. 2013. Ethnomedicinal practices for treating liver disorders of local communities in the southern regions of Korea. Evidence-Based Complementary Alternative Medicine: 2013: 869176. DOI: 10.1155/2013/869176.

Krithika S, Maji, Vasulu TS. 2008. A microsatellite guided insight into the genetic status of Adi, an isolated hunting-gathering tribe of Northeast India. PLoS One 3: e2549. 10.1371/journal.pone.0002549.

Kumar N, Kumar S, Singh B, Mishra BP, Singh B, Singh V. 2015. Traditional practices of utilization and conservation of non-wood forest products by Adi tribes of Arunachal Pradesh. J Appl Nat Sci 7: 111-118. DOI: 10.31018/jans.v7i1.573.

Mibang T, Choudhuri SK. 2003. Ethnomedicines of the tribes of Arunachal Pradesh. Himalayan Publishers, New Delhi (India).

Mipun P, Bhat NA, Borah D, Kumar Y. 2019. Non-timber forest products and their contribution to healthcare and livelihood security among the Karbi tribe in Northeast India. Ecological Processes 8: 41. DOI: 10.1186/s13717-019-194-4.

Murtem G, Chaudhry P. 2016. An ethnobotanical study of medicinal plants used by the tribes in Upper Subansiri District of Arunachal Pradesh, India. Ameri J Ethnomed 3: 35-49.

Nanda P, Teyi C, Gocham Y, Kumji T, Sharma H, Muthu J. 2018. Indigenous methods of preparation of tassey from palm tree Arenga obtusifolia Griff. by the Nyishi tribe of Kurung Kumey, Arunachal Pradesh, India. Intl Res J Biol Sci 7: 62-65.

Nimasow G, Ringu N, Nimasow OD. 2012. Ethnomedicinal Knowledge among the Adi Tribes of Lower Dibang Valley, Arunachal Pradesh, India. Intl Res J Pharm 3: 223-229.

Ong GH, Kim DY. 2014. Quantitative ethnobotanical study of the medicinal plants used by the Ati Negrito indigenous group in

Guimaras Island, Philippines. J Ethnopharmacol 157: 228-242. DOI: 10.1016/j.jep.2014.09.015

Pardo-de-Santayana M, Blanco JTE, Carvalho AM, Lastra JJ, Miguel ES, Morales R. 2007. Traditional knowledge of wild edible plants used in the northwest of the Iberian Peninsula (Spain and Portugal): a comparative study. J Ethnobiol Ethnomed 3: 27. DOI: 10.1186/1746-4269-3-27

Payum T, Das AK, Shankar R. 2014. Nutraceutical folk food plants used among indigenous people of East Siang District of Arunachal Pradesh, India. Amer J PharmTech Res 4: 696-704.

Phillips OLB, Gentry AH. 1993. The useful plants of Tambopata, Peru. II: additional hypothesis testing in quantitative ethnobotany. Econ Bot 47: 32-43. DOI: 10.1007/BF02862204.

Pieroni A. 2001. Evaluation of the cultural significance of wild food botanicals traditionally consumed in Northwestern Tuscany, Italy. J Ethnobiol 21: 89-104.

POWO. 2019. Plants of the World Online. Facilitated by the Royal Botanic Gardens, Kew. Published on the Internet; http: //www.plantsoftheworldonline.org/ Retrieved 21 January 2020.

Prance GT. 1991. What is ethnobotany today?. J Ethnopharmacol 32: 209-216. DOI: 10.1016/0378-8741(91)90120-3.

Rethy P, Singh B, Kagyung R, Gajurel PR. 2010. Ethnobotanical studies of Dehang Debang Biosphere reserve of Arunachal Pradesh with special reference to Memba tribe. Indian J Trad Knowl 9: 61-67.

Sharma TP, Borthakur SK. 2008. Ethnobotanical observations on Bamboos among Adi tribes in Arunachal Pradesh. Indian J Trad Knowl 7: 594-597. DOI: 10.1016/j.jep.2012.06.053.

Sharma UK, Pegu S, Hazarika D, Das A. 2012. Medico-religious plants used by the Hajong community of Assam, India. J Ethnopharmacol 143: 787-800.

Singh RK, Singh A, Tag H. 2007. Traditional skill among Adi tribes of Arunachal Pradesh. Indian J Trad Knowl 7: 27-36.

Singh RK, Sureja AK, Turner NJ. 2007. Food and cultural values of hidden harvest in livelihood of Adi tribes of Arunachal Pradesh. Indian J Ext Educat 43: 56-62.

Srivastava RC, Adi community. 2009. Traditional knowledge of Adi tribe of Arunachal Pradesh on plants. Indian J Trad Knowl 8: 146-153.

Tag H, Murtem G, Das AK, Singh RK. 2008. Diversity distribution of ethnobotanical plants used by Adi tribe of East Siang District of Arunachal Pradesh, India. Pleione 2: 123-136.

Taram M, Borah D, Rinyo R, Tag H. 2018. Wild Food Plant Resources of Komkar Adi Tribe of Upper Siang District in Arunachal Pradesh, India. Bulletin of Arunachal Forest Res 33: 27-35.

Teklehaymanot T, Giday M. 2010. Quantitative ethnobotany of medicinal plants used by Kara and Kwego semi-pastoralist people in lower Omo River Valley, Debub Omo Zone, Southern Nations, Nationalities and Peoples Regional State, Ethiopia. J Ethnopharmacol 130: 76-84. DOI: 10.1016/j.jep.2010.04.013.

Upadhyay B, Singh KP, Kumar A. 2011. Ethnoveterinary uses and informants consensus factor of medicinal plants of Sariska region, Rajasthan, India. J Ethnopharmacol 133: 14-25. DOI: 10.1016/j.jep.2010.08.054.

Yumnam JY, Bhuyan SI, Tripathi OP, Khan ML. 2011. Study on the ethnomedicinal plants used by Adi tribe of East Siang District, Arunachal Pradesh. J Econ Taxon Bot 35: 369-377.

Yumnam JY, Tripathi OP. 2013. Ethnobotany: Plants use in fishing & hunting by Adi tribe of Arunachal Pradesh. Indian J Trad Knowl 12: 157-161.

Table S1. List of ethnobotanicals used by the Adi-Komkar tribe in Arunachal Pradesh, India

[*Abbreviations used*: ***Habit*****:** B: Bamboo; HA: Annual Herb; HG: Geophytic Herb; HP: Perennial Herb; CG: Geophytic Climber; CH: Herbaceous Climber; CS: Shrubby Climber; E: Epiphyte; FB: Fungal fruit-body; L: Liana; P: Palm; PR: Root Parasite; PS: Stem Parasite; Sf: Suffrutescent; S: Shrub; T: Tree. ***Uses*** F: Food; M: Medicine; H: Hunting; Fh: Fishing; RBC: Rituals, beliefs, and Customs; O: Others; C: Construction; HHM: House Hold Materials; Fd: Fodder; Mst: Masticatory; Fn: Fence.***Plant Parts used:*** Br: Bark; Bu: Bulbil; Cm: Culm; Cr: Corm; Cy: Calyx; En: Endosperm; Fl: Flower; Fn: Frond; Fr: Fruit; In: Inflorescence; Lf: Leaf; Lsp: Leaf-sheath powder; Lt: Lignotuber; Lx: Latex; Pt: Petiole; Re: Resin; Rh: Rhizome; Rs: Tuberous Root Stock; Rt: Root; Sa: Sap; Sd: Seed; Sp: Stem pith; St: Stem; Ts: Tender Shoot; Tu: Tuber; Tw: Twig; Vn: Vein;.Wh: Whole plant***. Distribution*****:** E: Exotic; N: Native;-: not known.]

Botanical name [Family]; Voucher specimen	Adi-Komkar name	Habit	Part used	Used and application	Distribution	Use value (UV)
Acacia rugata (Lam.) Fawc. & Rendle [Fabaceae]; *MT-1501*	*Ramgir taang*	L	Br	Fh: Paste mixed in water to stupefy fishes	N	0.017
Acmella oleracea (L.) R.K. Jansen[Asteraceae]; *MT-1507*	*Marshang*	HA	Ts	F: Cooked as a vegetable	E	0.017
Acmella paniculata (Wall.ex DC.) R.K. Jansen [Asteraceae]; *MT-1528*	*Marshang-haali*	HA	Lf	F: Cooked as a vegetable	E	0.017
*Aconitum ferox*Wall. ex Ser. [Ranunculaceae]; *MT-1506*	*Eemo*	HP	Rh	H: Poisoning arrowheads for hunting	N	0.017
Actephila excelsa (Dalzell) Mull.Arg [Phyllanthaceae]; *MT-1508*	*Kamtar-oying*	S	Ts	F: Cooked as a vegetable	N	0.017
Aeschynanthus parasiticus C.B. Clarke [Gesneriaceae]; *MT-1503*	*Epom marsi*	E	Fl	RBC: believed to be of Jungle spirit's property	N	0.017
Aeschynanthus micranthus C.B. Clarke [Gesneriaceae]; *MT-1504*	*Epom marsi*	E	Fl	RBC: believed to be of Jungle spirit's property	N	0.017
Aeschynanthus monetarius Dunn [Gesneriaceae]; *MT-1811*	*Epom marsi*	E	Fl	RBC: It is believed to be of Jungle spirits property	N	0.017
Aeschynanthus novogracilis W.T.Wang [*A. gracilis* C.S.P.Paris ex C.B Clarke] [Gesneriaceae]; *MT-1505*	*Epom marsi*	E	Fl	RBC: believed to be Jungle spirit's property [spirit's use red flowers as their chili.'*Epom*" means jungle spirit; "*Marsi*" means chili]	N	0.017
Agapetes macrantha var. *grandiflora* (Hook.f.) D.Banik & Sanjappa [Ericaceae]; *MT-1502*	*Asi ponying*	CS	Fl, Lt	F: Flowers edible; M: Paste of lignotuber given topically to treat snake bite	N	0.034
Ageratum conyzoides (L.) L. [Asteraceae]; *MT-1509*	*Namsing eeing/ Migom Dumpu*	HA	Lf	M: Paste applied topically for cuts and wounds; juice gave orally in malaria	E	0.017
Ageratum houstonianum Mill.[Asteraceae]; *MT-1734*	*Namsing eeing/ Migom Dumpu*	HA	Lf	Paste applied topically on cuts and wounds to clot blood	E	0.017
Albizia odoratissima (L.f.) Benth. [Fabaceae]; *MT-1550*	*Tatkung*	T	St	C: Trunk to make mortar for traditional paddy de-husking (*Kii-par*)	N	0.017
Allium chinense G.Don [Amaryllidaceae]; *MT-1573*	*Talab/ dilab*	HA	Wh	F: Whole plants edible; RBC: crushed bulb applied on body as protection from snakes and wandering soul	E	0.034
Allium hookeri Thwaites [Amaryllidaceae]; *MT-1634*	*Disa talab/ byakung*	HP	Lf, Rt	F: Leaves edible; RBC: roots taken as a necklace during a local festival, believes that will protect them from infectious diseases	N	0.034
Alocasia macrorrhizos (L.) G.Don [Araceae]; *MT-1605*	*Ruksin*	HP	Wh	Fd: Cooked with paddy husk for pigs	E	0.017
Alpinia nigra (Gaertn.) Burtt [Zingiberaceae]; *MT3110*	*Gumba-bera*	HG	Fr	F: Ripe ones eaten raw	N	0.017
Alpinia roxburghii Sweet [Zingiberaceae]; MT-1683	*Gumba-bera*	HG	Fr	F: Ripe ones eaten raw	N	0.017
Altingia excelsa Noronha [Altingiaceae]; *MT-1692*	*Hiri/siri*	T	Tw	RBC: With belief, twigs are tied to pillars to strengthen the roof	N	0.017
Amaranthus spinosus L. [Amaranthaceae]; *MT-1565*	*Tapi-pilee*	HA	Ts	F: Cooked as a vegetable	E	0.017
Amaranthus viridis L.[Amaranthaceae]; *MT-1564*	*Tapi-pilee*	HA	Ts	F: Cooked as a vegetable	N	0.017

*Amomum pterocarpum*Thwaites [Zingiberaceae]; *MT-1578*	*Taje* (plant),*Jepo* (Inflorescences)	HG	In	F: Cooked as vegetable andin salad	N	0.017
*Amomum subulatum*Roxb.[Zingiberaceae]; *MT-1592*	*Taaling liite*	HG	Ts, Sd	F: Tender shoot and aromatic seeds edible	N	0.017
Amorphophallus kachinensis Engl. & Gehrm. [Araceae]; *MT-1587*	*Tabi eeging*	HG	Cr	H: Preparation of bait for rodents and birds	E	0.017
Aralia armata (Wall. ex G. Don) Seem. [Araliaceae]; *MT-1552*	*Tataterang*	T	Ts	F: Edible	N	0.017
Ardisia solanacea (Poir.) Roxb. [Primulaceae]; *MT-1680*	*Go-yakpin*	S	Lf	F: Young ones edible	N	0.017
Arenga obtusifolia Mart.[Arecaceae]; *MT-1557*	*Tasat*	P	Sp, Vn, LSP	Fd: Stem pith and leaves as fodder for pigs and cattle; HHM: Prepare broom with mid-vein of leaf pinnae; black fibers from leaf-sheath used to prepare local hats (*Leb-ro*), backpack (*Tali*) cover and broom; M: brown powder of leaf sheath applied topically on cuts and wounds for quick healing	E	0.051
Artemisia indica Willd. [Asteraceae]; MT-1646	*Eetki-daali*	Sf	Lf, Tw	M: Leaf-paste took orally in stomach disorder; RBC: twigs used in rituals performing on funeral	N	0.034
Artocarpus heterophyllus Lam.[Moraceae]; *MT-1625*	*Belang*	T	St	C: Trunk suitable for house-poles, big mortar (*Kipar*), and pestles (*Eeging*) for paddy dehusking	N	0.051
*Artocarpus lacucha*Buch.Ham. [Moraceae]; *MT-1779*	*Raami*	T	Fr	F: Taken raw when ripe, sour	N	0.017
Asystasiella neesiana (Wall.) Lindau [Acanthaceae]; *MT-1742*	*Obul*	HP	Lf	F: Cooked as a vegetable	N	0.017
Auricularia auricula-judae (Bull.) J.Schrot[Auriculariaceae]; *MT-1717*	*Koko-nyorung*	FB	FB	F: Cooked and eaten	-	0.017
Auricularia polytricha (Mont.) Sacc. [Auriculariaceae]; *MT-1718*	*Koko-nyorung*	FB	FB	F: Cooked and eaten	-	0.017
Baccaurea ramiflora Lour. [Phyllanthaceae]; *MT-1629*	*Bureng*	T	Sd	F: Aril on seeds edible	N	0.017
Balanophora dioica R.Br. ex Royle [Balanophoraceae]; *MT-1558*	*Taruk-langkaer*	PR	Rh	Mst: Chewed as chewing gum	N	0.017
Bambusa tulda Roxb. [Poaceae] ; *MT-1631*	*Dibang*	HP	Ts, Cm	F: Young shoots edible; M: fermented shoot used topically in inflammation, burns, and insect bites; HHM: culms for handicraft and construction	N	0.051
Bauhinia purpurea L. [Fabaceae]; *MT-3100*	*Ogok*	T	Ts	F: Cooked as a vegetable	N	0.017
*Bauhinia variegata*L. [Fabaceae]; *MT-1745*	*Ogok*	T	Ts	F: Cooked as a vegetable	N	0.017
Beaumontia grandiflora Wall. [Apocynaceae]; *MT-1636*	*Dongko-riyo*	L	Sd	RBC: To decorate traditional hats ‘‘*Leebro*’’-worn during war dance (*Taapu*)	N	0.017
Begonia aborensis Dunn [Begoniaceae]; *MT-1595*	*Sisibaying*	HP	Pt	F: Eaten raw; M: Dizziness, headache: eaten raw	N	0.034
Begonia acetosella Craib [Begoniaceae]; *MT-1638*	*Dumbo-leepang*	HP	Pt	F: Eaten raw, sour; M: Eaten raw against dizziness and headache	N	0.034
Begonia palmata D.Don [Begoniaceae]; *MT-1639*	*Dumbo-lepang*	HP	Pt	F: Eaten, sour	N	0.017
Begonia roxburghii A.DC. [Begoniaceae]; *MT-1594*	*Sisibaying*	HP		do-	N	0.017
Begonia silhetensis (A.DC.) C.B. Clarke [Begoniaceae]; *MT-3101*	*Sisibaying*	HP	Pt	F: Eaten raw, sour; M: Also eaten raw against dizziness and headache	N	0.034
Benincasa hispida (Thunb.) Cogn. [Cucurbitaceae]; *MT-1765*	*Pau/ paar*	CH	Fr	F: Cooked as a vegetable	N	0.017
Bidens pilosa L. [Asteraceae]; *MT-1553*	*Tasso-lepyo*	HA	Ts	F: Cooked as a vegetable	N	0.017
Blumea balsamifera (L.) DC.[Asteraceae]; *MT-1655*	*Eyok aain*	HA	Lf	M: crushed paste nixed with fresh dung of *Bos frontalis* and clean water from natural spring is applied on the forehead to treat malaria	N	0.017
Boehmeria penduliflora Wedd. ex D.G.Long [Urticaceae]; *MT-1740*	*Nyot-kyang*	S	Lf	Fd: Fodder for *Bos frontalis*	N	0.017

Boehmeria pilosiuscula (Blume) Hassk. [Urticaceae]; *MT-1739*	*Nyot-kyang*	S	Lf	Fd: Fodder for *Bos frontalis*	N	0.017
Boeica fulva C.B. Clarke [Gesneriaceae]; *MT-1704*	*Jongkot*	S	Lf	Mst: Chewed raw as a substitute for betel leaves	N	0.017
*Bombax ceiba*L. [Malvaceae]; *MT-1699*	*Hingyo gyomur*	T	Fr	HHM: Seed floss as stuffing material for pillows	N	0.017
Brachystemma calycinum D. Don [Caryophyllaceae]; *MT-1746*	*Okin-parin*	HA	Lf	Packed in *Phrynium pubinerve* leaves, warmed and locally applied cure cracked sole	N	0.017
Brassaiopsis glomerulata (Blume) Regel [Araliaceae]; *MT-1579*	*Tagor*	T	Sp	RBC: Dried pith cut into small square blocks to decorate traditional hat ‘‘*Leebro’’*,-worn during war dance (*Taapu*)	N	0.017
*Brassica juncea (*L.) Czern [Brassicaceae]; MT-1791	*Pettu*	HA	Sd	RBC: Burnt to protect the home from evil forces	E	0.017
Brassica nigra (L.) K.Koch [Brassicaceae]; *MT-1771*	*Pettu tulang*	HA	Sd	RBC: Burnt to protect the home from evil forces	E	0.017
Brugmansia suaveolens (Humb. & Bonpl. ex Willd.) Sweet [Solanaceae]; *MT-1546*	*Toti*	S	Wh	Fc: To barricade against trespassing of animals through paddy field [plants poisonous, so animals so avoid going near it]	E	0.017
Bryophyllum pinnatum (Lam.) Oken [*Kalanchoe pinnata* (Lam.) Pers.] [Crassulaceae]; *MT-1650*	*Eme kusureng*	HP	Lf	M: Sap applied on burns and inflammation	E	0.017
Cajanus cajan (L.) Millsp. [Fabaceae]; *MT-1769*	*Peradh*	S	Sd	F: Cooked as pulse	N	0.017
Calamus erectus Roxb. [Arecaceae]; *MT-1562*	*Tara*	L	Ts, Fr, Lf, St	F: Raw as well as roasted tender shoots edible; fruits sour; C: Leaves for thatching; HHM: Stem to prepare local handicrafts	N	0.051
Calamus flagellum Griff. ex Mart. [Arecaceae]; *MT-1541*	*Yoyi*	L	Ts, Fr, St	F: Tender shoots and ripe fruits edible; HHM: Prickly smoked stem used as a grinder	N	0.034
Callicarpa arborea Roxb. [Lamiaceae]; *MT-3102*	*Lalu*	T	Br	Mst: Bark has chewed with *Rubus moluccanus* leaves as a substitute for betel nut	N	0.017
Canarium strictum Roxb. [Burseraceae]; *MT-1687*	*Hilum*	T	Fr, Re	F: Fruits edible; O (MR): dry resin as fragrant incense or as mosquito repellant	N	0.034
Canna indica L. [*C. edulis* Ker Gawl.], [Cannaceae]; *MT-1707*	*Kampir eengin*	HP	Rh	F: Cooked and eaten	N	0.017
Capparis multiflora Hook. f. & Thomson [Capparaceae]; *MT-1776*	*Remsap*	CS	Fl	RBC: Its blooming indicate the time for paddy transplantation	N	0.017
*Capsicum frutescens*L. [Solanaceae]; *MT-1767*	*Peepit marsi*	HP	Fr	F: As spice in different food preparations	E	0.017
Cardamine hirsuta L. [Brassicaceae]; *MT-1751*	*Oram-petsik*	HA	Wh	F: Cooked as a green vegetable	N	0.017
Carex baccans Nees [Cyperaceae]; *MT-1677*	*Gemin-taabeng/tapok*	HP	Wh	RBC: Believed that *Carexbaccans* and *Saccharum aruninaceum* came from the same ancestor, so they use whole plants together in funeral rituals	N	0.017
Caryota urens L. [Arecaceae]; *MT-1570*	*Tamak*	P	St	HHM: Split stem used for making traditional weaving sword shape material (*Sumpa*) and hunting equipment	N	0.017
*Casearia varecа*Roxb. [Salicaceae]; *MT-1597*	*Sipe-siile*	S	Fr	H: Ripe ones used as bait in the traditional trap (*Etku*) to hunt birds and rodents	N	0.017
Castanopsis indica (Roxb. ex Lindl.) A.DC. [Fagaceae]; *MT-1602*	*Siirang*	T	En	F: Endosperm eaten raw or roasted	N	0.017
Castanopsis purpurella (Miq.) N.P.Balakr. [Fagaceae]; *MT-1618*	*Angke*	T	En	F: Endosperm eaten raw or roasted	N	0.017
Centella asiatica (L.) Urb. [Apiaceae]; MT-1711	*Kiiling kiipum*	HA	Wh	M: Plant paste is taken orally to treat gastrointestinal disorder	N	0.017
Chassalia curviflora var.*ophioxyloides* (Wall) Deb & B.Krishna [Rubiaceae]; *MT-1724*	*Longkin/ sityung oying*	S	Ts	F: Cooked as a vegetable	N	0.017
Chenopodium album L. [Amaranthaceae]; *MT-1700*	*Jili-mili*	HA	Ts	F: Cooked as a vegetable	N	0.017
Chenopodium giganteum D.Don [Amaranthaceae]; *MT-1616*	*Amateng*	HA	Ts	F: Cooked as a vegetable	N	0.017

Choerospondias axillaris (Roxb.) B.L.Burtt & A.W.Hill [Anacardiaceae]; *MT-1529*	*Belam*	T	Fr	F: Ripe ones sweet and edible; H: Also used as bait for hunting deer	N	0.034
Chromolaena odorata (L.) R.M.King & H.Rob. [Asteraceae]; *MT-1695*	*Ingkir*	Sf	Lf	Paste applied on cuts as a hemostat	E	0.017
Cinnamomum bejolghota (Buch.-Ham.) Sweet [Lauraceae]; *MT-1690*	*Hipir ayin*	T	Fr	F: Young ones steamed as chutney	N	0.017
Cinnamomum verum J.Presl [Lauraceae]; *MT-1596*	*Siri pori*	T	Br	F: Aromatic bark as a spice	E	0.017
Citrus × *aurantium* L. [Rutaceae]; *MT-1715*	*Kintirang*	T	Fr, Sd	F: Ripe ones eaten raw, sweet; H: Seeds as bait in traditional hunting trap (*Eetku*) for rodents	E	0.034
Citrus indica Yu. Tanaka [Rutaceae]; *MT-1681*	*Goyeng-hingkiin*	T	Fr	F: Ripe ones sour, taken raw	N	0.017
Citrus latipes (Swingle) Yu.Tanaka [Rutaceae]; *MT-1809*	*Hinnong/hingkom*	T	Fr	F: Taken raw, sour,	N	0.017
Citrus maxima (Burm.) Merr. [Rutaceae]; *MT-1714*	*Kintee*	T	Fr, Tw	F: Ripe ones eaten raw; RBC: Twigs used in rituals done for health and prosperity and to restrict negative forces	N	0.034
*Citrus medica*L.[Rutaceae]; *MT-1688*	*Hingkom*	S	Fr	F: Taken raw, sour	N	0.017
*Clathrusruber*P.Micheli ex pers. [Phallaceae]; *MT-1518*	*Memut-taput*	F	FB	Their bizarre looks signify an evil nature	-	0.017
Clerodendrum colebrookeanum Walp [Lamiaceae]; *MT-1517*	*Ongin*	S	Lf	F: Cooked as a vegetable; M: In hypotension and cough: cooked and eaten	N	0.034
Coix lacryma-jobi L. [Poaceae];*MT-1805*	*Ayak*	HA	Sd	F: Fermented *Nokyin* is prepared from self-made yeast '*siye.*	N	0.017
Colocasia esculenta (L.) Schott [Araceae]; *MT-1651*	*Enge* (corm); *Ngerek/ ngekong* (tender leaf)	HP	Cr, Lf	F: Corm and young leaves cooked as a vegetable	N	0.017
Corchorus capsularis L. [Malvaceae]; *MT-1516*	*Olab*	HA	Lf	F: Takencooked as vegetable	N	0.017
Cordia dichotoma G.Forst [Boraginaceae]; *MT-1514*	*Jongge*	T	Fr	O: Sticky mesocarp as glue for light materials like paper	N	0.017
Crassocephalum crepidioides (Benth.) S.Moore [Asteraceae]; *MT-1515*	*Eeli*	HA	Ts	F: Taken cooked as a vegetable	E	0.017
Cucumis melo L. [Cucurbitaceae]; *MT-1513*	*Mari*	CH	Fr	F: Ripe ones eaten raw	N	0.017
Cucurbita maxima Duchesne [Cucurbitaceae]; *MT-1512*	*Tapa* (fruit); *Payin* (tender shoot)	CH	Fr, Ts	F: Cooked and served as a vegetable	E	0.017
Curcuma caesia Roxb. [Zingiberaceae]; *MT-1510*	*Kala haaldi*	HP	Rh	M: Raw paste in water taken internally in empty stomach to cure acidity and gastritis	N	0.017
Curcuma longa L. [Zingiberaceae]; *MT-1511*	*Haaldi*	HP	Rh	M: Paste of rhizome is applied on the incision during vasectomy and tubectomy of cattle and even for bone fracture	N	0.017
Cyathea gigantea (Wall. ex Hook.) Holttum [Alsophila gigantea Wall. ex Hook.] [Cyatheaceae]; *MT-1519*	*Ngepi*	T	Fn	RBC: Believe that gates prepared with these fronds prevent the spread of infectious diseases inside the boundary	N	0.017
Cyathea spinulosa Wall. ex Hook. [*Alsophila spinulosa* (Wall. ex Hook.) R.M.Tryon [Cyatheaceae]; *MT-1554*	*Tasse*	T	Sp	F: Taken as a famine food	N	0.017
Debregeasia longifolia (Burm.f.) Wedd. [Urticaceae]; *MT-1741*	*Nyot-kyang*	S	Lf	Fd: Fodder for *Bos frontalis*	N	0.017
Deeringia amaranthoides (Lam.) Merr. [Amaranthaceae]; *MT-1747*	*Oko-libo*	CS	Ts	F: Cooked and served as a vegetable	N	0.017

Dendrocalamus giganteus Munro [Poaceae]; *MT-1653*	*Epo*	B	Cm, Ts	HHM: Making traditional utensils: jug (*Pekak*), plate (*Ekung*), spoon (*Penyo*), filtering local beverages *Kaksur* and *Apong*; C: making house-floor (*Tasut*); F: Tender shoot cooked as a vegetable or preserved as fermented food items like '*Ikung*' and '*Eyub*.'	N	0.051
Dendrocalamus hamiltonii Nees & Arn. ex Munro [Poaceae]; *MT-1643*	*Eemo* (plant), *Etiing* (young shoot); *Ekung* (fermented shoot)	B	Ts, Cm	F: Young shoots edible, fermented bamboo-shoot (*Ekung*), dried fermented-shoot (*Eyub*); M: fermented shoots applied on burns and insect bites; HHM: culms used for handicraft and construction	N	0.051
Dendrocnide sinuata (Blume) Chew [Urticaceae]; *MT-1762*	*Pantu tarung*	S	Lf	M: Infected wounds of *Bos frontalis* is beaten with its leaves (covered with stinging hairs) to kill infecting organisms	N	0.017
Dicranopteris linearis (Burm.f.) Underw. [Gleicheniaceae]; *MT-1559*	*Tarong*	HP	Pl	RBC: Long petioles decomposed under mud, fibrous pith will turn dark blue and used as a belt (*Beying*), anklets, and bangles (*Kongge*) in earlier times	N	0.017
Dillenia indica L. [Dilleniaceae]; *MT-1593*	*Sompa*	T	Cy	F: Acrescent calyx eaten raw	N	0.017
Dimetia scandens (Roxb.) R.J.Wang [Rubiaceae]; *MT-1697*	*Inkip-inkop*	CH	Ts, Tu	F: Cooked as a vegetable; M: Tubers used for curing gastrointestinal disorders	N	0.034
Dinochloa macclellandii (Munro) Kurz [Poaceae]; *MT-1581*	*Tagir*	B	Cm	C: Culm used as a rope to tie roofing leaves (*Ekap*) with the supporting pillars (*Papir*); HHM: Household articles; RBC: Rituals in ceremonies related to health issues	N	0.051
Dioscorea alata L. [Dioscoreaceae]; *MT-1778*	*Ramet*	CG	Rs	F: Tuberous and served cooked as a vegetable or roasted	N	0.017
Dioscorea bulbifera L. [Dioscoreaceae]; *MT-1652*	*Engin*	CG	Rs	F: Tuberous and served cooked as a vegetable or roasted	N	0.017
Dioscorea esculenta (Lour.) Burkill [Dioscoreaceae]; *MT-1832*	Ramet	CH	Rs	F: Tuberous and served cooked as a vegetable or roasted	N	0.017
Dioscorea pentaphylla L. [Dioscoreaceae]; *MT-1544*	*Uli*	CG	Bu	F: Roasted to eat	N	0.017
Diplazium esculentum (Retz.) Sw. [Athyriaceae]; *MT-1577*	*Takang*	HP	Fn	F: Young ones cooked as a vegetable	N	0.017
Duabanga grandiflora (DC.) Walp. [Lythraceae]; *MT-1716*	*Kobo*	T	St	C: Used as poles	N	0.017
Duchesnea indica (Jacks.) Focke [Rosaceae]; *MT-1648*	*Eki-tangkin*	HA	Fr	F: Ripe ones eaten raw, watery	N	0.017
Elatostema dissectum Wedd. [Urticaceae]; *MT-1825*	Onu	HA	Ts	F: Eatenas salad or cooked as a vegetable	N	0.017
Eleusine coracana (L.) Gaertn. [Poaceae]; *MT-1730*	*Mirung*	HA	Sd	RBC: Burnt in fire or spread on the floor to scare the evil spirits	E	0.017
Entada parvifolia Merr. [Fabaceae]; *MT-1774*	*Riilok*	L	Br	O: Paste worked as a soap	E	0.017
Entada phaseoloides (L.) Merr. [Fabaceae]; *MT-1773*	*Riipik*	L	Br	Fh: Root-bark used for stupefying fishes	N	0.017
Equisetum diffusum D.Don [Equisetaceae]; *MT-1603*	*Sedum tapum/ sisi dangki*	HP	Wh	RBC: In rituals related to health and prosperity	N	0.017
Erigeron canadensis L. [Asteraceae]; *MT-1696*	*Ingko-bodong*	HA	Ts	F: Cooked and served as a vegetable	E	0.017
Eryngium foetidum L. [Apiaceae]; *MT-1614*	*Ritak /Migom ori*	HP	Lf	F: Added to prepared food and salad for flavoring	E	0.017
Erythrina stricta Roxb.[Fabaceae]; *MT-1582*	*Tagat* (Nonflowering state), *Galling Appun* (Blomming state)	T	Wh	RBC: Beliefs, plant forms a boundary between human beings and souls; mostly planted near graveyards so that the departed soul leave the village and move forward for the spiritual world and its blooming of the flower indicates the time for broadcasting bean seeds	N	0.017

Euphorbia pulcherrima Willd. Ex Klotzsch [Euphorbiaceae]; *MT-1838*	-	S	Wh	Fc: Used as barricades for trespassing animals in the paddy field, animals avoid it for its poisonous nature. Also, its showy bracts add to the beauty	E	0.017
Euphorbia royleana Boiss. [Euphorbiaceae]; *MT-1630*	*Byakok*	S	Lx	M: Latex is pasted with *Nicotiana tabaccum* leaves to apply on infected wounds of cattle	N	0.017
Fagopyrum esculentum Moench [Polygonaceae]; *MT-1723*	*Lompuk*	HA	Lf	F: Young leaves as a vegetable	E	0.017
Ficus auriculata Lour. [Moraceae]; *MT-1756*	*Paapop*	T	Fr	F: Ripe hypanthodia and tender shoots edible	N	0.017
Ficus crassiramea (Miq.) Miq. [Moraceae]; *MT-1601*	*Siirot*	T	Wh	RBC: Beliefs, jungle spirit live on this tree, so people do not cut the tree, if they cut it then jungle spirit will get angry and harm the villagers	E	0.017
Ficus geocarpa Teijsm. Ex. Miq. [Moraceae]; *MT-1641*	*Ee berii*	T	Fr	F: Ripe hypanthodia edible, sweet	N	0.017
Ficus heteropleura Blume [Moraceae]; *MT-1790*	-	T	Fr	H: Ripe hypanthodia used as bait for birds	N	0.017
Ficus hispida L.f. [Moraceae]; *MT-1764*	*Pasuk-payuk/eki tapang*	T	Lf	F: Cooked and mixed with soya beans for quick fermentation	N	0.017
Ficus oligodon Miq. [Moraceae]; *MT-1761*	*Pameng*	T	Fr	F: Ripe hypanthodia edible, sweet	N	0.017
Ficus religiosa L. [Moraceae]; *MT-1600*	*Siirot*	T	Wh	RBC: Beliefs, jungle spirit live on this tree, so people do not cut it, if they cut it then jungle spirit will get angry and harm the villagers	N	0.017
Ficus semicordata Buch. Ham. ex Sm.[Moraceae]; *MT-1574*	*Takuk*	T	Fr	F: Ripe hypanthodia edible, sweet	N	0.017
Ficus simplicissima Lour. [Moraceae]; *MT-1575*	*Takpi*	T	Lf	F: Mixed with soybeans for fermentation	N	0.017
Ficus tinctoria G.Forst. [Moraceae]; *MT-1599*	*Siirot*	T	Wh	RBC: As in *Ficus religiosa*	E	0.017
Ficus variegata Blume [Moraceae]; *MT-1588*	*Taasik*	T	Fr	F: Ripe hypanthodia edible, sweet	N	0.017
Ficus virens Aiton [Moraceae]; *MT-1833*	-	S	Ts	F: Cooked and served as a vegetable	N	0.017
Fissistigma bicolor (Roxb.) Merr. [Annonaceae]; *MT-1816*	*Rika-riya*	L	Fr	F: Ripe fruits sweet, taken raw	N	0.017
Fissistigma polyanthum (Hook. f. & Thomson) Merr. [Annonaceae]; *MT-1772*	*Rika-riya*	S	Fr	F: Eaten ripe one raw, sweet	N	0.017
Garcinia anomala Planch. & Triana [Clusiaceae]; *MT-1561*	*Taraak*	T	Fr	F: Edible, sour	N	0.017
Garcinia lanceifolia Roxb. [Clusiaceae]; *MT-1560*	*Taraak*	T	Fr	F: Edible, sour	N	0.017
Garcinia pedunculata Roxb. ex Buch. Ham. [Clusiaceae]; *MT-1586*	*Tabing*	T	Fr	F: Ripe ones eaten raw, sweet; M: Smoked fruit wall taken orally to treat gastrointestinal problems	N	0.034
Glycine max (L.) Merr. [Fabaceae]; *MT-1770*	*Peron-rontung*	HA	Sd	F: Local recipe *naming Peron/ Ronyang* (fermented soya bean) is made of its seeds	E	0.017
Gnaphalium polycaulon Pers. [Asteraceae]; *MT-1758*	*Paaput*	HA	Lf	F: Cooked as a vegetable	N	0.017
Gonostegia hirta (Blume ex Hassk.) Miq. [Urticaceae]; MT-1755	*Oyik*	HA	Ts	F: Cooked as a vegetable	N	0.017
Gynocardia odorata R.Br. [Achariaceae]; *MT-1731*	*Mondo-tulpi*	T	Fr	Fh: Paste mixed in water for stupefying fishes	N	0.017
Gynura cusimbua (D.Don) S.Moore [Asteraceae]; *MT-1743*	*Ogen*	HA	Lf	F: Cooked as a vegetable	N	0.017
Helixanthera parasitica Lour. [Loranthaceae]; *MT-1555*	*Tasik*	PS	Fr	F: Ripe ones eaten raw, sweet	N	0.017
Helminthostachys zeylanica (L.) Hook.[Ophioglossaceae]; *MT-1620*	*Asi-bisi*	HG	Fn	F: Young ones cooked as a vegetable	N	0.017
Heteropanax fragrans (Roxb.) Seem. [Araliaceae]; *MT-1656*	*Gaatum-bopang*	T	Fr	H: As bait to trap rodents and birds	N	0.017
Hodgsonia macrocarpa (Blume) Cong. [Cucurbitaceae]; *MT-1552*	*Tatar-api*	L	Sd	F: Embryo edible after cooking	E	0.017
Hornstedtia arunachalensis S. Triphathi & V.Prakash [Zingiberaceae]; *MT-1627*	*Bele-belaak*	HG	Fl, Fr	F: Flower buds and fruits eaten raw	N	0.017

Houttuynia cordata Thumb. [Saururaceae]; *MT-1610*	*Roram*	HG	Wh, Lf	F: Whole plants edible; M: leaves taken raw orally in gastrointestinal disorders	N	0.034
Hydrocotyle himalaica P.K.Mukh. [Araliaceae]; *MT-1830*		HA	Wh	Fh: Paste mixed in water for stupefying fish	N	0.017
Hydrocotyle javanica Thunb.[Araliaceae]; *MT-1712*	*Kiling-kiipum*	HA	Wh	Fh: Paste mixed in water for stupefying fish	N	0.017
Impatient bracteolata Hook.f. [Balsaminaceae]; *MT-1735*	*Nanor-tangkor*	HA	Sh	F: Tender shoots serve as a vegetable	N	0.017
Ipomoea batatas (L.) Lam. [Convolvulaceae]; *MT-1644*	*Eengin-taari*	HG	Sh, Tu	F: Both served as a vegetable	E	0.017
*Kaempferia galanga*L. [Zingiberaceae]; *MT-3111*	*Pangkang takeng*	HP	Rh	M: Paste applied on skin to cure itching	N	0.017
Lablab purpureus (L.) Sweet [Fabaceae]; *MT-1611*	*Ronjab*	CH	Fr	F: Cooked as a vegetable	N	0.017
Lagenaria siceraria (Molina) Standl. [Cucurbitaceae]; *MT-1645*	*Eepum / eejuk/ giri*	CH	Fr	F: Cooked as a vegetable; HHM: Shell of matured dried fruits used as vessels: names and uses of vessels depend on the shape and are named as *AsiGiri* (water bottle): *Eejuk* for spoon-shaped and *Eepum* for urn shape meant for different purposes	E	0.034
Laphangium affine (D.) Tzvelev [Asteraceae]; *MT-1757*	*Paaput*	HA	Lf	F: Cooked as a vegetable	N	0.017
Lentinula edeodes (Berk.)Pegler [Marasmiaceae]; *MT-1721*	*Lolum*	FB	FB	F: Cooked and eaten	-	0.017
Leucosceptrum canum Sm. [Lamiaceae]; *MT-1545*	*Toti*	S	St	RBC: Believes, when the soul moves out from the human body by accident, in such cases, they perform rituals (*Leyo Goknam*) in which the twig of the plant is used that acts as a pathway for the soul to come back to the sufferer	N	0.017
Lindenbergia hookeri C.B.Clarke ex Hook.f. [Plantaginaceae]; *MT-1522*	-	S	Fl	F: Edible, sour	N	0.017
Litsea cubeba (Lour.) Pers. [Lauraceae]; *MT-1777*	*Rayil, tayir*	T	Fr	F: As a condiment, strongly aromatic	N	0.017
Livistona jenkinsiana Griff. [Arecaceae]; *MT-1520*	*Taek*	T	Lf, Fr	F: Tender leaves and fermented fruits edible; C: Leaves widely used for thatching houses	N	0.034
Macaranga cuspidata Boivin ex Baill. [Euphorbiaceae]; *MT-1521*	*Lagar*	T	Fr	H: As bait for birds and rodents	E	0.017
Maclura cochinchinensis (Lour.) Corner [Moraceae]; *MT-1808*	Tanyum-tang	S	Fr	F: Ripe ones eaten, sweet	N	0.017
Maesa indica (Roxb.) A.DC. [Primulaceae]; *MT-1654*	*Etjun-jayun*	S	Fr, Ts	F: Ripe fruits and tender shoots eaten raw	N	0.017
Mangifera sylvatica Roxb. [Anacardiaceae]; *MT-1686*	*Hidum-tagung*	T	Fr	F: Ripeones edible, sour	N	0.017
Manihot esculenta Crantaz. [Euphorbiaceae]; MT-1598	*Singyo engiin/ Situng eengin*	S	Ts, Rs	F: Tender shoot as vegetable and tuberous root used for local wine (*Nokyin*)	E	0.017
Melastoma malabathricum L. [Melastomataceae]; *MT-1709*	*Kasii rai*	Sf	Fr, Fl	F: Fruits ate raw; RBC: blooming initiation indicates the time for broadcasting of paddy seeds	N	0.034
Melothria trilobata Cogn. [Cucurbitaceae]; *MT-1635*	*Dongkong kayong*	CH	Fr, Tu	F: Ripe fruits eaten raw; M: tuber ate raw in gastrointestinal disorders	E	0.034
Microtropis discolor (Wall.) Arn. [Celastraceae]; *MT-1827*	-	T	Sd	H: Red seed used as bait for rodents	E	0.017
Mikania micrantha Kunth [Asteraceae]; *MT-1642*	*Eeli*	CS	Lf	M: Taken orally to cure stomachache and dysentery	E	0.017
Molineria capitulata (Lour.) Herb. [Curculigo capitulata (Lour.) Kuntze], [Hypoxidaceae]; *MT-1548*	*Tayek*	HP	Vn	O: Leaf veins used as thread to stitch the scrotum of piglets after castration	N	0.017
Molineria prainiana Deb [*Curculigo prainiana* (Deb) Bennet & Raizada] [Hypoxidaceae]; *MT-1815*	Tayek	PH	Vn	O: Leaf veins used as thread to stitch the scrotum of piglets after castration	N	0.017
Morus alba L. [Moraceae]; *MT-1789*	*Nini-guti*	T	Fr	F: Ripe ones sweet, edible	E	0.017
Morus macroura Miq. [Moraceae]; *MT-1647*	*Eeyum*	T	Lx	M: Applied on burns and inflammation of the skin	N	0.017

Murdannia nudiflora (L.) Brenan [Commelinaceae]; *MT-1693*	*Hodog/golgi*	HA	Fl	RBC: Initiation of its flowering signifies the time for broadcasting paddy seeds. Plants growing along the field borders for demarcation	N	0.017
Musa aurantiaca G.Mann ex Baker [Musaceae]; *MT-1640*	*Dumji*	HP	Wh	RBC: Believed that if a woman roams near or cuts the plant, their stomach will ache	N	0.017
Musa balbisiana Colla [Musaceae]; *MT-1726*	*Ludum/kolung* (for group of *Musa* sp.*)*	HP	In, Lf	F: Spadix cooked as a vegetable; HHM: Leaf sheaths split narrowly and dried to prepare mats; O: powdery substance collected from the abaxial surface of the lamina is used to reduce friction in a traditional loom	N	0.034
Musa sanguinea Hook.f. [Musaceae]; *MT-1760*	*Paksum*	HP	In	F: Young spadix cooked as a vegetable	N	0.017
Mussaenda glabra Vahl [Rubiaceae]; *MT-1547*	*Tekdeng*	S	Ts	F: Cooked as a vegetable	N	0.017
Mussaenda roxburghii Hook. f. [Rubiaceae]; *MT-1615*	*Akshap*	S	Ts	F: Cooked as a vegetable	N	0.017
Myrica esculenta Buch.Ham. ex D.Don [Myricaceae]; *MT-1551*	*Tatir*	T	Fr	F: Ripe ones eaten raw	N	0.017
Nasturtium officinale R.Br. [Brassicaceae]; *MT-1752*	*Orgyam*	HA	Tw	F: Leafy twigs cooked as a vegetable	E	0.017
Neohouzeaua helferi (Munro) Gamble [Poaceae];*MT-1834*	Tatpin	B	Lf	Fd: As fodder for *Bos frontalis*	N	0.017
Nephelium lappaceum L.[Sapindaceae]; *MT-1583*	*Tadar*	T	Fr	F: Ripe ones eaten raw, sour and sweet	N	0.017
Nephrolepis cordifolia (L.) C.Presl [Nephrolepidaceae]; *MT-1685*	*Hidum huli*	HP	Tu	M: Potato under-ground tubers taken orally for urinary tract infection	N	0.017
Nicotiana rustica L. [Solanaceae]; *MT-1684*	*Haali*	HP	Lf	O: Ground leaf is mixed with salt and then used to kill leeches	E	0.017
*Nicotiana tabacum*L. [Solanaceae]; *MT-1720*	*Kuser*	HA	Lf	Mst: Dried leaves produce tobacco; M: salt is added on leaf paste and then applied on infected wounds of cattle	E	0.034
Ocimum basilicum L. [Lamiaceae]; *MT-1576*	*Take-mare*	HA	Lf	F: Aromatic, used as a spice	N	0.017
Oenanthe javanica (Blume) DC. [Apiaceae]; *MT-1821*	-	HA	Ts	F: Cooked as a vegetable	N	0.017
Ophioglossum reticulatum L. [Ophioglossaceae]; *MT-1623*	*Ayo-borkok*	HG	Fn	F: Cooked as a vegetable	N	0.017
Ophioglossum vulgatum L. [Ophioglossaceae]; *MT-1622*	*Ayo-borkok*	HG	Fn	F: Cooked as a vegetable	E	0.017
Oryza sativa L. [Poaceae]; *MT-1617*	*Ammo*	HA	Sd	F: Fermented rice (*Nokyin*) and country liquor (*Yaka Apong*) are prepared using a self-made starter (*siye*); M: applied on burn and inflammation of the skin	E	0.034
Ostodes paniculata Blume [Euphorbiaceae]; *MT-1556*	*Tasi-gumbi*	T	Wh	Fc: Planted for fencing	N	0.017
Oxalis corniculata L. [Oxalidaceae]; *MT-1781*	*Piyag-hiyub*	HA	Fr	M: Sap of fruit dropped in eyes to cure the infection	E	0.017
Oxalis debilis Kunth [Oxalidaceae]; *MT-1783*	*Piiag-hiyub*	HG	Fl,Bu	F: Sour flower and watery bulbs eaten raw	E	0.017
Pachyrhizus erosus (L.) Urb. [Fabaceae]; *MT-1807*	*Lodol, lodor*	CS	Tu	F: Eaten raw, sweet	E	0.017
Paederia foetida L. [Rubiaceae]; *MT-1543*	*Yape taari/ riki ringkom*	CS	Lf	M: Taken orally to cure gastritis.	N	0.017
Pandanus furcatus Roxb. [Pandanaceae]; *MT-1788*	*Tako*	T	Sd, Lf	F: Dried seed edible; HHM: Local mat *Kurpyak* is made of dried leaves	N	0.034
Paris polyphylla Sm. [Melanthiaceae]; *MT-1737*	*Nyomrang takeng (*rhizome*)/ Kangkom oying (*leaves*)*	HG	Lf, Rh	F: Leaves served as a vegetable; M: Smoked or raw rhizome taken orally in gastrointestinal disorders	N	0.034
Perilla frutescens (L.) Britton [Lamiaceae]; *MT-1733*	*Namdung*	HA	Sd	F: Eaten raw	N	0.017
Persicaria barbata (L.) H.Hara [Polygonaceae]; *MT-1632*	*Diko-taamu*	HA	Wh	Fh: Crushed and mixed in water to stupefy fishes	N	0.017
Persicaria capitata (Buch. Ham. ex D.Don) H.Gross [Polygonaceae]; *MT-1624*	*Babing-kaling*	HA	Fr	F: Ripe ones eaten raw	N	0.017
Persicaria chinensis (L.) H.Gross [Polygonaceae]; *MT-1787*	*Babing-kaling*	Sf	Wh	O: Crushed to use as hand wash	N	0.017

Persicaria hydropiper (L.) Delarbre [Polygonaceae]; *MT-1633*	*Diko-taamu*	HA	Wh	Fh: Crushed and mixed in water to stupefy fishes	N	0.017
Persicaria nepalensis (Meisn.) Miyabe [Polygonaceae]; *MT-1623*	*Babing-kaaling*	HA	Wh	O: Crushed to use as hand wash	N	0.017
*Phallusindusiatus*Vent. [Phallaceae]; *MT-1736*	*Nyipong-tipur*	FB	FB	RBC: Its odor signifies a woman's evil spirit (*Nyipong*)	-	0.017
Phoebe cooperiana P.C. Kanjilal & Das [Lauraceae]; *MT-1563*	*Tapir*	T	Fr	F: Ripe ones eaten raw	N	0.017
Phrynium pubinerve Blume [Marantaceae]; *MT-1649*	*Ekkam*	HP	Sd, Lf	F: Seeds eaten raw; M: warmed leaves applied on muscle pain and sprain; O: leaves used for packing, especially for local rice cake '*Etting.'*	N	0.051
Phyllostachys mannii Gamble [Poaceae]; *MT-1585*	*Tabo*	B	Cm	HHM: Making walking sticks (*Banggen*): traditional too *leech*, used for weeding in crop-fields	N	0.017
Physalis lagascae Roem. & Schult. [Solanaceae]; *MT-1702*	*Jojing belang*	HA	Fr	F: Ripe ones eaten raw	E	0.017
*Pilea insolens*Wedd. [Urticaceae]; *MT 1568*	*Tango-lisak*	HA	Lf	F: Cooked leaves *of Pilea insolens* mixed with seeds of *Perillaocymoides*for fermentation	N	0.017
Pilea umbrosa Blume [Urticaceae]; *MT-1749*	*Oko-robo*	HA	Ts	F: Cooked as a vegetable	N	0.017
Piper betleoides C.DC. [Piperaceae]; *MT-1780*	*Popteng*	CS	Lf	Mst: Chewed as a masticator	N	0.017
Piper pedicellatum C.DC. [Piperaceae]; *MT-1609*	*Rori*	CS	Lf	F: Cooked as a vegetable	N	0.017
Plantago asiatica subsp. *Erosa* (Wall.) Z.Yu Li [Plantaginaceae]; *MT-1637*	*Donyi-borkor*	HA	Lf	F: Ciiked as vegetable	N	0.017
Pleurotus eous (Berk.) Sacc [Polyporaceae]; *MT-1698*	*Inyik*	FB	FB	F: Cooked to eat	-	0.017
Pleurotus ostreatus (Jacq.) P. Kumm [Polyporaceae]; *MT-1699*	*Inyik*	FB	FB	F: Cooked to eat	-	0.017
Pleurotus sajor-caju (Fr.) Fr. [Polyporaceae]; *MT-1784*	*Lengot*	FB	FB	F: Cooked to eat	-	0.017
Poikilospermum suaveolens (Blume) Merr. [Urticaceae]; *MT-1744*	*Ogik*	S	Ts	F: Cooked as vegetable	N	0.017
Polygonum molle D. Don [Polygonaceae]; *MT-1710*	*Kiibu-nanung*	S	Ts	F: Eaten raw, sour	N	0.017
Portulaca oleracea L. [Portulacaceae]; *MT-1682*	*Gubor-oying*	HA	Wh	F: Cooked as a vegetable	E	0.017
Pothos scandens L. [Araceae]; *MT-1722*	*Lomang looset*	E	Lf	M: Paste applied to treat bone fractures; RBC: if the patient dreams it, then the fracture will heal quickly	N	0.034
Pouzolzia sanguinea (Blume) Merr. [Urticaceae]; *MT-1754*	*Osik*	Sf	Ts	F: Edible as vegetable	E	0.017
Prunus persica (L.) Batsch [Rosaceae]; *MT-1719*	*Kombong*	T	Fl	RBC: Its blooming indicates the arrival of *Kombong Poolo* month when the *Unying*/ *Aran* festival is celebrated	E	0.017
Psidium guajava L. [Myrtaceae]; *MT-1732*	*Mudurang*	T	Fr, Ts	F: Ripe fruits edible; M: Tender shoots eaten raw to cure gastrointestinal disorders	E	0.034
Pteridium aquilinum (L.) Kuhn [Pteridaceae]; *MT-1725*	*Losup*	HP	Fn	F: Young fronds cooked as a vegetable	E	0.017
Pteris quadriaurita Retz. [Pteridaceae]; *MT-1607*	*Rukji*	HP	Fn	RBC: Beliefs, if a newly hatched chick's basket (*Petir*) is covered with its fronds, then chicks will grow into red cocks	N	0.017
Pteris tripartita Sw. [Pteridaceae]; *MT-1606*	*Rukji*	HP	Fn	F: Young fronds as vegetable	N	0.017
Pterospermum acerifolium (L.) Willd. [Malvaceae]; *MT-1691*	*Hipop*	T	Lf, Br	O: For packing finger millets; bark for dyeing cotton threads	N	0.017
Pueraria montana (Lour.) Merr. [Fabaceae]; *MT-1775*	*Riidin*	L	Rs, St	F: Root-tuber (Watery) eaten raw; M: fibers from stem-bark applied on cuts and wounds; RBC: this fiber is used in almost every ritual of the *Tani* clan and are tied on their hand (on the right hand for the married and left hand for unmarried) which is believed to be protective	N	0.051
Rhaphidophora decursiva (Roxb.) Schott [Araceae]; *MT-1571*	*Talo*	E	Lf	RBC: Leaf twig is used to perform rituals after the bear hunt for the departed soul to leave peacefully	N	0.017
Rhaphidophora hookeri Schott [Araceae]; *MT-1572*	*Talo*	E	Lf	RBC: Used to perform rituals after the bear hunt for departed souls to leave peacefully.	N	0.017

Rhus chinensis Mill. [Anacardiaceae]; *MT-1580*	*Tagmo*	T	Fr	M: Cooked with wild mushroom to avoid food poisoning	N	0.017
Rhynchotechum ellipticum (Wall. ex D.Dietr.) A.DC. [Gesneriaceae]; *MT-1705*	*Jongkot*	S	Lf	Mst: Young leaves chewed as a substitute for betel leaves	N	0.017
Rhynchotechum parviflorum Blume [Gesneriaceae]; *MT-1814*	*Jongkot*	S	Lf	Mst: Young leaves chewed as a substitute for betel leaves	N	0.017
Rhynchotechum vestitum Wall. ex C.B. Clarke [Gesneriaceae]; *MT-1706*	*Jongkot*	S	Fr	F: Fruits watery, eaten raw; leaves fermented with soya bean and both are eaten	N	0.017
Ricinus communis L. [Euphorbiaceae]; *MT-1678*	*Gopo-golo*	S	Lf	M: Leaf is warmed on fire and placed on paining joint, muscle, and sprain: bark of petiole also used as a bandage to cure fractured bone of chick	E	0.017
Ronabea emetica (L.f) A.Rich.[Rubiaceae]; *MT-1728*	*Margihop*	S	Fr	F: Ripe ones edible, sweet	E	0.017
Rorippa dubia (Pers.) H.Hara [Brassicaceae]; *MT-1753*	*Orgyam*	HA	Lf	F: Cooked as a vegetable	N	0.017
Rubus alceifolius Poir. [Rosaceae]; *MT-1763*	*Pasi-payi*	S	Fr	F: Ripe ones eaten raw, sweet	E	0.017
Rubus ellipticus Sm. [Rosaceae]; *MT-1759*	*Pakkom-tayin*	S	Fr	F: Ripe oned eaten raw, sweet	N	0.017
Rubus niveus Thumb. [Rosaceae]; *MT-1542*	*Yokpo-pongkung*	CS	Fr	F: Ripe ones eaten raw, sweet	N	0.017
Rubus paniculatus Sm. [Rosaceae]; *MT-1569*	*Tangkin*	CS	Fr	F: Ripe ones eaten raw, sweet	N	0.017
Rubus rosifolius Sm. [Rosaceae];*MT-1831*	Tangkin	S	Fr	F: Ripe ones eaten raw	N	0.017
Rubus sieboldii Blume [*R. moluccanus* L.], [Rosaceae]; *MT-1567*	*Tapa-tara*	S	Fr, Lf	F: Ripe fruits eaten raw, sweet: leaves as a substitute for *Piperbetel* leaves	N	0.017
Rubus sumatranus Miq. [Rosaceae]; *MT-1713*	*Kinbu-Beru*	CS	Fr	F: Ripe ones edible, sweet	N	0.017
Rumex maritimus L. [Polygonaceae]; *MT-1750*	*Okung*	HA	Lf	F: Young leaves as a vegetable	E	0.017
Saccharum arundinaceum Retz. [Poaceae]; *MT-1566*	*Tapii*	HP	Wh	RBC: Believed that it is the elder brother of *Carex* sp. and the whole plant of both species are used in rituals performing during the funeral	N	0.017
Saccharum spontaneum L. [Poaceae]; *MT-1782*	*Piko-pimur/ aasi-pimur*	HP	In	F: Roasted young inflorescence edible	N	0.017
Saurauia armata Kurtz [Actinidiaceae]; *MT-1619*	*Anpum*	T	Fr	F: Eaten raw, sweet	E	0.017
Saurauia griffithii Dyer [Actinidiaceae]; *MT-1829*	Taan	T	Fr	F: Ripe ones eaten raw	N	0.017
Saurauia napaulensis DC. [Actinidiaceae]; *MT-1590*	*Taan*	T	Fr, Tw	F: Ripe fruits eaten raw, sweet; RBC: Twigs are used in auspicious occasions, animal sacrifices, and rituals related to prosperity	N	0.034
*Saurauia punduana*Wall. [Actinidiaceae]; *MT-1589*	*Taan*	T	Fr, Tw	F: Ripe fruits eaten raw, sweet; RBC: Twigs are used in auspicious occasions, animal sacrifices, and rituals related to prosperity	N	0.034
Saurauia sinohirsuta J.Q.Li & Soejarto [Actinidiaceae]; *MT-1819*	Anpum	S	Fr	F: Ripe ones, sweet, taken raw	N	0.017
Sauropus androgynus (L.) Merr. [Phyllanthaceae]; *MT-1676*	*Gam-oying*	S	Lf	F: Cooked as a vegetable	N	0.017
Schizostachyum pergracile (Munro) R.B.Majumdar [Poaceae]; *MT-1835*	*Madang*	B	Cm	HHM: Small fiber (*Epang*) made from the stem used for house roofing to tie thatching materials	N	0.017
Setaria italica (L.) P.Beauv. [Poaceae]; *MT-1621*	*Ayak*	HA	Sd	F: Used with the fermentation of rice (*Nokyin*) and for country liquor (*Yaka Apong*); M: Fermented grains directly applied on burnt skin	E	0.034
Solanum aethiopicum L. [Solanaceae]; *MT-1727*	*Lutsaying*	HA	Fr	F: Young fruits as vegetable	E	0.017
Solanum erianthum D.Don [Solanaceae]; *MT-1768*	*Pepu sensu*	S	Lf	O: Leaves used for packing bananas for quick ripening and protection from damage	E	0.017

Solanum nigrum L. [Solanaceae]; *MT-1748*	*Okomamang*	HA	Ts	F: Tender shoots as a vegetable	E	0.017
Solanum spirale Roxb. [Solanaceae]; *MT-1527*	*Bangko*	S	Lf, Sd	F: Leaves as a vegetable; M: cooked leaves for gastrointestinal disorder and hypertension; dried fruits are taken orally in helminthiasis; warmed leaves applied on bruises	N	0.034
Solanum torvum Sw. [Solanaceae]; *MT-1526*	*Kodu/migom kopi/kopi piite*	S	Fr	F: Young ones, bitter, cooked as chutney	E	0.017
Solanum viarum Dunal [Solanaceae]; *MT-1525*	*Peeli-taang*	HA	Fr	M: Warmed on fire and then applied on infected teeth	E	0.017
Solanum villosum (L.) Willd. [Solanaceae]; *MT-1524*	*Okomamang*	HA	Ts	F: Tender shoots as a vegetable	N	0.017
Solanum violaceum Ortega [Solanaceae]; *MT-1523*	*Kopi piimik*	S	Fr	F: Young fruits cooked as chutney; M: raw fruits taken orally to remove intestinal worms	N	0.034
Spondias pinnata (L.f.) Kurz [Anacardiaceae]; *MT-1530*	*Dorgu-dorge*	T	Fr	F: Eaten raw, sour	N	0.017
Stapletonia seshagiriana (R.B.Majumdar) H.B.Naithani [*Schizostachyum seshagiriana* R.B. Majumdar], [Poaceae]; *MT-1584*	*Tabum*	B	Cm	HHM: Use as rope and in handicrafts	N	0.017
Stellaria media (L.)Vill. [Caryophyllaceae]; *MT-1694*	*Hosir oying*	HA	Wh	F: Cooked as a vegetable	N	0.017
Stenochlaena palustris (Burm.f.) Bedd. [Blechnaceae]; *MT-1604*	*Rukyo*	HP	Fn	RBC: Fronds inserted in the stomach of a sacrificed pig	N	0.017
Sterculia lanceolata var. coccinea (Jack) Phengklai [Malvaceae]; *MT-1549*	*Tayam*	T	Sd, Fr	F: Immature seeds eaten raw and mature ones roasted; RBC: open ripe fruit is hung on the door to scare the evil spirits	E	0.034
Sterculia striatiflora Mast. [Malvaceae]; *MT-1786*	*Tayam*	S	Sd, Fr	F: Immature seeds eaten raw and mature ones roasted; RBC: open ripe fruit is hung on the door to scare the evil spirits	N	0.034
Stixis suaveolens (Roxb.) Pierre [Capparaceae]; *MT-1613*	*Rokpo ketum-kelum*	L	Fr	F: Ripe ones taken raw, sweet	E	0.017
Syzygium cumini (L.) Skeels [Myrtaceae]; *MT-1703*	*Jongkeng*	T	Fr	F: Ripe ones taken raw, sweet	N	0.017
Syzygium formosum (Wall.) Masam [Myrtaceae]; *MT-1826*	Ponkan	T	Fr	F: Ripe ones eaten raw	N	0.017
Syzygium fruticosum DC. [Myrtaceae]; *MT-1828*	Jongkeng	T	Fr	F: Ripe ones eaten raw	N	0.017
Thelypteris parasitica (L.) Tardieu [Thelypteridaceae]; *MT-1608*	*Rukji*	HP	Fn	O: During broody nesting, the basket is covered with its dried fronds to kill poultry lice	N	0.017
Themeda villosa (Lam.) A.Camas [Poaceae] ; *MT-1820*	Tase	HP	Lf	C: Used in thatching	N	0.017
Thladiantha cordifolia (Blume) Cong. [Cucurbitaceae]; *MT-1738*	*Nyomrang-payin*	CH	Ts	F: Consumed as vegetable	N	0.017
Thysanolaena latifolia (Roxb. ex Hornem.) Honda [Poaceae]; *MT-1708*	*Kanggam*	HG	In	HHM: Maturedones used as a soft broom	N	0.017
Toddalia asiatica (L.) Lam. [Rutaceae]; *MT-1675*	*Gaming tatkeng*	CS	Tw	RBC: Used in rituals after hunting to deliver peace to the soul of the hunted	N	0.017
Toxicodendron hookeri (K.C. Sahni & Bahadur) C.Y. Wu & T.L. Ming [Anacardiaceae]; *MT-1626*	*Bemo*	T	Wh	RBC: Beliefs, if any harm is done to the plant, then it will curse them with bad health and skin infection	N	0.017
Trema Orientalis (L.) Blume [Cannabaceae]; *MT-1628*	*Bumlo*	T	Ts	F: Served as vegetable	N	0.017
Trevesia palmata (Roxb. ex Lindl.) Vis.[Araliaceae]; *MT-1679*	*Gorpak*	T	Fr	F: Young ones bitter and cooked as chutney	N	0.017
Urtica ardens Link [Urticaceae]; *MT-1701*	*Jimang*	S	Lf	M: Half burnt leaves are taken orally in allergy	N	0.017
*Urtica dioica*L. [Urticaceae]; *MT-1729*	*Matpe pereng*	S	Lf	M: Infected wounds of *Bos frontalis* is beaten with nettle leaf to kill the infectious organisms	N	0.017
Vigna unguiculata (L.) *Walp.*[Fabaceae]*; MT-1612*	*Rondong*	CH	Fr	F: Cooked as a vegetable	E	0.017
Viola betonicifolia Sm. [Violaceae]; *MT-1540*	*Jortung/japjor*	HP	Wh	F: Cooked as a vegetable	N	0.017
Viola pilosa Blume [Violaceae]; *MT-1539*	*Jorsing/japjor*	HP	Wh	F: Cooked as a vegetable	N	0.017

Wallichia oblongifolia Griff. [Arecaceae]; *MT-1538*	*Lepa*	P	Lf	RBC: The hunted deer (*Hidum*) is packed with its leaves in the local bag (*Tali*) so that deer's departed soul can't harm the hunter	N	0.017
Wallichia triandra (J.Joseph) S.K.Basu [Arecaceae]; *MT-1537*	*Taleng*	P	Lf	RBC: Same as for *Wallichia oblongifolia*	N	0.017
Youngia japonica (L.) DC. [Asteraceae]; *MT-1536*	*Rungdum*	HA	Lf	Mst: Dried leaves as a substitute for tobacco	N	0.017
Zanthoxylum armatum DC. [Rutaceae]; *MT-1535*	*Ombeng*	S	Fr, Lf, St	F: Fruits and leaves as a spice; M: twigs as toothbrush during toothache	N	0.034
Zanthoxylum oxyphyllum Edgew.[Rutaceae]; *MT-1534*	*Onger*	L	Lf, Br	F: Leaves as a condiment; Fh: Bark paste for fish stupefaction	N	0.034
Zanthoxylum rhetsa (Roxb.) DC. [Rutaceae]; *MT-1533*	*Onger*	T	Lf, Br	F: Leaves as a condiment; Fh: Bark paste for fish stupefaction	N	0.034
Zingiber officinale Roscoe [Zingiberaceae]; *MT-1532*	*Takeng*	HG	Rh	F: Most common condiment; M: warmed rhizome paste applied on infected wounds for fast healing	N	0.034
Zingiber sianginensis Tatum & A.K. Das [Zingiberaceae]; *MT-1531*	*Ke-kiir*	HG	Rh	F: Common condiment; M: In cough, stomachache, and vomiting raw rhizome orally; RBC: rhizome paste applied on the body to keep away the evil spirits and snakes by its aroma while in the jungle	N	0.051

ASIAN JOURNAL OF ETHNOBIOLOGY
Volume 3, Number 2, November 2020
Pages: 79-84

E-ISSN: 2580-4537
DOI: 10.13057/asianjethnobiol/y030205

Short communication: Differences in local perceptions of *Osteochilus spilurus* (Cyprinidae: Labeoninae) from several islands in Indonesia

ARDIANSYAH KURNIAWAN[1,2,♥], DASA Y. PRAMONO[3], ARTIN INDRAYATI[4], HERMANTO[5], IRA TRISWIYANA[5]

[1]Doctoral Program in Fisheries Science and Marine, Faculty of Fisheries and Marine Science, Universitas Brawijaya. Jl. Veteran, Malang 65145, East Java, Indonesia
[2]Departement of Aquaculture, Faculty of Fisheries, Agriculture and Biology, Universitas Bangka Belitung, Balunijuk, Merawang, Bangka, 33172, Kepulauan Bangka Belitung, Indonesia. Tel./fax.: +62-717-422145, ♥email: ardian_turen@yahoo.co.id
[3]Fisheries and Marine Departement of North Lampung District, Jl. Alamsyah RPN 327, North Lampung, Lampung, Indonesia
[4]Sekolah Usaha Perikanan Menengah Kota Agung. Jl. Pantai Harapan, Tanggamus, Lampung, Indonesia
[5]Research Institute for General Waters Fisheries and Fisheries Extension. Jl. Gubernur H.A Bastari 8, Palembang, South Sumatra, Indonesia

Manuscript received: 4 October 2020. Revision accepted: 26 October 2020.

Abstract. *Kurniawan A, Pramono DY, Indrayati A, Hermanto, Triswiyana I. 2020. Short communication: Differences in local perceptions of* Osteochilus spilurus *(Cyprinidae: Labeoninae) from several islands in Indonesia. Asian J Ethnobiol 3: 79-84. Osteochilus spilurus* is native freshwater fish on the islands of Sundaland, Indonesia. No study has reported this fish utilization other than in the Belitung Islands, so another local perception of the Indonesian island needs to be investigated. Local recreational fishing in Palangkaraya, Pontianak, and Pekanbaru and fishers in Palangkaraya, Eastern and western of Belitung, Southern and Central Bangka, and North Lampung were the sources of local knowledge. We obtained data using a Facebook app survey to see local recreational fishers' awareness, interviews with one fisherman in each region, and a literature review for Belitung public perception. There is a different awareness of people from East Belitung to the other areas. In East Belitung, knowledge of *O. spilurus* links to the local culture. Fishers have the most relevant fishing gear expertise for the catch of *O. spilurus*, based on environmental factors and fish behavior. Large-scale fishing, consumption, and trade only take place in East Belitung. It is impacted by non-environmentally sustainable mesh size nets that threaten their natural survival.

Keywords: Local knowledge, native fish, *Osteochilus spilurus*, Sundaland

INTRODUCTION

Indonesia is rich in ichthyofauna species in inland waters as a mega biodiversity country. The freshwater fish species were identified as 1,243 species, with 16% Cyprinidae (Fishbase 2020). As a part of Southeast Asia, the diversity of Cyprinidae in Indonesia is due to the Pleistocene Period (Dott and Prothero 1994). This period, which is often referred to as the ice age, has resulted in changes in river flow, the emergence of millions of lakes, sea-level changes, and the appearance of pluvial lakes. Sea level declined to 150 m in the last glaciation process connected to the lands now separated by oceans (Gradstein et al., 2004). The rise of seawater forms Indonesia's territory in the archipelago formation and has become one of the world's most ethnically diverse nations. More than 600 ethnic groups with over 400 languages in Indonesia (Nababan 1985). These differences have led to various naming fish species in the local language.

Osteochilus spilurus is a member of the Cyprinidae, widely distributed in Southeast Asia. This fish was identified in the Malay Peninsula and Sabah in Malaysia, South Sumatra, Lampung, West Kalimantan, Central Kalimantan, and South Kalimantan in Indonesia (GBIF 2019). This species is not yet widespread in Indonesia like other Osteochilus such as *O. vittatus*, *O. hasselti*, and *O. waandersii* developed as a fishery cultivation commodity. This fish does not even have an Indonesian name, so its naming depending on the local name dan allows the perception of different fish. That has happened in the Eastern of Belitung Island, where the people think this fish is endemic because it is not found in other areas (Saad 2012). This perception can be caused by economic value and large consumption in East Belitung (Kurniawan et al. 2016).

Many publications only position this fish as one of the fish listed in the freshwater river. Understanding the distribution on average comes from reports on river biodiversity, so that community response to this species has not been recorded. It raises the possibility of the conventional use of this fish in other regions that have never been reported before. Information on fish utilization is essential for its development and conservation. For this reason, a study of community perceptions on *O. spilurus* was carried out in several islands that are part of its distribution area in Indonesia. It is hoped that new material may be available that will supplement the socio-ethno knowledge of *O. spilurus*.

MATERIALS AND METHODS

Observation location

The observations were conducted on local recreational fishing and fishers. Information from local recreational fishing was used online discussion in three locations, i.e., Palangkaraya and Pontianak regions of Borneo Island and Pekanbaru areas of Sumatra Island. Six places in the western part of Indonesia were interviewed by *O. spilurus* fisherman, namely Palangkaraya on Borneo Island, Eastern and Western of Belitung Islands, South Bangka and Bangka on Bangka Island, and North Lampung on Sumatra Island. We observed eight regions in four Sundaland islands (Figure 1). The survey was completed between July and September 2020.

Methods

This research utilizes a stationary camera, mobile, Facebook application, and questionnaire. Survey methodology and literature review were used to obtain data. The survey was undertaken to collect locals information and to question fishers about the opinion of *O. spilurus*. The survey was performed using the Facebook app to see local recreational fishers' awareness carried out on *O. spilurus*. For locals, questions about recreational fishing are limited to their familiarization with the fish's photo (Figure 2). Informants are group members who respond to questions. Responses are presented in graphical form to show the local awareness towards *O. spilurus*.

We used secondary public perception data from the Gantung sub-districts, East Belitung (Kurniawan and Triswiyana 2019), and the Membalong sub-districts in the West Belitung (Kurniawan et al. 2020) for Belitung residents views. Both data are compared on introduction, consumption, how to get the fish, and to catch season knowledge. The comparison results are shown in graphical form.

Meanwhile, interviews with one fisherman in each region were undertaken to learn more about fish use and catch knowledge. Utilization, trading, economic value, and other fishing-related things become references for discussion with fishers. Observational data have been descriptively represented and illustrated in tables and images.

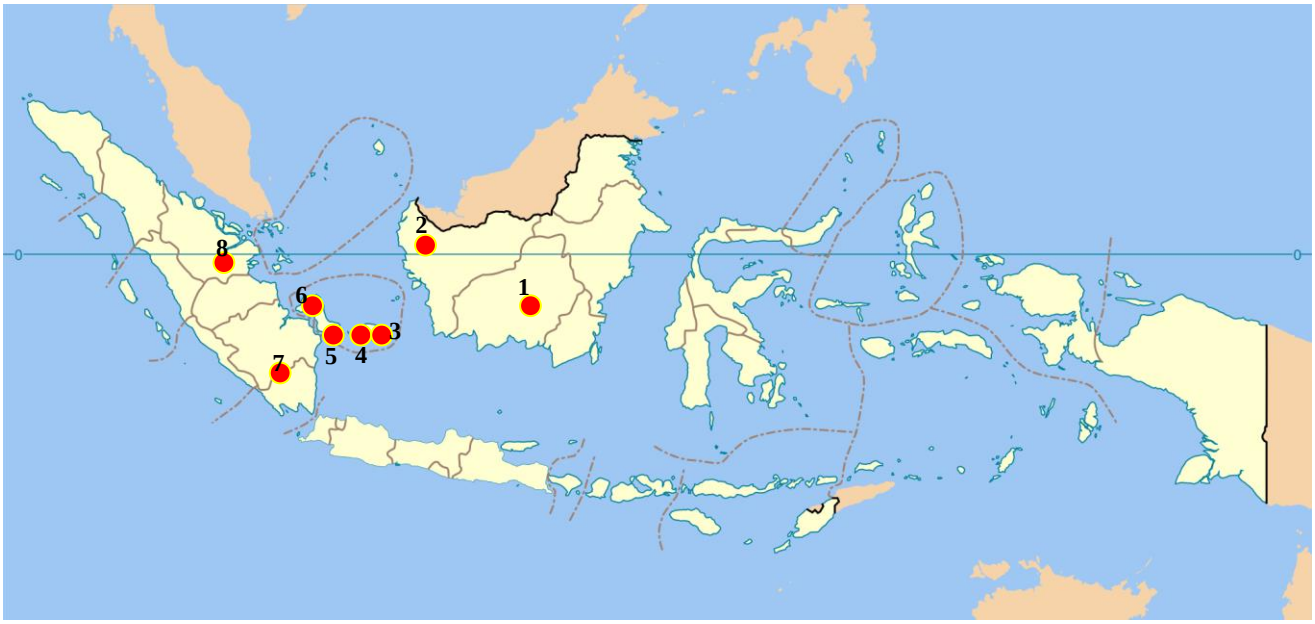

Figure 1. Maps of observation locations in this study. 1. Palangkaraya, 2. Pontianak, 3. East Belitung, 4. Western of Belitung, 5. South Bangka, 6. Central Bangka, 7. North Lampung, 8. Pekanbaru

Figure 2. *Osteochilus spilurus* photographs for awareness survey of local recreational fishers

RESULTS AND DISCUSSION

Residents perception

There is a gap in people's understanding of *O. spilurus*, where more people talk about it on Belitung Island instead of Palangkaraya, Pontianak, and Pekanbaru. Belitung's people name this fish as *Cempedik* fish stands for "*macem empedu di aik*," meaning water-like bile. It is called *Kepait* on Bangka Island, which means bitter. Residents of Palangkaraya call *Seluang Licin*. Some citizens know it in Pontianak as *Seluang Batu*, and in Pekanbaru as *Siburuk* or *Sibuok*. Pulungan (2009) says that Siburuk fish is a local name of *O. spilurus* in Riau. The definition of *Siburuk* refers to the state of the fish that quickly rots and splits its intestine. The local name of *O. spilurus* in another region was verified using the fishermen's interview information. In areas beyond Belitung Island, *O. spilurus* is limited, with most respondents not understanding or mentioning various fish (Figure 3).

The graph shows that although local respondents from Palangkaraya, Pontianak, and Pekanbaru are recreational anglers, often associated with rivers and fish, they are less familiar with O. spilurus than the general public Belitung Island. This fish is also the same as other small fish outside Belitung Island. *Wader* (*Barbodes binotatus*), *Bantak* (*Osteochilus wandersii*), *Puyau* (*Osteochilus hasselti*), *Lelan* (*Diplocheilichthys pleurotaenia*), and *Seluang* (*Rasbora* sp) is considered to be the same as *O. spilurus* because they have the same several characters, especially in size. These fish are often caught together because they swim in the same schooling (Fakhrurrozi et al., 2016). This reaction explains that *O. spilurus* has little relationship with humans in regions outside of Belitung Island. Meanwhile, the high identification in Belitung is due to the increased strength of O. *spilurus* and humans' interaction.

There are two reasons for the familiarization of the Belitung community with *O. spilurus*. The first is the practice of eating it. People want to consume this fish (Kurniawan and Triswiyana 2019). Fish are processed with special handling to remove the bitter taste (Kurniawan et al. 2019). They use a stick of coconut leaf to empty the stomach contents from the anus hole of the fish. The use of a knife is not ideal because of the small size of the fish. The second reason is that this fish is considered close to the culture of the Belitung people. This local wisdom is demonstrated by the presence of a traditional song with the title "*Ke Pice*" (Fakhrurrozi 2015) depicting *Cempedik* fishing in the Pice dam and its flavor description and a modern Belitung batik with a Cempedik fish motif (Detiktravel 2015). In other regions, symptoms related to such a culture are not seen.

Belitung residents perception

The residents' reaction to *O. spilurus* in East Belitung and West Belitung shows a distinct perception based on analyzed data from the Kurniawan and Triswiyana (2019) and Kurniawan et al. (2020) surveys. This fish's consumption and trade are higher in East Belitung, while the people of West Belitung prefer individual catches. After his capture, there are also differences between the two regions, where individuals in East Belitung feel more comfortable being captured in the rainy season. By contrast, it is the dry season that the inhabitants of West Belitung say (Figure 4).

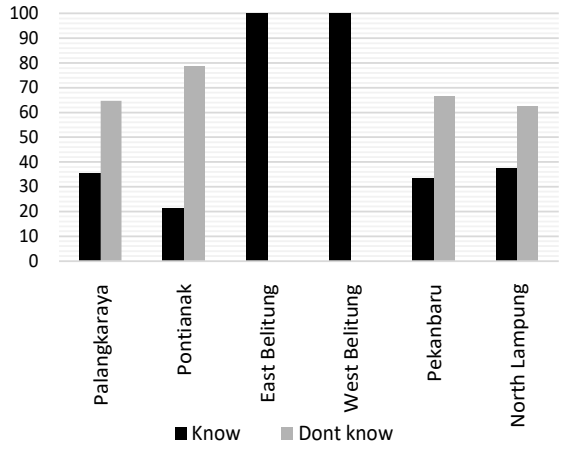

Figure 3. Percentage of respondents in multiple regions who know about *Osteochilus spilurus*

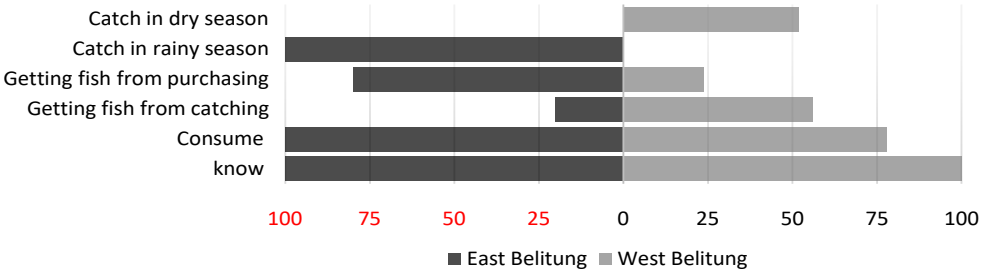

Figure 4. Belitung resident's response of *Osteochilus spilurus*

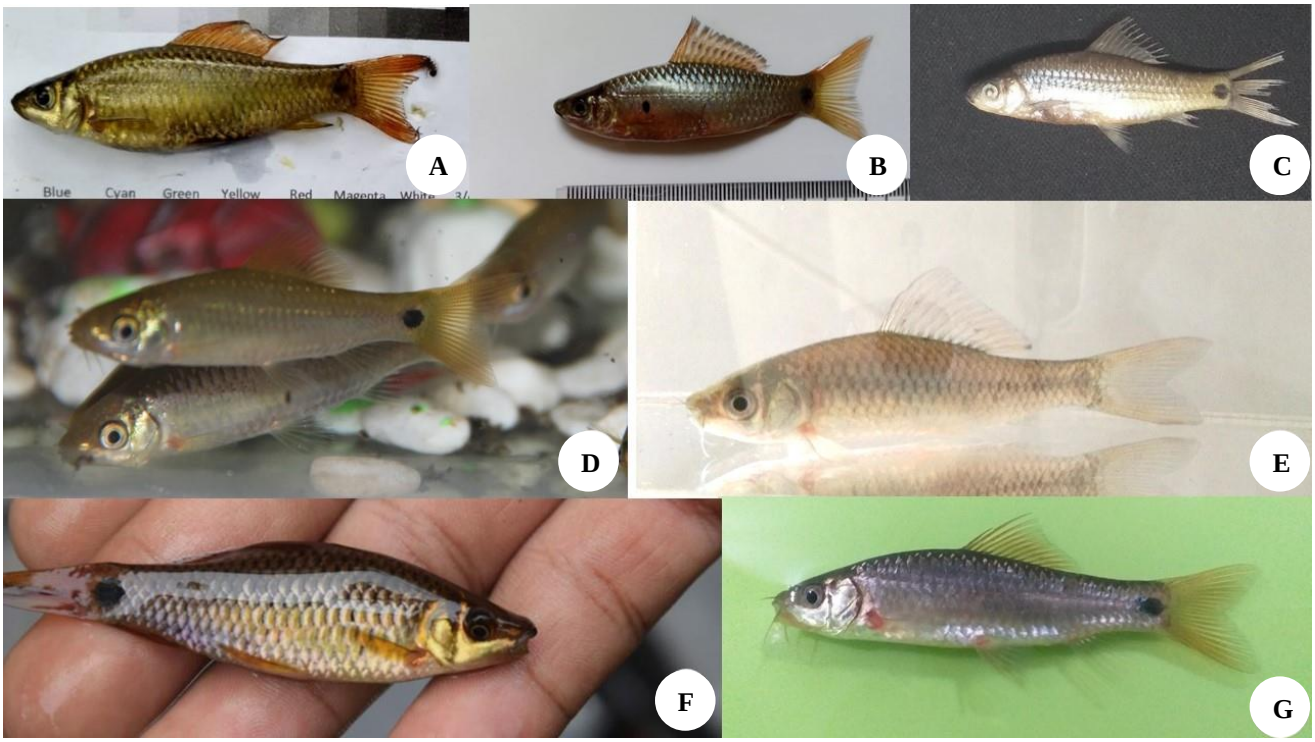

Figure 5. Photograph of *Osteochilus spilurus* from fishermen from six regions. A. South of Bangka, B. Western of belitung, C. Palangkaraya, Borneo, D and F. East Belitung, E. North Lampung, Sumatra, G. Central Bangka

The fishing season variation is due to a community guide's local awareness of fishing activities in the river setting. The significant fish sources in Belitung are the Lenggang and Kembiri rivers, large rivers with different conditions. In East Belitung, the Lenggang River has a dam that has the capacity in the rainy season to trigger currents and does not dry out in the dry season. Meanwhile, the Kembiri River dries out in the dry season, giving rise to water pools in the deeper portion of the river. Through their respective ethnic technology, fish catchers adapt to the habits of *O. spilurus*. Fisherman East Belitung uses fish traps to capture fish on the river bank against the current (Fakhrurrozi et al., 2016). People from Western Belitung wait for low deep water to make it possible for successful fishing gear to catch fish. Fishing gear ethnic technology is a breakthrough in fishing productivity for local communities (Nurdin and Ng 2013). Fishers' adaptation to the environment is their effort to get the best catch (Musinguzi et al., 2016).

Fisherman knowledge

The Fishermen recognize *O.spilurus* even though they only know its local name. The fisherman showed a similar fish to *O.spilurus*, as in Figure 5. These fish have the same morphological character of *O. spilurus* described by Weber and de Beaufort (1916), i.e., tight body, snout cone, dorsal height gradually increasing in size before dorsal fin, lateral line with 28-30 scales, dorsal fin with 12-13 rays, the emarginate shape of the caudal fin, long maxillary barbels, and a large black blotch on the caudal peduncle.

Table 1. Resume of the interview with fishers in six regions in Indonesia

Region	Local name	Utilization	Trade	Economical	Fishing gear	Capture season
Palangkaraya	Seluang licin	Consume	Yes	Yes	Lift net	Dry season
East Belitung	Cempedik	Consume	Yes	Yes	Fish trap, nets	Rainy season
West Belitung	Cempedik	Consume	No	No	Nets, fish trap	Dry season
South Bangka	Kepaet	No	No	No	Fish trap	Dry season
Bangka	Kepaet	Consume	No	No	Nets, fish trap	Dry season
North Lampung	Seluang sungai	Fish feed	No	No	Lift net	All season

Figure 6. Fishing gear that using for *Osteochilus spilurus* catching. A. Scoop nets in Air Tering River, West Belitung, B. Scoop nets in Pice Dam, East Belitung, C-D. Fish trap called "Sero" in Lenggang River, East Belitung, E. Jala, F. Bamboo fish trap, G. Lift nets in Palangkaraya

Its use, which has economic importance, can only be seen in the region of East Belitung, while other areas in Belitung island are not traded (Tabel 1). Trade is only in East Belitung and Palangkaraya, but there is an imbalance from the price point of view, even though the sale and purchase system is in the same device, namely the non-standardized cup. In East Belitung, this fish's price is Rp. 10,000 per cup of an average one kilogram consisting of five cups, while the price in Palangkaraya is Rp. 3000 to Rp. 5000 in a bowl. The informant of Lampung fishers usually uses *O.spilurus* to feed his predatory fish cultivation. However, when the catch of small fish is abundant, *O.spilurus* trades in the mix with other fish with a small bowls trading unit.

The fishing gear used by fishermen varies according to the environmental conditions of the river as well. The Palangkaraya and North Lampung capture have the same tool, namely the lift net, while others use the fish traps and nets to get these fish. Passive fishing gear is more often used for capturing this fish (Figure 6).

In West Belitung, fish in small rivers are collected using scoop nets constructed from a small mesh-size net (Figure 6a). When the water level is lowest, or the fish are trapped in river pools during the dry season, this fish is more comfortable to capture. Tangguk (Figure 6b), a long stick scoop net, was also found in the Pice dam portion of the Lenggang River, East Belitung. The fish that fell from the dam stream attempt to return by jumping on the riverbank. This moment makes it possible for fishers to capture it (Kurniawan et al., 2016).

Bubu, made of bamboo or rattan, are typically the fish traps used by fishermen in each area (Figure 6f). This tool is used in limited numbers to capture fish, but its compact size allows it to be mounted in several places. Bubu is popularly used in rivers, swamps, and lakes as a tool to trap fish (Koeshendrajana & Cacho 2001). When the placement process does not harm the environment, Bubu is not a destructive fishing gear (Pet-Soede & Erdmann 1998).

Many catches are expected by the high demand for fish in East Belitung, so fishers make a large fish trap made of set nets called Sero (6c). Set nets are put in a schooling fish environment on the riverbank with the mouth opposite the river flow direction. They understand the behavior of *O. spilurus* swimming in groups against the current on the riverbank when the river is inflow (6d). Set net is generally used as fishing gear in marine waters (Madduppa et al. 2014) and used in Nujiang River, China (Pan et al. 2017). It is considered environmentally friendly fishing gear (Bubun et al. 2015; Salim et al. 2019). Nevertheless, the set nets forms applied in the Lenggang River also resemble aerial traps, categorized as fishing tools that are disturbing and damaging to the minister of Marine Affairs and Fisheries of Indonesia No. 71 2016 (KKP, 2016). The use of 5 mm mesh size nets as material fishing gear endangers fish's natural sustainability because of their low selectivity (Muthmainnah et al., 2014).

The use of nets is carried out in throwing nets and lift nets. In the Lebak river, Bangka Regency, throwing nets is usually used to capture fish with the primary target other than *O. spilurus*. The lift net in North Lampung is equipped with lights as an attractor at night. Early in the morning, the fisher raised the lift nets only to pick the fish once one night. Meanwhile, in Palangkaraya, lift nets are carried out during the day when fish are trapped in the fishing gear. Lift nets are fishing gear commonly used in rivers (Sugeng et al., 2019). If the attractor in the form of lights is neglected, catching fish using lift nets during the day is more effective than at night (Kirana et al., 2015). The selection of nets with a mesh size that allows the fish to grow up is necessary for sustainability in their natural habitat (Takar & Gurjar 2020).

This study finds that the individual's knowledge about O. *spilurus* in Belitung Island compared to other regions varies. In East Belitung, in particular, the ability has a connection with the local culture. All fishermen know of the most appropriate fishing gear for O. *spilurus* depending on environmental conditions and fish behavior. Large-scale fishing, eating, and trading takes place in East Belitung. It impacts the use of mesh scale nets that are non-environmentally friendly and endanger their natural existence.

ACKNOWLEDGEMENTS

We sincerely thank LPDP (Indonesia Endowment Fund for Education) for providing me with financial support during the first author doctoral study and research in Universitas Brawijaya, Indonesia Suhery, Nicko, Andres, and Fitri for field assistance and members of the fishing mania Facebook group in Pekanbaru, Palangkaraya, and Pontianak.

REFERENCES

Bubun R, Fajriah F, Marlisa N. 2015. Composition of catches and hospitality level of *Sero* fishing gear in the village of Tapulaga, Southeast Sulawesi. Jurnal Airaha 4 (2): 48-56. [Indonesian]

Detiktravel. 2015. Not only Java, Belitung also has batik!. https://travel.detik.com/. [Indonesian]

Dott RH, Prothero DR. 1994. Evolution of the Earth, McGraw-Hill. Inc. New York.

Fakhrurrozi Y, Kurniawan A, Kurniawan A. 2016. Development of Cempedik fish potential in East Belitung: A biological and ethnobiological approach. Scripta Biologica 3 (4): 1-15. DOI: 10.20884/1.sb.2016.3.4.49. [Indonesian]

Fakhrurrozi, Yulian. 2015. Fish and fish-related cultural products in the work of Belitung traditional songs. Proceedings of the 8th National Fish Seminar 2014, Bogor. DOI: 10.20884/1.sb.2016.3.4.49. [Indonesian]

Fishbase. 2020. List of Freshwater Fishes reported from Indonesia. https://www.fishbase.se/country/CountryChecklist.php?resultPage=17&what=list&trpp=50&c_code=360&sortby=alpha2&ext_CL=on&ext_pic=on&vhabitat=fresh [10/07/2020]

GBIF. 2019. *Osteochilus spilurus* (Bleeker, 1851). GBIF Backbone Taxonomy. DOI: 10.15468/39o accessed via GBIF.org [2020-09-15].

Gradstein F, Ogg J, Smith A. 2004. A Geologic Time Scale 2004. Cambridge University Press, New York. DOI: 10.1017/CBO9780511536045.

Kirana EN, Boesono H, Fitri ADP. 2015. Analysis of catch results on *Anco* fishing equipment (lift net) based on the difference in operating time day and night in the Kedungombo Boyolali Reservoir. J Fish Resour Util Manag Technol 4 (4): 125-134 [Indonesian]

KKP. 2016. Regulation of the minister of marine affairs and fisheries of the Republic of Indonesia Number 71/PERMEN-KP/2016 concerning fishing routes and placement of fishing gear in the fisheries management area of the Republic of Indonesia. [Indonesian]

Koeshendrajana S, Cacho OJ. 2001. Management options for the inland fisheries resource in South Sumatra, Indonesia: I bioeconomic model. Working Paper Series in Agricultural and Resource Economics University of New England, Armidale, Australia.

Kurniawan A, Fakhrurrozi Y, Kurniawan, A. 2016. Ethnozoological study of cempedik fish in Lenggang River, Gantung, East Belitung Regency. Akuatik 10 (1): 6-12. [Indonesian]

Kurniawan A, Kurniawan A, Fakhrurrozi Y, Widyanthi F, Setiawan J, Kartika K, Arezki T. 2020. Local knowledge of Cempedik Fish (*Osteochilus spilurus*) in Membalong District, Belitung. Journal of Aquatropica Asia 5 (1): 16-20. [Indonesian]. DOI: 10.33019/aquatropica.v5i1.1823.

Kurniawan A, Kurniawan A, Fakhrurrozi Y. 2019. Potential development of *Cempedik* fish (*Osteochilus spilurus*) in East Belitung: a study of consumption, handling, and nutrition. Acta Aquatica Aquat Sci J 6 (1): 32-36 [Indonesian]. DOI: 10.29103/aa.v6i1.1262.

Kurniawan A, Triswiyana I. 2019. Perception of the economic utilization and sustainability of *Cempedik* fish (*Osteochilus Spilurus*) in East Belitung Regency. ECSOFiM (Economic and Social of Fisheries and Marine) 7 (01): 109-119. [Indonesian]

Madduppa HH, von Juterzenka K, Syakir M, Kochzius, M. 2014. Socio-economy of marine ornamental fishery and its impact on the population structure of the clown anemonefish *Amphiprion ocellaris* and its host anemones in Spermonde Archipelago, Indonesia. Ocean Coast Manag 100: 41-50. DOI: 10.1016/j.ocecoaman.2014.07.013.

Musinguzi L, Efitre J, Odongkara K, Ogutu-Ohwayo R, Muyodi F, Natugonza V, Naigaga S. 2016. Fishers' perceptions of climate change, impacts on their livelihoods and adaptation strategies in environmental change hotspots: A case of Lake Wamala, Uganda. Environ Develop Sustain 18 (4): 1255-1273. DOI: 10.1007/s10668-015-9690-6.

Muthmainnah D, Makri S, Atminarso D, Sawestri S, Makmur S. 2014. Selectivity and effectiveness of different gillnet mesh sizes used in Ranau Lake of Sumatra. J Biodivers Environ Sci 5 (5): 82-89.

Nababan PWJ. 1985. Bilingualism in Indonesia: Ethnic language maintenance and the spread of the national language. Asian J Soc Sci 13 (1): 1-18. DOI: 10.1163/080382485X00020.

Nurdin BV, Ng KSF. 2013. Local knowledge of Lampung people in Tulang Bawang: an ethnoecological and ethnotechnological study for utilization and conservation of rivers. Procedia-Soc Behav Sci 91: 113-119. DOI: 10.1016/j.sbspro.2013.08.408

Pan L, Cheng XW, Xu J, Yang T, Li PP, Wang ZX, Shao DG. 2017. Length-weight relationships of four fish species from the Nujiang River, China. J Appl Ichthyol 33 (6): 1299-1300. DOI: 10.1111/jai.13476.

Pet-Soede L, Erdmann M. 1998. An overview and comparison of destructive fishing practices in Indonesia. SPC Live Reef Fish Inform Bull 4: 28-36.

Pulungan CP. 2009. Fish fauna from the Tenayan River, a tributary of the Siak River, and the surrounding swamps, Riau. Berkala Perikanan Terubuk 37 (2): 78-90. [Indonesian]

Saad S. 2012. I found "A Ling," starting from the Tin Museum to the Word Museum. https://www.kompasiana.com/santorry/55198ff9a333114019b6594e. [10/24/2020] [Indonesian]

Salim G, Firdaus M, Alvian MF, Indarjo A, Soejarwo PA, Prakoso LY. 2019. Socio-economic analysis and environmental friendliness of sero fishing gear (set net) in the waters of Bangkudulis Island, Tana Tidung Regency, North Kalimantan. Buletin Ilmiah Marina Sosial Ekonomi Kelautan dan Perikanan 5 (2): 85-94. [Indonesian]. DOI: 10.15578/marina.v5i2.8112.

Sugeng S, Khristyson SF, Yusim AK. 2019. Floating equipment design module for fish catching activities with *Anco* catching equipment. Jurnal Pengabdian Vokasi 1 (1): 43-47. [Indonesian]

Takar S, Gurjar UR. 2020. Minimum legal size: A tool for sustainable fisheries management. Biotica Res Today 2 (7): 658-660.

Weber MWC, de Beaufort LF. 1916. The Fishes of the Indo-Australian Archipelago. E.J. Brill Limited, Nederland.