Bangor University

DOCTOR OF PHILOSOPHY

Co-production of knowledge with Indigenous peoples for UN Sustainable Development Goals (SDGs): Higaonon Food Ethnobotany, and a discovery of a new Begonia species in Mindanao, Philippines

Buenavista, Dave

Award date:
2021

Awarding institution:
Bangor University

Co-production of knowledge with Indigenous peoples for UN Sustainable Development Goals (SDGs): Higaonon Food Ethnobotany, and a discovery of a new *Begonia* species in Mindanao, Philippines

A thesis submitted to Bangor University by

Dave Paladin Buenavista

for the degree of

Doctor of Philosophy in Conservation Biology

PRIFYSGOL
BANGOR
UNIVERSITY

College of Environmental Sciences and Engineering

School of Natural Sciences

Bangor University

Bangor, United Kingdom – 2021

Declaration

I hereby declare that this thesis is the results of my own investigations, except where otherwise stated. All other sources are acknowledged by bibliographic references. This work has not previously been accepted in substance for any degree and is not being concurrently submitted in candidature for any degree unless, as agreed by the University, for approved dual awards.

Dave Paladin Buenavista

29th January 2021

Yr wyf drwy hyn yn datgan mai canlyniad fy ymchwil fy hun yw’r thesis hwn, ac eithrio lle nodir yn wahanol. Caiff ffynonellau eraill eu cydnabod gan droednodiadau yn rhoi cyfeiriadau eglur. Nid yw sylwedd y gwaith hwn wedi cael ei dderbyn o’r blaen ar gyfer unrhyw radd, ac nid yw’n cael ei gyflwyno ar yr un pryd mewn ymgeisiaeth am unrhyw radd oni bai ei fod, fel y cytunwyd gan y Brifysgol, am gymwysterau deuol cymeradwy.

Dave Paladin Buenavista

29th January 2021

Title:	Co-production of knowledge with Indigenous peoples for UN Sustainable Development Goals (SDGs): Higaonon Food Ethnobotany, and a discovery of a new *Begonia* species in Mindanao, Philippines
Principal supervisor:	**Professor Morag A. McDonald** *Professor of Ecology and Catchment Management* School of Natural Sciences, Bangor University
Co-supervisor	**Dr. Eefke Maria Mollee** *Lecturer in Agroforestry & International Development* School of Natural Sciences, Bangor University
	Dr. Sophie Wynne-Jones *Lecturer in Human Geography* School of Natural Sciences, Bangor University
	Dr. Paula Roberts *Senior Lecturer in Environmental Management* School of Natural Sciences, Bangor University
Financed by:	CHED – Newton Fund through the British Council (UK), and the Commission on Higher Education (Philippines)
Assessment Committee:	**Professor Andrew Pullin (Chair)** *Professor of Evidence-based Conservation* School of Natural Sciences, Bangor University
	Professor John Healey (Internal Examiner) *Professor of Forest Sciences* School of Natural Sciences, Bangor University
	Professor Steve Newman (External examiner) BioDiversity International/The Open University
Date of registration:	1 February 2017
Date of the first submission:	29 January 2021
Date of the final submission:	27 June 2021

BRITISH COUNCIL

COMMISSION ON HIGHER EDUCATION
1994
OFFICE OF THE PRESIDENT OF THE PHILIPPINES

Newton Agham

Acronyms

ASEAN	Association of Southeast Asian Nations
BARMM	Bangsamoro Autonomous Region in Muslim Mindanao
BLASTn	Basic Local Alignment Search Tool Nucleotide
CADT	Certificate of Ancestral Domain Title
CALT	Certificate of Ancestral Land Title
CBD	Convention on Biological Diversity
CITES	Convention on International Trade in Endangered Species of Wild Flora and Fauna
CFS	Community Forests System
EJ	Environmental Justice
FAO	Food and Agriculture Organisation
gDNA	genomic deoxyribonucleic acid
IKSP	Indigenous Knowledge Systems and Practices
ILK	Indigenous and Local Knowledge Systems
ILO	International Labour Organisation
IPBES	Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services
IPCC	Intergovernmental Panel on Climate Change
IPLCs	Indigenous peoples and local communities
IPRA	Indigenous Peoples' Rights Act of 1997
IPR	Indigenous Peoples' Rights
IUCN	International Union for Conservation of Nature
IWGIA	International Work Group for Indigenous Affairs
KBA	Key Biodiversity Areas
LEK	Local Ecological Knowledge
FL	Fidelity Level
LGU	Local Government Unit
matK	Maturase K
MENRO	Municipal Environment and Natural Resources Office
MENRE	Ministry of Environment, Natural Resources, and Environment
MDGs	Millennium Development Goals
NCBI	National Centre for Biotechnology Information
NCIP	National Commission on Indigenous Peoples
NU	Number of Uses
PCR	Polymerase Chain Reaction
PIC	Prior Informed Consent
SDGs	Sustainable Development Goals
TEK	Traditional Ecological Knowledge
UN	United Nations
UNDRIP	United Nations Declarations on the Rights of Indigenous Peoples
UR	Use-Report
UV	Use-Value
VCF	Village Community Forests
WHO	World Health Organisation

Table of Contents

Abstract viii

Acknowledgments ix

Chapter 1. Introduction **1**

1.1 The Plants - Indigenous Peoples' Connection 2
1.2 What we learnt so far from studying plants used by indigenous peoples 6
1.3 Addressing global problems and national issues through ethnobotany 9
1.4 Shortcomings of the SDGs 11
1.5 Context and Background: History and Cultural landscape 13
1.6 Research Approach 15
1.7 Aims and objectives 16
1.8 Potential Beneficiaries 17
1.9 Structure of the thesis 17
1.10 Compliance with ethical standards 18

Chapter 2. Indigenous peoples, Indigenous Knowledge Systems, and the Global Sustainable Development Goals: A Review **20**

2.1 Introduction 20
2.2 Research Approach 21
2.3 The Definition of Indigeneity in Asia 21
2.4 Indigenous peoples in the Sustainable Development Goals (SDGs) 25
2.5 The Role of Indigenous Knowledge Systems 27
2.6 Putting Indigenous Knowledge Systems into Practice 28
2.6.1 Food Security and Community Livelihood 28
2.6.2 Natural Resources Management and Conservation 30
2.7 Conclusion 33

Chapter 3 Bridging Ethnobotany and SDG 2: Is there any alternative to rice? Ethnobotanical use of edible plants by the Higaonon tribe in Bukidnon, Philippines **35**

3.1 Introduction 35
3.2 Materials and Methods 38
3.2.1 Study Area 38
3.2.2 Ethnobotanical Data Collection 39
3.2.3 Data Analysis 41
3.3 Results 43
3.3.1 Demography of respondents 43
3.3.2 Botanical diversity of edible plants 45
3.3.3 Quantitative ethnobotanical analysis 45
3.3.4 Plant Knowledge and Gender 53
3.4 Discussion 54
3.5 Conclusion 61

Chapter 4 Molecular identity and indigenous peoples' utilisation of poisonous 'Lab-o' (Wild Yam, Dioscoreaceae) **63**

4.1 Introduction 63
4.2 Materials and Methods 66
4.2.1 Collection of Plant Materials 66
4.2.2 Genomic DNA extraction 67
4.2.3 PCR Amplification 68

4.2.4 Visualisation 68
4.2.5 Sequencing and BLASTn Analysis 68
4.3 Results and Discussion 69
4.4 Conclusion 73
Chapter 5 Intersecting taxonomy with social justice in Begonia bangsamoro (Begoniaceae, section Petermannia), a new species described from the Mindanao Island, Philippines **74**
5.1 Introduction 74
5.1.1 Asian Begonia under threat 76
5.1.2 The Research Area and the New Begonia 76
5.2 Materials and Methods 78
5.2.1 Collection, Processing, and Taxonomic Examination of Plant Materials 78
5.3 Results 79
5.4 Discussion 84
5.5 Conclusion 91
Chapter 6 General Discussion, Conclusion, and Recommendations **92**
6.1 Discussion 92
6.1.1 Background 92
6.1.2 Indigenous peoples and Sustainable Development Goals 93
6.1.3 Food and nutrition security and Food Ethnobotany 95
6.1.4 Co-production of knowledge with indigenous peoples 98
6.1.5 Bangsamoro – the name of the land, people, and identity 100
6.2 Conclusion 105
6.3 Recommendations 106
References 107
Annexes 154
Annex 1 Field data collection sheets 155
Annex 2 DNA sequence alignment of three samples of *Dioscorea* 157
Annex 3 Electropherogram from *Dioscorea hispida* Dennst. *matK* sequence 160
Annex 4 Holotype of *Begonia bangsamoro* sp. nov. deposited in the Botany and National Herbarium Division of the National Museum of the Philippines, Manila 166

List of Figures

1.1	Interconnectivity between the indigenous peoples and environmental and cultural resources.	4
1.2	An overview of the Indigenous Peoples' position in the UN 2030 Agenda	9
1.3	Map of Barangay Dumalaguing, Impasug-ong, Bukidnon, Philippines	14
1.4	Panoramic view of Barangay Dumalaguing, Impasug-ong, Bukidnon, Philippines	15
1.5	Conceptual figure of Two-Eyed Seeing.	15
3.1	Location of Dumalaguing in the central part of Mindanao island, Philippines	38
3.2	Elicitation of the plant knowledge in Barangay Dumalaguing, Bukidnon, Philippines	40
3.3	Drying of coffee beans in Dumalaguing and the delivery of products to the municipal centre.	44
3.4	Road construction from the Municipality of Impasug-ong to the village of Dumalaguing	44
3.5	Botanical diversity of edible plants	45
3.6	Chord diagram showing the distribution of 1, 254 use-reports (UR) for the 76 species of food plants (bottom half) utilised by the Higaonon tribe as vegetables, fruits, seasonings, and beverages (use-categories in the top half).	46
3.7	Radial plot showing the use-value of the 76 species of food plant species.	50
3.8	Alluvial diagram showing the frequency distributions across uses, respondents, and use categories	52
3.9	Venn diagram showing the species richness and distribution of food plants in five villages	53
3.10	A Higaonon household drying their corn (left). Corn rice with fern (Diplazium esculentum (Retz.) Sw.) salad (Right)	56
3.11	Terraced rice paddy in the village of Bundaan, Bukidnon, Philippines	57
3.12	Sandayung or connected split bamboo poles used for irrigation	57
4.1	Gathering, processing, and consumption of 'Lab-o'	65
4.2	'Lab-o' (Wild Yam) from the forest of Dumalaguing, Bukidnon, Philippines	67
4.3	Genomic DNA isolated from three samples of 'Lab-o' amplified with primers for matK (D1, D2, D3; L- DNA Ladder)	69
4.4	Electropherogram section from 'Lab-o' matK sequence	70
5.1	Map indicating the type locality of *B. bangsamoro* in the Municipality of Wao, province of Lanao del Sur, Mindanao Island, Philippines.	77
5.2	Line drawing of *B. bangsamoro*.	81
5.3	Field photographs of *B. bangsamoro*	82
5.4	Plantation of cash crops surrounding the forest patch and clearing in the forest edge	84
5.5	Field photographs of *B. incisa* from Cuernos de Negros, Siaton, Negros Oriental.	87
5.6.	Field photographs of *B. contracta*	87
5.7	Field photographs of *B. mindanaensis* from Mount Hamiguitan, Davao Oriental.	88
5.8	Map of the Philippines indicating the type locality of *B. bangsamoro* in Mindanao *B. quercifolia* in the islands of Samar and Leyte	89
6.1	*Begonia bangsamoro* featured by various news agency in the Philippines	97
6.2	Field survey conducted by the members of the Ministry for Environment, Natural Resources and Energy of the Bangsamoro Government	99

List of Tables

2.1	Indigenous Populations and Number of Indigenous Groups in Selected Asian Countries	23
2.2	The key benefits of traditional Community Forests System	31
2.3	Economic, social, and/or cultural foundations of home gardens	32
3.1	Demographic information of respondents (n=100) from the Higaonon tribe of Bukidnon, Philippines	43
3.2.	Food plants locally consumed by the indigenous Higaonon Tribe in Bukidnon, Mindanao Island, Philippines	47
3.3	Knowledge comparison between men and women in the household of Higaonon tribe	54
3.4	Knowledge comparison associated with the different collection sites in five villages	54
3.5	Comparison of the nutrient composition of selected staple crops	59
5.1	Morphological comparison between B. contracta Warb., B. incisa A.DC., and B. bangsamoro	86

Abstract

Indigenous peoples and indigenous knowledge systems are now considered as vital components of global conservation, science-policy assessments, and global targets indicated in the UN 2030 Agenda. In this Ph.D. project, I critically reviewed the social, political, and environmental issues over the concept of “indigenous peoples” in Asia and its implications for local and international policies with emphasis on the UN Sustainable Development Goals (SDGs) of the 2030 Agenda. This study showed that the legitimate recognition of indigenous peoples and indigenous knowledge systems and practices (IKSP) are important to achieve the SDGs. Zero Hunger (SDG 2), for example, may be achieved through the valorisation and conservation of the indigenous food system, biocultural refugia, and local plant resources. The food ethnobotany of the Higaonon tribe of Bukidnon in the Philippines provided valuable insights on the potential of neglected and underutilised species (NUS) in the diversification of the nutrient-poor and rice-centred diet of the majority of the Filipinos. The Higaonon tribe’s local staples consisted of yautia, taro, sweet potato, maize, and other NUS, may be tapped as additional food and nutrient sources to address the country’s problem of malnutrition and micronutrient deficiencies. This Ph.D. project also demonstrated the benefits of collaboration with indigenous peoples in the co-production of knowledge, specifically on improving food safety in the local communities. Using the Two-Eyed Seeing approach, the protocol for the molecular identification of a poisonous wild yam locally known as ‘Lab-o’ (*Dioscorea hispida* Dennst.) was developed along with documentation of the traditional detoxification process practised by the Higaonon tribe. Apart from its function as a reservoir of ethnobotanical knowledge, indigenous traditional territory is also home to a new species of *Begonia* L., a member of a horticulturally valuable group of flowering plants. Named after the Bangsamoro people of the southern Philippines, *Begonia bangsamoro* reflects the name and cultural identity of both the people and the land, and implicitly acknowledges indigenous relationships with the environment. This culture-sensitive approach in taxonomic naming contributed to the societal recognition of the indigenous peoples’ rights, and it also opened the opportunity for a meaningful engagement with the indigenous peoples and the government for conservation. Lastly, my Ph.D. thesis redefined the research approach in the field of taxonomy and ethnobotany to be socially just in a way that respects the universal rights of indigenous peoples, their land, and resources.

Acknowledgements

This project was supported by the CHED – Newton Agham Scholarship Fund awarded by the British Council, UK, and the Philippines' Commission on Higher Education. I am very grateful to my supervisors; Morag McDonald, Eefke Mollee, Sophie Wynne-Jones, and Paula Roberts for all the support. I could not complete this work without their guidance and mentorship. I am also grateful to my committee, Andrew Pullin, John Healey, and Steve Newman for sharing their valuable insights and ideas throughout the process.

I would like to give special thanks to the Higaonon tribal community for their kindness and hospitality, and for generously sharing their indigenous knowledge. I am also grateful to a lot of friends who helped me in this project; Ms. Oda Beltran of Bukidnon Resource Management Foundation, Inc. (BRMFI) for the fieldwork assistance; Sandra Saplian Tominao and Ornie Mayonan for guiding me in the entire village of Dumalaguing and for helping me with the Higaonon translation; Daryl Salas and Nikko Dinopol for assisting me in the field and laboratory work.

I would like to also thank my Filipino friends in Bangor; Ate Ellen, Kuya Honesto, and Dylan Lasaten, Jean Ellaine Flores, Marie Jessica Gabriel, Julze Alejandre, and Ivanah Edquiban.

Beyond words, I am also thankful to my family for always being there for me.

Madamo gid nga Salamat!

Chapter 1

1 Introduction

This thesis is grounded in ethnobotany which explores the interactions between two components: *Indigenous peoples* and *Plant*s. Although ethnobotany only emerged in 1896 as an academic discipline, the relationship between plants and indigenous peoples has been widely known in the course of human history beginning with the prehistoric use of plants by hunter-gatherer to the advent of agriculture, and the development of human culture (Balick & Cox, 1996, 2020). This entanglement of indigenous peoples, plants, and culture makes ethnobotany relevant in the areas of both social and environmental sciences. Its field of application encompasses many global issues including food security, climate change, conservation biology, and human health (Quave & Pieroni, 2015). As stewards of nature, indigenous peoples and their knowledge systems are vital in global conservation since they inhabit and govern over a quarter of the world's land surface which intersects with approximately 40% of all terrestrial protected areas and ecologically intact landscapes (Garnett et al., 2018; Reyes-García & Benyei, 2019). In Asia, for example, the largest remaining tropical forest is managed by indigenous communities which represent nearly two-thirds of the world's indigenous peoples' populations (Errico, 2017; Rerkasem et al., 2009). This also makes indigenous practices and land stewardship central to any comprehensive climate stabilisation strategy (Kurashima et al., 2019; Walker et al., 2020).

Yet, despite its importance, indigenous and local knowledge systems (ILK) and knowledge-holders are still marginalised and excluded in various international climate change research and policy fora (García-del-Amo et al., 2020), and conservation initiatives (Benyei et al., 2020). One of the major barriers is the conflicting socio-political views on the "recognition" of indigenous peoples and their rights to traditional lands and resources (Buenavista et al., 2018; Martin et al., 2016). Whilst highly relevant in the conservation sector, the issue of 'recognition' is the least understood aspect of environmental justice (Martin et al., 2016). Across the globe, the repercussions of this socio-political turmoil resulted in the exploitation of indigenous territories and the killings of many environmental defenders who are mainly indigenous peoples (Global Witness, 2016, 2017, 2020; McGregor et al., 2020). This means respectful joint partnerships with indigenous peoples are an urgent conservation issue and a compelling human rights matter (Artelle et al., 2019; Howitt, 2018; Larsen et al., 2020). Nevertheless, collaboration with indigenous peoples presents some challenges. Amongst the key gaps include our limited understanding of the role of indigenous and local knowledge to people (Mastrángelo et al., 2019) as well as the bridging between indigenous and scientific knowledge systems (Hill et al., 2020). In this introductory chapter, I outline the inter- and multi-disciplinary nature of ethnobotany and the issues affecting the indigenous peoples - plant relations with an emphasis in Asia, and the Philippines. I then discuss the contributions of ethnobotanical research and the relevance of the discipline in addressing the present global challenges using the framework of the UN Sustainable Development Goals (SDGs) of the 2030 Agenda. Lastly, I outline the specific aims, objectives, and structure of this thesis.

1.1 The Plants - Indigenous Peoples' Connection

Through indigenous knowledge systems and practices (IKSP), many indigenous communities around the world have been using plants for food, shelter, healthcare, material culture, and livelihood to sustain their community and maintain their cultural identity (Balick & Cox, 1996, 2020; Karki et al., 2017). The myriad and complex nature of IKSP has captured the interests of many social scientists and biologists as evidenced by the plethora of published works in the subject coming from different disciplines particularly in Asia (Hidayati et al., 2015; Joa et al., 2018). Whilst IKSP holds significant promise in the field of conservation (Joa et al., 2018; Maru et al., 2020), various initiatives (i.e., research, policy/legislation efforts) largely overlooked the value of indigenous peoples' inclusion (Benyei et al., 2020; Kadykalo et al., 2021; Lam et al., 2020; Meijknecht & de Vries, 2010).

At the country level, knowledge-holders or 'indigenous peoples' are often referred to as "tribes", "ethnic minorities", "natives", and other derogatory labels mirroring the impaired progress in indigenous peoples' recognition (Errico, 2020; German, 2019). The problem instigates from the subjective and political definition of "indigenous peoples" across Asia (Baird, 2016; Baird et al., 2017; Kingsbury, 1998). This resulted in the exploitation, deforestation, and clearing of the uplands inhabited by the local and indigenous communities for the expanding plantation economy (Zeng et al., 2018), and human rights violations towards land and environmental defenders (Global Witness, 2016, 2017, 2020). According to Global Witness (2020) report, the killings of land and environmental defenders in 2019 shows the highest number of murder in a single year. A total of 212 land and environmental defenders were killed in 2019 – an average of more than four people a week whilst over half of all reported killings last year occurred in two countries: Colombia and the Philippines.

The critical value of the indigenous lands and territories lies in its function as *biocultural refugia* - areas that not only shelter species, but also carry local people's knowledge and experiences about the practical management of biodiversity and ecosystem services (Barthel et al., 2013; Idohou et al., 2014; Raymond et al., 2018). Indigenous territories, forests, home gardens, mountain villages, and other plant-rich biocultural refugia further serve as a reservoir of indigenous and local knowledge that plays an important role in the socio-ecological resilience of many societies (Barthel et al., 2013; Calvet-Mir et al., 2016; Quave & Pieroni, 2015; Sõukand & Pieroni, 2019a).

Indigenous knowledge (IK), also referred to as Traditional knowledge (TK) or Indigenous and Local Knowledge (ILK) (Benyei et al., 2020; Turvey et al., 2018) could be defined as the collection of the different knowledge systems (i.e., skills and innovations in farming or hunting, know-how in ethnomedicine, knowledge of flora and fauna) accrued through generations of socio-ecological interactions in localised or culture-specific context (Benyei et al., 2020). This body of knowledge is broadly categorised based on the nature of knowledge acquisition as (1) local ecological knowledge (LEK) or experiential knowledge derived from personal observation and interactions with the local environment, and (2) traditional ecological knowledge (TEK), representing the cumulative body of knowledge, beliefs, values, and traditions associated with the natural world that is culturally transmitted from one generation to the next (Berkes, 1993; Gadgil et al., 1993; Turvey et al., 2018).

The connectivity between indigenous peoples and their local environment is of particular importance in conservation as the extinction of certain species could potentially lead to the loss of indigenous knowledge and culture since both domains of IK are key components of cultural expression and identity (Seyler et al., 2020; Turvey et al., 2018; Wilder et al., 2016). Unfortunately, the dramatic decline in indigenous knowledge has already been documented in many indigenous societies (Aswani et al., 2018; Barreau et al., 2016; Bussmann et al., 2018; Cámara-Leret & Bascompte, 2021; Reyes-García et al., 2013; Sahoo et al., 2013; Saynes-Vásquez et al., 2013). It is therefore timely to explore, document, and preserve the IKSP of many indigenous communities that are of particular interest in the field of conservation, resource management, social policy, environmental law, and indigenous peoples' rights (Figure 1.1).

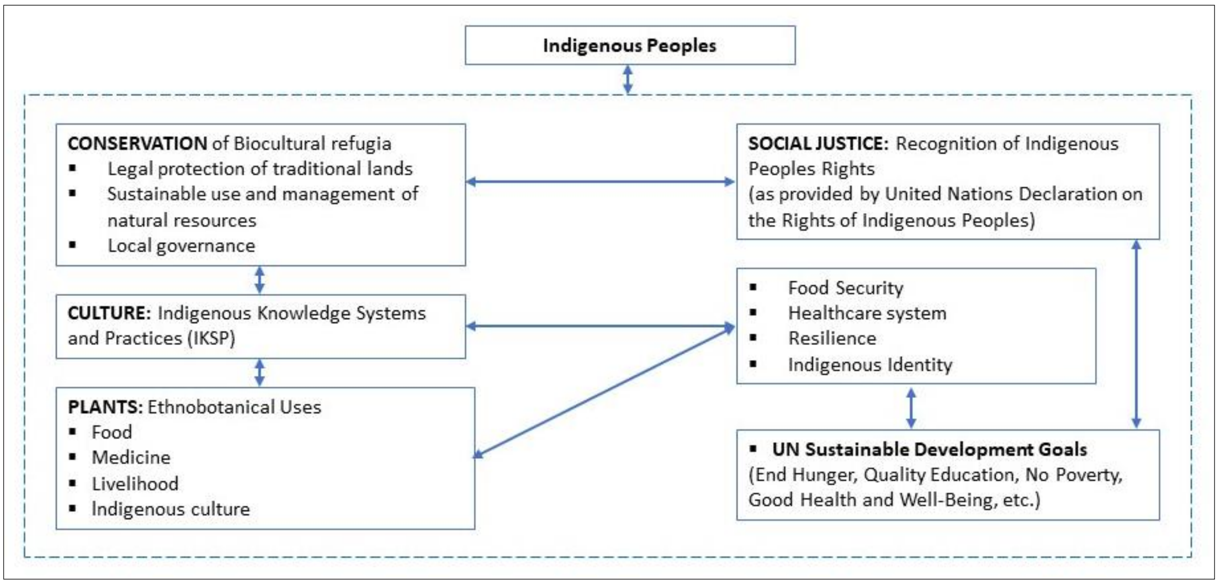


Figure 1.1 Interconnectivity between the indigenous peoples and environmental and cultural resources. The legal protection and conservation of biocultural sites are critical in addressing social and environmental issues such as food security and social injustice which are amongst the global challenges affecting the indigenous peoples as reflected in the UN Sustainable Development Goals (SDGs). Modified from Tuomisto et al. (2017).

Consequently, the Intergovernmental Panel on Climate Change (IPCC), the Convention on Biological Diversity (CBD), Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) and, United Nations Sustainable Development Goals (SDGs) urged the inclusion of indigenous peoples and indigenous knowledge systems in various assessments and initiatives (Ford et al., 2016; Tengö et al., 2017; United Nations, 2015). In the 2019 report, the IPCC acknowledged for the first time the contribution of indigenous peoples and indigenous knowledge affirming that;

"*Agricultural practices that include indigenous and local knowledge can contribute to overcoming the combined challenges of climate change, food security, biodiversity conservation, and combating desertification and land degradation*" (Chapter 4.3, page 34)

- Intergovernmental Panel on Climate Change (2019)

Yet, with a 500 times faster than the normally expected extinction rate for plants (Humphreys et al., 2019) and far-reaching forest loss in the Southeast Asian highlands (Zeng et al., 2018), documenting the biological and cultural value of plants is a race against time especially in the ancestral and/ traditional lands of indigenous peoples that immediately needs protection and legal recognition. This problem is still present even in the Philippines which to date, is one of the only two countries in Asia that legitimately recognise its indigenous populations (Castillo & Alvarez-Castillo, 2009; Huesca, 2016; Nagai, 2019; Osakada, 2020; Perez & Bukluran, 2018). The legislative branch of the government of the Philippines passed the Republic Act No. 8371 otherwise known as "The Indigenous Peoples' Rights Act of 1997" or the IPRA Law (*Republic Act No. 8371*, 1997). The IPRA Law paved the way for the indigenous peoples to legally own their land through the issuance of a Certificate of Ancestral Domain Title (CADT) for communal ownership, or a Certificate of Ancestral Land Title (CALT) for private ownership (individual, family, or household). However, the claim to land rights and ownership of land in the Philippines is a legal battle that even takes decades before the land title is formally awarded to indigenous groups (Larson et al., 2015; Villamor & Lasco, 2009). The appeal for legal recognition requires extensive documentation of physical landscapes as well as the biological, cultural, and social elements of the claimed ancestral domain (Novellino, 2000; Prill-Brett, 2007).

As of March 2018, a total of 5,411,798.9257 hectares (ha) of CADT had been approved by the NCIP (National Commission of Indigenous Peoples, 2018). Yet, conflicts with the government's "development projects" and financial interest of private companies are taking place within the ancestral domains (Capistrano, 2010; Delina, 2020; Eligio, 2012; Hagen & Minter, 2020; McHenry et al., 2013; Wetzlmaier, 2012). In one particular case, the NCIP failed to uphold the rights of the Mangyans by granting certificates to the mining companies in Mindoro island (Castillo & Alvarez-Castillo, 2009). This endangered the unique biodiversity of Mindoro as well as the lives of the indigenous Mangyan (Castillo & Alvarez-Castillo, 2009; De Alban, 2010; Goodland & Wick, 2008). The road and ecotourism projects spearheaded by the government also led to the displacement of the Agta, a population of hunter-gatherers living in the Northern Sierra Madre Natural Park in Luzon, Philippines (Hagen & Minter, 2020).

Other than the Philippines, Japan constitutionally recognised its indigenous peoples in 2019 through the Ainu Policy Promotion Act (Berger et al., 2020; Nagai, 2019; Osakada, 2020). With the reconsideration of indigenous peoples' rights, lands titled and/or governed by indigenous communities can advance forest conservation (Artelle et al., 2019; Blackman et al., 2017). Ethnobotany, the study of people's interactions with plants, may, therefore, provide useful insights that can contribute to societal transformation and nature conservation. Examining indigenous practices may also help suggest practical sustainable solutions for pressing problems such as food insecurity in response to climate change (Ember et al., 2020). It is therefore essential to explore the indigenous and local knowledge for a more inclusive approach to science-policy assessments (Cámara-Leret & Dennehy, 2019) and the development of culturally relevant and appropriate climate change adaptation policies (Ford et al., 2016; Maldonado et al., 2016).

1.2 What we learnt so far from studying plants used by indigenous peoples

Many pioneers in the field of ethnobotany have been interested in the local culture and medicinal plants used by the indigenous peoples (Balick & Cox, 2020; Heinrich & Gibbons, 2001; Heinrich, 2015; Ponman & Bussmann, 2012; Prance, 2001; Ramírez, 2005; Sheng-Ji, 2001). These local and tribe-specific studies have an indispensable scientific contribution as evident by the development of drugs that were originally discovered through the study of herbal medicines and traditional knowledge of the indigenous peoples (Heinrich & Gibbons, 2001; Howes et al., 2020; Singh et al, 2020).

Around the world, a total of 25,791 species of plants have been documented for medicinal use (Antonelli et al., 2020). This list includes important drugs such as quinine obtained from *Cinchona* or 'Peruvian bark' which is the only effective antimalarial medication in more than 350 years (Gachelin et al., 2017; Meshnick & Dobson, 2001). Cinchona bark was introduced to Europe as a treatment for the ague in the 17th century by Jesuit missionaries who discovered the traditional remedy of indigenous Peruvians (Meshnick & Dobson, 2001). Apart from the cure for malaria, the rainforest of Amazon is also the source of "Ayahuasca" – a psychedelic drink made of *Banisteriopsis caapi* and *Psychotria viridis* consumed by the indigenous peoples of the Amazon (Apud Peláez, 2020; Rivier & Lindgren, 1972; Tupper, 2006). The ayahuasca brew contains N,N-dimethyltryptamine, and monoamine oxidase - inhibiting alkaloids, and is currently used in psychotherapy for anxiety, depression, drug addiction, and other mental health ailments (Apud Peláez, 2020; Giovannetti et al., 2020; Jiménez-Garrido et al., 2020; Labate & Cavnar, 2014).

For viral infections, amongst the promising compound is the antiviral drug prostratin isolated from *Homalanthus nutans* (G. Forst.) Guill. which is being developed for the treatment of HIV/AIDS as adjuvant therapy (Johnson et al., 2008). The AIDS Research Alliance received the exclusive license from the National Institutes of Health (NIH) to develop prostratin as an anti-HIV drug and has completed both in vitro and in vivo studies to examine the efficacy of prostratin to activate the HIV latent reservoir, as well as to identify potential toxicity, genotoxicity, and pharmacokinetic limitations. (AIDS Research Alliance, n.d.). Upon approval of prostratin as an Investigational New Drug (IND), a Phase I human clinical trial has been set to evaluate the safety and pharmacokinetics of prostratin given via intravenous administration to HIV-infected individuals on antiretroviral therapy (AIDS Research Alliance, n.d.). Prostratin is a product of ethnobotanical work in Samoa and drug development also paved the way for the financial benefits for the local and indigenous communities of the island (Cox, 2001). The progressive breakthroughs in pharmacology and medicine underscore the important role of indigenous plant knowledge in drug discovery and the improvement of human health and well-being. Complementary to the emerging technologies, ethnobotanical researches may serve as a valuable library for potential plants and new molecules.

The World Health Organisation (WHO) similarly recognises the importance of medicinal plants and further supports the promotion of traditional healthcare systems in addressing important global healthcare priorities especially in combating the global epidemic in non-communicable diseases and promoting self-health care (Burton et al., 2015; WHO, 2011, 2013). Within the food – medicinal plant continuum, the ethnobotanical usage of plants for health and well-being is also of particular interest. The Okinawans of Ryukyu island, one of the only two known indigenous groups in Japan is the focus of various studies due to the islanders' exceptional longevity - the world's longest life expectancy (Salen & De Lorgeril, 2011; Sho, 2001; B. J. Willcox et al., 2007; D. C. Willcox et al., 2014). The Okinawan diet of root and green vegetables, soybean-based foods, and medicinal plants provides potential health benefits beyond nutrition such as neuroprotective (Cox & Metcalf, 2017), anti-obesity (Niwano et al., 2009), and cardioprotective functions (Yamashiro et al., 2003), and delayed aging (Le Couteur et al., 2016). Moreover, many neglected and underutilised plant species are only known to marginalised populations have the potential to contribute to food and nutritional security (Hunter et al., 2019; Nyadanu & Lowor, 2014). The investigation of wild, neglected, and underutilised plants as functional food and nutraceuticals also offer promising solutions for the health-diet-environment trilemma (Abbasi et al., 2015; Benítez et al., 2017; Ceccanti et al., 2018). In fact, some of the useful plant-derived products from ethnobotanical resources have been patented and commercially produced. This includes patents and commercial products from bioactive components of Gumbi Gumbi (*Pittosporum angustifolium* G. Lodd.), Soap Tree (*Alphitonia excelsa* (Fenzl) Reissek ex Benth.), Giant Water Lily (*Nymphaea gigantea* Hook.) and Kakadu plum (*Terminalia ferdinandiana*) traditionally utilised by the Aboriginal Australians (Robinson, 2010; Robinson et al., 2018) as well as Camu camu (*Myrciaria dubia* Kunth (McVaugh) plant of the indigenous peoples of Peru, and Açai berry (*Euterpe oleracea* Mart.) of Brazil (Robinson, 2010).

Apart from food, medicinal, and other economically important plants, indigenous territories also harbor many endemic plant species yet to be described and named. A few have been named after the indigenous peoples such as the *Begonia tagbanua*, after the Tagbanua tribe of Palawan Island (Rubite et al., 2015), and *Nepenthes talaandig*, named after the Talaandig tribe of Bukidnon, Mindanao Island (Gronemeyer et al., 2014). Such discoveries within indigenous territories also influenced the science of Taxonomy with the appreciation of indigenous language. The integration of Māori language in species nomenclature, for example, further strengthens the recognition of the Māori people as well as their indigenous culture (Veale et al., 2019; Wehi et al., 2019; Whaanga et al., 2013). As such, the need to re-examine the established taxonomic protocols has also been proposed in the context of assigning and reinstating indigenous names (Gillman & Wright, 2020).

Historically, the appreciation of indigenous perspectives has been instrumental in the transformation of ethnobotany; from a disciple which focuses mainly on the descriptive listing of plant uses to what is currently known as indigenous knowledge systems (Albuquerque & Alves, 2016; Berkes, 1993; Hunn, 2007; Roy, 2016). The pioneering IKSP studies of Harold C. Conklin on Hanunoo of Mindoro island, Philippines, in particular, inaugurated the linguistically-informed, and emic–centred approach (Conklin, 1954a, 1954b, 1957). Conklin's work expanded from Hanunoo botanical nomenclature and classification to the process of appropriation of natural resources, and indigenous peoples' relation to the biota (plants and animals) as well as how the biota relates to the different physical (soil, water, topography, climate, etc.) and biological factors (Conklin, 1954a, 1954b, 1957). The Hanunoo may be considered expert botanists, ecologists, and agriculturists (Conklin, 1957; Russell, 1988). As described by Conklin (1957), the Hanunoo agriculture system is practiced with great sophistication in as much as their soil classification stands up to modern scientific analysis. Moreover, they know all about slopes, erosion, and the value of litter as mulch. The Hanunoo's ethnobotanical knowledge encompasses 1,600 different plant species and varieties, and they cultivate more than 400 kinds of plants in the swidden (Conklin, 1957). The Hanunoo cultivates a given plot for only 2-4 years, leaving it fallow for 8-10 years to allow regeneration of soil and forest vegetation (Conklin, 1957). In this particular type of swidden or "kaingin", the yield per unit area may be low but, it protects the soil and requires no fossil energy-based inputs such as commercial fertiliser, herbicide, or insecticide making it an ecologically sound method to traditional agriculture (Russell, 1988; Suarez & Sajise, 2010). Indeed, as observed in many indigenous cultures, indigenous peoples' IKSP are intimately intertwined with culture-based food production, traditional management of natural resources, and preservation of cultural heritage (Ahmad & Pieroni, 2016; Cuevas et al., 2015; Kuhnlein et al., 2009; Punchay et al., 2020; Son et al., 2021).

1.3 Addressing global problems and national issues through ethnobotany.

The project adopts the framework of the United Nations 2030 Agenda which identifies the current and pressing global challenges that affect the indigenous peoples (Figure 1.2).

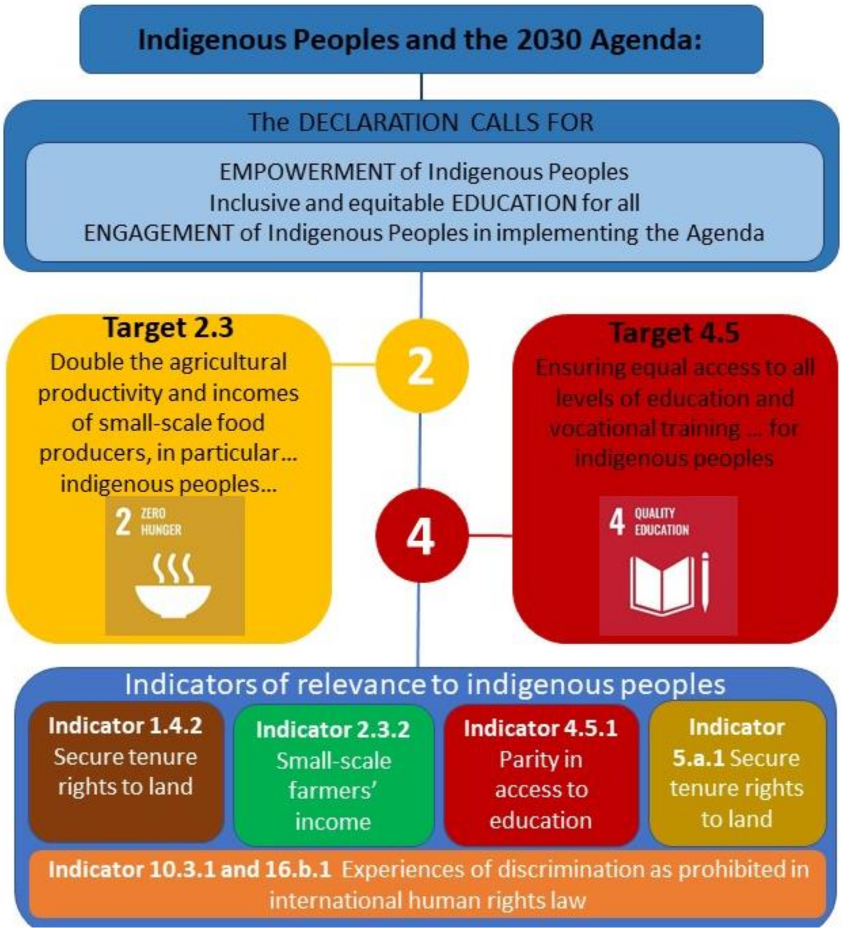


Figure 1.2 An overview of the Indigenous Peoples' position in the UN 2030 Agenda
Source: https://www.un.org/esa/socdev/unpfii/documents/2016/Docs-updates/Indigenous-Peoples-and-the-2030-Agenda-with-indicators.pdf

This framework and universal action plan articulate the inclusion of the indigenous peoples in the social, economic, and environmental dimensions of sustainable development. The UN 2030 Agenda is composed of 17 sustainable development goals (SDGs) with 169 targets to be achieved in 2030 (United Nations, 2015). The UN described the formulation of the 2030 Agenda as the most inclusive in its history as it considers the standards and principles of human rights and equality. Its importance lies in the decades of neglect over indigenous issues despite the ratification of the UN Declaration on the Rights of Indigenous Peoples in 2007 (IWGIA, 2017, 2018). Through active participation in the process towards the 2030 Agenda, the indigenous peoples have been included in the political declaration of the SDGs as well as in the follow-up and review section that calls for indigenous peoples' participation (United

Nations, 2015). Two of the SDGs are specifically referred to the indigenous peoples in its target by 2030: SDG 2 which broadly aims to end hunger, and SDG 4 for inclusive and equitable quality education. The relevance of ethnobotany in achieving the SDG 2 may be gleaned from examining the resilience of many rural communities whose knowledge of plants play an important role in food security and health strategies (Azam et al., 2014; Bharucha & Pretty, 2010; Guyu & Muluneh, 2015; Ju et al., 2013; Quave & Pieroni, 2015). The problem is that many plant foods are neglected and underutilised because of the scarcity of ethnobotanical information (Bvenura & Afolayan, 2015) and knowledge erosion (Sujarwo et al., 2014; Voeks & Leony, 2004). This was noted by some ethnobotanists in certain communities that experienced profound cultural change brought about by forest loss, acculturation, and modernisations (Barreau et al., 2016; Bussmann et al., 2018; Saynes-Vásquez et al., 2013). Though the wider promotion of little-known food plant resources is desirable, the conservation and protection of culturally important sites must be first prioritised.

Despite the worldwide trend of indigenous knowledge loss, important biocultural refugia of traditional knowledge persist amongst local communities particularly in developing countries (Benyei et al., 2020; Carson et al., 2018; Gómez-Baggethun et al., 2013; Reyes-García et al., 2013). Beyond cultural norms, traditional knowledge of food plants plays an important role especially in times of food insecurity and natural calamities (Warren, 2018). An in-depth understanding of indigenous food/health systems may, therefore, provide substantial contributions to achieve SDG 2.

The inclusion of the indigenous peoples in the areas of social development through access to quality education is embodied in SDG 4. This is problematic because many nations in Asia reject the notion of Indigenous Peoples Rights (IPR) (Anaya, 1996, 2004; Kingsbury, 1998). Many indigenous populations remain politically oppressed and denied citizenship along with basic human rights (Fukurai, 2018; Keating, 2013; Milton et al., 2017; Toyota, 2005). Though social reforms and policies may not be linked directly to ethnobotany, documenting plant-people interactions can strengthen the claim for ancestral domains and Indigenous Peoples Rights. Ethnobotanical documentations also serves as evidence of prior art against misappropriation and claims of so-called patents of “innovation” derived from the native plant resources and traditional knowledge of indigenous peoples (Robinson, 2010).

This is applicable particularly in the Philippines which has a constitutional provision (Indigenous Peoples’ Rights Act of 1997) for indigenous peoples' claims to ancestral domains and natural resources. The Philippines is home to an estimated 14-17 million indigenous peoples belonging to 110 ethnolinguistic groups (United Nations Development Programme, 2010). Most indigenous peoples in the Philippines inhabit their respective ancestral domains which overlap with the national parks and protected areas (Cairns, 1997; W. H. Dressler & McDermott, 2010; Major et al., 2018; Perez & Bukluran, 2018; Rosales, 2019). The country's exceptional biological diversity placed it as one of the global biodiversity hotspots (Myers et al., 2000). However, illegal logging (van der Ploeg et al., 2011), and "development" projects (i.e. dams, palm oil plantations) persist within natural parks/ancestral domains (Hagen & Minter, 2020; Huesca, 2016). These conflicts resulted in the displacements of many indigenous communities and human rights violations. In 2015 and 2016, a total of 61 killings of land and environmental defenders were documented in the Philippines - the second deadliest place in the world next to Brazil with 99 killings, followed by Colombia with 49 victims (Global Witness, 2016, 2017). The Philippines, however, had the highest number of indigenous victims when compared to any other country (Global Witness, 2016, 2017). As reflected in the indicators of the 2030 Agenda, the indigenous peoples' tenure rights to land are of particular importance in achieving the SDGs. According to the International Labour Office (2018), initiatives that combine social and environmental protection for indigenous peoples can contribute to national development strategies. This study, therefore, explores the connection between people and plant resources and its implications in the attainment of social justice, environmental protection, human health and well-being, and biocultural conservation.

1.4 Shortcomings of the SDGs

One of the major criticisms about the 2030 Agenda is the absence of environmental justice in the language and spirit of the UN SDGs (Kopnina, 2016; Martin et al., 2020; Menton et al., 2020). Environmental justice (EJ) embodies the need for equity, recognition, participation, and other capabilities for the basic functioning of nature, culture, and communities (Schlosberg, 2007, 2013; Schlosberg & Carruthers, 2010). Environmental justice scholars described it as an overlapping of three dimensions: *distributive justice*, which focuses on the fair distribution of environmental costs and benefits; *recognitional justice*, which refers to the respect and recognition of personal dignity and self-recognition of all individuals and cultural groups; and *procedural or participatory justice* which is concerned with the extent to which different actors and actor groups have meaningful involvement in the decision-making process (Martin et al., 2020; Massarella et al., 2020; Menton et al., 2020; Schlosberg, 2007). For many indigenous communities, these concerns are typically connected with the failures of the State and private sectors to respect indigenous peoples' rights (*recognitional justice*), in particular, on the control and utilisation of natural resources within traditional territories (*distributive justice* and *procedural justice*). With the exclusion of EJ, the ambition of achieving the SDGs may be impossible considering that the "elephant in the room" – the root causes of poverty, hunger, social inequalities, and environmental degradation are still unheeded (Menton et al., 2020; Schleicher et al., 2018). Indeed, one of the systematic flaws in the 2030 Agenda is the lack of analysis as it failed to deconstruct the underlying causes of the worldwide problems. There is no political economy approach to understanding the genesis and cycles of poverty and inequities (Koehler, 2016). Although SDG 16 (to promote peaceful and inclusive societies for sustainable development, provide access to justice for all, and build effective, accountable, and inclusive institutions at all levels) centres on justice, it does not address EJ at all, and the term justice is not defined (Menton et al., 2020). Instead, SDG 16 gives strong emphasis on state power and the rule of law which often favour the political elite and/or large-scale industry actors whose interest lies in the unlawful exploitation and destruction of natural resources, and economic gains (McDermott et al., 2020). In the case of Brazil, the orchestrated use of power by the state have been responsible for violating the rights of indigenous peoples and the destruction of the Amazon rainforest under the justification of progress and development (Conselho Indigenista Missionário, 2014; De Carvalho et al., 2021; Diele-Viegas et al., 2020; Ferrante, Gomes, et al., 2020; Ferrante, Leite, et al., 2020; Global Witness, 2020; Ribeiro & Morato, 2020; Walker & Simmons, 2018; Walker, 2020). As stated in the manifesto of the indigenous Guarani-Kaiowá themselves:

"*To whom will we denounce the violence committed against our lives? To which Justice of Brazil? If the Federal Court itself is generating and fuelling violence against us... this old territory of ours has buried many of our grandfathers and grandmothers, great grandfathers and great grandmothers, it is the cemetery for all of our ancestors. Conscious of this fact, we are now going to and want to be killed and buried along with our ancestors right here where we are today, therefore, we ask of the Government and Federal Justice system not to make an order for our eviction/expulsion, but instead, we request that they decree our mass death and to bury all of us here* (Guarani-Kaiowá Community, 2012)"

The persistence of environmental injustices is not only a problem in Brazil as many indigenous communities around the world suffer from different forms of environmental and social injustices (Camargo & Vázquez-Maguirre, 2021; Goyes et al., 2021; Liddell et al., 2021; McDermott et al., 2020; Rambaree et al., 2020; Westra, 2012). Despite the promise of "No one will be left behind" by the framers of the SDGs, the exclusion of EJ will impede the global goals of achieving a more inclusive, just, and humane environment for the future generation.

Beyond the SDGs, there is also a need to change the existing uninformed government policies that directly affect the livelihood and quality of life of many indigenous peoples, particularly in Asia. The state control and restriction on the utilisation of forest products, and prohibition of customary agricultural practices have led to extreme poverty, violence, and further marginalisation of many indigenous peoples in the region (Baird, 2021; Dove, 1993; Dressler et al., 2017; Novellino, 2010). In the Philippines, the government ban of indigenous swidden practices resulted in severe poverty, food insecurity, and intense harvesting of limited forest products such as rattan and almaciga resin to compensate for the loss of agricultural production (Novellino, 2010). This prohibition violated the tenets of the IPRA Law that constitutionally recognised and protect the rights of indigenous peoples and cultural communities (*Republic Act No. 8371*, 1997). Whilst the indigenous peoples were criminalised as 'slash-and-burners' in their traditional territories, the government has given concessions to commercial logging and mining corporations (Castillo & Alvarez-Castillo, 2009; De Alban, 2010; Eder, 1990; Maohong, 2012; Novellino, 2010; Remigio, 1993), and the expanding agro-industrial crop plantations (i.e., palm oil, banana, pineapple, etc.) (Huesca, 2016; Imbong, 2020) – the main drivers of the deforestations in Southeast Asia (Hughes, 2017; Zeng et al., 2018). As lessons learnt from history, the government must recognise that indigenous agricultural systems are integral to the customary way of life and livelihood of indigenous farmers, and policies disproportionately blaming and criminalising indigenous peoples must be revisited by the policymakers (Dove, 1993; Dressler et al., 2020; Smith & Dressler, 2020).

1.5 Context and Background: History and Cultural landscape

The ethnobotanical work for this Ph.D. thesis was carried out in Barangay Dumalaguing (N 08.36090˚, E 125.05598˚; 677 m.a.sl. - 1232 m.a.s.l.), a rural mountainous community in the municipality of Impasug-ong, province of Bukidnon, Mindanao Island, Philippines (Figures 1.3 & 1.4). The town was organized in 1877 during Spanish colonisation and is also amongst the earliest settlement for indigenous peoples specifically, the Higaonons (Local Government Unit of Impasug-ong, 2014). Early contacts with the Higaonons commenced during the Spanish subjugation of the Philippines from the 17th-19th century which provides historical accounts of the tribes' precolonial practices, belief systems, and complex socio-political organisation (F. Lynch & Clotet, 1967; Paredes, 2013). Though the Higaonons resisted the assimilation, several centuries of colonisation ipso facto has influenced the social organisations in the uplands (R. Lynch, 1955; Paredes, 2013). As a modern population, they can be distinguished linguistically, culturally, historically, and genealogically from other residents of northern Mindanao who are relatively recent arrivals in the region (Paredes, 2006). Based on the 2015 census, Barangay Dumalaguing has a total of 2, 800 inhabitants (Philippine Statistics Authority, 2015). Though the official number of indigenous peoples' population is unavailable, the local government of Impasug-ong estimates the Higaonon tribes' population at 65 percent while the remaining 35 percent are mixed tribes (Local Government Unit of Impasug-ong, 2014). The municipality of Impasug-ong receives significant rainfall throughout the year even in the driest month (May) with an annual average rainfall of 2496 mm, and an average annual temperature of 23.3 °C (Climate-Data.org, 2019).

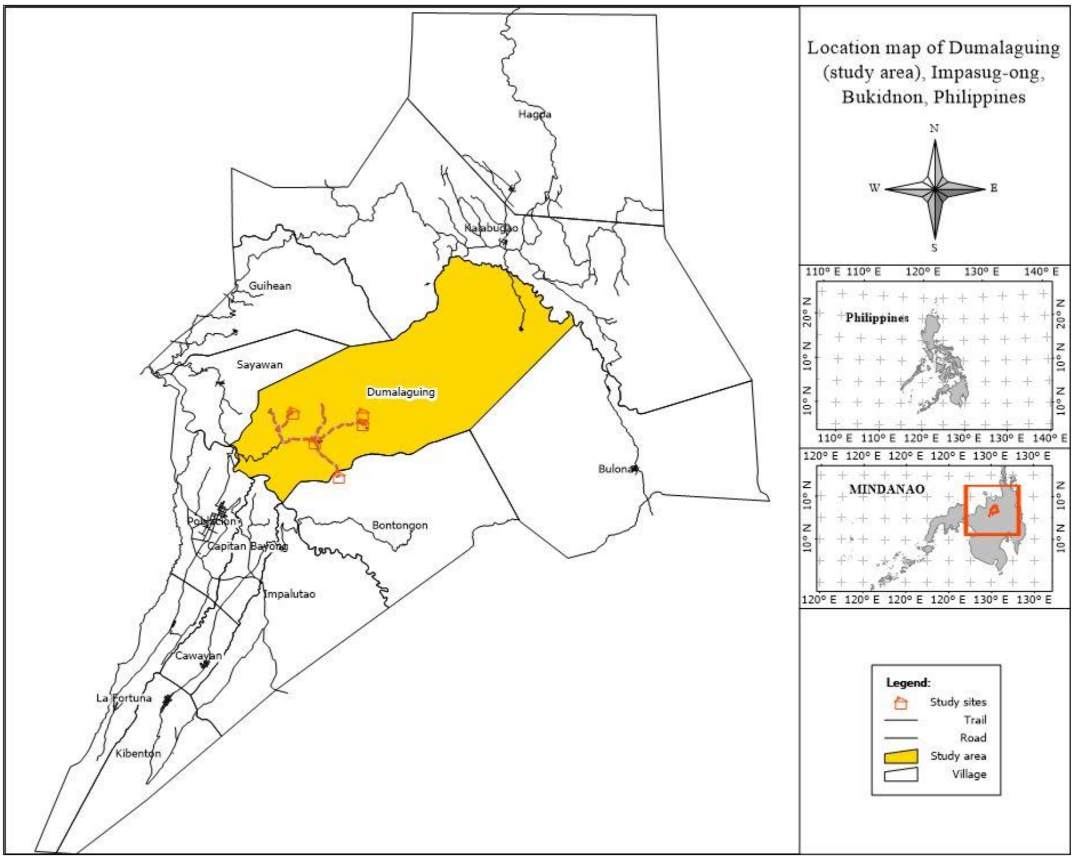


Figure 1.3 Map of Barangay Dumalaguing, Impasug-ong, Bukidnon, Philippines

Figure 1.4 Panoramic view of Barangay Dumalaguing, Impasug-ong, Bukidnon, Philippines

1.6 Research Approach

The project adopted the "two-eyed seeing" approach, particularly in Chapters 2 and 4 to bridge indigenous knowledge and science-based knowledge systems (Figure 1.5). First described by Albert Marshall, an indigenous elder from the Mi'kmaq First Nations, this approach is described as "*To see from one eye with the strengths of indigenous knowledge, and from the other eye with the strengths of the scientific process of knowing, and to use both of these eyes for the benefit of all*" (Bartlett et al., 2012).

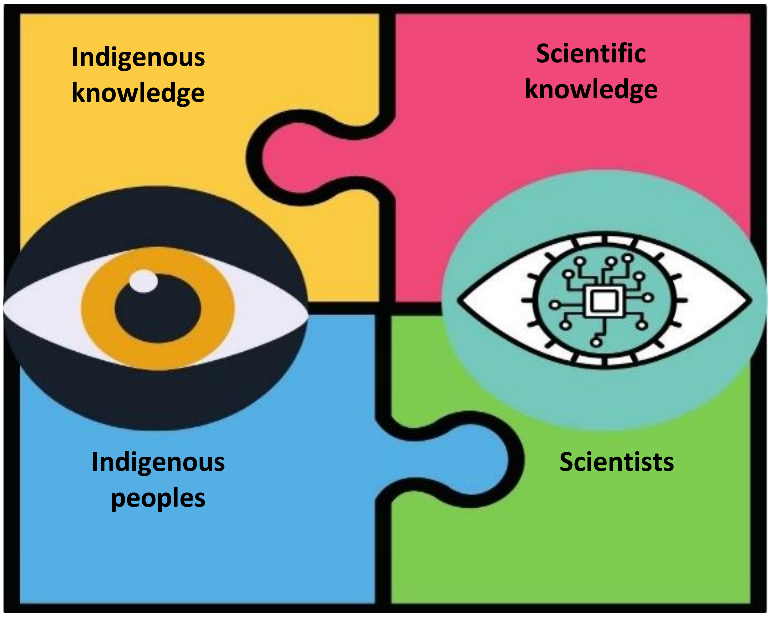


Figure 1.5 Conceptual figure of Two-Eyed Seeing.
Modified from http://www.integrativescience.ca/Principles/TwoEyedSeeing/

The pieces of the jig-saw puzzle imply that no individual has more than one piece of knowledge and that knowledge is collective (Bartlett et al., 2012). Two-eyed seeing offers a practical way to bridge science and indigenous knowledge systems by providing strategies for checking the accuracy and filling in the gaps of each, without one knowledge system subsuming the other (Abu et al., 2020). Also, two-eye seeing offer a more transparent, and constructive way of creating synergies across knowledge systems (Tengö et al., 2014). This approach follows the "weaving" principle adopted by IPBES and CBD which emphasises collaborations that respect the integrity of each knowledge system (Hill et al., 2020; Tengö et al., 2017).

1.7 Aims and objectives

The general aim of the work is to contribute to ethnobotanical research in a manner that integrates the IKSP in the process of co-production of knowledge relevant to the local and global challenges outlined in the UN SDGs[1]. This study also reinvents ethnobotany as a science of preserving the diverse knowledge systems of indigenous peoples and their biocultural refugia. Furthermore, the project includes a description of a new species of endemic flora which highlights the conservation value of indigenous lands and the potential role of field research in bridging science and social justice. The indigenous peoples in this project are the Higaonon tribe inhabiting the uplands of Impasug-ong, province of Bukidnon, the island of Mindanao, Philippines. On the same island, a novel species of horticulturally important *Begonia* (Begoniaceae) from the Bangsamoro region is also described.

To achieve the project aims, the following main objectives are formulated:

1. Review the concept of indigenous peoples and indigenous knowledge systems as well as its implications in Asia (Chapter 2).

2. Explore the Higaonon tribe's traditional utilisation of food plants and its adaptive function to the indigenous community (Chapter 3).

3. Bridge the two knowledge systems: indigenous and scientific knowledge in co-production of knowledge by examining the molecular identity and traditional use of a poisonous yam (family Dioscoreaceae) consumed by the Higaonon tribe (Chapter 4).

4. Describe the new species of endemic *Begonia* from the Mindanao island, Philippines (Chapter 5).

[1] As defined by Armitage et al., (2011), co-production of knowledge is a collaborative process of bringing together the diversity of knowledge systems to address a defined problem knowledge and build an integrated understanding of that problem

1.8 Potential Beneficiaries

This work is multi- and interdisciplinary as such, it could be of potential use to the different sectors of society. The Higaonon tribe and other indigenous peoples, in particular, may benefit from the documentation and safeguarding of IKSP as well as on the critical review of the indigenous peoples' issues vis-à-vis to the UN SDGs. The study also contributes to advancing interdisciplinary and multidisciplinary approaches in indigenous research spanning the fields of political ecology, anthropology, botany, and social policy. The different government and non-government agencies in the Philippines (i.e., Department of Agriculture, Department of Science and Technology, and Department of Environment and Natural Resources, etc.) may also explore the potential uses of indigenous plant resources to address the country's problem on food insecurity. This contribution to the body of knowledge will also benefit the academic institutions in the Philippines as the country's Commission on Higher Education (CHED) recently called for the integration of indigenous peoples' studies in the various university curricula (Commission on Higher Education, 2019). Hopefully, this will also be adopted in other universities in the ASEAN region. The governments in ASEAN countries may likewise benefit from this work especially on the formulation of relevant policies strategic to the inclusion of the indigenous peoples in the 2030 Agenda and other international initiatives.

1.9 Structure of the thesis

This thesis is structured as follows:

Chapter 2 explores the problematic and politized definition of indigenous peoples in Asia, its implications in the SDGs, and relevant international agreements. This chapter also tackles the diversity of IKSP with emphasis on land-related knowledge and ethnobotany and its contribution to the resilience of many indigenous societies which in turn ensures sustainability and conservations of their natural environment. This chapter aims to address the following questions:

1. Why is the concept of indigeneity disputed in Asia?
2. What are the social, political, and environmental issues affecting the indigenous peoples in Asia?
3. What is the relevance of indigenous knowledge systems and practices for Asia's indigenous communities?
4. Why do indigenous knowledge systems and practices (IKSP) matter in sustainability and conservation?

Chapter 3 investigates the ethnobotanical use of food plants that are cultivated and/or gathered from various biocultural refugia and its implications on the resilience of the Higaonon tribe; specifically, this chapter aims to answer the following questions:

1. Which edible plant species comprise the Higaonon tribe's food system?
2. How are these edible plants traditionally prepared and consumed?
3. Is there a difference between men and women in the Higaonon household in terms of knowledge of food plants?
4. How adaptive is the Higaonon food system within the context of rice shortage and nutrient-poor diet in the Philippines?

Chapter 4 describes the protocol for the molecular identification of taxonomically problematic wild yam (*Dioscorea* sp.) used as a famine food and examines the food-processing technique involved in the consumption of the poisonous root crop. This chapter aims to answer the following questions:

1. What is the molecular identity of the wild yam eaten as a famine food by the Higaonon tribe?
2. How do indigenous peoples traditionally detoxify wild yams?
3. What are the potential dangers and benefits of wild yam consumption?

Chapter 5 describes the new species of *Begonia* (Begoniaceae) from the Bangsamoro region. This chapter addresses the following questions:

1. What are the unique morphological characteristics of the new species?
2. What are the threats to the species' populations?
3. Which interventions are required to conserve and protect the species?

1.10 Compliance with ethical standards

This project was reviewed and approved by the Bangor University Ethics Review Committee. The data used in this project was collected with prior and informed consent from all participants. The goals of the project were explained in the local dialect as well as the fact that participation was free and voluntary. Participants were free to stop their participation at any time. The Wildlife Permit for the authorised collection of the new species was granted by the Municipal Environment and Natural Resources Office (MENRO) of Wao, Lanao del Sur, Bangsamoro Autonomous Region in Muslim Mindanao, Philippines. During the conduct of this project, the research site, Mindanao island, Philippines is under martial law or full military control for two a half years from 23 May 2017 till 31 December 2019 due to the terrorist attack in Marawi City, Bangsamoro region which is adjacent to the province of Bukidnon (Cervantes, 2018; *Proclamation No. 216 Declaring a State of Martial Law and Suspension of the Privilege of the Writ of Habeas Corpus in the Whole of Mindanao*, 2017). With the suspension of the privilege of the *writ of habeas corpus* in Mindanao, travelling requires complete documentation as anyone can be arrested without a warrant of arrest. A series of terrorist attack also happened within the research site and the provincial capital on the 20th of December 2018 as well as on the 14th and 27th of February 2019 (Jerusalem & Madera, 2019; Kalinaw News: The Official Online Press of the Philippine Army, 2018, 2019). Hence, for security reasons, the fieldwork was often limited to a few days per site as advised by the local authorities. This concern also prevented the researcher from collecting some of the food and medicinal plants from the forests. As a consequence, some of the ‘wild’ plants, especially the medicinal plants, were only known by their local names and were not properly identified. The mountain range surrounding the research site is a confirmed lair of the terrorist (Jerusalem, 2019) and subsequent attacks occurred on the 18th of February 2020 (Sablad, 2020). Also, considering that military operations are not made public, fieldwork activities were conducted with caution and consultation with the Local Government Units, and the 8th Infantry Battalion of the Philippine Army based in Impasug-ong, Bukidnon, Philippines. The researcher was accommodated by the Tribal Leader of the Higaonon Tribe and community leaders during data gathering. Fieldwork in 2020 was also hampered by the COVID-19 pandemic due to community lockdowns and travel restrictions in the Philippines (Philippine Congress, 2020).

Chapter 2

Indigenous peoples, Indigenous Knowledge Systems, and the Global Sustainable Development Goals: A Review

Published as:

Buenavista, DP, S Wynne-Jones, M McDonald. 2018. Asian Indigeneity, Indigenous Knowledge Systems, and the Challenges of 2030 Agenda. *East Asian Community Review*. 1:221-240. DOI: 10.1057/s42215-018-00010-0 (Palgrave Macmillan/Springer Nature).

2.1 Introduction

About two-thirds of the world's indigenous peoples live in Asia, which is home to more than 2,000 civilizations and languages (UN Department of Public Information, 2014). Aside from being a critical biodiversity hotspot, the Southeast Asian region has more than 1, 500 indigenous groups - amongst the richest ethnic diversity in the world (IWGIA, 2017, 2018). Yet, the indigenous people of this region are also among the world's most vulnerable, politically oppressed, and neglected minorities (Clarke, 2001; Fukurai, 2018). The concept of indigeneity in Asia is far from clear and naturalized, especially when compared to other nations (Baird, 2011). Though signatories in the 2007 United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP), many Asian countries contested the definition and does not acknowledge the notion of "indigenous peoples" and its applicability to their respective political territory (Etchart, 2017; IWGIA, 2017, 2018). The gravity of the socio-political issues led to historical and concurrent ethnic-based conflicts, genocide, and ethnic cleansing in some countries which to date, others remain unresolved (Anderson, 2015; Beyrer & Kamarulzaman, 2017; Candelaria, 2018; Clarke, 2001; Fukurai, 2018; Kolås, 2017; T. M. Li, 2002). Understanding the scale, location, and nature conservation values of the lands over which indigenous peoples exercise traditional rights is central to the implementation of several global conservation and climate agreements (Garnett et al., 2018). The neglect over indigenous peoples' issues prompted the 70th Session of the United Nations General Assembly to include this matter in the 2030 Agenda for Sustainable Development Goals (SDGs) adopted by the heads of state from 193 countries (United Nations, 2015). This universal action plan, which will guide development programs and policies throughout the world until 2030, comprises 17 SDGs, 169 targets, and 232 indicators that take into account issues left unresolved by the

Millennium Development Goals (MDGs) in 2000, which did not include a single reference to indigenous peoples (Cisneros, 2017). Apart from the direct references in the declaration, two of the Sustainable Development Goals and many of the associated targets are relevant for indigenous peoples (United Nations, 2015). Moreover, the overarching framework of the 2030 Agenda contains numerous elements that can go towards articulating the development concerns and participation of indigenous peoples (United Nations, 2015). The 2030 Agenda came into effect on 1 January 2016 and will carry through the next 15 years; however, the indigenous peoples in Asia still struggle for recognition and support for empowerment. With denied rights and limited access to basic social services, many ethnic minorities managed to survive by adapting and mitigating in various ways the impacts of global environmental change (Gómez-Baggethun et al., 2013; Maldonado et al., 2016; Mercer et al., 2010; Miyan, 2015; Nkomwa et al., 2014). Traditional ecological knowledge has also sustained the cultures, livelihoods, and agricultural resource management systems of local and indigenous communities throughout Asia for centuries (Altieri & Nicholls, 2017; Cordero et al., 2018; Parrotta et al., 2009). As such, we also highlighted in this paper the challenges faced by the indigenous peoples in Asia as well as the need for greater engagement in integrating indigenous knowledge systems for inclusive and sustainable development initiatives in the implementation of the 2030 Agenda.

2.2 Research Approach

This review follows a qualitative approach as the term "indigenous peoples" is politically contested and not widely used in many parts of Asia. Instead, the corresponding local terms such as 'Masyarakat adat' (Indonesia), "Ainu or Okinawan" (Japan), and "Orang Asli or Orang Asal" (Malaysia) were used as key terms in searching the literature. Moreover, due to the vast linguistic diversity in Asia, only peer-reviewed and fully accessible research articles published in the English language were included in this review. Using the "Two-Eyed Seeing" approach, the consolidated articles were classified and synthesized based on their relevance in the specific SDGs of the 2030 Agenda which include food security and community livelihood, and natural resources management and conservation.

2.3 The Definition of Indigeneity in Asia

The term "indigenous" has long been used as a designation distinguishing those who are "native" from their "others" in specific locales and with varying scope (Merlan, 2009). Historically, this concept was first applied at the end of the 19th century by European colonizers to racially differentiate themselves from the colonized subjects (Baird, 2011, 2015; Casumbal-Salazar, 2015). This definition changed over the years and in 1938, the Pan-American Union referred to it as the first inhabitants of the lands (Baird, 2011). This “first” or “original” peoples’ concept of indigeneity, which differentiates based on ethnicity has emerged and become popularized in Asia in the 1970s and 1980s (Baird, 2015). Recently, the term “indigenous” has also been used to distinguish the marginalized and vulnerable people living in the state borders, including those who may not be the “first peoples” (Baird, 2016). The label “indigenous peoples” or its equivalent term in countries that still reject the concept are thus both highly political and subjective, reflecting opposing efforts to define the social basis of nation-states (Bertrand, 2011; Clarke, 2001). In fact, many Asian nations still contested the definition and do not acknowledge the concept of “indigenous peoples” even after the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP) in September 2007 (Etchart, 2017; IWGIA, 2017, 2018). Disputes focus on conceptions of the particularly sustainable environmental relations of indigenous groups, on the compatibility of universal human rights with the particular entitlements of indigenous and cultural minorities, as well as on the justification for and achievement of their claims to local resources, self-determination, and autonomy (Buergin, 2015; United Nations, 2008). The concept often provokes considerable caveats at the national level, particularly among Asian states. In Southeast and East Asia, only the Philippines and Japan accept the use of the term “indigenous peoples” to describe parts of their populations (Aikenhead & Ogawa, 2007; Buergin, 2015; Casumbal-Salazar, 2015).

On the other hand, the majority of ASEAN (Association of Southeast Asian Nations) members together with India, China, and other nations rejected the framework due to varying political and ideological interpretations claiming it does not apply to them (Baird, 2015, 2016; Bertrand, 2011; Buergin, 2015; Clarke, 2001; IWGIA, 2017). Indonesian authorities argued that the concept of indigenous peoples is not applicable as almost all Indonesians (except for the ethnic Chinese) are indigenous and thus entitled to the same rights (Nababan & Sombolinggi, 2017). The government granted autonomy in some areas, albeit for both minority and non-minority (Baird, 2011). In a particular case, the Indonesian government gave concessions to the Papuans but not the rights of indigenous peoples (Bertrand, 2011). Consequently, the Indonesian government has rejected calls for specific needs from groups identifying themselves as indigenous (Nababan & Sombolinggi, 2017). Vietnam, Laos, Bangladesh, and China have a similar stance to that of Indonesia for not recognizing indigenous peoples (IWGIA, 2017). The Lao government, however, severely restricts fundamental rights, including freedom of speech (IWGIA, 2017). Organizations openly focused on indigenous peoples or using related terms in the Lao language are not allowed and open discussions about indigenous peoples with the government can be sensitive (IWGIA, 2017). Nonetheless, the very existence of indigenous people in Asia is evident even from a local and international perspective (Table 2.1). In different parts of Asia, indigenous peoples are called “Masyarakat adat” in Indonesia, “Orang Asli or Orang Asal” in Malaysia, “hill tribes” in Thailand, “Scheduled Tribes”or “Adivasis” in India, “Jummas” in Bangladesh, “Adivasi Janajati” in Nepal, ethnic minorities, and among others distinguishing them as socio-culturally distinct group of people from the majority (IWGIA, 2017, 2018).

Table 2.1 Indigenous Populations and Number of Indigenous Groups in Selected Asian Countries

Asian Nations	Indigenous Population	No. of Indigenous Groups
East and Southeast Asia		
1. Japan	1,100,000-1,400,000	2
2. Taiwan	559,036	16
3. China	111,964,901	55
4. Philippines	14,000,000-17,000,000	110
5. Indonesia	50,000,000-70,000,000	1,128
6. Malaysia	4,369,176	57
7. Thailand	923,257	9
8. Vietnam	12,300,000	54
9. Laos	No data available	49
10. Myanmar	35,020,000	100
11. Cambodia	400,000	24
South Asia		
12. India	104,000,000	705
13. Bangladesh	1,586,141	54
14. Nepal	9,540,000	63

Note: Except for Taiwan, which is a non-member of the United Nations, the aforementioned Asian nations voted in favor and among the signatories of the UN Declaration on the Rights of Indigenous Peoples (UNDRIP). Source: (IWGIA, 2017, 2018; United Nations Development Programme, 2010)

This criterion of self-identification and identification of others as members of a distinct socio-cultural group have been the institutional definition for indigenous peoples by the World Bank’s Operational Directive 4.20 (World Bank, 1991). Other indicators include having an indigenous language different from the national language, the presence of customary and political institutions, close attachment to territories and natural resources, and subsistence-oriented production (World Bank, 1991). Yet, to date, some of these ethnic groups are not only denied such recognition but also citizenship thereby making them socially excluded and amongst the impoverished sectors (Milton et al., 2017; Toyota, 2005).

The politicized non-recognition of indigenous peoples in Asia may explain the paucity of research data and their under-representation in both local and international policies as well as in the continuing marginalization of many indigenous groups in the region. Among Asian countries, very few countries have fully recognised the international concept of indigenous people and given unconditional right of self-determination to the indigenous peoples (IWGIA, 2017). Both Japan and Malaysia have adopted the UNDRIP and endorsed the Outcome Document of the World Conference on Indigenous peoples but have not ratified International Labour Organisation (ILO) Convention 169 (IWGIA, 2017, 2018). Taiwan, on the other hand, is not a member of the United Nations and has not been able to vote on the UNDRIP, nor to consider ratifying ILO Convention 169 (IWGIA, 2017). At present, one of the major challenges faced by many indigenous peoples in Asia appears to be deep-rooted in the lack of national recognition and consequently, the denied legal rights despite the UNDRIP and ILO 169 agreements. The new Constitution of Nepal promulgated in 2015 denies the collective rights and aspirations for identity-based federalism of indigenous peoples (IWGIA, 2017). In 2017, the Indigenous peoples' Bill submitted by Indonesia's indigenous movement still awaits to be discussed in the National Legislation whereas Vietnam's draft proposal on the development of the Law on Ethnic Minorities was already rejected by its National Assembly (IWGIA, 2017). There are also continued efforts to get indigenous peoples' rights in the draft Constitution of Thailand that is still subject to further deliberation (Baird et al., 2017; IWGIA, 2017). The historical cause of regional conflicts and issues stemmed from the absence of an authoritative definition nor a general agreement to the meaning of indigenous peoples (Kingsbury, 1998). Though certain criteria have been established to identify indigenous peoples by the ILO and World Bank, the United Nations has adopted no definition even in the UN Declaration on the Rights of Indigenous peoples (Office of the United Nations High Commissioner for Human Rights, 2013). Given its relevance in political discourse, national and international policies, and legal implications, the consensus on the definition is highly needed in Asia. Similar to SDGs, the ASEAN Socio-Cultural Community Blueprint 2025 also envisions an inclusive community with the goal of reducing the barriers on ethnic minority groups, vulnerable and marginalized groups, and to promote indigenous and traditional knowledge (ASEAN, 2016). This, however, will be likewise unattainable without a regional consensus devoted to the recognition and protection of minorities and indigenous peoples.

Finally, finding a common ground in recognising and defining the indigenous peoples in the Asian community could also be advantageous. With policies strategically defined by global institutions, the legitimate recognition as indigenous peoples provides transnational benefits provided by various international organizations, intergovernmental agencies, and other foreign governments, which have policies targeted towards overseas indigenous peoples (Kingsbury, 1998). Indigenous peoples may be defined in accordance to the World Bank Operational

Manual (World Bank, 1991) which refers to the "social groups with a social and cultural identity distinct from the dominant society that makes them vulnerable to being disadvantaged in the development process". The distinctiveness of indigenous identity is very discernible from the dominant culture and language and so, they are even labelled as "tribal groups", "ethnic minorities" amongst others. In this study, I propose to define indigenous peoples as "*self-identified indigenous inhabitants living within the traditional territories or ancestral domains attested by history and distinct cultural identity"*.

The legitimate recognition would allow indigenous peoples in Asia to benefit from various international projects and financial assistance, for example, the World Bank's Dedicated Grant Mechanisms (DGM) for indigenous peoples and local communities, and support for enhanced participation of indigenous peoples in benefit-sharing of carbon emission reduction programs through the Enhancing Access to Benefits while Lowering Emissions - EnABLE Fund (World Bank, 2021). Other funders like the Indigenous Peoples Assistance Facility (IPAF) and The GEF Small Grants Programme, also provides financial support for projects that empowers indigenous peoples' organisations, and capacity development for local livelihoods and customary institutions as well as revitalisation and protection of indigenous knowledge and cultural practices (International Fund for Agricultural Development, 2021; The SGP The GEF Small Grants Programme, 2021).

2.4 Indigenous peoples in the Sustainable Development Goals (SDGs)

The idea of the Sustainable Development Goals (SDGs) first emerged from the outcome of the Rio+20 Conference in 2012 (United Nations, 2012). In September 2015, after three years of negotiations, the 193 world leaders in the UN General Assembly adopted the SDGs consisting of 17 global goals with 169 targets to be achieved in 2030 (United Nations, 2015). The UN described the formulation of the 2030 Agenda as the most inclusive in its history. The SDGs address some of the key shortcomings and gaps of the Millennium Development Goals (MDGs) where indigenous peoples were largely invisible. Indeed, one of the major criticism of the MDGs is its setting that partly ignored the human rights standards and principles, especially on the issues of inequality within a country (Office of the United Nations High Commissioner for Human Rights, 2008). In contrast to the MDGs, the SDGs incorporate a broader and more transformative agenda relevant to the challenges of the 21st century through global goals (Fukuda-Parr, 2016).

Through active engagement in the process towards the 2030 Agenda, the indigenous peoples have been included in the political declaration of the SDGs as well as in the follow-up and review section that calls for indigenous peoples' participation (United Nations, 2015). Two of the SDGs are specifically referred to the indigenous peoples in its target by 2030. First, it is the Goal 2 section 2.3 on enhancing agricultural productivity and income of small-scale producers, in particular the indigenous peoples and other marginalized groups, including through secure and equal access to land, other productive resources, and inputs, knowledge, financial services, markets and opportunities for value addition and non-farm employment (United Nations, 2015). The second goal broadly aims to end hunger, achieve food security and improve nutrition, and promote sustainable agriculture. Second, it is Goal 4 section 4.5 on eliminating gender disparities in education and ensuring equal access to all levels of education and vocational training for the vulnerable, including persons with disabilities, indigenous peoples, and children in vulnerable situations (United Nations, 2015). The fourth SDG aims to ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

At the national level, the governments of Bangladesh, India, Indonesia, Japan, Malaysia, Nepal, Philippines, and Thailand adopted and started the implementation of the SDG framework through baseline and benchmarking studies (Allen et al., 2018). The goal-setting process of the UN SDG presents a novel approach as it affords extensive freedom for implementation among the member states (Biermann et al., 2017). The role of the government, therefore, is critical in setting the priorities for the national goals, targets, and strategies within the context of global goals. This will require significant capacities for political leadership on sustainable development at all the levels of government from national to local and cutting across sectoral borders (Biermann et al., 2017; Stafford-Smith et al., 2017). In this regard, the sectors of indigenous peoples are key components of the sustainability agenda especially on environmental policies as they occupy over a quarter of the world's land surface of conservation importance (Garnett et al., 2018) and their indigenous knowledge systems are now widely recognized tool in natural resource management (Ban et al., 2018; Ens et al., 2016; Maldonado et al., 2016; Tengö et al., 2014). The largest remaining natural resources in Asia are safeguarded by indigenous populations (Poffenberger, 2006; Rerkasem et al., 2009) and the perspective of integrating indigenous knowledge systems in both local and regional policies should be reconsidered. Some models of indigenous knowledge integration in environmental governance can be examined from the experience of other nations like Australia, Canada, Mexico, and many others (Arsenault et al., 2018; Audefroy & Sánchez, 2017; Duncan et al., 2018; Leiper et al., 2018). Moreover, the International Panel on Climate Change (IPCC) even calls for the inclusion of indigenous knowledge systems in international reports highlighting its importance on science, policy, and global politics (Ford et al., 2016). The role of academic researchers is likewise indispensable in the framing of research agenda, knowledge production, policy analysis, and expert assessments needed by the national government and the international community (Ford et al., 2016; Parsons et al., 2016). For these reasons, implementing and achieving the goals of the 2030 Agenda requires interlinkages between indigenous peoples' organizations, academic researchers, and the national government.

2.5 The Role of Indigenous Knowledge Systems

Indigenous knowledge is broadly defined as an evolving cumulative body of knowledge, practice, and belief about the relationship of living beings (including humans) with one another and with their environment handed down through generations by cultural transmission (Berkes, 1993; Gadgil et al., 1993). It is also called traditional ecological knowledge, traditional wisdom, aboriginal science, traditional knowledge, and among others (Aikenhead & Ogawa, 2007; Hummel & Lake, 2015). This knowledge is a product of direct experience and careful observations of the natural world by the indigenous peoples and has been a conceptually problematic field of research (Aikenhead & Ogawa, 2007). Locally shared knowledge could be considered as an asset distinctive from the other five capitals (physical, financial, human, social, and natural capital) (Shiro et al., 2007). In the case of Yunnan farmers in China, spatially dispersed farmers carefully observed the local ecosystem (human capital) and shared their experience within the community (social capital), which resulted in anthropogenic accumulation of collective knowledge, and this enabled the farmers to identify and find the solution to local problems (Shiro et al., 2007). Knowledge capital stock could be depleted or vanished due to abandonment, displacement, loss of interest, and among others (Shiro et al., 2007; Sujarwo et al., 2014). Thus, for rural development to be sustainable, there is a need to consider local, community, and/or traditional knowledge as capital assets in rural development projects (Shiro et al., 2007). Studies exploring indigenous peoples' experiences and responses to pertinent global environmental concerns have increased in the past two decades (Parsons et al., 2016). A number of these publications discuss the pivotal role of indigenous knowledge on a wide array of themes encompassing the field of social, environmental, and health sciences. Its applicability on ecosystem degradation, climate change and climate-related hazards, food security, human well-being, and conservation of biodiversity has lately gained more interest and recognition worldwide (Ford et al., 2016; Garutsa & Nekhwevha, 2016; Hiwasaki et al., 2015; Ingty, 2017; Mistry & Berardi, 2016; Nkomwa et al., 2014; Oniang'o, R., Allotey, J., and Malaba, 2004; Quave & Pieroni, 2015; Wilder et al., 2016). This includes the inclusion of indigenous knowledge systems on international reports and assessments of the Intergovernmental Panel on Climate Change (IPCC) (Ford et al., 2016), the Convention on Biological Diversity (CBD), and the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) (Tengö et al., 2017). However, that many traditional knowledge and practices are understudied and fast disappearing worldwide (Atreya et al., 2018; Parrotta et al., 2009; Parsons et al., 2016; Reyes-García et al., 2013; Saynes-Vásquez et al. 2013; Srithi et al., 2009; Voeks & Leony, 2004). The distinctiveness of indigenous peoples' knowledge, cultural identity, and traditional practices over ancestral domains are markers shared by indigenous populations. Furthermore, their history of oppression, marginalization, and disappearing culture warrants their claims for legitimate recognition as indigenous peoples (Anaya, 1996).

2.6 Putting Indigenous Knowledge Systems into Practice

2.6.1 Food Security and Community Livelihood

With the growing population all over the world, it is unclear how the current global food system will meet the future demand for food hence, ensuring equal access to adequate and nutritious food produced in an environmentally and socio-culturally sustainable manner is one of the greatest challenges of the time (Vinceti et al., 2013). This important issue is among the SDGs of the 2030 Agenda directly referred to the indigenous peoples and other vulnerable sectors of the society. Embedded in their respective traditional practices, indigenous knowledge systems concerning wild food resources are essential for subsistence and livelihood income for many ethnic communities in Asia (Broegaard et al., 2017; Delang, 2006b; Jianchu & Mikesell, 2003; Tamayo, 2010). Though efforts to domesticate selected plant species for local people have started in some region, many government agencies and research institutions still overlooked the potential economic benefits of wild edible plants as well as the advantages of traditional systems and practices (Bvenura & Afolayan, 2015; Delang, 2006a, 2006b; Ebert, 2014; Lulekal et al., 2011; Maroyi, 2014). In the case of the Tagbanua tribe of Palawan Island in the Philippines, local vegetables and fruits are outsourced from traditionally managed plots while their main earnings are derived from harvesting of resin from the Almaciga tree (*Agathis dammara* (Lambert) L.C. Rich or *Agathis philippinensis* Warb.) and rattan (W. Dressler, 2005; Lacuna-Richman, 2003, 2004). The Tagbanua restrict themselves from clearing parts of the forest due to their dependence on almaciga resin and other forest resources which sustains their livelihood and basic needs in the community (W. Dressler, 2005; Lacuna-Richman, 2003, 2004). In Nepal, the collection of yarsagumba (*Ophiocordyceps sinensis*) in the Himalayan mountains accounts for up to 65% of total household income with the highest contribution in the poorest households which further reduces income inequality by 38% (Shrestha et al., 2017). The current market price for 1 kg of high-grade Tibetan Yarsagumba in China, Hong Kong, and in the US is now USD 128,000 from USD 32,000 in 2006 making it one of the most expensive medicinal herbs in the world (Koirala et al., 2017; Shrestha et al., 2017). The use of economically important plant resources and innovative practices are also crucial to many households in the region. One of the lesser-known traditions is the use of *Elaeocarpus floribundus* seeds as a source of vegetable oil in Myin Ka village in Myanmar (Shin et al., 2018). The vegetable oil from *E. floribundus* seeds is still uncommercialized and could be further explored for its potential to generate additional livelihood revenue for the community. The *E. floribundus* fruits are eaten raw as a wild edible fruit in South Asia and recent studies reported that its fruit extract has antibacterial activity against food-borne pathogens (Sircar & Mandal, 2017) while the leaf extracts had significant activities against CEM-SS cancer cells (Utami et al., 2006). The gathering of food plants in the wild is a local practice of foraging tribes in the Philippines to augment the food shortage (Balilla et al., 2012; Mandia, 2004; Tangan, 2007). Aside from subsistence, the Karen hill tribes inhabiting Thailand also valued wild food for additional profits apart from growing cash crops though with certain restrictions set by the government (Delang, 2006b, 2006a; Suk, 2016). About 50% of the poor and at-risk households in Timor-Leste similarly forage for wild food during the food-deficit season (Erskine et al., 2014). Such knowledge is important for human survival. In fact, some of the reported emergency food plant species are often cited as coping strategies of indigenous peoples during periods of insufficiency. Other ethnic communities also considered it as part of the traditional culinary practice and cultural identity transmitted across generations (Iwasaki-Goodman, 2017). The local populace is also more engaged in the conservation of plant species that are part of the traditional cuisine (Putri et al., 2017). Given the importance of indigenous knowledge systems in food security, community livelihoods, and well-being in many underserved indigenous populations, the potential contribution of indigenous peoples should be re-examined in realizing the SDGs on Zero Hunger (SDG 2) and other relevant targets.

2.6.2 Natural Resources Management and Conservation

The indigenous peoples safeguard the sites of few remaining natural resources, and their way of life, customs, and traditions had helped sustain rural communities and protect vulnerable forests in the age of modernity (Etchart, 2017). For instance, the Dayak people in East Kalimantan, Indonesia practices a traditional farming system called “simpukng” which is a managed secondary forest planted with selected species of fruits, rattan, bamboo, timber, and other plants (Mulyoutami et al., 2009). These sustainable forest gardens are owned by families and passed down from one generation to the next while others are managed on a communal basis (Mulyoutami et al., 2009). This concept of sustainable utilization and management of shared resources is similar to the Village Community Forests (VCF) of the indigenous peoples of Bangladesh (Chowdhury et al., 2018; Misbahuzzaman & Smith-Hall, 2015), the “ala-a system” of Ifugaos in the Philippines (Camacho et al., 2012), and the Fengshui forest in China (Kim et al., 2017; Yuan & Liu, 2009). It is estimated that there may be over 140 million forest-dependent people in Cambodia, Indonesia, the Philippines, Thailand, and Vietnam, representing about one-third of the population in these nations. This estimate includes people who live on or near forest lands and are dependent on forest resources for a significant portion of their subsistence and livelihood requirements (Poffenberger, 2006). Almost all of the indigenous communities in Bangladesh are also living within the boundary of 2.53 million ha of forest lands representing about 17.5% of the country's area (Rahman & Alam, 2016). Yet, despite the largely indigenous population and economic dependence, various governments in the region did not consider them to be a major component in management until recently (Poffenberger, 2006). In the community forests system (CFS), the entire community has a consensus on the management of which is also the source of livelihoods such as bamboo and timber harvesting as well as for wild fruits, herbs, and other resources (Table 2.2).

Table 2.2. The key benefits of traditional Community Forests System

Utilization/Relevance	**References**
Food source for local households (wild vegetables and fruits)	(Chowdhury et al., 2018; Mulyoutami et al., 2009)
Livelihood income derived from harvested and processed forest products	(Camacho et al., 2012; Kim et al., 2017; Mulyoutami et al., 2009; Pinyopusarerk et al., 2014)
Sources of fuelwood	(Camacho et al., 2012; Chowdhury et al., 2018; Kim et al., 2017; Mulyoutami et al., 2009)
Source of drinking water	(Chowdhury et al., 2018)
Source of medicinal plants	(Camacho et al., 2012; Chowdhury et al., 2018; Mulyoutami et al., 2009)
Source of construction materials	(Camacho et al., 2012; Chowdhury et al., 2018; Kim et al., 2017; Mulyoutami et al., 2009; Pinyopusarerk et al., 2014)
Community funds	(Chowdhury et al., 2018)
Social functions (forest plants are used in traditional ritual ceremonies)	(Chowdhury et al., 2018; Kim et al., 2017; Mulyoutami et al., 2009)

The success of VCF has been demonstrated in many parts of Asia. In Bangladesh, the villagers have maintained collective funds from the income of the VCF products that provide for children's education and medical treatment of disadvantaged families (Misbahuzzaman & Smith-Hall, 2015). The Tay and Nung ethnic groups in the mountain regions of Vietnam (Pinyopusarerk et al., 2014), and Masyarakat Adat of Indonesia (Astuti & McGregor, 2017) were able to secure joint ownership and exclusive rights to community land forest. With these few exceptions, most of the traditional community forests have no land tenure though owned traditionally or otherwise occupied or managed continuously by the indigenous populations. The traditional community forests are not only sustainable but also economically beneficial to the participating households even in different regions (Chowdhury et al., 2018; Jha, 2015; Rai et al., 2016). Other ethnic groups are also engaged in tropical home gardens, one of the oldest forms of managed land-use systems considered to be an epitome of sustainability (B. M. Kumar & Nair, 2004). Tropical home gardens have economic and socio-cultural importance in many regions, especially to those with constrained access to land resources (Table 2.3).

Table 2.3. Economic, social, and/or cultural foundations of home gardens

1. Low capital requirements and labor costs – suitable for resource-poor and small-holder farming situations
2. Better utilization of resources, greater efficiency of labor, even distribution of labor inputs, and more efficient management
3. Diversified range of products from a given area and increased value of outputs
4. Increased self-sufficiency and reduced risk to income from climatic, biological, or market impacts on particular crops/products
5. Higher-income with increased stability, greater equity, and improved standards of living
6. Better use of underutilized land, labor, or capital, besides creating capital stocks to meet intermittent costs or unforeseen contingencies
7. Enhanced food/nutritional security and ability to meet the food, fuel, fodder, and timber requirements of the society
8. Increased fulfillment of social and cultural needs through sharing or exchange of produces and recreational opportunities
9. Better preservation of indigenous knowledge

Source: (B. M. Kumar & Nair, 2004)

With limited land rights and forced migration, Thailand's ethnic minorities rely on home gardens as an important food source (Srithi et al., 2012). Thailand's Karen, Hmong, and Mien home gardens are very rich in species, making them important repositories for botanical agro-biodiversity, particularly for food crops. In fact, 90% of home gardens in Northeast Thailand include wild food plants (Cruz-Garcia & Struik, 2015). For Cao Lan home gardens in Vietnam, most plant species are used for food, but some other species are valued for ornamental, medicinal, construction, animal fodder, stimulants, and other purposes (Timsuksai et al., 2015). Though most home gardens tended native plants, the "hill people" in the Indo–Burma biodiversity hotspot incorporates introduced species and cultural practices that make the home gardens in the region a sustainable and economically viable subsistence (Barbhuiya et al., 2016). They also serve as an important means of conservation of native plants through use thereby reducing pressure on wild resources (Barbhuiya et al., 2016). Its role in conservation is evident in the home gardens of the Orang Asli in Malaysia, which include the domestication of IUCN threatened species such as the *Aquilaria malaccensis* Lamk. and *Eurycoma longifolia* Jack (Milow et al., 2013). Evidence of farmers' extensive transplanting of species in their gardens and fields indicates that they are ensuring availability and stability of the wild food plant supply for domestic consumption, which is crucial for local food security (Cruz-Garcia & Price, 2014). This also shows the positive role of integrating indigenous knowledge in protecting the threatened species and vulnerable habitats from the peril of extinction. The Intergovernmental Platform for Biodiversity and Ecosystem Services (IPBES) includes the commitment to recognize and respect the contribution of indigenous and local knowledge to the conservation and sustainable use of biodiversity and ecosystems in its operating principles

(Karki et al., 2017). The function of some home gardens, however, had shifted from subsistence towards commercial farming for higher income. In a case study in Indonesia, this resulted in decreased plant diversity and evenness, a higher level of ecological and financial risk to the owners, higher requirements for external inputs such as fertilizers and pesticides, a lower level of community equitability, and increased instability (Abdoellah et al., 2006). Indeed, recent findings indicate that collaborations involving conservationists, indigenous peoples, and governments would yield significant benefits for the conservation of biocultural diversity for future generations (Garnett et al., 2018).

2.7 Conclusion

The inclusion of the indigenous peoples in the Sustainable Development Goals (SDGs) has paved the way to revisit relevant issues on indigenous peoples' rights, recognition of IKSP, and the socio-political and environmental concerns within Asia. Science-policy governing bodies and agreements such as the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), Intergovernmental Panel on Climate Change (IPCC), and the Convention on Biological Diversity (CBD) acknowledges the importance of indigenous and local knowledge systems to inform international biodiversity assessments and decision-making process (Ford et al., 2016; Tengö et al., 2017). The treatment of indigenous issues in the IPCC is of particular interest because the indigenous peoples have been identified as being uniquely sensitive to climate change impact, and their accumulated knowledge is now given due regard (Ford et al., 2016). It is now highly recommended that efforts to solve real-world problems should first engage with those local communities that are most affected, beginning from the perspective of indigenous knowledge and then seeking relevant scientific knowledge to expand the range of options for action (Altieri & Nicholls, 2017; Brondizio & Tourneau, 2016; Mistry & Berardi, 2016). This stemmed from the growing evidence on the relevance of indigenous knowledge systems and experience in addressing the present and future pressing concerns on global environmental change (Alexander et al., 2011; Ford et al., 2016; Gómez-Baggethun et al., 2013; Ingty, 2017; Rahman & Alam, 2016), disaster risk reduction and management (Hiwasaki et al., 2015; Mercer et al., 2010), natural resources management (Anthwal et al., 2010; Karki et al., 2017; R. K. Singh et al., 2010), sustainable agriculture (Neyra-Cabatac et al., 2012; Shiro et al., 2007; R. K. Singh et al., 2010), and food security (Ong & Kim, 2017; Oniang'o, R., Allotey, J., and Malaba, 2004; Putri et al., 2017). Yet, despite the surge of interest in this research area, indigenous knowledge is underutilized, not fully integrated into policies, and under-represented in various national and international forums. With the adoption of the 2030 Agenda, the Asian community needs to re-examine the social, economic, political, and environmental policies that directly affect the lives of the indigenous populations. The legal recognition of indigenous communities and the acknowledgment of the contribution of their local knowledge are vital in promoting resilience in the face of critical biodiversity loss and threats of environmental degradation. This is of particular importance as the loss of knowledge and practices has already been noted in recent years (Atreya et al., 2018; Caneva et al., 2017; Srithi et al., 2009; Sujarwo et al., 2014). The future of sustainable management of natural resources in the Asian community lies in forging collaborations between academic researchers, policy-makers, and indigenous peoples. The implementation of the 2030 Agenda, therefore, calls for culturally sensitive initiatives and better engagement with the indigenous peoples to uphold their rights and be involved in achieving the new sustainable goals. Whilst indigenous peoples are included in the UN-formulated indicators (Leadership Council of the Sustainable Development Solutions Network, 2015; United Nations Statistical Commission, 2016), the government must clearly define its national policy, local SDG initiatives, implementation coverage, and beneficiaries. Without transparency, indigenous peoples will likely remain "invisible" in the implementation of the 2030 Agenda. In one particular case, Australia reports success in achieving the goal for quality and access to safe drinking water and sanitation (SDG 6), though indigenous Australians living in remote communities still faces the problem of unsafe contaminated water, poor sanitation, and diseases (Hall et al., 2020). Similarly, the indigenous peoples of Guatemala and Peru also suffer from social exclusion particularly on universal health coverage (Samuel et al., 2020). As such, having culturally diverse stakeholders and evidence-based assessments should also be taken into consideration to ensure the just and equitable implementation of the SDGs.

Chapter 3

Bridging Ethnobotany and SDG 2: Is there any alternative to rice? Insights from the ethnobotanical use of edible plants by the Higaonon tribe in Bukidnon, Philippines

3.1 Introduction

Globally, it is estimated that nearly 690 million people suffer from hunger, or 8.9 percent of the world population – an increase of 10 million people each year and nearly 60 million in total within five years (FAO et al., 2020). As hunger affects almost all regions in the world, the challenge of attaining food security is reflected in one of 17 Sustainable Development Goals (SDGs) aimed to be achieved in 2030 (United Nations, 2015). The UN SDG2, in particular, envisions to end hunger, achieve food security, and improve nutrition and promote sustainable agriculture, where nutrition, neglected and underutilised species (NUS), and genetic diversity coalesce (Hunter et al., 2019). SDG Target 2.5 states:

"By 2030, maintain the genetic diversity of seeds, cultivated plants, and farmed and domesticated animals and their related wild species, including through soundly managed and diversified seed and plant banks at the national, regional, and international levels, and promote access to and fair and equitable sharing of benefits arising from ***the utilization of genetic resources*** *and* ***associated traditional knowledge****, as internationally agreed"* (United Nations, 2015).

In many developing countries, the problem of hunger, undernutrition, and failed agriculture was already encountered in the 1972-1973 and the 2007-2008 food crises driven by the worldwide shortage and unaffordability of rice (Dawe, 2010). Many countries were affected including the Philippines which is part of the current global food systems that mainly rely on either three staple crops – rice, maize, and wheat which account for more than 50% of the calories consumed (Hunter et al., 2019). During these crises, the government of the Philippines mitigated this problem by importing more rice – the main staple in both rural and urban Filipino communities making the Philippines the world's largest rice importer (Dawe, 2010; Dawe et al., 2008). By 2019, the country still held this record with an estimated total import of 2.9 million tonnes of rice (Reuters, 2020b). However, the COVID-19 outbreak has shocked the world economies and disrupted the global supply chains, particularly on agricultural products (Lin & Zhang, 2020). Vietnam, the world's third-largest rice exporter, has temporarily suspended new rice export contracts whilst Cambodia also imposed a temporary ban on rice exports to ensure local food security, with the Philippines seeking an additional 300,000 tonnes on top of its 1.3 million tonnes rice import to ensure sufficient domestic supply (Reuters, 2020b, 2020a). About 15 million families in the country consume rice at approximately 463 kg per family per year or 8.9 kg a week (Philippine Statistics Authority, 2010). At present, it is estimated that the Philippine government will import at least 1.69 million tonnes of rice to feed its people (Dela Cruz, 2021).

This economic burden, however, may be unnecessary considering that the monotonous rice diet of Filipinos has serious consequences on their health (Angeles-Agdeppa et al., 2019, 2020). The Filipino diet consisting mainly of rice, fish, meat, and sweetened beverages is extremely poor and inadequate of important macro- and micronutrients (Angeles-Agdeppa et al., 2019, 2020). Indeed, finding another source of calories is not the sole problem as the Food and Agriculture Organization changed the language of food security to ‘‘food and nutrition security,” reflecting the growing concern on micronutrient deficiencies (Blesh et al., 2019). As defined by FAO, food and nutrition security means that all people at all times have physical, social, and economic access to food of sufficient quantity and quality in terms of variety, diversity, nutrient content, and safety to meet their dietary needs and food preferences (FAO et al., 2020). Other than rice, numerous edible plants have been used throughout human history particularly those by indigenous peoples. Many indigenous and local communities are holders of extensive knowledge of edible plants, many of which are neglected and underutilised by the majority of the populations (Del-Castillo et al., 2019; Hunter et al., 2019; Kuhnlein et al., 2009; Padulosi et al., 2013; Ulian et al., 2020). Indigenous peoples also maintain their traditional food system to be food secure and resilient independent from the market system (Budowle et al., 2019; Cuevas et al., 2015; Gayao et al., 2018; Meldrum et al., 2020). Indigenous peoples’ food systems may be described as those foods that indigenous peoples have local access to, without having to purchase them, and within traditional knowledge and the natural environment from farming or wild harvesting (Kuhnlein et al., 2009). This in contrast to “market foods” or those foods that enter the community from various commercial industries, and must be purchased (i.e., sugar, oil, canned goods, powdered milk, etc.) although in some circumstances, indigenous peoples may purchase some of their culturally based traditional foods (i.e., wildmeat, coffee beans, local rice varieties, and vegetables) from others with land and/or time to harvest them (Kuhnlein et al., 2009).

Consequently, the Intergovernmental Panel on Climate Change (IPCC) had acknowledged the contribution of indigenous peoples and indigenous knowledge systems (IKS) affirming that agricultural practices that include indigenous and local knowledge can contribute to overcoming the combined challenges of climate change, food security, biodiversity conservation, and combating desertification and land degradation (Intergovernmental Panel on Climate Change, 2019). As such, exploring the potential of neglected and underutilised species, along with the wealth of indigenous knowledge about their uses and practices, offer a largely untapped resource to combat malnutrition, support food security and sustainable agriculture (Ghosh-Jerath et al., 2020; Meldrum et al., 2020; Ulian et al., 2020) – the key goals of SDG 2. This strategy is particularly promising in a biodiverse yet food insecure country like the Philippines. With over 10, 000 species of plants (Pelser et al., 2011) and 110 groups of indigenous peoples (United Nations Development Programme, 2010), the Philippines may be considered as one of the most important sites for ethnobotanical research in the continent. However, the land managed by indigenous peoples is rapidly disappearing as agricultural plantations encroach and expand in the uplands of the Philippines (Huesca, 2016). For example on Mindanao, the second largest island in the Philippines, extensive lands in the mountainous province of Bukidnon have been transformed into the country's largest producer of pineapple (59.73 metric tons/hectare) and other cash crops such as tobacco and rubber for export (Philippine Statistics Authority, 2018). Whilst large-scale agricultural investments increased agricultural productivity in Mindanao, these investments have largely failed to curb persistent poverty or improve the general well-being of local people especially in the rural communities (Huesca, 2016). Amongst the most affected on Mindanao Island are the villages of the Higaonon tribe residing in the uplands of Bukidnon. The traditional lands managed by the Higaonon tribe encompass the key biodiversity areas of conservation value whilst the local plant resources are an important food source for the remote indigenous populations (Abeto et al., 2004; Bukidnon-Higaonon Community, 2019). The knowledge and contribution of indigenous women are also explored in this study which supports the UN SDG 5 – gender equality. The women of the Higaonon tribe may be equally knowledgeable to men as such, they must be represented within the community. The empowerment of women and girls will make a crucial contribution to progress across all the goals and targets (United Nations, 2015). Moreover, the achievement of full human potential and sustainable development is not possible if one half of humanity continues to be denied its full human rights and opportunities (United Nations, 2015). Unfortunately, the indigenous knowledge system and food ethnobotany of the

Higaonon tribe is still undocumented despite the imminent threat of biocultural loss and growing concern of food security.

To fill this gap, an ethnobotanical investigation was carried out to explore the traditional lands and associated edible plants used by the Higaonon tribe; specifically, this study aims to answer the following questions: 1. Which edible plant species comprise the Higaonon tribe's food system? 2. How are these edible plants traditionally prepared and consumed? 3. Is there a difference between men and women in the Higaonon household in terms of knowledge of food plants (total number of recognised species in all sites, and in specific collection sites (i.e, homegardens, forests, etc.)? 4. How adaptive is the Higaonon food system within the context of rice shortage and nutrient-poor diet in the Philippines?

3.2 Materials and Methods

3.2.1 Study Area

The study was carried out in Barangay Dumalaguing, a rural mountainous community in the municipality of Impasug-ong, province of Bukidnon, Mindanao Island, Philippines (Figure 3.1).

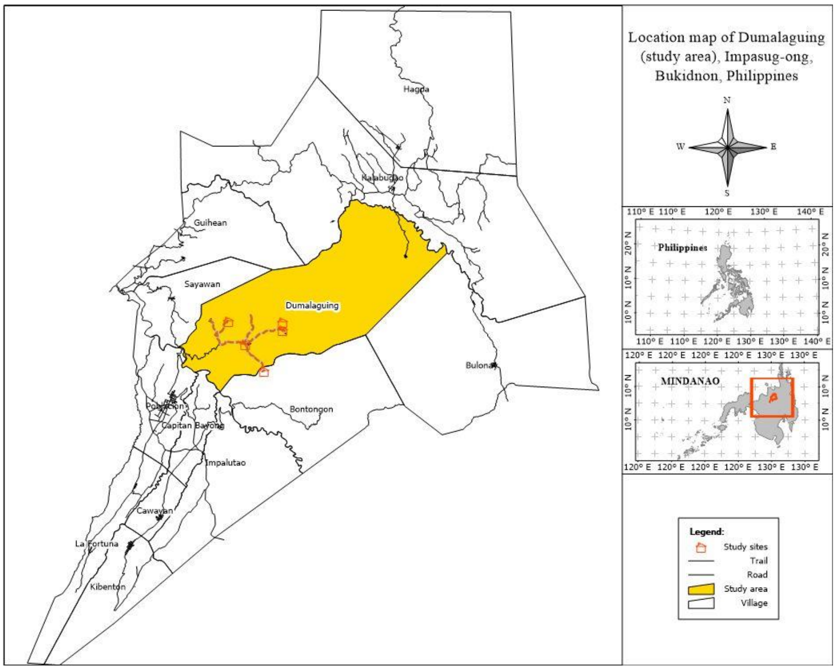


Figure 3.1 Location of Dumalaguing in the central part of Mindanao Island, Philippines

Five out of seven villages were selected for the study, this includes the following: 1. Dumalaguing Poblacion – 677 m.a.s.l. (N 08.34529˚; E125.05598˚); 2. Bunda-an – 1093 m.a.s.l. (N 08.35522˚; E 125.08214˚); 3. Kalipayan – 1085 m.a.s.l. (N 08.36090˚; E 125.03284˚); 4. Gabunan – 1232 m.a.s.l. (N 08.36194˚; E 125.04388˚); and 5. Bati-ao – 1188 m.a.s.l. (N 08.32662˚; E 125.06863˚).

3.2.2 Ethnobotanical Data Collection

In collaboration with a local NGO, Bukidnon Resources Management Foundation Inc. (BRMFI), the project was first presented to the Local Government Unit of Dumalaguing in November 2017. The project was then approved by the Barangay Captain of the Local Government Unit (LGU), and the Tribal Chieftain of the Higaonon tribe. However, due to the implementation of Martial Law which placed the entire Mindanao Island under full military control, data collection was delayed and only conducted from December 2018 until April 2019. A total of 100 respondents from five villages consented to participate in the study. Two villages, Ananaso and Guihean were excluded from the study due to the inaccessibility of the terrain. All the respondents were of legal age (18 years of age and older), permanent village residents, and of Higaonon tribe descent. In each village, households were selected based on accessibility within the village. With the help of a local translator, the research team visited each household and give courtesy to the family members by introducing the research group. The background and objectives of the study were explained in both Bisaya and Higaonon dialects. Any of the adults chiefly responsible for food collection and/or preparation in the household, either the father, mother, or grandparent were then requested to participate voluntarily in the interview. After the verbal consent was obtained, the structured interview was initiated by getting the personal and socio-economic profile of the respondent. The interview was conducted flexibly following the social norms of the Higaonon tribe. In most cases, this was done inside the house or by invitation in the household of the local leaders (locally referred to as the *Barangay Kapitan)*, albeit some interviews were conducted outside the household, for example, walking interviews whilst collecting food plants within the community, homegarden, or nearby farm (Figure 3.2). Though it entails more time than the average 20-minute household interview, the walking interview which often lasted for more than 30 minutes was also helpful to the researcher since the respondents can directly locate and refer to some readily available food plants especially those in the homegardens and communal area. It also enabled the researcher to provide preliminary field identification, sample collection, and photo documentation. All information was recorded in the datasheet (Annex 1). The interview concluded by reading the respondents' answers for completeness and confirmation. If the plant mentioned during the interview was unknown to the researcher, a guided survey was requested to the respondent to locate the plant for documentation and taxonomic verification. After collating the data, each village was revisited to locate the remaining unidentified plants, especially the plants that were gathered from the forest, and areas outside the village.

Figure 3.2 Elicitation of the plant knowledge in Barangay Dumalaguing, Bukidnon, Philippines

The study considered both wild and cultivated food plants found within the ancestral lands[2] of the Higaonon tribe. Following the definition of Heywood (1999), ‘wild’ species was defined as plants that grow simultaneously in self-maintaining populations in a natural or semi-natural

[2] As defined by *The Indigenous Peoples Rights Act of 1997* (1997), ancestral lands refers to land occupied, possessed and utilised by individuals, families and clans who are members of the Indigenous Cultural Communities (ICCs)/Indigenous peoples (IPs) since time immemorial, by themselves or through their predecessors-in- interest.

habitat without direct human action. The term was contrasted with "cultivated" or "domesticated" plant species that have arisen through human action, such as selection or breeding, and that depend on management for their continued existence (Heywood, 1999). This may include all the plants that were gathered (not cultivated), even those growing on cultivated lands instead of forested areas (Termote et al., 2011). All specimens were identified by the author and other taxonomists in the University Herbarium of Central Mindanao University, Bukidnon, Philippines. The botanical nomenclature and taxonomic treatment used in this study were referred from the Kew's Plants of the World online database (http://www.plantsoftheworldonline.org/) and Co's Digital Flora of the Philippines (https://www.philippineplants.org/).

3.2.3 Data Analysis

The data collected during fieldwork was organised in a Microsoft Excel spreadsheet for analysis. Using the checklist of all the reported food plants, descriptive statistics on the number and percentage of botanical families, genera, and species were calculated as well as their life-forms, collection sites, and edible plant parts. The food plants were then classified based on FAO food use-categories (Kennedy et al., 2010):

Cereals – includes corn, rice, or any other grains as well as products and foods derived from cereal crops (i.e., porridge, noodles, and other local foods); White roots and tubers, and plantains – this group include all non-grain-based, and non-pigmented starchy staples (i.e., cassavas, potatoes, and yams); Vitamin A-rich vegetables and tubers – this include roots, tubers, and other yellow/red/orange vegetables (i.e., carrots and sweet potatoes). This group also include items botanically considered as fruits but locally used as vegetables in culinary use (i.e., squash); Green leafy vegetables – medium to dark green leafy vegetables (i.e., cabbage, spinach, and sweet potato leaves); Other vegetables – include all the non-leafy edibles such as eggplant, okra, tomato, and bamboo shoots; Vitamin A-rich fruits – include locally available dark yellow or orange fruits that are sources of Vitamin A (i.e., ripe mango and papaya). Other Fruits – this group includes various parts of a plant; leaves, stem, fruit, and flowers (i.e., durian, rambutan, and edible flowers of torch ginger); Legumes, nuts, and seeds – include beans, dried peas, lentils, nuts, or seeds (i.e., peanuts and mung bean), as well as products made from these; Spices, condiments, and beverages – include items commonly used in small quantities and mainly used to enhance the flavour of the dish (i.e., black peppers and garlic). This list may include many additional items, including various flavouring pastes and seeds, depending on local knowledge of their uses. Beverages such as coffee, tea, and alcoholic beverages are included in this group.

For quantitative ethnobotanical analysis, the Use-Report (UR), Use-Value (UV) index, Number of Uses (NU), and measure of Fidelity Level (FL) were all calculated using the statistical software R with the R package *ethnobotanyR* (Whitney, 2020). The Use-Report (UR) calculates the total reported uses of each species in all the use-categories by all respondents (G. T. Prance et al., 1987). The Use-Value index developed by (Phillips & Gentry, 1993) determines the relative importance of each species based on the formula: $UV = (\sum U_i)/n$, where U_i is the number of uses (counted based on use-category) mentioned by each respondent, and n equals the total number of respondents interviewed. The UV index determines the most widely used food plant species (highest UV) as well as the underutilised species (lowest UV index approaching 0). The UV index, however, cannot determine whether the species is used singly or for multiple purposes. As such, the Number of Uses (NU) per species was likewise determined by calculating the sum of all the use-categories for which a species was cited (Prance et al., 1987). The Fidelity Level (FL) percentage on the other hand identifies the central role of each reported food plant species as agreed upon by all the respondents (Quave & Pieroni, 2015). The FL % of each food plant species was expressed as the ratio of the total number of respondents who independently suggested the use of a species for a specific use-category (I_p) and the total number of respondents who mentioned the plant for any use irrespective of the use-category (I_u) (Friedman et al., 1986) calculated as $FL = (I_p/I_u) X 100$. The species richness of utilised edible plants in the five villages was also compared and visualised in a Venn diagram using the free software: http://bioinformatics.psb.ugent.be/webtools/Venn/ of Ghent University.

To determine the difference in the plant knowledge between men and women in the Higaonon household, the mean was compared using a student t-test and the level of significance was determined at $p < 0.05$. ANOVA test was also performed to compare the knowledge of food plants in different collection sites in all five villages. The statistical analyses were done using the SPSS version 24.0 software package for Windows.

3.3 Results

3.3.1 Demography of respondents

In total, 100 respondents were interviewed from the five villages; 24 from Dumalaguing, 24 from Kalipayan, 22 from Bati-aw, 16 from Bundaan, and 14 from Gabunan. Most of the participants were females (74%) whilst males account for 26%. In terms of education, nearly a quarter (74%) reached the primary level, 16% had no formal education, 10% attended the secondary level, and only 1% attended college or the tertiary level. Only kindergarten and primary schools exist in the villages. Students from the farthest village (Bati-aw) had to walk for 2-3 hours to school whilst attending secondary education requires them to leave the village. In most cases, the children stop schooling after primary school for farm work. The majority of the respondents are farmers (79%), 3% works for the local government, and 18% works at home or engage in other occupations. Others own agricultural lands though employed as full-time government employees or owners of "sari-sari" or local sundry stores. Most of the interviewed households earn less than 1000 Php = £16.16 (£1= 61.91 Php) per month (52%), 47% have a monthly income of 1000-5000 Php, and only 1% earn 6000-10000 Php. (Table 3.1).

Table 3.1 Demographic information of respondents (n=100) from the Higaonon tribe of Bukidnon, Philippines

Sex	
Male	26 (26%)
Female	74 (74%)
Education	
No Formal Education	16 (16%)
Primary Level	73 (73%)
Secondary Level	10 (10%)
Tertiary Level	1 (1%)
Occupation	
Farmer	79 (79%)
Government Employee	3 (3%)
Others	18 (18%)
Estimated monthly income	
Less than 1000 Php	52 (52%)
1000-5000 Php	47 (47%)
6000-10000 Php	1 (1%)
Village	
Bati-aw	22 (22%)
Gabunan	14 (14%)
Bundaan	16 (16%)
Kalipayan	24 (24%)
Dumalaguing	24 (24%)

The income of the villagers are mainly derived from selling coffee beans, abaca or hemp, vegetables (i.e., sweet peas, chili peppers, tomatoes, etc.), peanuts, corn, and handicrafts such as bags and basket made of rattan, and mats weaved from sedge locally known as ‘tikug’, *Fimbristylis umbellaris* (Lam.)Vahl, and ‘sudsud’, *Cyperus iria* L. Most of the Higaonon families, however, rely on the once-a-year harvest of coffee. On the other hand, the road from farm to market is only passable by motorcycle or on foot (Figure 3.3), and the road construction only started in 2019 (Figure 3.4). The village of Bati-aw, in particular, has no electricity and proper water supply system. This has been an economic burden for the farmers whose income is further curtailed by expensive transportation (Php150) and low buying price for coffee beans (Php 50 pesos or 80 pence per kilogram), and other agricultural produce in Malaybalay city – the capital of Bukidnon.

Figure 3.3 Drying of coffee beans in Dumalaguing and the delivery of products to the municipal centre.

Figure 3.4 Road construction from the Municipality of Impasug-ong to the village of Dumalaguing

3.3.2 Botanical diversity of edible plants

A total of 76 species of edible plants belonging to 62 genera and 36 botanical families constitute the traditional food system of the Higaonon tribe (Figure 3.5, Table 3.2). The botanical family yielding the highest number of edible plants was the family Fabaceae with six species. Other well-represented botanical families in the Higaonon food system include Solanaceae (nightshade family), and Zingiberaceae (gingers) each with six species. This is followed by the Cucurbitaceae (gourd family) and Poaceae (grass family) with five species each, along with members of Malvaceae (the mallows) and Rutaceae (citrus), each with four species. The list also includes three species of Araceae (aroids), Dioscoreaceae (yams), and Myrtaceae (myrtle family). The 21 plant families represented by a single species include Amaranthaceae, Anacardiaceae, Annonaceae, Asteraceae, Athyriaceae, Bambusaceae, Basellaceae, Bromeliaceae, Caricaceae, Clusiaceae, Convulvulaceae, Euphorbiaceae, Fagaceae, Lauraceae, Moringaceae, Musaceae, Phyllanthaceae, Rubiaceae, Salicaceae, Sapindaceae, and Sapotaceae.

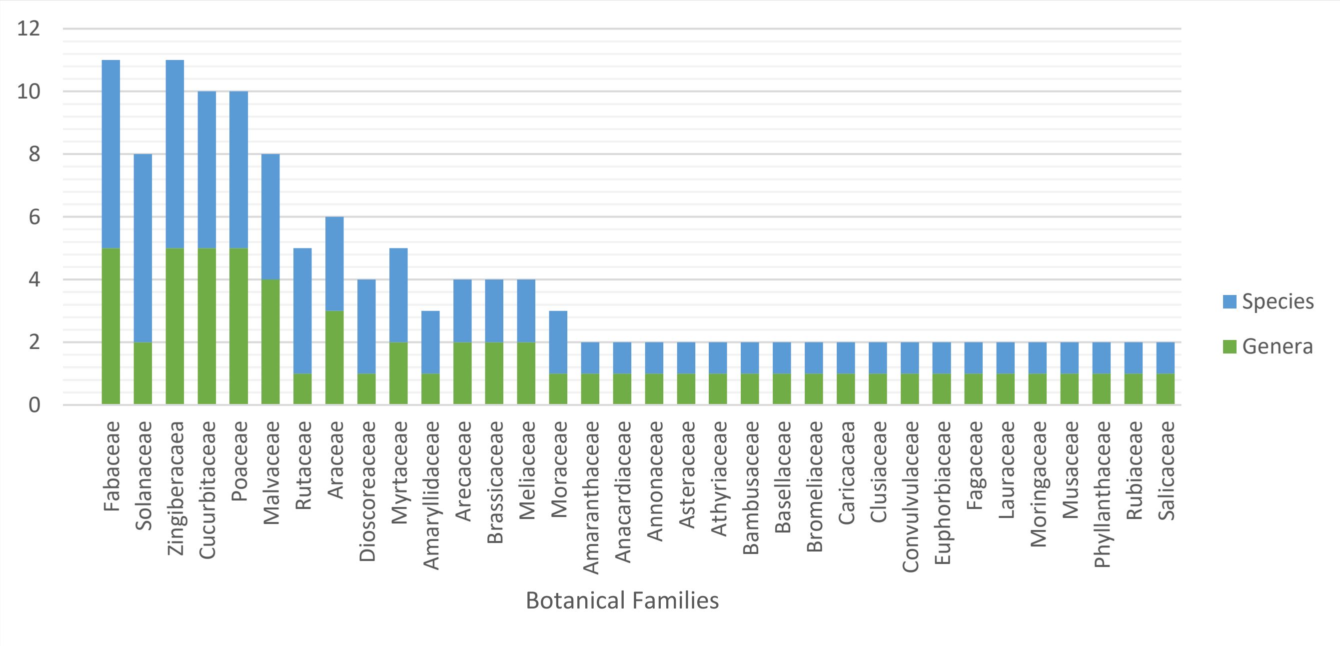


Figure 3.5 Botanical diversity of edible plants

3.3.3 Quantitative ethnobotanical analysis

A total of 1, 254 use-reports were accounted for in all 9 use-categories (Figure 3.6, Table 3.2). Out of 76 species of plants, 3 species (3.94%) were consumed as cereals, 8 species (10.52%) were white roots, tubers, and plantains, 3 species (3.94%) were Vitamin A-rich vegetables and tubers, 16 species (21.05%) were eaten as green leafy vegetables, 12 species (15.78%) were categorised as other vegetables, 2 species (2.63%) were Vitamin A-rich fruits, 27 species

(35.52%) were considered as other fruits, 7 species (9.21%) were legumes, nuts, and seeds, and 8 species (10.52%) were used as spices, condiments, and beverages. A few species have multiple usages such as *Calamus* species (rattan) stem's pith which is cooked and eaten as a vegetable (Other vegetables category) aside from its edible fruits (Other fruits category); *Coix lacryma-jobi* L. seeds are also an important rice substitute (Cereals category), and is fermented to produce the Higaonon tribe's rice wine locally known as "langkuga" (Spices, condiments, and beverages category); *Capsicum annuum* L. fruits which are being used as a seasoning (Spices category) and vegetables (Vitamin A rich vegetable category), and its leaves and shoots are also cooked as vegetables (Green leafy vegetable category). The checklist of food plants including their local usage and ethnobotanical value is summarised in Table 3.2.

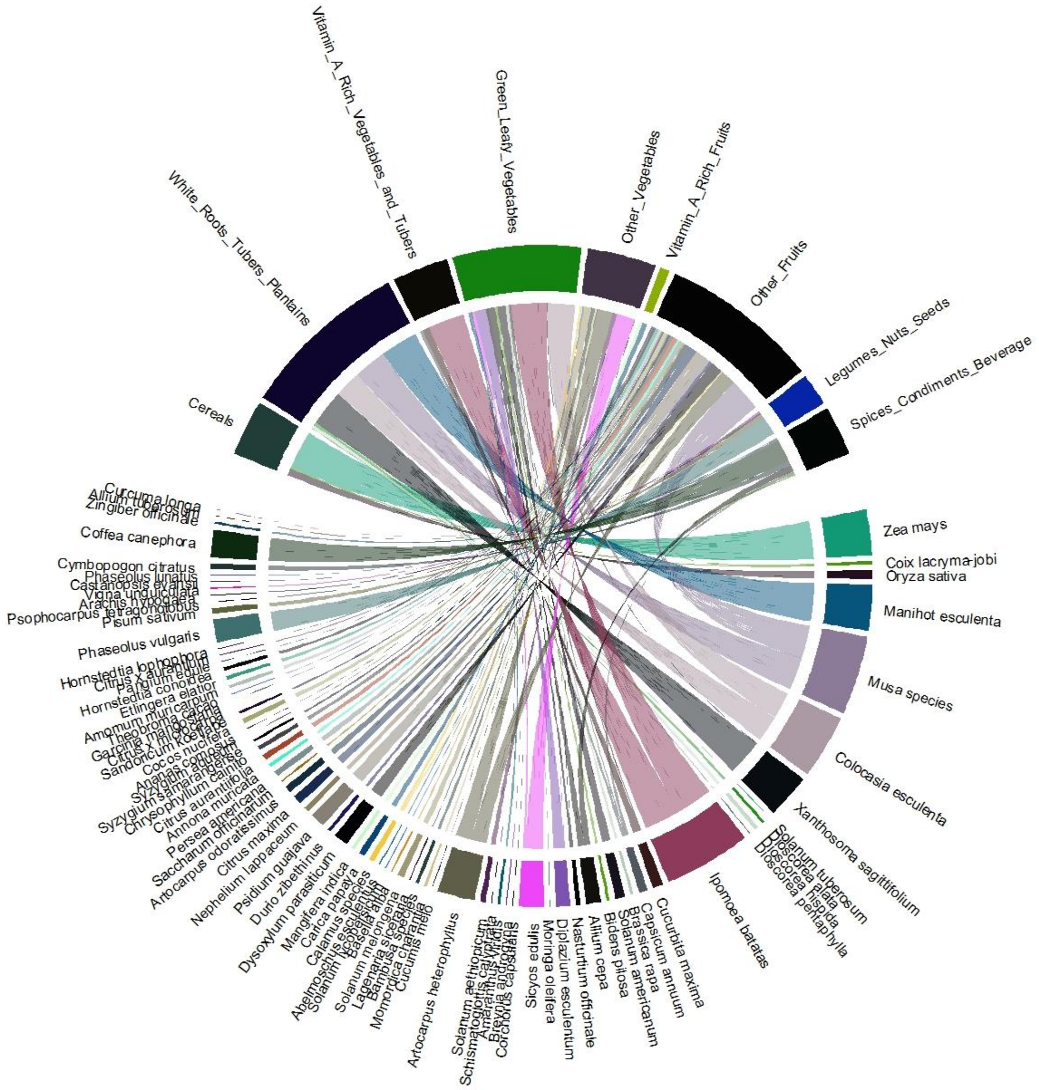


Figure 3.6 Chord diagram showing the distribution of 1, 254 use-reports (UR) for the 76 species of food plants (bottom half) utilised by the Higaonon tribe as cereals, white roots, tubers, and plantains, vitamin A-rich vegetables, green leafy vegetables, other vegetables, vitamin-A rich fruits, other fruits, legumes, nuts, and seeds, spices, condiments, and beverages (use-categories in the top half).

Table 3.2 Food plants locally consumed by the indigenous Higaonon Tribe in Bukidnon, Mindanao Island, Philippines

Botanical family	Scientific name	Local name(s)	Plant Source	Life-form	Edible parts	Use-Report (UR)	Use-Value (UV)	Number of Use	FL%**
Amaranthaceae	*Amaranthus viridis* L.	Kudyapa	W	herb	leaves, shoots	5	0.05	1	G: 100
Amaryllidaceae	*Allium cepa* L.	Ganda	C	herb	leaves	26	0.26	2	G: 100; S: 100
Amaryllidaceae	*Allium tuberosum* Rottler ex Spreng.	Ganda na yupipi	C	herb	leaves	1	0.01	1	S: 100
Anacardiaceae	*Mangifera indica* L.	Mangga	C	tree	fruits	6	0.06	1	OF: 100
Annonaceae	*Annona muricata* L.	Bana/Abana	C	tree	fruits	5	0.05	1	OF: 100
Araceae	*Xanthosoma sagittifolium* (L.) Schott	Lutya/Adupa/hanupa	C/W	herb	corms	76	0.76	1	W: 100
Araceae	*Colocasia esculenta* (L.) Schott.	Gabi/Dakan/Labug	C/W	herb	corms, young leaves	111	1.11	2	W: 100; G: 100
Araceae	*Schismatoglottis calyptrata* (Roxb.) Zoll. & Moritzi	Kapusaw	W	herb	young leaves	1	0.01	1	G: 100
Arecaceae	*Cocos nucifera* L.	Lubi	C	tree	fruits	8	0.08	1	OF: 100
Arecaceae	*Calamus species*	Libas/Uway	W	shrub	fruits, pith (centre of the stem)	9	0.09	2	OV: 100; OF: 50
Asteraceae	*Bidens pilosa* L.	Karago	W	herb	young leaves, shoots	5	0.05	1	G: 100
Athyriaceae	*Diplazium esculentum* (Retz.) Sw.	Pako	W	herb	leaves, shoots	24	0.24	1	G: 100
Bambusaceae	*Bambusa* sp.	Dabong/Kawayan	W	shrub	shoots	6	0.06	1	OV: 100
Basellaceae	*Basella alba* L.	Alugbati	C	herb	leaves, shoots	3	0.03	1	OV: 100
Brassicaceae	*Nasturtium officinale* R.Br.	Water grass	W	herb	leaves	7	0.07	1	G: 100
Brassicaceae	*Brassica rapa* L.	Petchay	C	herb	leaves, shoots	5	0.05	1	G: 100
Bromeliaceae	*Ananas comosus* (L.) Merr.	Pinya	C	herb	leaves	1	0.01	1	OF: 100
Caricacaea	*Carica papaya* L.	Kapayas	C	herb	fruits	10	0.1	1	VF: 100
Clusiaceae	*Garcinia mangostana* L.	Mangosteen	C	tree	fruits	1	0.01	1	OF: 100
Convulvulaceae	*Ipomoea batatas* (L.) Lam.	Kamote/Wangkid	C	herb	leaves, shoots, tubers	150	1.50	2	VA: 100; G: 100
Cucurbitaceae	*Sicyos edulis* Jacq.	Sayote	C	herb	leaves, shoots, fruits	43	0.43	2	OV: 100; G: 13.16
Cucurbitaceae	*Cucurbita maxima* Duchesne	Kalabasa	C	herb	shoots, fruits	18	0.18	1	VA: 100; G: 20
Cucurbitaceae	*Momordica charantia* L.	Kabaring/paliya	C	herb	shoots, fruits	4	0.04	1	OV: 100
Cucurbitaceae	*Lagenaria siceraria* (Molina) Standl.	Upo	C	herb	fruits	2	0.02	1	OV: 100

Cucurbitaceae	*Cucumis melo* L.	Patola	C	herb	fruits	1	0.01	1	OV: 100
Dioscoreaceae	*Dioscorea hispida* Dennst.	Lab-o	W	herb	tuber	7	0.07	1	W: 100
Dioscoreaceae	*Dioscorea alata* L.	Ubi	C	herb	tuber	5	0.05	1	W: 100
Dioscoreaceae	*Dioscorea pentaphylla* L.	Dala-igay/ikalimalima	W	herb	tuber	2	0.02	1	W: 100
Euphorbiaceae	*Manihot esculenta* Crantz	Binggala/balanghuy	C	shrub	tuber	78	0.78	1	W: 100
Fabaceae	*Phaseolus vulgaris* L.	String beans/Batong/Banat	C	herb	pods, seeds	40	0.4	1	L: 100
Fabaceae	*Pisum sativum* L.	Sweetpeas	C	herb	pods, seeds	9	0.09	1	L: 100
Fabaceae	*Arachis hypogaea* L.	Mani	C	herb	seeds	2	0.02	1	L: 100
Fabaceae	*Vigna unguiculata (L.) Walp.*	Taki-taki/Cowpea/ manggulising	C	herb	pods, seeds	2	0.02	1	L: 100
Fabaceae	*Phaseolus lunatus* L.	Balatong/Minanok	C	herb	pods, seeds	1	0.01	1	L: 100
Fabaceae	*Psophocarpus tetragonolobus* (L.) DC.	Sali-an	C	herb	pods, seeds	1	0.01	1	L: 100
Fagaceae	*Castanopsis evansii Elm.*	Kati-i	W	tree	seeds	1	0.01	1	L: 100
Lauraceae	*Persea americana* Mill.	Abokado	C	tree	fruits	10	0.1	1	OF: 100
Malvaceae	*Durio zibethinus* L.	Durian	C	tree	fruits	6	0.06	1	OF: 100
Malvaceae	*Abelmoschus esculentus* (L.) Moench	Okra	C	herb	fruits	2	0.02	1	OV: 100
Malvaceae	*Corchorus capsularis* L.	Saluyot	C	herb	leaves, shoots	1	0.01	1	G: 100
Malvaceae	*Theobroma cacao* L.	Cacao	C	tree	fruits	1	0.01	1	OF: 100
Meliaceae	*Dysoxylum parasiticum* (Osbeck) Kosterm.	Lansones/Bugka	C	tree	fruits	25	0.25	1	OF: 100
Meliaceae	*Sandoricum koetjape* (Burm.f.) Merr.	Santol	C	tree	fruits	4	0.04	1	OF: 100
Moraceae	*Artocarpus heterophyllus* Lam.	Nangka	C	tree	fruits	64	0.64	2	OV: 100; OF: 100
Moraceae	*Artocarpus odoratissimus* Blanco	Marang	C	tree	fruits	12	0.12	1	OF: 100
Moringaceae	*Moringa oleifera* Lam.	Malunggay	C	shrub	leaves	1	0.01	1	G: 100
Musaceae	*Musa species*	Saging/Du-ol/balulan/amas	C	herb	fruits	136	1.36	2	W: 100; OF: 100
Myrtaceae	*Psidium guajava* L.	Bayabas	C/W	tree	fruits	25	0.25	1	OF: 100
Myrtaceae	Syzygium samarangense *(Blume) Merr. & L.M.Perry*	Makopa	C	tree	fruits	4	0.04	1	OF: 100
Myrtaceae	*Syzygium aqueum* (Burm.f.) Alston	Tambis	C	tree	fruits	1	0.01	1	OF: 100
Phyllanthaceae	*Breynia androgyna* (L.) Chakrab. & N.P.Balakr.	Chinese Kamunggay	C	shrub	leaves	1	0.01	1	G: 100
Poaceae	*Oryza sativa* L.	Bugas-humay/Humay	C	herb	seeds	15	0.15	1	C: 100
Poaceae	*Cymbopogon citratus* (DC) Stapf	Tanglad	C	herb	leaves	10	0.10	1	S: 100

Poaceae	*Coix lacryma-jobi* L.	Adlay	C	herb	seeds	6	0.06	2	C: 100; S: 100
Poaceae	*Saccharum officinarum* L.	Tubo	C	herb	stems	3	0.03	1	S: 100
Poaceae	*Zea mays* L.	Ma-is/bugas-mais	C	herb	seeds	79	0.79	1	C: 100
Rubiaceae	*Coffea canephora* Pierre ex A.Froehner	Kapi	C	shrub	seeds	48	0.48	1	S: 100
Rutaceae	*Citrus maxima* (Burm.) Merr.	Baongon	C	tree	fruits	16	0.16	1	OF: 100
Rutaceae	*Citrus aurantiifolia* (Christm.) Swingle	Citrus	C	tree	fruits	9	0.09	1	OF: 100
Rutaceae	*Citrus* × *aurantium* L.	Valencia orange	C	tree	fruits	2	0.02	1	OF: 100
Rutaceae	*Citrus* × *microcarpa* Bunge	Kalamansi	C	shrub	fruits	1	0.01	1	OF: 100
Salicaceae	*Pangium edule* Reinw. ex Blume	Pangi	W	tree	fruits	1	0.01	1	OF: 100
Sapindaceae	*Nephelium lappaceum* L.	Rambutan	C	tree	fruits	9	0.09	1	OF: 100
Sapotaceae	*Chrysophyllum cainito* L.	Kaimito	C	tree	fruits	7	0.07	1	OF: 100
Solanaceae	*Solanum americanum* Mill.	Hagpa/Andayugong	W	herb	leaves, shoots	17	0.17	1	G: 100
Solanaceae	*Solanum melongena* L.	Talong	C	herb	fruits	11	0.11	1	OV: 100
Solanaceae	*Solanum aethiopicum* L.	Tahong/Tawong pait	C	herb	fruits	9	0.09	1	OV: 100
Solanaceae	*Capsicum annuum* L.	Atsal/Katumbal	C	herb	fruits, leaves, shoots	15	0.15	3	VA: 100; G:50; S: 100
Solanaceae	*Solanum lycopersicum* L.	Kamatis	C	herb	fruits	2	0.02	1	OV: 100
Solanaceae	*Solanum tuberosum* L.	Patatas	C	herb	tuber	1	0.01	1	W: 100
Zingiberaceae	*Amomum muricarpum* Elm.	Tugis	W	herb	fruit	6	0.06	1	OF: 100
Zingiberaceae	*Etlingera elatior* (Jack) R.M. Sm.	Tikala	W	herb	inflorescence	6	0.06	1	OF: 100
Zingiberaceae	*Hornstedtia conoidea* Ridl.	Pana-on	W	herb	fruits	6	0.06	1	OF: 100
Zingiberaceae	*Zingiber officinale* Roscoe	Luy-a	C	herb	rhizomes	4	0.04	1	S: 100
Zingiberaceae	*Curcuma longa* L.	Kalawag	C	herb	rhizomes	1	0.01	1	S: 100
Zingiberaceae	*Hornstedtia lophophora* Ridl.	Tagbak	W	herb	fruits	1	0.01	1	OF: 100

Legend:

***W –** Wild; **C –** Cultivated

****C –** Cereals; **W –** White roots, tubers, plantains; **VA –** Vitamin A rich Vegetables; **G –** Green leafy vegetables; **OV –** Other vegetables; **VF** – Vitamin A rich fruits; **OF** – Other fruits; **L –** Legumes, nuts, and seeds; **S –** Seasonings, condiments, and beverages.

The edible plant species with the highest use-reports (UR) and use-values (UV) (Figure 3.7; Table 3.2) were *Ipomoea batatas* (L.) Lam. (UR = 150; UV= 1.5), *Musa* species (UR = 136; UV = 1.36), *Colocasia esculenta* (L.) Schott. (UR = 111; UV = 1.11); *Zea mays* L. (UR = 79; UV = 0.79); *Manihot esculenta* Crantz (UR = 78; UV = 0.78), *Xanthosoma sagittifolium* (L.) Schott (UR=76; UV= 0.76), *Artocarpus heterophyllus* Lam. (UR = 64; UV= 0.64); *Coffea canephora* Pierre ex A.Froehner (UR = 48; UV = 0.48), *Sicyos edulis* Jacq. (UR = 43; UV = 43), *Phaseolus vulgaris* L. (UR = 40; UV = 0.40). Amongst the species with the least UR (1) and UV (0.01) includes *Hornstedtia lophophora* Ridl., *Pangium edule* Reinw. ex Blume, *Schismatoglottis calyptrata* (Roxb.) Zoll. & Moritzi, and *Castanopsis evansii* Elm. The UR and UV of all plant species are listed in Table 3.2.

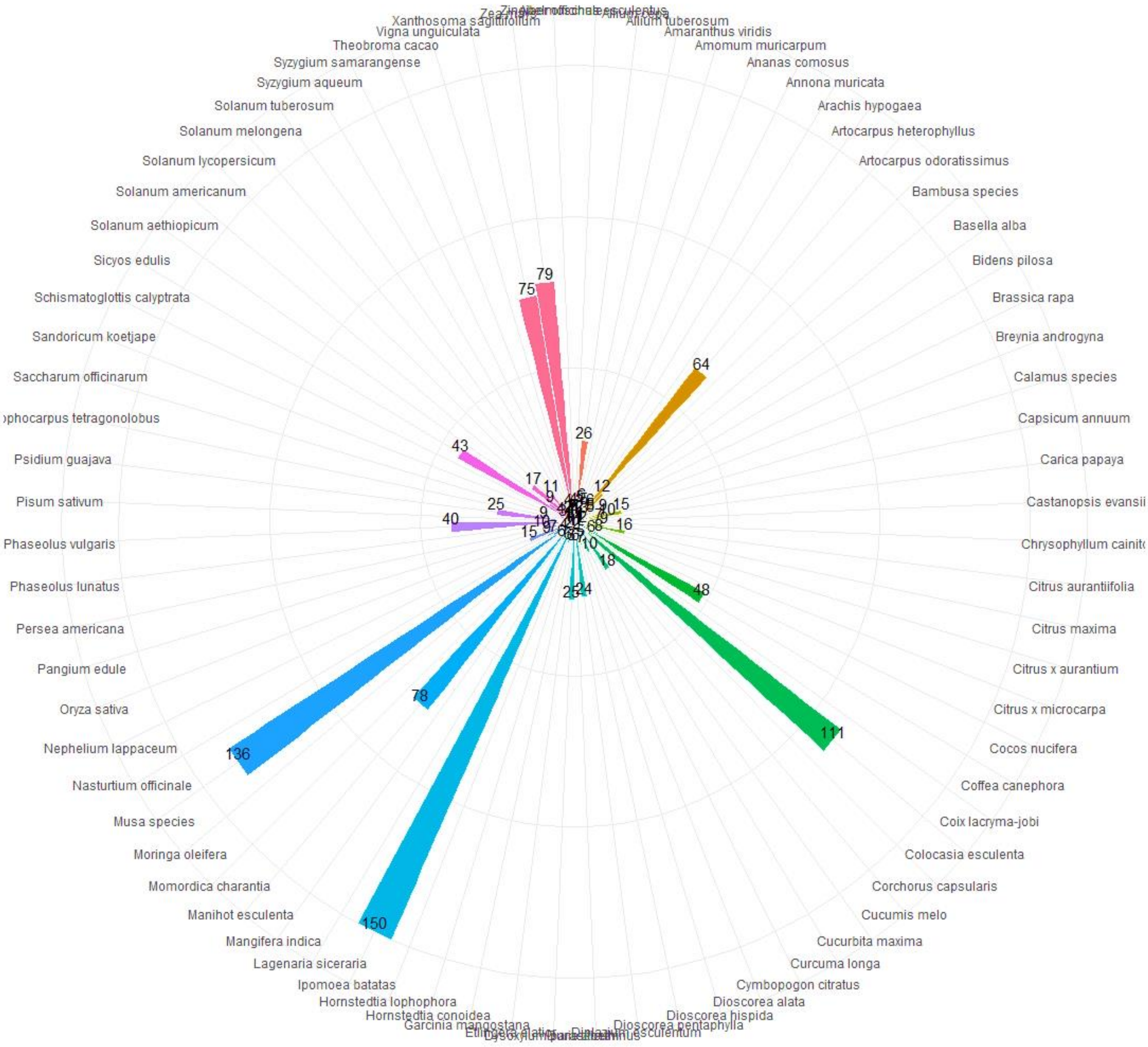


Figure 3.7 Radial plot showing the use-value of the 76 species of food plant species. The species with the highest use-values have long rays in shades of blue (*M. esculenta* Crantz, *I. batatas* (L.) Lam., species), green (*C. esculenta* (L.) Schott., *C. canephora* Pierre ex A.Froehner), and red (*Z. mays* L., *X. sagittifolium* (L.) Schott) whilst species with low use-values have shorter rays in shades of purple and yellow clustered in the centre.

Most of the respondents have reported similar use(s) for the specific plant species with a fidelity level (FL) of 100% except for 4 species. In the case of *Sicyos edulis* Jacq. (chayote), *Capsicum annuum* L. (chili), and *Cucurbita maxima* Duchesne (squash), all the respondents reported the utilisation of its fruit as vegetables (FL = 100) but very few mentioned the use of leaves as green leafy vegetables with an FL value of 13.16% (chayote), 50% (chili), and 20% (squash) respectively. Rattan or *Calamus* species, on the other hand, was mainly consumed as a vegetable (FL = 100) however, only a few reported the consumption of its fruits (FL = 50%). *Capsicum annuum* L. (chili) had the greatest number of uses (3), followed by *A. cepa* L., *A. heterophyllus* Lam., *Calamus* sp., *C. lacryma-jobi* L., *C. esculenta* (L.) Schott., *C. maxima* Duchesne, *Musa* species, *I. batatas* (L.) Lam., *S. edulis* Jacq. with two-uses. All the other plant species are of single-use. The number of uses and fidelity values of all plant species are indicated in Table 3.2. The flow of the distribution of the respondents' report relating to the 76 species of plant species across the 9 use categories is depicted in the alluvial diagram (Figure 3.8).

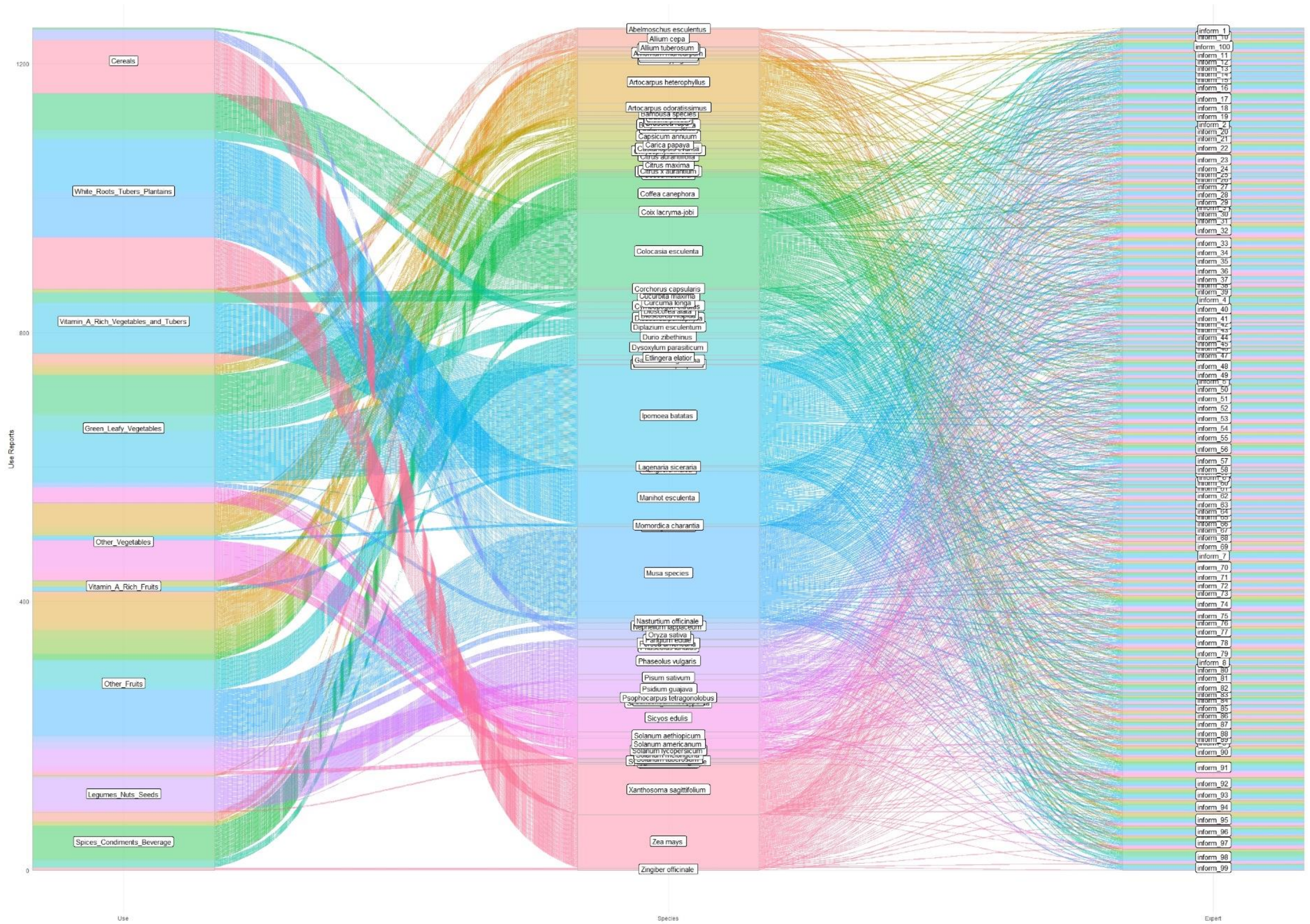


Figure 3.8 Alluvial diagram showing the frequency distributions across uses, respondents, and use categories.

Seventeen species of food plants were commonly reported in the five villages (Figure 3.9). This includes *Zea mays* L., *Citrus maxima* (Burm.) Merr., *Coffea canephora* Pierre ex A.Froehner, *Ipomoea batatas* (L.) Lam., *Solanum americanum* Mill., *Dysoxylum parasiticum* (Osbeck) Kosterm., *Artocarpus odoratissimus* Blanco, *Phaseolus vulgaris* L., *Sicyos edulis* Jacq., *Manihot esculenta* Crantz, *Musa acuminata* Colla, *Artocarpus heterophyllus* Lam., *Xanthosoma sagittifolium* (L.) Schott, *Carica papaya* L., *Cucurbita maxima* Duchesne, *Colocasia esculenta* (L.) Schott., *Psidium guajava* L.

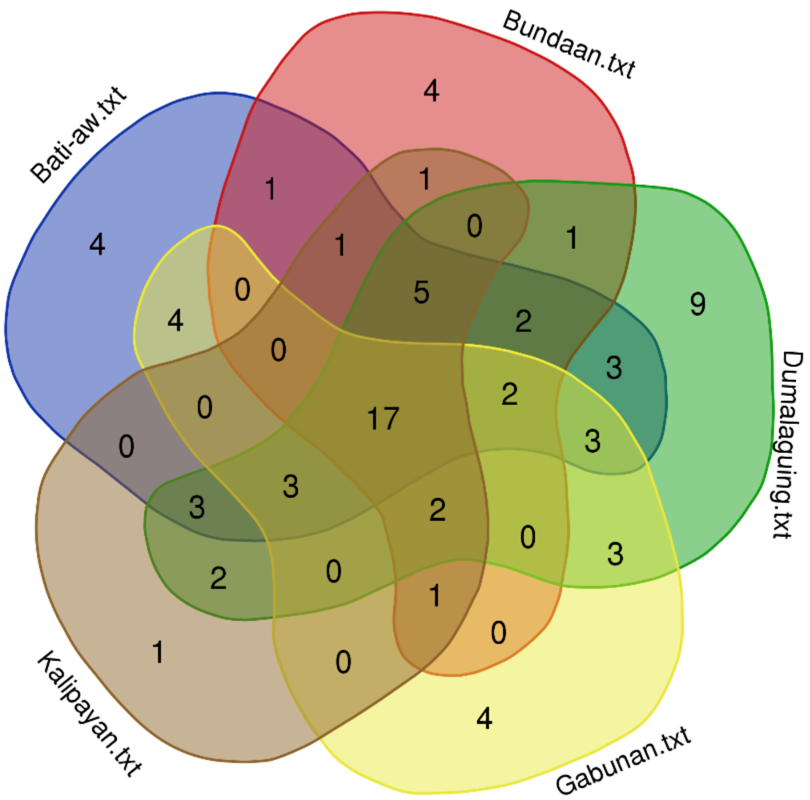


Figure 3.9 Venn diagram showing the species richness and distribution of food plants in five villages

3.3.4 Plant Knowledge and Gender

Results showed that men were significantly more knowledgeable of food plant species than women ($p < 0.00$; Table 3.3). This difference is particularly significant with plant species collected from the forest ($p < 0.010$) and communal area ($p < 0.022$) in the villages. However, there were no significant differences between gender with knowledge of food plants harvested in homegardens ($p < 0.529$), along the river banks ($p < 0.556$), and farms ($p < 0.383$).

Table 3.3 Knowledge comparison between men and women in the household of Higaonon tribe

	Gender	N	Mean	Std. Deviation	Std. Error Mean	Sig. (2-tailed)
Food Plant Knowledge	Female	74	9.38	3.60	0.42	0.000**
	Male	26	13.19	4.78	0.94	
Farm	Female	74	6.36	3.18	0.37	0.383 ns
	Male	26	7.00	3.16	0.62	
Homegardens	Female	74	2.78	2.57	0.30	0.529 ns
	Male	26	3.19	3.49	0.68	
Communal Area	Female	74	0.38	1.00	0.12	0.022*
	Male	26	1.42	2.12	0.42	
Forest	Female	74	0.04	0.20	0.02	0.010*
	Male	26	2.08	3.72	0.73	
Riverine	Female	74	0.01	0.12	0.01	0.556 ns
	Male	26	0.00	0.00	0.00	

(t-test, *p < 0.05; **p < 0.01; ns - not significant)

Overall, except for homegardens (p <0.029), there is no significant difference in the knowledge of food plants associated with the different collection sites in all five villages (Table 3.4).

Table 3.4 Knowledge comparison associated with the different collection sites in five villages

		Sum of Squares	df	Mean Square	F	Sig.
Food Plant Knowledge	Between Groups	54.87	4.00	13.717	0.748	0.562 ns
	Within Groups	1742.44	95.00	18.342		
	Total	1797.31	99.00			
Farm	Between Groups	54.59	4.00	13.648	1.376	0.248 ns
	Within Groups	942.32	95.00	9.919		
	Total	996.91	99.00			
Homegardens	Between Groups	83.71	4.00	20.927	2.816	0.029*
	Within Groups	706.08	95.00	7.432		
	Total	789.79	99.00			
Communal Area	Between Groups	5.32	4.00	1.33	0.627	0.644 ns
	Within Groups	201.43	95.00	2.12		
	Total	206.75	99.00			
Forest	Between Groups	32.86	4.00	8.214	1.972	0.105 ns
	Within Groups	395.65	95.00	4.165		
	Total	428.51	99.00			
Riverine	Between Groups	0.05	4.00	0.013	1.33	0.264 ns
	Within Groups	0.94	95.00	0.01		
	Total	0.99	99.00			

(ANOVA, *p < 0.05; ns – not significant

3.4 Discussion

In the Higaonon food system, Fabaceae, Solanaceae, Zingiberaceae, Cucurbitaceae, Poaceae, Malvaceae, and Rutaceae were the most species-rich group. This may be explained by the fact that Fabaceae is the world's largest group of food plants composed of about 625 edible species (Antonelli et al., 2020). Apart from the legumes, Solanaceae is also one of the major edible botanical family which includes some important staples such as potato, tomato, aubergine, and capsicums (Samuels, 2015). Several species of the ginger family Zingiberaceae is likewise domesticated and used as food (i.e., spices, flavouring agents, etc.) in many parts of the world (Rachkeeree et al., 2018). Cucurbitaceae on the other hand includes a large number of vegetables that are widely cultivated in many parts of the world (i.e., squash, chayote, bitter gourd, etc.) (Rolnik & Olas, 2020). Plant families with many edible species, like Poaceae (314 edible species worldwide), and Malvaceae (257 edible species worldwide) (Antonelli et al., 2020) are also well-represented in the Higaonon food system. Moreover, citrus (Rutaceae) which is the most extensively produced tree fruit crop in the world (Ollitrault & Navarro, 2012), is also the most species-rich fruit group recorded in the study.

As to the quantitative ethnobotanical analysis, the result showed that white roots, tubers, and plantains were the most important crops for the Higaonon tribe. This includes important carbohydrate sources such as sweet potatoes, bananas, taro, cassava, and arrowleaf elephant ear. The specific utilisation of these starch-rich edible plants appeared to be the same throughout the five villages with a 100% Fidelity level. Subsistence agriculture is part of the Higaonon tribe's indigenous practices, and the aforementioned plants were amongst the primary staples of the early indigenous communities in the Bukidnon uplands (Cole, 1956; F. Lynch & Clotet, 1967). Interestingly, apart from various types of roots and tubers, rice is the chief crop in the Bukidnon uplands since the 1800s (Cole, 1956; F. Lynch & Clotet, 1967). It is integrated into various ceremonial practices of the Higaonon tribe such as farming rituals, weddings, and rice-wine making (Cole, 1956). The predominance of corn over rice as the main cereal crop in the present study may have been a biocultural adaptation, particularly during the food-deficit years whilst the population of the upland villages expanded. Historically, corn cultivation spread from the islands of the Visayas to Mindanao island in the nineteenth century, and it became a regional staple in some areas since World War II (Spencer, 1975). Since corn yield was greater than that of millet on the dry-soil areas that cannot grow rice, corn cultivation increased the food supply necessary to support the rapid growth of the population in the Visayas region (Spencer, 1975). At present, corn is the most important cereal crop of the Higaonon tribe. It is locally consumed as *'bugas mais'* (*'corn rice'*) which is coarsely ground corn cooked in the same way as rice and is usually eaten with green leafy vegetables (Figure 3.10). In most cases, every Higaonon family reserved their corn for the family's food subsistence.

Figure 3.10 A Higaonon household drying their corn (left). Corn rice with fern fronds (*Diplazium esculentum* (Retz.) Sw.) salad (Right)

Indeed, some biocultural adaptations have been vital in the resilience of rural communities with limited food resources. In this context, resilience is defined as the ability of the indigenous Higaonon communities to cope with the social and cultural disintegration (Cullen, 1979; Edgerton, 1983), socio-economic stresses (Imbong, 2020; Lao, 1987; Sealza, 1994), and landscape change (Huesca, 2016; Poffenberger & McGean, 1993) in the Bukidnon uplands.

Apart from improving food security, diversifying our staple foods could also improve our agriculture to be more adaptable to climate change (Narciso & Nyström, 2020; Ulian et al., 2020). The Higaonon tribe's food system diversification consisting of corn, root, and tubers, plantains, vegetables, and fruits may be further explained by the mountainous terrain of the Higaonon villages and the constraints of rice production in the Bukidnon uplands. Out of the five villages, rice is only cultivated in the village of Bundaan (Figure 3.11). The terraced rice paddy is irrigated through a series of connected split bamboo poles called "sandayung" with water coming from the mountain (Figure 3.12). The ingenious strategy to bring water from forested mountain areas to the rice terraces is also practiced by other indigenous groups such as the Hani people of China (Yang et al., 2018), the Ifugao of northern Philippines (Camacho et al., 2016), and the Hmong ethnic group of Vietnam (Turner, 2012).

Figure 3.11 Terraced rice paddy in the village of Bundaan, Bukidnon, Philippines

Figure 3.12 *Sandayung* or connected split bamboo poles used for irrigation

Furthermore, robusta coffee (*Coffea canephora* Pierre ex A.Froehner) (UR = 48; UV = 0.48) is the main beverage widely consumed (FL% = 100) other than the traditional rice wine made from fermented *Coix lacryma-jobi* L. (UR = 6; UV = 0.6). The most cited plants also include vegetables such as *Sicyos edulis* Jacq. (UR = 43; UV = 4.3), *Phaseolus vulgaris* L. (UR = 40; UV=0.40), and *Diplazium esculentum* (Retz.) Sw. (UR = 24; UV = 0.24) as well as fruits like *Dysoxylum parasiticum* (Osbeck) Kosterm. (UR = 25; UV = 0.25), and *Psidium guajava* L. (UR=25; UV=0.25). *Artocarpus heterophyllus* Lam. (UR = 64; UV = 6.4) or jackfruit, on the other hand, is consumed as a vegetable when unripe, and fruit when ripe. Out of 76 species of food plants, 57 (75%) were domesticated species and 16 (21%) were classified as wild species. Unfortunately, some parts of the forests and farms outside the village were not accessible due to remoteness and security concerns. This resulted in some problems with the identification of certain wild plants gathered in the forests. The rattan or "uway", for example, was possibly more than a single species but was collectively placed in *Calamus* species in this study. This genus of rattan in the Philippines is composed of at least 59 species (Baja-Lapis, 2010). Three (3.9%) species have both wild and cultivated populations; taro (*Colocasia esculenta* (L.), yautia or arrowleaf elephant ear (*Xanthosoma sagittifolium* (L.) Schott), and guava (*Psidium guajava L.*). are cultivated in farm and homegardens but some residents collect from the wild populations growing naturally in communal areas.

With 76 edible plant species, the Higaonon tribe's food system has an exceptional diversity when compared to certain groups of indigenous peoples and cultural minorities. The diverse minorities (i.e., Georgians, Kists, Bats, Udis, Ossetians, etc.) in Northeast Georgia, Caucasus, for example, collectively use only 46 species of food plants (Pieroni et al., 2021). Moreover, the "Fur" indigenous peoples of Sudan have 27 food plant species whilst the ethnic foods of the Angami Nagas in Nagaland State, India only consists of 29 food plant species (Hegazy et al., 2020; Singh & Teron, 2017). It is also more diverse than the Bhangalis living in the tribal area of Western Himalaya which uses 50 food plant species (Thakur et al., 2017). Indeed, the Higaonon food system could provide new insights on the potential of NUS as only 15 crop plants contribute to 90% of humanity's energy intake, and more than four billion people rely on just rice, maize, and wheat (Antonelli et al., 2020).

The limited varieties of food and more rice-centred diet of the majority of the Filipinos however, may have serious health consequences (Angeles-Agdeppa et al., 2019). Based on the 2015 national survey, many Filipinos suffer from protein-energy malnutrition and micronutrient deficiencies such as anaemia, vitamin A deficiency, and iodine-deficiency disorders (Capanzana & Aguila, 2020; Department of Science and Technology-Food and

Nutrition Research Institute (DOST-FNRI), 2015). One of the strategies to address this problem is to find an alternative and/or supplemental food source that may likewise improve the diet of many Filipinos. By examining the staple crops consumed by the Higaonon tribe, a number of staple crops may provide potential solutions to this problem as well as leverage to achieve SDG 2. When compared with other staple crops (Table 3.5), corn grits ("*bugas-mais*") can provide more than twice the amount of energy and protein available in rice; cooked banana and taro can also be a good source of protein and energy. Moreover, the yellow variety of sweet potato, and banana can even provide a higher carbohydrate source than rice. Also, other staple crops have higher mineral and vitamin content than rice. Yautia, corn grits, and taro, for example, can be an excellent source of iron, phosphorus, and calcium whilst sweet potatoes and banana contain higher vitamins which may be absent or in trace amount in rice, especially beta-carotene – the precursor of Vitamin A (Grune et al., 2010; Strobel et al., 2007). Thus, diversifying the food and nutritional sources based on the diversity of traditional plant-based foods could be adopted as a dietary strategy to address the challenges of rapidly emerging diet- and lifestyle-linked non-communicable chronic diseases (Sarkar et al., 2020).

Table 3.5 Comparison of the nutrient composition of selected staple crops*

	Staple Crops						
	Rice (milled and cooked)	Corn grits ("*bugas-mais*")	Cassava (cooked)	Yautia/ arrowleaf elephant ear	Sweet potato (yellow) (cooked)	Banana (cooked)	taro (cooked)
Proximates							
Energy, calculated (kcal)	129	350	111	122	128	159	105
Protein (g)	2.1	7.7	0.4	0.8	0.5	1.2	1.5
Total Fat (g)	0.2	0.8	0.1	0.1	0.3	0	0.1
Carbohydrate, total (g)	29.7	78.1	27.1	29.4	30.7	38.6	24.4
Minerals							
Calcium (mg)	11	22	10	38	30	19	37
Phosphorus (mg)	36	213	22	53	26	37	41
Iron (mg)	0.6	1.3	0.3	1.5	0.4	1.1	0.7
Sodium (mg)	3	1	4	24	43	2	11
Fat-Soluble Vitamins							
Retinol, Vitamin A (µg)	0	0	0	0	0	0	0
beta-Carotene (µg)	0	65	0	0	280	170	5
Retinol Activity Equivalent, RAE (µg)	0	5	0	0	23	14	0
Water-Soluble Vitamins							
Thiamin, Vitamin B1 (mg)	0.02	0.14	0.03	0.01	0.04	0.05	0.08
Riboflavin, Vitamin B2 (mg)	0.02	0.03	0.01	0.03	0.02	0.04	0.01
Niacin (mg)	0.5	1.3	0.4	0.5	0.3	0.7	1
Ascorbic Acid, Vitamin C (mg)	0	0	22	5	14	25	6

*Source: Philippine Food Composition Tables Online Database (PhilFCT®) of Food and Nutrition Research Institute of the Department of Science and Technology (https://i.fnri.dost.gov.ph/login/homepage)

As with other remote communities, many of these food plant species, along with the wealth of indigenous knowledge are important in resiliency and food security (Bvenura & Afolayan, 2015; Ferguson et al., 2017; Giraldi & Hanazaki, 2014; Quave & Pieroni, 2015). Unfortunately, some of these important ethnobotanical plants are often neglected and underutilised species (NUS). Within the Higaonon tribe's food system, some NUS, based on the list of Ulian et al., (2020) include *Artocarpus heterophyllus* Lam. (jackfruit), *Bambusa vulgaris* Schrad. ex J.C.Wendl. (common bamboo), *Coix lacryma-jobi* L. (Jobs' tears), *Colocasia esculenta* (L.) Schott (taro), *Etlingera elatior* (Jack) R.M.Sm. (torch lily), *Moringa oleifera* Lam. (moringa), and *Solanum aethiopicum* L. (African eggplant). The Higaonon tribe also consumes wild fruits and vegetables which may be considered as NUS locally. These include *Dioscorea hispida* Dennst., *Dioscorea pentaphylla* L., *Schismatoglottis calyptrata* (Roxb.) Zoll. & Moritzi, *Calamus* sp., *Castanopsis evansii* Elm., *Pangium edule* Reinw. ex Blume, *Hornstedtia conoidea* Ridl., and *Hornstedtia lophophora* Ridl. The aforementioned edibles are harvested in the forests, and the communal area in the villages. These NUS have untapped potentials as an alternative and/supplemental source of nutrients that could help transform food systems to combat malnutrition, hunger, poor health, and even starvation (Baldermann et al., 2016; Hunter et al., 2019; Mustafa et al., 2019; Padulosi et al., 2013; Ulian et al., 2020).

From an ethnographic point of view, both Higaonon men and women work in the family-owned farm, and homegardens during planting and harvesting season hence, there is a non-significant difference in the plant knowledge between gender. However, for food plants collected in the forest and communal area, men appeared to be more knowledgeable than women. This may be explained by the gender-specific task in the Higaonon tribe such as hunting, and gathering of non-timber products in the forest which is exclusively done by men (Cole, 1956). This is considered as part of the prevailing gender roles in the upland vegetable-producing community in Bukidnon that ascribe heavier load to men and lighter work to women (Chiong-Javier, 2012). Like the Higaonon tribe, the forest-related task is also done by men in the indigenous Agta of Luzon, Philippines (Hagen et al., 2016) as well as with the Laklãnõ-Xokleng indigenous people in Southern Brazil (Heineberg & Hanazaki, 2019). In other cultures, however, gender does not appear to influence knowledge of plants such as the case of Mayans in Guatemala (Turreira-García et al., 2015), and the Rarámuri community in Mexico (Camou-Guerrero et al., 2008). The influence of gender on food plant knowledge may be therefore affected by the social organisation of the tribe as well as with specific biocultural refugia. The Higaonon tribe's plant knowledge associated with homegardens on the other hand had a significant difference. This may be explained by the varying size and diversity of homegardens which differ in every household and village. Some households are also located just adjacent to their farm. As such, some households do not have homegardens or have less diverse species of plants compared to others. However, the homegarden size and species abundance were not covered in the data gathering, and should be considered for future study.

3.5 Conclusion

Using the framework of UN SDG 2 on Zero Hunger, this study explores the ethnobotanical use of food plants by the Higaonon tribe within the context of finding a solution to rice shortage and nutrient deficiency – the problem constantly faced by the Filipino population. The ethnobotanical investigation showed that the Higaonon tribe's food system is composed of 76 species of edible plants belonging to 62 genera and 36 botanical families. A total of 1, 254 use-reports were accounted for in all 9 use-categories: 3 species (3.94%) were consumed as cereals, 8 species (10.52%) were white roots, tubers, and plantains, 3 species (3.94%) were Vitamin A-rich vegetables and tubers, 16 species (21.05%) were eaten as green leafy vegetables, 12 species (15.78%) were categorised as other vegetables, 2 species (2.63%) were Vitamin A-rich fruits, 27 species (35.52%) were considered as other fruits, 7 species (9.21%) were classified as legumes, nuts, and seeds, and 8 species (10.52%) were used as spices, condiments, and beverages. Since rice cultivation is a major challenge in the mountain terrain of Bukidnon, the Higaonon tribe relies on a variety of carbohydrate sources which include sweet potatoes, arrowleaf elephant ear, taro, corn, cassava, and bananas. Aside from the strain of rice cultivation in the mountainous terrain, the transformation Higaonon tribe's food system from a rice-centred diet into more diverse starchy staples of roots, tubers, plantains, and corn may have been a result of biocultural adaptations with the increasing population in the uplands and insufficient rice yield. The tribe also tapped other rice substitutes such as *Coix lacryma-jobi* L., wild yams (*Dioscorea hispida* Dennst. and *Dioscorea pentaphylla* L.), and other neglected and underutilised species as a food source. Both the men and women in the Higaonon tribe possess knowledge of food plants gathered from homegarden, farms, and riverine. However, the men in the tribe showed to be more knowledgeable of edible plants harvested in the forest and communal areas than the women. The social organisation in the tribal community may also play an important role in the process of knowledge acquisition. Within the Higaonon tribe, foraging and hunting in the forest remain part of the gender roles for men whilst women are in-charged of work within the households. Lastly, several plant resources can be tapped to address the perennial problem of rice shortage and nutrient deficiency in the country. Together with the indigenous peoples' plant knowledge on the use of various species, achieving SDG 2 is feasible considering the number and potential use of plant resources and NUS.

Chapter 4

Molecular identity and indigenous peoples' utilisation of poisonous 'Lab-o' (Wild Yam, Dioscoreaceae)

Published as:

Buenavista, DP, NMA Dinopol, E Mollee, M McDonald. 2021. From Poison to Food: On the Molecular Identity and Indigenous peoples' Utilisation of Poisonous 'Lab-o' (Wild Yam, Dioscoreaceae) in Bukidnon, Philippines. *Cogent Food and Agriculture* 7:1, 1870306, DOI: 10.1080/23311932.2020.1870306 (Taylor & Francis)

4.1 Introduction

"Man ...has discovered the art of making fire, by which hard and stringy roots can be rendered digestible, and poisonous roots or herbs innocuous"

– Charles Darwin, The Descent of Man (1871)

Whilst roots have been important food components by early humans, the adoption of food-processing techniques and cooking had shaped human evolution, and societies (Carmody & Wrangham, 2009; Wrangham & Conklin-Brittain, 2003). It is argued that with the advent of the human use of fire, such innovation has been essential in detoxifying poisonous plants, improve the hominid diet, and significantly influence our biological evolution (Wrangham & Conklin-Brittain, 2003). In modern times, the indigenous knowledge and skills of detoxifying poisonous plants for food can still be found in some local and indigenous communities. Amongst the plants used since time immemorial is yam of the genus *Dioscorea* L. (family Dioscoreaceae) which remains an economically important source of food and medicine. In fact, the consumption of yams can be traced back from archaeological records to early agriculture and plant domestication in New Guinea and Southeast Asia (Denham, 2011; Fullagar et al., 2006; Xhauflair et al., 2017). At present, several species of yams are still part of traditional food systems of the local and indigenous communities such as the Sakai tribe of Thailand (Maneenoon et al., 2008), the rural populace of India (Kumar et al., 2017), Nepal (Bhandari & Kawabata, 2005; Sharma & Bastakoti, 2009), Indonesia (Trimanto & Hapsari, 2015), and Timor-Leste (Erskine et al., 2014). In the Philippines, many indigenous populations rely on several yam species for subsistence such as the Ati Negrito of Guimaras Island (Ong & Kim, 2017), the Igorots of the Cordillera mountain ranges (Gayao et al., 2018), the Pala'wan and

Tagbanua tribes of Palawan Island (Bernadas & Peralta, 2017; Dressler, 2005; Lacuna-Richman, 2004), and the Alangan Mangyan of Mindoro Island (Mandia, 2004).

Apart from food, wild *Dioscorea* species are valuable in the global pharmaceutical industry as the main source of diosgenin – the precursor for the production of steroidal drugs and contraceptives (Price et al., 2016; Shen et al., 2018), and a promising compound against cancer (Corbiere et al., 2004; Jesus et al., 2016; Li et al., 2010; Sethi et al., 2018), Alzheimer's disease (Tohda et al., 2012, 2017), and Hepatitis C virus (Wang et al., 2011). This resulted in large market demand and a gradual decline in the wild populations of *Dioscorea.* In India, for example, steroidal drug production is 100% based on diosgenin, which is extracted from tonnes of *Dioscorea* species making them the most significant plant group amongst the medicinal plants (Chaturvedi et al., 2007). The diosgenin production industry involves the harvesting of 550-650 tonnes of plants worldwide with an estimated market value of $500 million (Singh & Kaushal, 2007). As such, its ecology and distribution are of particular interest for sustainable utilisation (Shen et al., 2018). However, species identification and classification have impeded advancing our understanding of the economic potential of this genus (Sun et al., 2012). With approximately 630 species of *Dioscorea* distributed across Southeast Asia, Africa, Central, and South America, and other tropical and subtropical regions, identifying *Dioscorea* species is difficult due to unreliable morphological characters shared within the genus (Xia et al., 2019). Whilst anatomical examinations coupled with HPTLC analyses showed to be advantageous, there is no adequate anatomical studies available for most *Dioscorea* species (Raman et al., 2014). Yam taxonomy presents a challenge even to systematists considering the morphological diversity, dioecy, and small flowers of yams (Wilkin et al., 2005). The pacific yam (*Dioscorea nummularia* Lam.), for example, is a highly polymorphic species that is sometimes confused with *D. alata, D. glabra, D. transversa* and other poorly described *Dioscorea* species (Lebot et al., 2017).

To resolve taxonomic issues, DNA barcoding proved to be a useful tool in discriminating species of various plant taxa (Hollingsworth et al., 2016; Kress et al., 2005). This approach has been widely applied in identifying and promoting the neglected and underutilised species (NUS) (Campanaro et al., 2019), and medicinal plants (Kumar et al., 2018; Li et al., 2011). Furthermore, the WHO recommends to barcode various medicinal plants for correct species identification, and verification of purity and concentration of biochemical components (Palhares et al., 2015). This is of particular importance as food and medicinal products of botanical origin have been adulterated and/or substituted thereby threatening the health of consumers (Han et al., 2016; Peng et al., 2017; Srirama et al., 2017; Tnah et al., 2019). In this study, I examined the identity of a wild yam locally as "*Lab-o*" to the Higaonon tribe of Bukidnon in Mindanao Island of the Philippines; and explore the indigenous knowledge systems and practices associated with wild yam processing and consumption. The indigenous Higaonon tribe gather this particular yam from the forests during the time of scarcity ("*tigkabagol"*) and it serves as a carbohydrate source for the local community in times of food insufficiency, particularly, from June to August. Paradoxically, '*Lab-o'* was reported by the members of the Higaonon tribe to be highly poisonous and inedible if carelessly prepared and consumed. The traditional processing is done by slicing the tuber very thinly and soaking it in brine for at least three days then, in flowing water or river for an additional three days. After this, the yam chips are boiled and eaten similar to other root crops. The labour-intensive task of gathering and processing the wild yam (Figure 4.1), from a poisonous to an edible product contributes to the resilience of the Higaonon tribe.

Figure 4.1 Gathering, processing, and consumption of '*Lab-o*' (Photo credit: Coleen Sumonda of the Higaonon Tribe, Bukidnon)

Given the plants' indispensable value to food security, this chapter uses the Two-Eyed Seeing approach to explore the safe consumption of a potentially poisonous wild yam. In one-eye (the perspective of a botanist), I focused on the identification of the botanically unknown yam species using the DNA barcoding technique since some cases of poisoning have been associated with misidentification of the plant. In the other eye (the perspectives of indigenous peoples), I reviewed the indigenous knowledge and traditional detoxification process of the wild yam from various food cultures in Asia. Using both eyes, this chapter demonstrates the benefits of bridging scientific, and indigenous knowledge systems in the co-production of knowledge.

4.2 Materials and Methods

4.2.1 Collection of Plant Materials

With the assistance of the local guides from the Higaonon tribe, the fresh leaves and tubers of the wild yam (*Dioscorea* sp.) locally known as '*Lab-o*' (Figure 4.2) were collected from the forest of Barangay Dumalaguing (N 08.34529˚; E125.05598˚), Province of Bukidnon, Republic of the Philippines. Due to military restrictions within the forested areas, the plant materials were limited from one sampling site and three plant individuals. All plants were sterile and cannot be taxonomically identified based on morphology. The excised leaves were placed in labeled polyethylene bags and immediately transported to the Tuklas Lunas Development Centre at Central Mindanao University. The leaf samples were stored temporarily in the biofreezer (Thermo Scientific Revco UxF) at - 82°C before gDNA extraction.

4.2.2 Genomic DNA extraction

Figure 4.2 '*Lab-o*' (Wild Yam) from the forest of Dumalaguing, Bukidnon, Philippines

The genomic DNA (gDNA) was extracted from the *Dioscorea* leaves using the DNeasy® Plant Mini Kit (Qiagen Biotech Co., Hilden, Germany) with modifications in the protocol. The gDNA extraction was accomplished by using 100 mg of leaf samples milled at 30 Hz for 10 minutes. The milled plant material was mixed with 400µL of buffer (AP1) and 4µL RNAse A, vortexed, then incubated for 65°Celsius for two hours. The second buffer (P3) was then added to the mixture followed by five minutes of incubation on ice. The resulting lysate was centrifuged for five minutes at 10 000 x *g*, pipetted into the QIAshredder Mini spin column, and centrifuged for two minutes at 20 000 x *g*. The flow-through was transferred in a new tube and 1.5 volumes of buffer (AW1) were added to dissolve the precipitate. Then, 650 µL of the mixture was transferred to a DNeasy Mini spin column to be centrifuged for one minute at 6 000 x *g*. The resulting flow-through was discarded and the sample in the spin column was washed with 500µL buffer (AW2), centrifuged for two minutes at 20 000 x *g* to dry the membrane. The column was transferred to a 2 mL centrifuge tube for the elution process. Lastly, 50 µL of buffer AE was added followed by five minutes of incubation at room temperature (15°C-25°C), and then centrifuged at 6 000 x *g* for one minute. The final step was performed twice to give 100 µL eluted DNA.

4.2.3 PCR Amplification

A set of primers, *matK-390f* (5'-CGATCTATTCATTCAATATTTC-3) and *matK-1326r* (5'-TCTAGCACACGAAAGTCGAAGT-3') were used for amplification of the *matK* gene. The selection of *matK* sequences over other DNA barcodes (i.e. *rbcL, psbA-trnH, trnL-F*) was based on previous findings showing a higher discrimination rate for *Dioscorea* species when compared to other barcodes (Xia et al., 2019). With the use of gDNA as a template, *matK* was amplified using a PCR thermocycler (Applied Biosystems™ Veriti™, 96-Well Thermal Cycler, Thermo Fisher Scientific). The polymerase chain reaction was performed in a 20 µL mixture containing the following: ultrapure water, 1 x KAPA *Taq* Buffer B with Mg^{+}, 2.5 mM $MgCl_2$. 012 mM dNTPs, 0.3 µM forward primer, 0.3 µM reverse primer, 1U/µL Kapa *Taq* DNA polymerase, and 1 µL of gDNA. The amplification was carried out in the following conditions: initial denaturation at 94°C for 45 seconds, annealing at 55°C for 30 seconds, and extension at 72°C for 90 seconds.

4.2.4 Visualisation

Both the gDNA and PCR products were visualised through gel electrophoresis using 1% agarose in Tris-Boric Acid-EDTA (TBE) stained with Biotium GelRed (10% vol/vol). Gels were loaded with 2 µL of gDNA samples or 5 µL of the PCR product mixed with 2 µL of 2x loading dye (Vivantis NM0410) loaded into the wells of the agarose gel. One µL of 1 Kb plus Ladder (Invitrogen, Inc.) was loaded on the first well of the gel. The gel was run at 100V for 30 minutes using the Mupid-One Electrophoresis system and viewed using Gel Doc EZ Imager (Bio-Rad Laboratories, California, U.S.A). The PCR bands on the gel were used to determine the success of the gDNA extraction method.

4.2.5 Sequencing and BLASTn Analysis

The bidirectional DNA sequencing of the PCR products was carried out by Macrogen Inc., (Seoul, South Korea). All sequences of the gDNA were edited and aligned using the default parameters in BioEdit Sequence Alignment Editor. To minimize the positional dissimilarity, all missing data and gaps within the sequences were removed. Basic Local Alignment Search Tool (BLAST) analysis was done for homology determination to available sequences in the National Centre for Biotechnology Information (NCBI) nucleotide database (https://blast.ncbi.nlm.nih.gov/Blast.cgi).

4.3 Results and Discussion

Using the leaf samples of *'Lab-o'*, gDNA extraction of high molecular weight was successfully isolated and amplified from three DNA plant samples (designated D1, D2, D3). In the PCR amplification step, *matK* yielded a single band with an amplicon length of 1000 bp suggesting a 100% success rate in the amplification and sequencing efficiency (Figure 4.3).

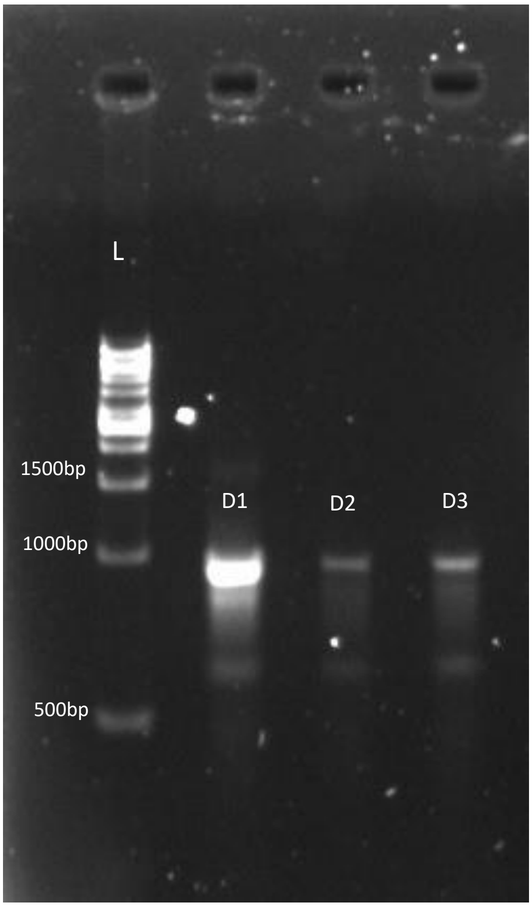


Figure 4.3 Genomic DNA isolated from three samples of *'Lab-o'* amplified with primers for *matK* (D1, D2, D3; L- DNA Ladder)

The results of the sequenced PCR products were of high quality and were confirmed in the electropherogram. The peaks in the electropherogram were non-overlapping and broad, with minimal background noise (Figure 4.4; Annex 3)

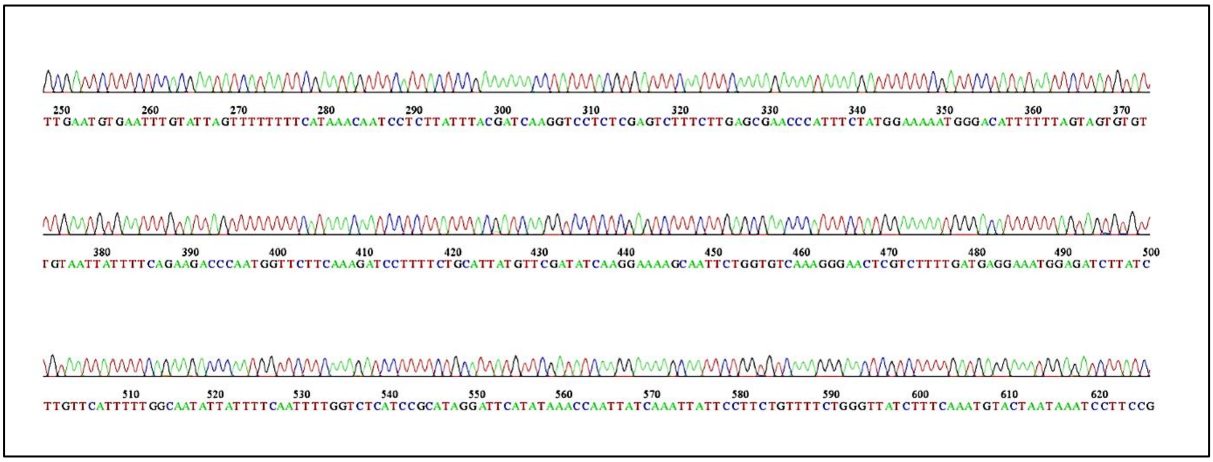


Figure 4.4 Electropherogram section from ‘*Lab-o’ matK* sequence

The final sequence with 1154 bp (Annex 2) was then compared against the NCBI GenBank database for identity match using the BLASTn analysis (downloaded 08 November 2019). The top “hits” (best matches) in the database with 99 to 100 sequence identity and E- value ≤0.001, was considered a match (Arulandhu et al., 2019; Haldar, 2019). The BLASTn algorithm is based on the estimation of the similarity scores between the query sequence and the sequences of the different species of organisms available in the database hence, the “hits” are listed from top to bottom with decreasing similarity (Haldar, 2019). The Expect value (E) on the other hand is a parameter that determines the number of expected “hits” obtained by chance in the NCBI database for a fixed length of nucleotide. As such, the lower the E-value, or closer to zero, the more “significant” the match is (Haldar, 2019). The result of the BLASTn analysis identifies the leaf samples of *‘Lab-o’* belonging to *Dioscorea hispida* Dennst. of family Dioscoreaceae.

Following the ranking, the top “hits” for species identification were consistent with an identity percentage of 98.87% (Accession No. AY957589.1), 98.88% (Accession No. KJ922806.1, KJ922835.1, KY710780.1, KJ922792.1), and 99.33% (Accession No. AY957589.1). The aforementioned accession numbers had a significant E-Value of 0. For plant species identification, above 98% sequence identity was considered a match in interpreting the results of BLASTn analysis (Arulandhu et al., 2019). *Dioscorea hispida* Dennst. is one of the 17 known species of *Dioscorea* in the Philippines (Pelser et al., 2011). It occurs throughout the country and native to tropical Asia (Burkill, 1951). It can be found naturally growing in tropical rainforest, thickets forest understory and forest margins, at low to medium altitudes up to 1500 m (Lim, 2016). This species is taxonomically distinct from other *Dioscorea* species through its sessile (without a stalk) male flowers (Burkill, 1951). As such, a sterile specimen would be impossible to be taxonomically ascertained. In this study, we demonstrate the advantage of the DNA barcoding technique in identifying problematic and cryptic taxa. The precise identification could further provide fundamental information on the origin, distribution, and authentication of raw materials such as leaves and seeds (Campanaro et al., 2019). As predicted, the use of *matK* as a barcode was found to be efficient in discriminating against the aforementioned species of Dioscoreaceae.

The accurate identification of this species is very important since it is considered to be the most poisonous yam and it is often found in the wild together with other species of *Dioscorea* (Burkill, 1951; Lim, 2016; Sharma & Bastakoti, 2009). *Dioscorea hispida* Dennst. accounted for 252 cases of poisoning and three deaths in Thailand (Sriapha et al., 2015) and four incidences of poisoning and another cause of death in the Philippines (Azanza, 2006; Azanza et al., 2019). Its toxicity is mainly attributed to the presence of an alkaloid dioscorine, and cyanogenic glycosides that make the yam poisonous when directly consumed or incorrectly processed (Burkill, 1951; Kumoro et al., 2011; Lim, 2016). Dioscorine is a neurotoxic isoquinuclidine alkaloid that affects the nervous system and can cause acute kidney injury, toxic encephalopathy, and even death (Kang & Taek Heo, 2015; Sasiwatpaisit et al., 2014; Sriapha et al., 2015). Also, as a cyanogenic plant, it could cause amblyopia, paralysis, neuropathy, and metabolic disorders (D. A. Jones, 1998). Following cyanide ingestion, symptoms occur in minutes to hours depending on the dose: low-dose exposures frequently cause headache, dizziness, mild confusion, abdominal cramping, nausea, and vomiting; large-dose exposures eventually lead to dyspnea, respiratory depression, apnea, hypotension, arrhythmias, coma, and seizure (Hendry-Hofer et al., 2019).

The molecular identification of ‘Lab-o’ further confirms the Higaonon tribes’ report on the inedibility of the yam when incorrectly processed before consumption. The Higaonon tribes’ traditional processing of the tuber in brine for at least three days helps remove the cyanide content of the plant. Recent studies showed that cyanide levels in *Dioscorea hispida* Dennst. immersed in a salt solution (5% NaCl) significantly decreases the cyanide concentration to 99.70% making it safe for human consumption (Kresnadipayana & Waty, 2019). The practical application of salt in the technological processing of the wild yam is currently being explored as part of improved and safer food preparation in Indonesia (Kresnadipayana & Waty, 2019). The process of detoxification appeared to vary from region and indigenous groups in Asia. In Nepal, the sliced tubers of *Dioscorea hispida* Dennst. are mixed with *Dioscorea kamoonensis* Kunth. when boiled to reduce the toxicity, then dipped in running water for 24 hours before it is eaten (Sharma & Bastakoti, 2009). In Java (Indonesia), the tuber slices are coated with ashes, soaked in seawater, washed, and then sun-dried whereas, in Odisha (India), it is detoxified by boiling together with *Antidesma acuminata* Wight, or tamarind (Lim, 2016). In Malaysia, it is boiled, roasted, soaked in water, and made into flour for pancakes and porridge (Ashri et al., 2014). By soaking and cooking the wild yam tubers, a lot of hydrogen cyanide (a known inhibitor of cellular respiration chain at the cytochrome oxidase level) is lost and as well as other water-soluble anti-nutritional components like phenolics and tannins, thereby reducing the danger of toxicity (Shanthakumari et al., 2008). The process of drying the tuber starch also reduces some toxins (Kresnadipayana & Waty, 2019). This lengthy and labour-intensive preparation (i.e., chopping, drying, washing) is similarly practiced by the indigenous Amami people of Japan in processing their poisonous famine food "sotetsu" from *Cycas revoluta* (Hayward & Kuwahara, 2013). In the case of highly toxic *Aconitum carmichaelii* Debeaux traditionally eaten by the locals of Qinling mountains (China), detoxification of the root vegetable requires drying and long hours of boiling up to 8-10 hours (Kang et al., 2012). The adoption of cooking to detoxify and improve the nutritional quality of plant foods is considered a key feature of human evolutionary adaptation (Wrangham & Conklin-Brittain, 2003). These exemplify the invaluable contribution of indigenous knowledge systems and practices in the valorisation of the wild plants as well as in the improvement of the human diet.

Though some species are poisonous, wild yams also play an important role in times of food shortage and famine in Southeast Asia. In the Philippines, for example, typhoons and other natural calamities often result in the displacement of the rural populace and severe agricultural loss (Bamforth, 2015; Bohra-Mishra et al., 2017; Chandra et al., 2017). As a result of domestic food shortage, the country imports 10% of its rice annually in the past 25 years, and in 2008, it became the world's largest importer of rice – the staple and main source of sustenance for the majority of the Filipinos (Dawe et al., 2008). Yet, for the country's indigenous population, this problem is mitigated by processing and consuming different species of wild yams as a rice substitute (Gayao et al., 2018; Warren, 2018). Similarly, in some parts of Indonesia and Timor-Leste, wild yam serves as a substitute for maize and rice during the dry season and food deficit years (Erskine et al., 2014; Miyagawa, 2002; Trimanto & Hapsari, 2015). Depending on the varieties, *Dioscorea hispida* Dennst. tuber contain 15.8 - 37.8% water, 1.13 - 6.20% crude protein, 1.99 - 9.36% crude lipid and, 0.29 - 1.24% ash (Saleha et al., 2018). Its total carbohydrate (58.3 - 71.9%) is higher when compared with other wild edible yam species such as *D. bulbifera*, *D. deltoidea*, *D. versicolor*, and *D. triphylla* which only in the range of 17.4 - 25.9% (Bhandari & Kawabata, 2005). Moreover, *Dioscorea hispida* Dennst. may provide better nutrition for diabetics due to its hypoglycemic effects (Harijono et al., 2013; Hashimoto et al., 2009).

Beyond traditional staple, *Dioscorea hispida* Dennst. is cultivated by farmers in East Java to be processed into chips for local trade (Fauziah & Mas'udah, 2015; Trimanto & Hapsari, 2015). In contrast, indigenous peoples in the Philippines and other Asian countries still depend on the wild populations of *Dioscorea hispida* Dennst. However, due to the incidences of poisoning and death attributed to ingesting the plant, correct identification of the species must be taken into consideration. The DNA barcoding strategy could be used to accurately identify the plant in the wild which could be propagated in local nurseries to avoid misidentification. The indigenous knowledge and practices associated with the utilisation of *Dioscorea hispida* Dennst. and other neglected and underutilised plant resources could be likewise considered in addressing food insecurities in Asia.

4.4 Conclusion

Despite the long and tedious preparation involved in detoxifying famine foods, wild yams play an important role in the food and nutritional security of the Higaonon tribe and other indigenous peoples in Asia. Yet, harvesting *Dioscorea* species in the wild entails a serious health risk due to the taxonomic difficulty of differentiating the non-poisonous and poisonous yam relatives. This problem could be resolved through the DNA barcoding technique which proved to be useful in the accurate and correct identification of *Dioscorea hispida* Dennst. (Buenavista, Dinopol, et al., 2021). Considering the benefits accrued by Indonesian farmers in cultivating *Dioscorea hispida* Dennst., the economic potential of 'Lab-o' could be further explored as an additional source of livelihood for the locals. This could likewise change the negative connotations on the use of famine food similar to the "sotetsu" or *Cycas revoluta* of the Amami people in Japan. Complementary to the molecular identification of the plant, integrating local and indigenous knowledge showed to beneficial in the process of knowledge production particularly on the potential economic uses of local plant resources. In this case, despite the notorious reputation of poisonous yam, this tuber has been an important food alternative in times of crisis. As a final point, bridging scientific, and indigenous knowledge systems using the two-eyed seeing approach may provide an invaluable contribution in ensuring food safety and food security in local communities.

Chapter 5

Intersecting taxonomy with social justice in *Begonia bangsamoro* (Begoniaceae, section *Petermannia*), a new species described from the Mindanao Island, Philippines

Published as:

Buenavista, DP, YP Ang, MAK Pranada, DS Salas, E Mollee, M McDonald. 2021. *Begonia bangsamoro* (Begoniaceae, section *Petermannia*), a new species from the Mindanao Island, Philippines. *Phytotaxa*. 497(1): 039-048. DOI: 10.11646/phytotaxa.497.1.4 (Magnolia Press).

5.1 Introduction

"If you do not know the name of things, the knowledge of them is lost too"

– Carolus Linnaeus, Philosophia Botanica (1751)

Taxonomy plays an important role in the conservation and legal protection of endangered species (Ely et al., 2017; Mace, 2004). Combating illegal plant trade, for example, requires accurate identification, description, and conservation assessments of the plants listed in the IUCN Red List, CITES, and various government agencies (Ely et al., 2017; Gale et al., 2019; Phelps & Webb, 2015). Yet, the same field has been the subject of various criticism as some taxonomists have been involved in the smuggling and/or "discovery" of new species using poached and/or illegally traded specimens (Fukushima et al., 2020; Law, 2019, 2021; van den Burg & Weissgold, 2020). In the case of ornamental plants, many species entered the local and international commercial trade even before they are taxonomically described and named, for example, *Dendrochilum hampelii* or "Big Pink" (Sulistyo et al., 2015) and many other species of horticulturally important orchid (Pedersen, 2011; Pedersen et al., 2004; Tuan & Averyanov, 2017; Vermeulen et al., 2014; Vermeulen & Lamb, 2011), pitcher plants (i.e., *Nepenthes robcantleyi*) (Cheek, 2011), and several *Begonia* species (Kiew, 2004; Ku et al., 2004; Tan et al., 2018).

Biopiracy is a controversial term that is more often applied to the illegal appropriation of biological resources and/or traditional knowledge of indigenous peoples without fair sharing of benefits or other non-monetary incentives associated with the resource/knowledge (Efferth et al., 2016; Gulati, 2019; Ho, 2006). In a broader sense, biopiracy can be defined as any type of unauthorised access to biological material, such as collecting and transporting wildlife without permits (Fukushima et al., 2020). This injustice against the country of origin is exacerbated by re-naming the organisms with names and specific epithets that are sometimes irrelevant, insensitive, and offensive to the indigenous peoples (Gillman & Wright, 2020). The prime example is the plant name "Niggerhead" which is painfully offensive yet, an accepted common name for *Enneapogon nigricans, Carex secta, and Eriophorum vaginatur* (Hunter, 1991). Another unreasonably named plant is the "Digger Pine" or *Pinus sabiniana* in the western United States whose common name is very derogatory and insulting for the Paiute and other indigenous Indian groups (Hunter, 1991; Jackson, 2020). Historically, the term "diggers" was originally used by the locals to mockingly called the Native Americans which they observed to forage on roots and bulbs (Hunter, 1991). Some of the pejorative terms were even included in the assignment of scientific names. An example is the usage of the term "kaffir" or "caffer", a form of a racial slur in South Africa which, unfortunately, have been incorporated into the species names of plants; for example, the edible fruit tree species, *Dovyalis caffra* Warb. and *Harpephyllum caffrum* Bernh. ex C. Krauss (Gillman & Wright, 2020; Hunter, 1991). The species names, as mentioned in the previous examples, are irrelevant to the plants' morphological characters, ecology, and geographical origin, nor to its economic uses hence, it does not provide any useful or meaningful botanical information.

Whilst naming a new species is a matter of discretion for the discoverers, scientists should respectfully engage with the country/region of origin and its people irrespective of the international treaties and domestic laws. In New Zealand, for instance, discoveries within indigenous territories enable scientists to promote indigenous language and gain local support for conservation (Veale et al., 2019; Whaanga et al., 2013). In return, the integration of the Māori language in species nomenclature further strengthens the recognition and aspirations of the Māori people as well as their indigenous culture (Wehi et al., 2019; Whaanga et al., 2013). Some scientists further acknowledge the need to re-examine the established taxonomic protocols in the context of assigning and reinstating indigenous names which is not yet covered in the present codes of taxonomic nomenclature (Gillman & Wright, 2020; Veale et al., 2019). In this chapter, Bangsamoro – the name of the land, people, and identity is represented by *Begonia bangsamoro,* a new species from the Bangsamoro region, Mindanao Island, Philippines. This chapter aims to contribute to the description of a new species of *Begonia* as well as in the development of an ethical and culturally sensitive approach in the field of Taxonomy and Conservation. As such, the new species is named in recognition of the indigenous Bangsamoro peoples' empowerment for self-determination.

5.1.1 Asian *Begonia* under threat

Historically established by Plumier in 1700 with only six species (Doorenbos et al., 1998; Dryander, 1791), *Begonia* (Linnaeus, 1753) is now a remarkable genus comprised of over 1,800 species making it the sixth-largest genus amongst angiosperms (Moonlight et al., 2018). This group is mainly found in Southeast Asia – the centre of *Begonia* diversity (Moonlight et al., 2018; Thomas et al., 2012; Tian et al., 2018). *Begonia* section *Petermannia* (De Candolle, 1859; Klotzsch, 1854), in particular, has the highest species richness in Asia with more than 200 species (Peng et al., 2017). However, the same region is also a hotspot of tropical deforestation driven by the expanding plantation economy (Kenney-Lazar & Ishikawa, 2019; Zeng et al., 2018) and "invisible" illegal trade of wild ornamental plants (Phelps & Webb, 2015). With approximately 82 billion m^2 of the area being converted into croplands (Zeng et al., 2018), and 500 times faster than the expected extinction rate for plants (Humphreys et al., 2019), documenting and conserving the region's flora is a race against time, especially in the remaining ecologically intact landscapes and other little-known biocultural territories.

Asian *Begonia* species are highly prized horticultural plants due to their striking colour varieties and variegated leaves (Chua et al., 2009; Tan et al., 2018). It is not a surprise therefore that a vast array of *Begonia* is of conservation importance either because of restricted distribution, habitat loss, illegal collection, and over-harvesting for ornamental or medicinal use (Chua et al., 2009; Tan et al., 2018; Tian et al., 2018). In the Philippines, 24 *Begonia* species are already in the threatened categories; 13 endangered species and 11 vulnerable species though, some newly discovered species are placed in the critically endangered category (Ang et al., 2020; Bustamante et al., 2020; Department of Environment and Natural Resources, 2017; Rule et al., 2020).

5.1.2 The Research Area and the New *Begonia*

Amongst the botanically unexplored areas of Southeast Asia is the Bangsamoro region on the island of Mindanao, Philippines. Established in 2019, the Bangsamoro Autonomous Region in Muslim Mindanao (BARMM) is a newly recognized region that gained its autonomy after decades of armed conflict between the government of the Philippines and the Bangsamoro people whose historical assertion of self-governance and statehood date back to the middle of 15th-century Sultanates (Abubakar, 2019; Abuza & Lischin, 2020; Lingga, 2004). The decades of socio-political conflict, violence, and insurgency hampered all fieldwork in the region and many of its mountain flora (i.e., Mount Ragang and Mount Makaturing in Lanao del Sur, BARMM) remain poorly known.

To fill this gap, field surveys were carried out in the forest patches of Wao, Province of Lanao del Sur in the Bangsamoro region, Philippines (Figure 5.1). The Municipality of Wao has a total land area of 1, 206, 182 hectares which are classified as Alienable and Disposable (A & D) lands (44.11 %), and Forestlands/Timberland (55.89%) (Local Government of Wao, n.d.). With the photo-documentation of the local flora in the area, the digital photographs of an unidentified *Begonia* closely resembling two other species from Luzon Island in the northern Philippines was hypothesised to be an undescribed species. This was validated and confirmed through morphological comparisons of the fresh and herbarium specimens and literature reviews. As such, with a window of opportunity to botanically explore the Bangsamoro region, this chapter presents the discovery of a new species of *Begonia* from section *Petermannia*.

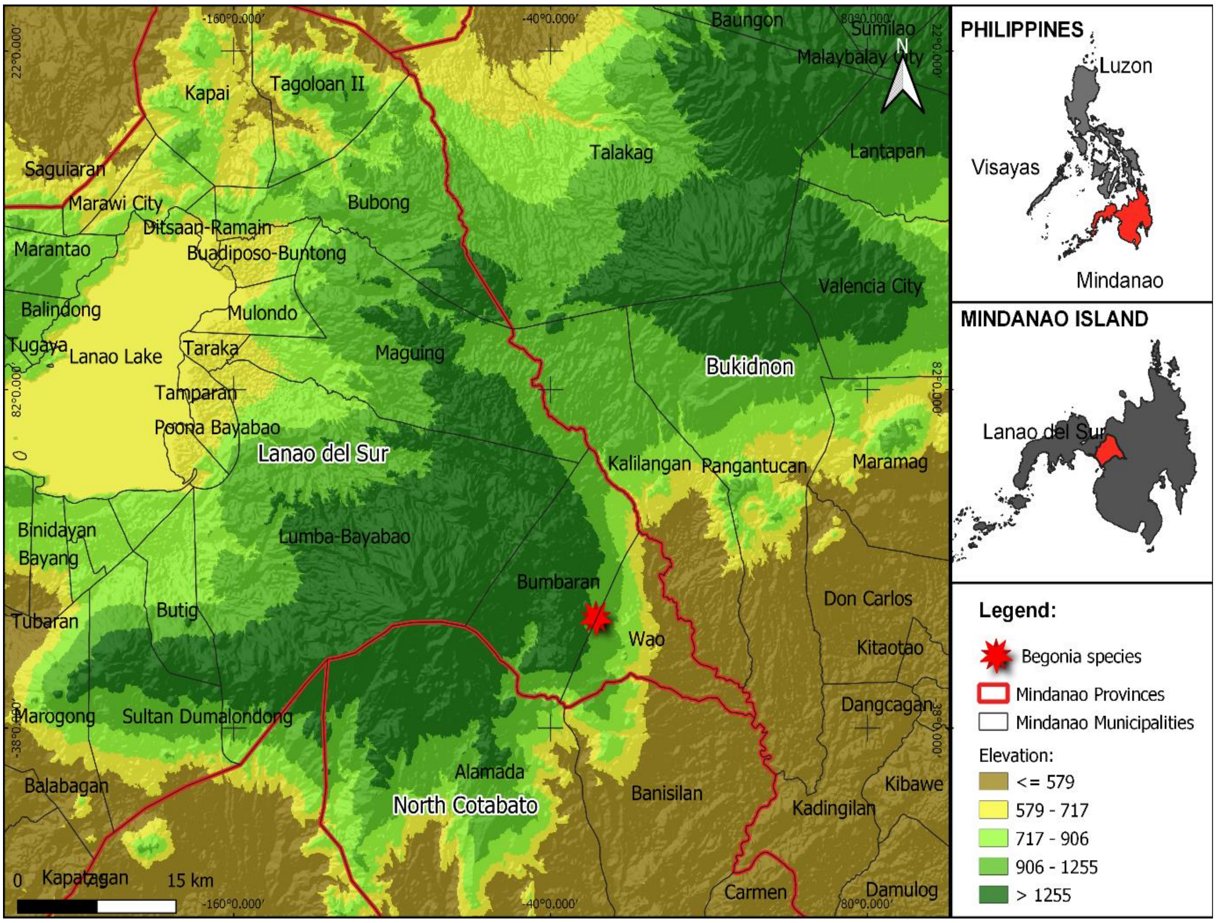


Figure 5.1 Map indicating the type locality of *B. bangsamoro* in the Municipality of Wao, province of Lanao del Sur, Mindanao island, Philippines.

5.2 Materials and Methods

5.2.1 Collection, Processing, and Taxonomic Examination of Plant Materials

For the authorised collection of plant samples, we were granted Prior Informed Consent (PIC), and Municipal Wildlife Permit on the 13th of July 2020 through the Office of the Municipal Mayor Elvino B. Balicao Jr. and the Municipal Environment and Natural Resources Office (MENRO) of Wao, respectively. The site was revisited for the field documentation and collection of herbarium specimens on the 9th of August 2020. The inflorescence of both staminate and pistillate flowers was preserved in spirit whilst plant samples for type specimens were pressed and dried for herbarium collections.

Qualitative morphological characters like colour, shape, and texture were described using the plant terminologies of Beentje (2016). For quantitative morphological characters, measurements were taken using a ruler, digital calliper, and dissecting microscope with a graduated eyepiece (for microscopic structures like the hairs). The hypothesis that the *Begonia* from Lanao del Sur represents a new and distinct taxon was then tested by morphological comparison with the phenetically similar *Begonia* species in the section Petermannia from the Philippines. The undescribed species, in particular, has morphological characteristics similar to *Begonia contracta* Warb., *Begonia incisa* A.DC., and *Begonia quercifolia* DC. occurring in Luzon and Visayas Islands, Philippines. The three *Begonia* species were then compared using the protologues, digitally available type specimens, and botanical descriptions from relevant publications.

Due to the travel restrictions brought about by the COVID-19 pandemic, these were also supplemented with the field observations of my research collaborators from the Philippine Taxonomic Initiative, Yu Pin Ang, and Mc Andrew Pranada for the Luzon *Begonia.* After delineating the new *Begonia* species, typifications were made following the provisions of the Shenzhen Code otherwise known as the International Code of Nomenclature for Algae, Fungi, and Plants (Turland et al., 2018). The holotype and isotype were deposited in the Botany and National Herbarium Division of the National Museum of the Philippines, Manila (Annex 4). The conservation status of the new species was assessed according to the provisions of IUCN Categories and Criteria Version 14 (IUCN Standards and Petitions Committee, 2019).

5.3 Results

Taxonomic Treatment

***Begonia bangsamoro* Buenavista, Pranada & Y.P. Ang** *sp. nov.* § *Petermannia* (Figures 5.2 & 5.3)

Type Specimens

PHILIPPINES. Mindanao Island, Province of Lanao del Sur, Municipality of Wao, Barangay Banga, Sitio Trese, N 07°41’04.6’’; E 124°40’15.5’’, 1197 m elevation, 9 August 2020, *D.P. Buenavista: DPB 001; PNH 258465* (holotype: PNH!); *DPB 002; PNH 258466* (isotype: PNH!).

Diagnosis

Begonia Bangsamoro (Figure 5.2) is unique among Philippines *Begonia* from section *Petermannia* by having lacerate leaves (meaning, irregularly lobed at the margin), terminal inflorescence with 4 tepaled staminate (male) flowers, and a sparsely puberulous ovary.

Monoecious (meaning, with male and female flowers on the same plant), terrestrial, perennial herb, up to *ca.* 55 cm tall. **Stem** terete (meaning, circular in cross-section), brown to red, red to white pubescent (meaning, with hairs) (*ca.* 2 mm long), *ca.* 2–3 mm thick, internodes 32.9–65.8 mm long, nodes slightly swollen. **Stipules** persistent**,** ovate**,** red, keeled, adaxially glabrous (meaning, smooth and without hairs), abaxially hirsute (meaning, with coarse stiff hairs on the underside surface) on the upper half of keel, margins entire, 5.9–9.6 × 7.2–7.5 mm, apex aristate (meaning, with a long, bristle-like point), arista extended for an addition *ca.* 3.5 mm long. **Petiole** terete, red, *ca.* 1.5–2.1 mm thick, red puberulous (meaning, densely covered with soft short hairs) (*ca.* 2 mm long), 2.0–6.5 mm long. **Leaves** alternate; lamina basifixed (meaning, directly attached to the leaf base), lance-ovate, asymmetric, 7.6–10.8 × 3.1–4.1 cm; margins lacerate, serrated to doubly-serrated, shallowly undulating, ciliate (*ca.* 0.5 mm long); apex acute; adaxially (upper leaf surface) green, veins reddish-brown, minutely puberulent (meaning, the hairs are hardly visible to the naked eye) (*ca.* 1 mm long), abaxially (lower leaf surface) pale green, intervein glabrous, veins reddish-brown, slightly raised, appressed puberulous; venation basally palmate, primary veins *ca.* 7, actinodromous (meaning, with three or more veins originating from the base of the leaf, running towards the margin), secondary veins craspedodromous (meaning, with veins running from the midrib to the leaf margin). **Inflorescence** terminal, bisexual, protogynous (meaning, first functionally female, and afterward functionally male), pistillate flower solitary, basal to staminate flower parts, staminate inflorescences on occasionally branching monochasial cymes (meaning, inflorescence with a terminal flower and one bracteole subtending a lateral flower), ascending, peduncle 1.59–1.69 cm long, pale red, pilose. **Bracts** ovate, caducous (meaning, falling off after formation), hyaline (meaning, almost transparent), glabrous, up to 5.2 × 1.7 mm, decreasing in size towards the summit of inflorescence nodes, apex cuspidate (meaning, abruptly tipped with a sharp rigid point), margins entire. **Staminate or Male flower** pedicel 0.38–0.53 cm long, glabrous, tepals 4, white suffused with pink, glabrous; outer tepals 2, ovate to widely elliptic, margins entire, apex bluntly obtuse, base rounded, 6.7–7.2 mm × 4.7–5.1 mm; inner tepals 2, elliptic, margins entire, apex rounded, base rounded, 5.8–6.7 mm × 1.7–1.8 mm; androecium actinomorphic (meaning, the clusters of stamens are radially symmetric), *ca.* 2 mm in diameter, stamens 20–25, yellow, crowded on elongated axis *ca.* 3 mm in length; anthers obovoid, *ca.* 1.17 mm long. **Pistillate or Female flower** pedicel 0.38–0.53 cm long, sparse puberulous, tepals 5, white suffused with pink, glabrous; inner tepals 3, narrowly elliptic, 13–14.3 mm × width 5–4.1 mm; outer tepals 2, narrowly elliptic, 13.1 × 2.8 mm, obovate, margins entire, apex rounded; styles 3, yellow, bifid, *ca*. 3 mm long; stigma spirally twisted and papillose (meaning, bearing many small soft nipple-like projections) all around; ovary pale green, sparse hirsute, trigonous-ellipsoidal, 5.8–7 × 4.7 mm (wings excluded), wings 3, lunate, proximally rounded and distally truncated, 5.1–5.2 mm long, 3–3.5 mm wide, locules 3, placentae axile, bilamellated (meaning, consisting of two plates). **Capsule** similar in dimensions to the ovary, recurved when mature.

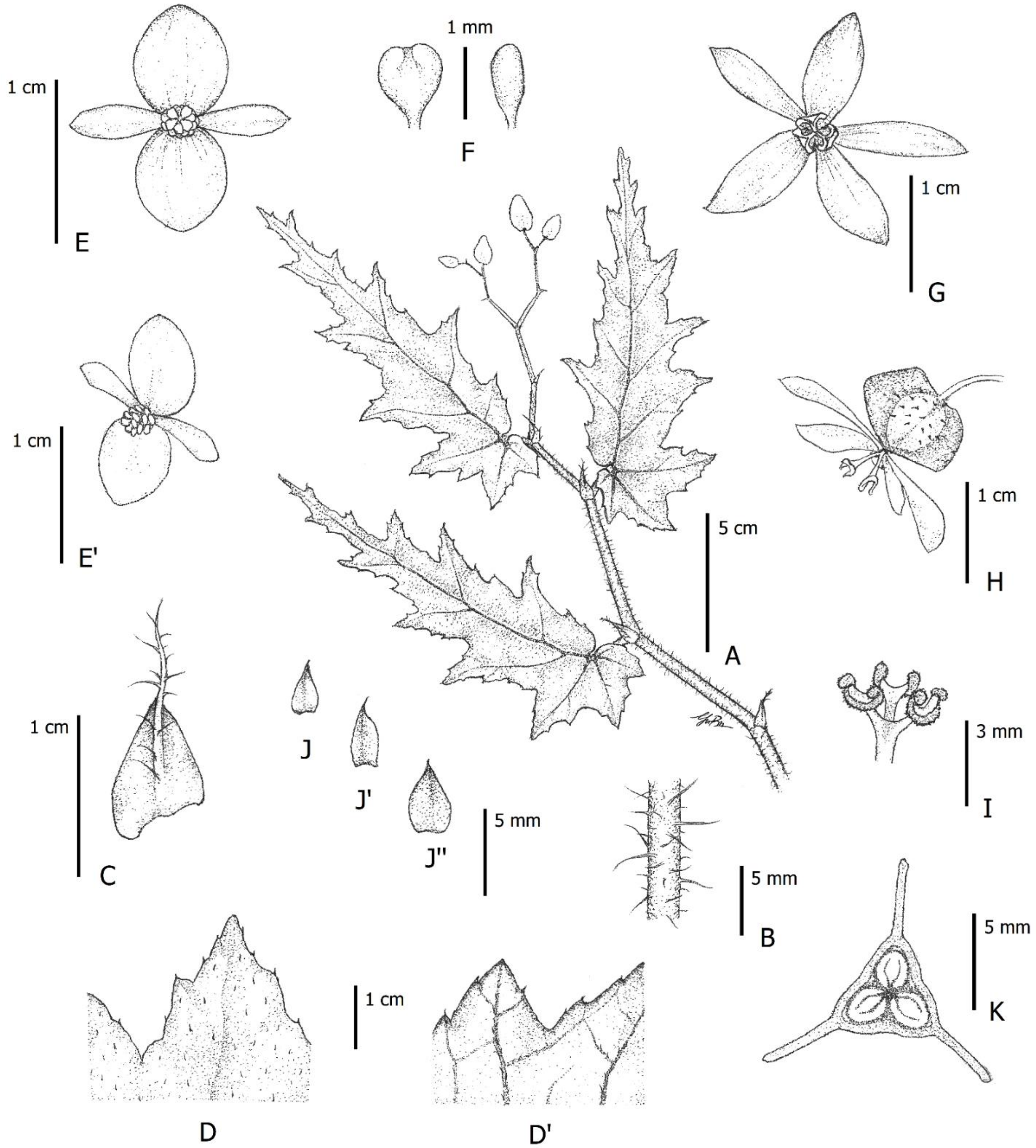


Figure 5.2 Line drawing of ***B. bangsamoro*.** **A**. Habit; **B**. Stem; **C**. Stipule; **D**, **D'** Leaf adaxial and abaxial surfaces; **E, E'**. Staminate flower face and angled view; **F**. Stamen top and side view; **G**. Pistillate flower face view; **H**. Pistillate flower side view, showing ovary; **I**. style; **J, J', J''**. Bracts; **K**. Ovary cross-section. *Illustrated by Yu Pin Ang (Used with permission).*

Figure 5.3 Field photographs of ***B. bangsamoro*****.** **A**. Habitat and habit; **B**. Stem; **C**. Stipule; **D**. Bract; **E, E'**. Leaf adaxial and abaxial surface respectively; **F**. Inflorescence; **G**. Staminate flower face view; **H**. Pistillate flower face view; **I**. Pistillate flower side view, showing ovary; **J**. Capsule; **K**. Ovary cross-section. *Photos by Dave P. Buenavista.*

Etymology

The specific epithet is named after the Bangsamoro people. As defined by the (*Republic Act No. 11054 - An Act Providing for the Organic Law for the Bangsamoro Autonomous Region in Muslim Mindanao, Repealing for the Purpose Republic Act No. 6734, Entitled "An Act Providing for An Organic Act for the Autonomous Region in Muslim Minda*, 2018), the Bangsamoro people refer to "*those who, at the advent of the Spanish colonization, were considered natives or original inhabitants of Mindanao and the Sulu archipelago and its adjacent islands, whether of mixed or full blood, shall have the right identity themselves, their spouses and descendants, as Bangsamoro*".

The Bangsamoro people collectively include the thirteen ethnolinguistic groups native to the southern Philippines namely, the Bajao, Iranun, Jama Mapun, Kalagan, Kalibugan, Maguindanao, Palawanon, Maranaw, Molbog, Sama, Sangil, Tausug, and Yakan. With livelihoods and culture intimately intertwined with nature, the Bangsamoro people living within the traditional territory safeguard several Key Biodiversity Areas or KBA's (i.e., Lake Lanao, Mount Piagayungan, and Tawi-Tawi Island). These designated KBA's in the Bangsamoro region is of global importance to biodiversity conservation of terrestrial, freshwater, and marine ecosystems.

Distribution and ecology

Begonia bangsamoro thrives within the riparian forest along the Ginapukan river in Sitio Trese, Barangay Banga, Wao, Lanao del Sur, BARMM. The population of this species is sparsely distributed on the forest floor and along the river banks with a closed canopy. Some individuals were observed to creep up and shallowly rooting into a wet substrate such as the roots of tree fern to gain support and height. This forest fragment, however, is surrounded by agricultural lands, in particular, vegetable and sugarcane plantations. To date, this species is observed in Lanao del Sur, but the full extent of the distribution is not known due to the inaccessibility of certain provinces within the Bangsamoro region.

Conservation status

With the expanding plantation of cash crops and continuous clearing of the forests (Figure 5.4), the population of this species within the fragmented forest is restricted and faces a potential decline in the near future. The entire population of *B. bangsamoro* composed of about 180 individuals occurs within one km^2. The nearest *B. bangsamoro* population is approximately 30 metres away from the forest edge surrounded by the aubergine and coffee plantations. As such, following the IUCN Red List Version 14, Category D for species with a very small or restricted population, we recommended the inclusion of *B. bangsamoro* in the Endangered (EN) category considering its population is < 250 mature individuals.

Figure 5.4 Plantation of cash crops surrounding the forest patch and clearing in the forest edge

5.4 Discussion

Following the provision of the Shenzhen Code; Section 4 Name of Species; Article 23 (Turland et al., 2018), the specific epithet *bangsamoro* was chosen for the new *Begonia* species. The species name reflects not only the plants' place of origin but also the identity of both the indigenous inhabitants and the native flora. This work exemplifies the potential contribution of scientific discovery in recognising indigenous peoples' identity, traditional land, and right to self-determination. Beyond identification, the incorporation of cultural knowledge, vernacular, and place names as epithets can empower and motivate indigenous cultures in taxonomic work through a shared sense of ownership over the species and the choice of epithet (Veale et al., 2019). This approach preserves the indigenous language and dialects which further enhance awareness and understanding about local conservation amongst the local communities (Wehi et al., 2019). Indeed, taxonomy and other field studies can be an intersection of science and social justice which encapsulates diversity (inclusion of different types of people), equity (broadening participation and achievement), identity (how one views him/herself and how he/she is viewed by others), and creativity (expanded view of innovation) (Erduran et al., 2020). Considering the number of human rights violations committed against indigenous peoples in the name of conservation (Buergin, 2015; Domínguez & Luoma, 2020; Duffy et al., 2019; Hitchcock, 2019; Loperena, 2016; Tauli-Corpuz, 2016), creating a social impact is of great significance to change the negative connotations regarding field scientists working on indigenous lands and natural resources.

In terms of plant resources, the Philippines has one of the highest species diversity of *Begonia* with a total of 140 species (Pelser et al., 2011). Out of the three sections occurring in the country viz., *Petermannia*, *Diploclinium*, *Baryandra* (Rubite, 2013), the new *Begonia bangsamoro* is classified under section Petermannia. This group has a cane-like or shrubby habit, protogynous, terminal inflorescences often with paired or solitary female flowers at the base, larger terminal cyme of male flowers, and pistillate flowers with three ovarian locules each usually with a bilamellate placenta (Girmansyah et al., 2019; Lin et al., 2017).

Botanically, *Begonia bangsamoro* exhibits morphological affinities with two other *Begonia* species occurring in the island of Luzon and Visayas, Philippines. Designated in the section Petermannia, *Begonia incisa* (De Candolle, 1859) (Figure 5) and *Begonia contracta* (Warburg, 1904) (Figure 6) bears lamina with lacerate margins and a terminal staminate inflorescence and a 5-tepaled pistillate flower similar to *B. bangsamoro*.

In delineating the three taxa, the original botanical descriptions in Latin[3] were translated and referred to the terminologies of Short & George (2013) and Stearn (1983). The digitised copy of the type specimens of *Begonia contracta* Warb. and *Begonia incisa* A. DC. were likewise examined through the Global Biodiversity Information Facility (https://www.gbif.org/). Unfortunately, the botanical descriptions translated in the English language were incomplete as the type specimens of *B. contracta* Warb. and *B. incisa* A.DC. described in the protologues were sterile. The supplemental data, particularly on the floral parts, were based on the *in situ* observations of Y.P. Ang and M.A.K. Pranada of the Philippine Taxonomic Initiative, and descriptions of Rubite (2013).

Based on the results, the new taxon, *B. bangsamoro* differs from *B. contracta* Warb. by having pubescent stem (vs. glabrous), leaf adaxial surface puberulous (vs. glabrous), 4 (vs. 2) staminate tepals, red ovate stipules with aristate apex, and sparsely puberulous (vs. glabrous) ovary. In comparison with *B. incisa* A.DC., *B. bangsamoro* differs distinctively by having

[3] the use of English language in the diagnosis was only adopted in 2012 (Miller et al., 2011; Nicolson et al., 2017)

pubescent setose stem (vs. puberulous with finer hairs), stipules which are ovate (vs. lanceolate-subulate), 4 (vs. 2) staminate tepals, ovary sparse hirsute (vs. puberulous). The morphological comparison between the three *Begonia* species is summarised in Table 5.1.

Table 5.1 Morphological comparison of the three Philippine *Begonia* species.

Character	*B. contracta* * (Fig 5.6)	*B. incisa* ** (Fig 5.5)	*B. quercifolia**	*B. bangsamoro* (Figs 5.2, 5.3)
Height (cm)	80	50	-	*ca.* 55
Stem				
vestiture	glabrous	puberulous	glabrous	pubescent (*ca.* 2mm long)
diameter (mm)	3–4	5–7		2–3
internodes (mm)	30–50	40–70	21-32	32.9–65.8 mm
Stipule				
shape	oblanceolate	lanceolate-subulate	oblong	ovate
dimension (mm)	9 × 4	7 × 2	5-10 length	9.4 –13.1 × 7.2–7.5
Petiole				
vestiture	glabrous	puberulous	sparsely pilose	puberulous
length (mm)	15–20	10–17	7.5 -61	2.0–6.5
Leaves				
shape	obovate	obovate-oblong	oblong	lance-ovate
dimension (cm)	9–11 × 3–4	7–12 × 3–5	9.5–14.4 × 2.8–5	7.6–10.8 × 3.1–4.1
margins	irregularly and coarsely dentate and denticulate	deeply incised, irregularly dentate, and ciliate	deeply incised, irregularly dentate	lacerate, serrated to doubly-serrated, shallowly undulating, ciliate
adaxial vestiture	glabrous	puberulous	sparsely pilose	minutely puberulous
Bract				
shape	oblanceolate	ovate	oblong	ovate
dimension (mm)	8 × 4	5 × 4	3–5 × 2–3	5.2 × 1.7
Staminate flower				
tepal count	2	2	2	4
outer tepal shape	broadly ovate, apex obtuse	broadly ovate, apex acute	-	ovate to widely elliptic, apex bluntly obtuse
Ovary vestiture	glabrous	puberulous**	glabrous	sparse hirsute

*In addition to type description from protologues (De Candolle, 1859; Warburg, 1904), morphological data were supplemented with descriptions from Rubite (2013) and digitised herbarium collections freely available in the Global Biodiversity Information Facility (https://www.gbif.org/).

**From observation of live specimen in-situ at Cuernos de Negros, Siaton, Negros Oriental.

Figure 5.5 Field photographs of *B. incisa* from Cuernos de Negros, Siaton, Negros Oriental. **A**. Habitat; **B, B'**. Leaf adaxial and abaxial surface respectively; **C**. Inflorescence and staminate flowers; **D, D'**. immature capsule side view and face view respectively. *Photo Credit: Y.P. Ang and M.A.K. Pranada (Used with permission).*

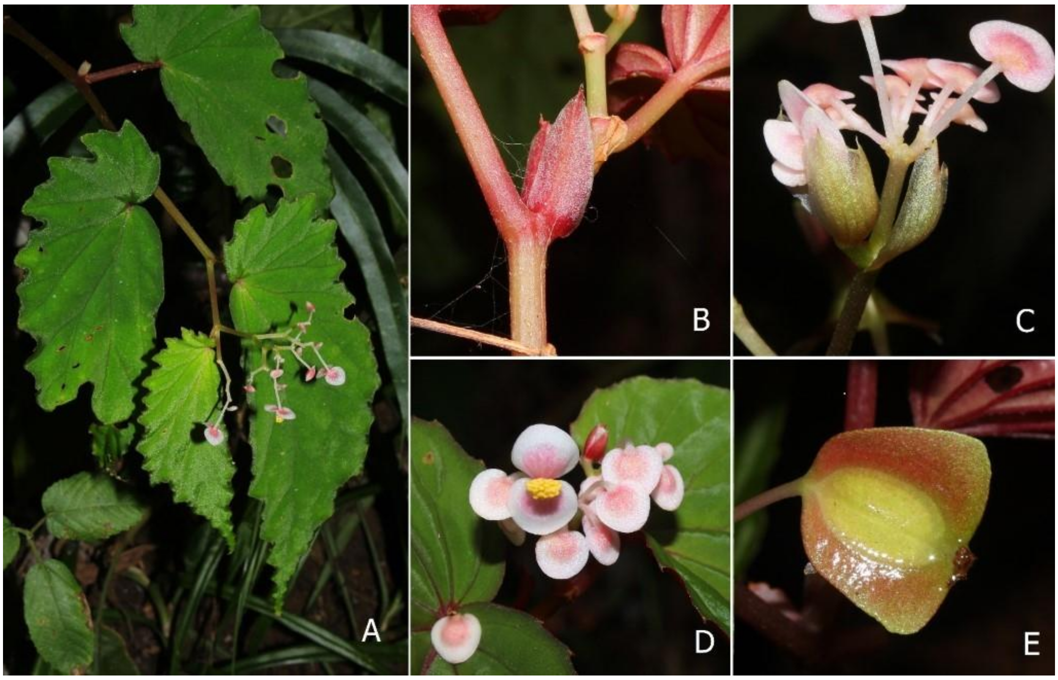


Figure 5.6 Field photographs of *B. contracta* **A**. Habitat; **B**. Stipule; **C**. Bract; **D.** Staminate inflorescence; **E.** Immature ovary. *Photos by M.A.K. Pranada (Used with permission).*

Within the region of Mindanao, *B. mindanaensis* (Figure 7) resembles *B. bangsamoro* by bearing leaves with lacerate margins and a 4-tepaled staminate flower. However, it can be easily differentiated by having axillary (vs. terminal) inflorescence.

Figure 5.7 Field photographs of *B. mindanaensis* from Mount Hamiguitan, Davao Oriental. **A**. Habitat and habit; **B, B'**. Leaf adaxial and abaxial surface respectively; **C**. Staminate flower face view; **D**. Pistillate flower face view; **E**. Pistillate flower side view. *Photos by M.A.K. Pranada (Used with permission).*

In the peer-review process, however, the reviewers further suggested the species delimitation of *Begonia quercifolia* DC occurring in the islands of Samar and Leyte, and the Mindanao endemic *Begonia bangsamoro* based on island biogeography and morphological examinations of the aforementioned species. As widely known, *Begonia* colonisation in Malesia is characterized by distinct dispersal patterns and massive island-endemic radiations (Thomas et al., 2012). This pattern of colonisation followed by island-by-island differentiation also supports the diversification of both flora and fauna in the Philippines (Jones & Kennedy, 2008). After colonisation, gene flow apparently halts in most island groups as evidenced by monophyletic island populations with virtually no shared haplotypes among them to suggest recent gene flow (Jones & Kennedy, 2008).

Within the clade of Sulawesi species assigned to the *Begonia* section Petermannia, for example, two patterns are notable. Firstly, there is no indication of exchange between neighbouring islands, except for the presence of the Philippine *Begonia pseudolateralis* nested within this clade. Secondly, *Begonia* species (section Petermannia) exhibits considerable geographic structure, and every major peninsula (north, east, south-west, and south-east) shows clades of endemics (Thomas et al., 2012). The presence of island-endemics is also notable in the Philippine archipelago. An example of island-endemics includes *Begonia elnidoensis, Begonia acclivis*, and *Begonia beijnenii* which are only known from Palawan Island*; Begonia biliranensis* exclusively occurring in Samar Island; and *Begonia halconensis* from Mindoro Island. Similarly, *Begonia quercifolia* DC, a narrow-range endemic species appeared to be geographically restricted within the islands of Samar and Leyte (Figure 5.8).

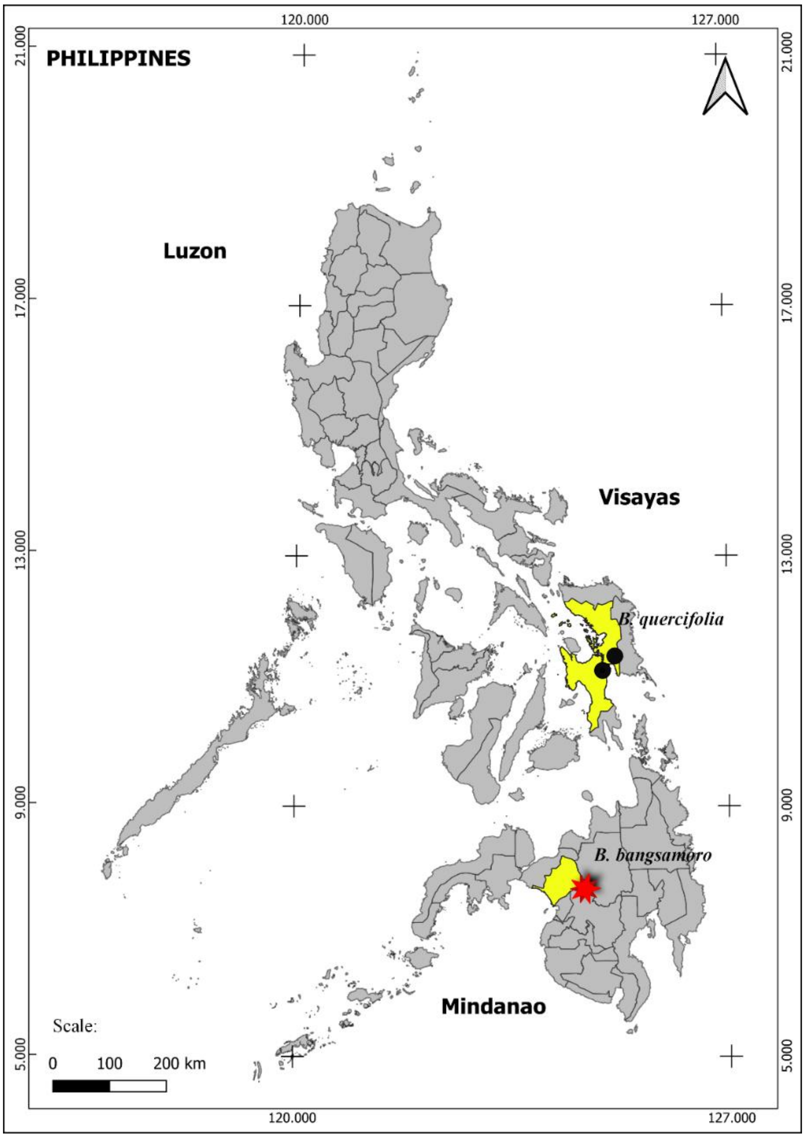


Figure 5.8 Map of the Philippines indicating the type locality of *B. bangsamoro* in Mindanao *B. quercifolia* in the islands of Samar and Leyte.

For centuries, there are no known collection or any report of this species outside this range, even in the neighbouring islands of Cebu and Bohol. Whilst the dispersal ecology of many *Begonia* in section Petermannia is unknown, anemochory or dispersal by wind is unlikely to result in long dispersal distances (i.e., Mindanao island) in suitable conditions of the moist ground layer habitats preferred by the majority of Asian *Begonia* species (Hughes & Hollingsworth, 2008). Moreover, *B. quercifolia* DC thrives in the lower elevation (750 feet) whereas *B. bangsamoro* is restricted in higher elevation (1, 197 m.a.s.l.).

Apart from the biogeographical limitations, we present the key diagnostic characters that would distinguish the Mindanao endemic *B. bangsamoro* from the Samar-Leyte endemic *B. quercifolia* (Table 5.1). The two species remarkably differ in both vegetative (i.e., stipules and leaf shape) and floral characters (i.e., type and position of inflorescence, number of staminate tepals). Additionally, the type specimens of *B. quercifolia* collected by Cuming (1696) exhibit persistent bracts in the staminate inflorescence as opposed to the caducous bracts of *B. bangsamoro* (Buenavista, Ang, et al., 2021). Moreover, *B. bangsamoro*, can be also readily distinguished from *B. quercifolia* by the number of their staminate tepals with 4 for the former and 2 for the latter. As such, *Begonia bangsamoro* is a distinct species from Mindanao Island. With regards to the conservation assessment, *B. bangsamoro* was provisionally designated Endangered (EN) since its population is composed of < 250 mature individuals based on the 2020 field survey. The remaining population is under threat of the ongoing clearing for the expanding plantation. The nearest *B. bangsamoro* population is approximately 30 metres away from the forest edge surrounded by vegetable and sugarcane plantations. With its deteriorating habitat, the need for a conservation translocation strategy, that is to move some of the wild population in a new habitat outside the species' current range (Rayne et al., 2020), should be explored to enhance the survival of the dwindling populations of *B. bangsamoro*. Though the Municipality of Wao has no botanical gardens or nature parks, this can be a feasible project with the local nurseries and the establishment of community gardens. Other *ex-situ* conservation approaches such as seed banking and *ex-situ* propagation may be accomplished through collaboration with various universities and government agencies (i.e., Bureau of Plant Industry, and Ministry of Environment, Natural Resources and Energy) in Mindanao. Also, a limited number of living collections may be translocated in botanic gardens (i.e., Central Mindanao University Botanical and Zoological Garden, Bukidnon) outside the region. As part of the biocultural heritage, the conservation of the region's threatened flora should be included in the agenda of the new Bangsamoro Government.

5.5 Conclusion

This chapter demonstrates the potential contribution of taxonomy in promoting social justice for indigenous peoples and their traditional territories. *Begonia bangsamoro,* a new species from the Bangsamoro region, Mindanao Island, Philippines represents the land, people, and identity. The new taxon has morphological affinities with *B. contracta* Warb., *B. incisa* A.DC., and *B. quercifolia* DC. from the islands of Luzon and Visayas, however, it has remarkably distinct vegetative and floral characters; pubescent stem, lance-ovate leaves, red ovate stipules with aristate apex, 4 tepaled staminate flowers, and a sparsely puberulous ovary. With < 250 mature individuals thriving within a fragmented forest, the wild population of *B. bangsamoro* is under threat hence, classified as Endangered under the IUCN criteria. Local conservation projects should be initiated in collaboration with the local communities and government agencies to protect and conserve the species. An *ex-situ* conservation strategy should be explored to rescue and conserve the remaining populations in the wild.

Chapter 6

General Discussion, Conclusion, and Recommendations

6.1 Discussion

6.1.1 Background

The field of Ethnobotany, the study of plants used by indigenous peoples was first established by botanists to find new medicines for the benefit of humankind (Balick & Cox, 2020; Heinrich, 2015b). Whilst products of indigenous plant knowledge saved millions of lives and profoundly advanced the field of basic and applied sciences (Howes et al., 2020; Singh et al., 2020), the source of this knowledge – the indigenous peoples in traditional territories, are often deprived of basic human rights, and have been rarely "recognised" and protected against violence and environmental crimes (Global Witness, 2020; Sylvander, 2021; Tauli-Corpuz et al., 2020; Tauli-Corpuz, 2016).

To explore this social, political, and environmental trilemma, I integrated the principles of indigenous peoples' rights, social and environmental justice in the field of ethnobotany and taxonomy. This Ph.D. thesis, in particular, identified the knowledge gap concerning indigenous peoples' socio-political marginalisation in Asia and provided new insight into the potential of IKSP in addressing the local and global challenges outlined in the UN SDGs (Chapter 2). Aside from the SDGs, I also emphasised the need of implementing the provisions of the CBD and Nagoya Protocol to protect the IKSP and the associated genetic resources of the indigenous peoples. Drawing upon the ethnobotanical knowledge of the Higaonon tribe of Bukidnon, I demonstrated in Chapter 3 the potential of the Higaonon tribe's traditional food system in leveraging the Philippines' perennial problem of rice shortage and poor nutrition to achieve SDG 2 (Zero Hunger). With the wider use of NUS, the diversification of food and nutrient sources appeared to be a promising strategy considering that rice cultivation significantly contributes to global agricultural and anthropogenic greenhouse gas emissions. Within the Higaonon tribe's traditional food system, I also explored the potential benefits of knowledge co-production by bridging indigenous knowledge and science-based knowledge systems. This was accomplished by investigating the molecular identity and traditional detoxification process of a poisonous wild yam (*Dioscorea hispida* Dennst.) which provided an important molecular protocol that is useful in the improvement of food safety in local communities (Chapter 4). Apart from advancing the field of food ethnobotany, my Ph.D. thesis also presents the discovery of an undescribed species of *Begonia* L. (Begoniaceae) and further provided new insights on upholding social justice and ethical considerations in the taxonomic nomenclature of plants (Chapter 5). I tackled this topic by exploring how the name of a species could positively or negatively impact public perception and the willingness of the stakeholders to support conservation. Using *indigenous peoples* and *plants* – the common thread running throughout this Ph.D. thesis, the key findings of the thesis chapters are discussed in the broader context in this section.

6.1.2 Indigenous peoples and Sustainable Development Goals

The literature review (Chapter 2) describes the social and political issues on the recognition of indigenous peoples and their inclusion in the SDGs of the 2030 Agenda. Though indigenous peoples are now included in the global development plan, the exclusion of social and environmental justice in the language and spirit of the 2030 Agenda undermines its promise of "No one will be left behind" (Menton et al., 2020). Environmental justice embodies the need for equity, recognition, participation, and other capabilities for the basic functioning of nature, culture, and communities (Schlosberg, 2007, 2013; Schlosberg & Carruthers, 2010). In the absence of social and environmental justice, many indigenous peoples will continue to live without citizenship and rights to traditional lands and natural resources despite the adoption of UNDRIP in all Asian nations (Buenavista et al., 2018). Degai & Petrov (2021) proposed to address this policy gap by revising the existing 17 goals with the additions of "Sustainable Governance and Indigenous Rights", "Resilient Indigenous Societies", "Livelihoods and Knowledge systems" amongst others. Yet, the 2030 Agenda is not a legally binding instrument (Biermann et al., 2017). As such, its implementation, especially with regard to achieving the 17 SDGs and 169 targets, depends significantly on the practice of evidence-based monitoring and evaluation at the national and international levels (Yonehara et al., 2017).

Relevant to the SDGs and targets, the IKSP of indigenous peoples could potentially contribute to food security, community livelihoods, human well-being, natural resources management, and biodiversity conservation (Buenavista et al., 2018). Moreover, IKSP is intimately intertwined with traditional territories or ancestral domains in a way that when plant species are driven to extinction, the knowledge networks collapse as well (Cámara-Leret et al., 2019; Seyler et al., 2020). Consequently, cultural erosion (i.e., language extinction) coupled with the loss of biodiversity could also lead to the extinction of indigenous knowledge (Cámara-Leret & Bascompte, 2021; Wilder et al., 2016).

Indigenous peoples' lands are of global conservation priority (Fa et al., 2020; Garnett et al., 2018), and their protection is vital for the survival of many indigenous communities as well as in the preservation of indigenous knowledge systems (Reyes-García & Benyei, 2019). Indigenous peoples are also recognised stakeholders in various international initiatives of the CBD, IPBES, and IPCC (Ford et al., 2016; Hill et al., 2020; Tengö et al., 2017). As such, beyond the SDGs, the call for legitimate recognition of indigenous peoples and local communities' rights is being advocated in relation to the post-2020 Biodiversity Agenda and the CBD's 2050 vision of "Living in harmony with nature" (Reyes-Garcia et al., 2021).

As stewards of biodiversity, indigenous peoples' rights must also be protected. Although every country in Asia has a different political and judicial system, every state should revisit its commitments and obligations vis-à-vis the Convention on Biodiversity and the Nagoya Protocol – two of the most important legally binding treaties. As stated in the Convention of Biological Diversity, Article 8(j) (Secretariat of the Convention on Biological Diversity, 1992): Each contracting Party shall, as far as possible and as appropriate:

"*Subject to national legislation, respect, preserve and maintain knowledge, innovations, and practices of* ***indigenous and local communities*** *embodying traditional lifestyles relevant for the conservation and sustainable use of biological diversity and promote their wider application with the approval and involvement of the holders of such knowledge, innovations, and practices and encourage the equitable sharing of the benefits arising from the utilization of such knowledge innovations and practices*".

Moreover, the Nagoya Protocol adopted in 2010 significantly advances the Convention's third objective on the fair and equitable sharing of benefits arising from the utilisation of genetic resources by providing a strong basis for greater legal certainty and transparency for both providers and users of genetic resources (Secretariat of the Convention on Biological Diversity, 2011). In addition, the Nagoya Protocol's provisions on access to traditional knowledge held by indigenous and local communities associated with genetic resources also strengthen the ability of indigenous communities to benefit from the use of their knowledge, innovations, and practices (Secretariat of the Convention on Biological Diversity, 2011).

The Nagoya Protocol provided legal protection over the cultural and spiritual integrity of indigenous knowledge and natural resources which is being unfairly appropriated for commercial gains using patents (Robinson et al., 2018). One of the well-known cases of biopiracy is the *Hoodia* plant which contains P57 or oxypregnane steroidal glycoside, an appetite suppressant (Kapepiso & Higgs, 2020). Following observation and documentation of the San people's knowledge of *Hoodia,* research has since been conducted to isolate P57 leading to drug development and clinical trials by Phytopharm, Pfizer, and Unilever to develop a slimming drug for commercialisation (Kapepiso & Higgs, 2020). The injustice of bio-pirating indigenous resources leads, somehow, to the erasure of indigenous knowledge as the people perceived the feeling of being robbed of their resources and knowledge. The San's *Hoodia* knowledge was also found to have been de-contextualised by the researchers who exploited the plant for research and commercial use (Kapepiso & Higgs, 2020).

As part of the global report on CBD, the Local Biodiversity Outlooks 2 launched in September 2020 featured significant contributions from over 50 indigenous and local authors and communities (IIFB et al., 2020). The report highlights the critical roles played by indigenous peoples and local communities (IPLCs) in maintaining and enhancing biological and cultural diversity and outlines indigenous and local perspectives on the transformational changes needed to realise the vision of a world living in harmony with nature (IIFB et al., 2020).

In this regard, the proposed addition to the SDGs may be unnecessary considering that IKSP and the associated genetic resources are protected under the CBD and the Nagoya Protocol. The implementation, compliance, and assessment, however, must be clearly defined at the local and regional policies. Whilst local governments (i.e., cities and municipalities) are not directly involved in the negotiation of international agreements, which are signed by the national government, these agreements and obligations are implemented at the local level (Puppim de Oliveira et al., 2011).

6.1.3 Food and nutrition security and Food Ethnobotany

Unlike the rice-centred diet of the Filipinos, the Higaonon food system (Chapter 3) relies on diverse staples such as corn, cassava, sweet potatoes, arrowleaf elephant ear, taro, bananas, and wild yams. For other indigenous groups such as the Ati and Suludnons in Iloilo, Philippines, the cultivation of these crops (i.e., cassava, taro, and sweet potato) is associated with strategic preparation for an extreme event such as the El Niño phenomenon (Nelson et al., 2019). In the aftermath of a climatic shock of super-typhoon Ompong in 2018, root and tuber crops such as cassava and sweet potatoes also significantly contributed to household resilience capacity in the Philippines (Gatto et al., 2021). Since underground crops are spared from the super-typhoon, root crops like sweet potato provide a readily available source of food which also reduces the household's need to mobilize their savings and/or need to solicit food from others (Gatto et al., 2021). Moreover, the locals were able to sell these crops in local markets to generate cash income or exchanged them for other desired consumables (Gatto et al., 2021).

Tapping alternative food sources has never been more important with the disruptions of the global food system due to the COVID-19 pandemic (Béné, 2020; Laborde et al., 2020). The global crisis revealed how unprepared the world was to respond appropriately to the pandemic (Béné, 2020), and it also showed how the Philippines struggled after the ASEAN neighbours temporarily stopped the rice importation (Reuters, 2020b).

Within the context of leveraging rice shortage and improving the needed nutrition of Filipinos, the local plant resources of the Higaonon tribe are available, accessible, utilised, and stable – the "four pillars" of food and nutrition security (El Bilali et al., 2019; FAO et al., 2020). The various collection sites of the Higaonon tribe (i.e., farm, forest, homegardens, etc.) may be considered as "food biocultural refugia" considering its socio-ecological function in addressing food security, biodiversity conservation, and preservation of indigenous knowledge (Barthel et al., 2013; Sõukand & Pieroni, 2019b).

Finding an alternative to rice also addresses the global concern on global warming. Rice is the world's second-most-produced staple crop and its cultivation is one of the largest human-induced sources of the potent greenhouse-gas (GHG) methane (CH_4) (Carlson et al., 2017; Groenigen et al., 2012). Worldwide, rice cultivation is responsible for over 10% of global agricultural greenhouse gas (GHG) emissions and about 1.3% to 1.8% of the anthropogenic GHG emissions (Maraseni et al., 2017). The increasing GHG and the warming climate are also projected to negatively affect the future of rice cropping systems and global food security (Chen et al., 2020; Groenigen et al., 2012).

Apart from the environmental harm caused by intensive rice cultivation, the rice-centred diet is also nutrient-poor. As discussed in Chapter 3, the monotonous rice diet of many Filipinos may explain the prevalence of protein-energy malnutrition and micronutrient deficiencies such as anaemia, vitamin A deficiency, and iodine-deficiency disorders (Capanzana & Aguila, 2020; Department of Science and Technology-Food and Nutrition Research Institute (DOST-FNRI), 2015). One way to solve this problem is crop diversification through the wider use of NUS for food and nutritional security (Li et al., 2020; Siddique et al., 2021). To identify and promote the wider use of NUS, the FAO under its Regional Initiative on Zero Hunger (RI-ZH) initiated the Future Smart Food (FSF) Initiative to support countries in the identification of NUS with high potential to be integrated into agricultural and food systems (Li & Siddique, 2018). Future Smart Food is defined as NUS that is nutritionally-dense, climate-resilient (e.g., require low inputs, promote climate change resiliency, environmentally friendly by reducing runoff and erosion), economically viable (generate income and reduce physical labour), and locally available or adaptable (Li et al., 2020; Li & Siddique, 2018).

Through ethnobotanical approach, many scholars probe the local/indigenous food systems to examine the potential food uses of NUS (Borelli et al., 2020; Gallois et al., 2020; Hunter et al., 2019; Kuhnlein, 2002; Kuhnlein et al., 2006; Kuhnlein, 2014; Pawera et al., 2020; Sarkar et al., 2020). In the Philippines, this ethnobotanical information could be obtained from indigenous peoples such as the Higaonon tribe of Bukidnon. The indigenous knowledge of utilising non-traditional foods, in particular, improves the resilience of some indigenous and local communities by exploiting certain plants that are often neglected due to toxicity or undesirable properties. Yet, these poisonous plants could be tapped as supplemental food that is safe for human consumption when aptly processed and consumed. The traditional detoxification of dioscorine and cyanide-containing *Dioscorea hispida* Dennst. described in Chapter 4 provided valuable insights on the important contribution of IKSP in the resilience of indigenous communities. Similar to *Dioscorea hispida* Dennst., the traditional knowledge of detoxifying the poisonous *Cycas revoluta, Aconitum carmichaelii,* and *Pangium edule* also played an important role as emergency food for local communities (Hayward & Kuwahara, 2013; Kang et al., 2012; Nelson et al., 2019). For the residents of Amami Islands in Japan, the further improvement in the food processing of "sotetsu" or *Cycas revoluta* eventually provided a livelihood for the locals (Hayward & Kuwahara, 2013). Interestingly, *Pangium edule*, a non-traditional food plant of the indigenous Suludnons in the Philippines is primarily used as a fish poison (Nelson et al., 2019). The fruit of *Pangium edule* is traditionally processed by boiling, slicing, soaking the fruit in flowing water for two nights to be safely eaten (Nelson et al., 2019). The taste of boiled fruit was described to be like smoked coconut meat and is eaten together with boiled sweet potato and cassava (Nelson et al., 2019).

Pertinent to SDG 2, Hunter et al. (2019) proposed two key strategic actions that any country can take to promote the greater utilization of NUS to address healthy diets and improved nutrition:

1. Establish effective research partnerships that undertake nutritional composition work to strengthen a key part of the knowledge base; and
2. Set up multi-sectoral platforms or target already existing platforms that are in a position to use this new knowledge to better mainstream NUS into relevant national nutrition and food security policies, strategies, and actions.

Ethno-culinary tourism development and innovations could be used to promote the appreciation of the indigenous food system (Pereira et al., 2019; Putri et al., 2017; Wijaya, 2019; Yeh et al., 2021). This could be initiated through respectful collaboration between indigenous peoples organisations, academic institutions, NGOs, and government agencies. An example is the development of indigenous-focused food guides, community-based food programmes, and Food Wisdom Repository launched in Canada (Johnson-Jennings et al., 2020; Kamal et al., 2015; Skinner et al., 2021; Wilson & Shukla, 2020). Creating an online database of food recipes with indigenous ingredients was also proposed for the wider dissemination of knowledge (Marcial et al., 2017). In Nepal, NUS projects were strategically positioned to the achievement of SDG 2 by transforming NUS into Future Smart Food (Joshi et al., 2019). Value addition also showed to be a highly strategic intervention in popularising NUS as nutritionally rich local crops (Kahane et al., 2013). In India, for example, the different traditional foods prepared with minor millets proved to have a promising potential for enhancing nutrition security and income generation for the indigenous community, especially for the women (Yenagi et al., 2010). Such initiatives could benefit the indigenous community, the region’s agrobiodiversity as well as the local economy.

6.1.4 Co-production of knowledge with indigenous peoples

Worldwide, researchers, funding agencies, and global scientific organisations suggest that research aimed at addressing sustainability challenges is most effective when ‘co-produced’ by academics and non-academic actors such as the government, NGOs, and indigenous peoples (Norström et al., 2020). Conceptually, knowledge co-production is part of the evolving participatory and transdisciplinary research approach which rejects the notion that scientists are solely in charge to identify the problem, conduct the research, and deliver knowledge to society (Norström et al., 2020). Traditionally, nature conservation has been pursued separately from aspects of cultural heritage; a situation which seems perplexing when we consider the significance of local and indigenous peoples’ in the maintenance of biodiversity in many areas now “protected” for nature (Bridgewater & Rotherham, 2019). The knowledge co-production approach is therefore adopted in this study since the research project aimed to establish respectful collaboration with indigenous peoples, specifically the Higaonon tribe of Bukidnon. It is also grounded on the rationale that landscape change and the alarming biodiversity loss are occurring in areas inhabited by indigenous peoples (Garnett et al., 2018; Kik et al., 2021b, 2021a). Yet, cultural and linguistic diversity remains an underappreciated component of biodiversity (Frainer et al., 2020).

In Chapter 4, I explored one of the interesting components of the Higaonon food system which is the utilisation of a poisonous wild yam (*Dioscorea hispida* Dennst.), an important famine food of the tribe and other rural communities in the Philippines. The study demonstrated the potential benefits of bridging indigenous knowledge and science-based knowledge systems as exemplified by the accurate identification of the plant through DNA barcoding (science component) coupled with the traditional process of yam detoxification (indigenous knowledge component). The knowledge co-produced in this project was accomplished using the "Two-Eyed Seeing" – a research approach that can be applied by many field scientists working with indigenous peoples. Two-Eyed Seeing both accepts the contribution of indigenous peoples and scientists without one knowledge system subsuming the other (Abu et al., 2020).

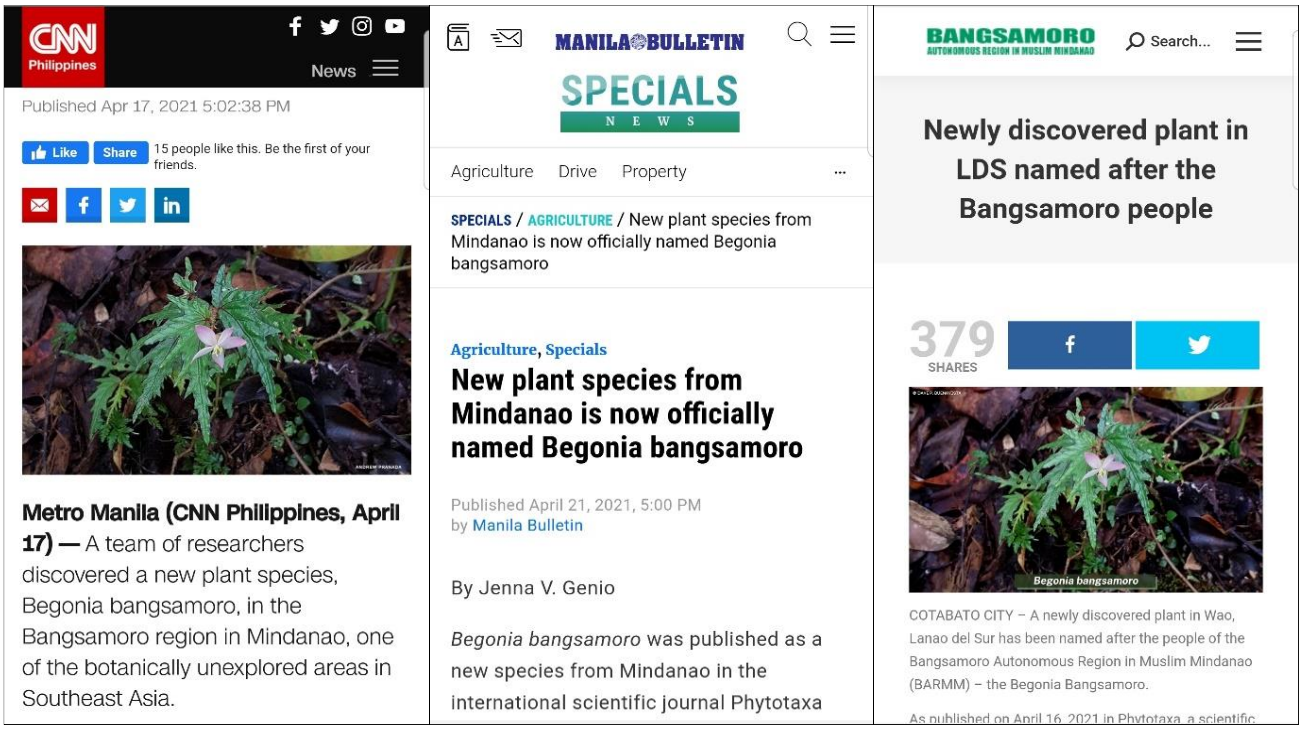
The Two-Eyed Seeing approach has been advocated by many scholars who worked with indigenous peoples as it creates a space for science and indigenous perspectives to come together using the best of both worldviews to aid understanding and solve complex problems (Abu et al., 2020; Arsenault et al., 2018; Colbourne et al., 2019; McKivett et al., 2020; Rayne et al., 2020; Reid et al., 2020; Wright et al., 2019). Two-Eyed Seeing enables researchers to respectfully and effectively work with different epistemologies and ontologies in the process of developing new and innovative strategies (McKivett et al., 2020).

This is in contrast to the integration approach which has been popular for several decades (Bohensky & Maru, 2011). Yet, the "integration" of indigenous knowledge and science has long been criticised for the implicit assumption that the cultural beliefs and practices referred to as indigenous knowledge conform to western conceptions about knowledge (Nadasdy, 1999). It also disregards the power relations between indigenous peoples and the state by assuming that indigenous knowledge is simply a new form of data to be incorporated into existing management bureaucracies that principally served the state rather than the indigenous peoples (Nadasdy, 1999).

On the other hand, the Two-Eyed Seeing approach follows the "weaving" principle adopted by IPBES and CBD which emphasises collaborations that respect the integrity of each knowledge system (Hill et al., 2020; Tengö et al., 2017). As described in Chapter 3, food safety and subsistence could be improved in local communities if scientists can help with identifying edible species from the poisonous species that require further processing. Yet, indigenous knowledge is equally valuable in addressing the problem of food safety since the indigenous practice of yam detoxification allowed the safe consumption of otherwise poisonous food plants. Many rural communities in the Philippines could potentially benefit from these findings considering that the incidence of yam poisoning is still happening in the country. On the 10th of April 2020, 80 residents from Sagay City, Negros Occidental, Philippines were hospitalised due to the consumption of porridge made of unprocessed *Dioscorea hispida* Dennst. (Guadalquiver, 2020). Indeed, research engagements with indigenous peoples can offer positive and beneficial outcomes especially in the appropriate usage of neglected and underutilised food plant resources.

6.1.5 Bangsamoro – the name of the land, people, and identity

Apart from being important biocultural refugia, indigenous peoples' land and traditional territory also harbor an undescribed species of a horticulturally important *Begonia* L. (Chapter 5). The discovery of a new threatened species raised the social consciousness of many Filipinos on the conservation value of the species as well as its habitat within the indigenous territories. After the article was published in Phytotaxa, many news agencies in the Philippines featured the discovery of *Begonia bangsamoro* (Figure 6.1).


CNN Philippines
News
Published Apr 17, 2021 5:02:38 PM
Like Share 15 people like this. Be the first of your friends.

Metro Manila (CNN Philippines, April 17) — A team of researchers discovered a new plant species, Begonia bangsamoro, in the Bangsamoro region in Mindanao, one of the botanically unexplored areas in Southeast Asia.

MANILA BULLETIN
SPECIALS NEWS
Agriculture Drive Property
SPECIALS / AGRICULTURE / New plant species from Mindanao is now officially named Begonia bangsamoro

Agriculture, Specials
New plant species from Mindanao is now officially named Begonia bangsamoro
Published April 21, 2021, 5:00 PM
by Manila Bulletin

By Jenna V. Genio

Begonia bangsamoro was published as a new species from Mindanao in the international scientific journal Phytotaxa

BANGSAMORO
AUTONOMOUS REGION IN MUSLIM MINDANAO
Search...
Newly discovered plant in LDS named after the Bangsamoro people
379 SHARES
Begonia bangsamoro
COTABATO CITY – A newly discovered plant in Wao, Lanao del Sur has been named after the people of the Bangsamoro Autonomous Region in Muslim Mindanao (BARMM) – the Begonia Bangsamoro.

Figure 6.1 *Begonia bangsamoro* featured by the various news agency in the Philippines

Whilst the potential impacts of social media in conservation science are still poorly understood (Minin et al., 2015; Wu et al., 2018), the publicity of newly discovered species, especially horticulturally valuable begonias had both positive and negative outcomes in the Philippines. Recently described species like *Begonia beijnenii* and *Begonia cabanillasii,* though classified as threatened species, were illegally harvested by some locals for local trade (Cetenta, 2020; Fabro, 2020). Unfortunately, the pandemic heightened the commercial plant trade especially in large cities in the Philippines. The so-called “plantdemic” fuelled the interest of many new plant enthusiasts also known as “plantitos” and “plantitas” to collect decorative and highly-priced plants. Apparently, entrepreneurs and workers who lost their wages during the pandemic have begun selling plants to make ends meet as the demand for ornamental plants increased, particularly in Manila – one of the world’s most densely populated cities (Ratcliffe, 2020). Yet, even before the pandemic, illegal wildlife trade is already a problem in the Philippines as well as in other Southeast Asian countries (OECD, 2019; Phelps & Webb, 2015; Phelps, 2015; The World Bank, 2005).

On a positive note, the public interest over the discovery of *Begonia bangsamoro* was profoundly positive that the Bangsamoro Government expressed its support for the protection of the species. As stated by the Senior Minister Abdulraof A. Macacua of the Ministry for Environment, Natural Resources and Energy (MENRE):

“The RA No. 11054 or the Bangsamoro Organic Law provides that the Bangsamoro Government, thru the ministry, shall give priority to the protection, conservation, and development of natural resources that will support ecological balance and biodiversity conservation in the region. This includes the management of the region’s biodiversity to ensure the protection of any rare, threatened, or endangered species and habitat critical to their survival” (Bangsamoro Information Office, 2021b).

Moreover, the provincial Environment Officer Asmarie M. Labao together with representatives from the Office of Bangsamoro Parliament Deputy Minority Floor Leader Atty. Rasol Mitmug, Jr. also visited the forests of Lanao del Sur to check the population of *Begonia bangsamoro* (Bangsamoro Information Office, 2021a). In a press report, the provincial officials also expressed their pride and support for the protection of *B. bangsamoro.* According to MENRE Provincial Officer Labao (Bangsamoro Information Office, 2021a):

"The discovery of this new plant species in our Inged a Ranaw signifies the richness of our place in terms of biodiversity. We will be proposing collaborative efforts with the local government units of Wao, non-governmental organizations, and academic institutions for possible partnership in the preservation and protection of the Begonia Bangsamoro and its habitat"

Source: https://bangsamoro.gov.ph/news/latest-news/menre-vows-to-protect-begonia-bangsamoro-plant/?fbclid=IwAR0ZkC04tRmqtwMkd5ikgwV_vYpRzVmc1XKQeYenXj8Yzqf9rBCuQdewwKA

Figure 6.2 Field survey conducted by members of the Ministry for Environment, Natural Resources and Energy of the Bangsamoro Government. Photo Credit: *Bangsamoro Information Office (Used With Permission*)

The public attention received by the *Begonia bangsamoro* is quite astounding considering the fact that many plants and animals are being discovered in the Philippines each year. What sets apart *B. bangsamoro* from other newly described species is that the specific epithet reflects the name and cultural identity of both the people and the land. The usage of indigenous names retains the language and dialects, supports the cultural aspirations, and implicitly acknowledges indigenous relationships with the environment (Wehi et al., 2019). After all, territories occupied by indigenous peoples are not only valued for their exceptional biodiversity but also for their cultural and spiritual significance – a critical driving force in nature conservation and ecosystem management (Liljeblad & Verschuuren, 2019; Verschuuren, 2006; Verschuuren et al., 2021).

Although the evidence in literature is still scanty, the designated name of a species appears to have a significant impact on how people relate to it, and this may be especially important for threatened endemic species, and the willingness of the locals to support conservation (Pillon, 2021). In an independent survey conducted by George Mason University in the U.S., species names with negative connotations provoked less support for conservation whilst charismatic sounding names prompted greater support for conservation (Karaffa et al., 2012). Since the founding of taxonomy by Linnaeus, it has been a common practice to name species after people (eponyms) for their contribution in the discovery or distinguished achievements in the field of botany (Figueiredo & Smith, 2011). At present, following the Shenzhen Code, the name of a species may be taken from any source and the author(s) have also been given the freedom to composed it arbitrarily (Turland et al., 2018).

Yet, in certain taxonomic groups like birds, most eponymous species tended to be named after non-local men (DuBay et al., 2020). The lack of connection and familiarity of species names to the locals could pose a problem in raising awareness and protection of the species. In the municipality of Wao, for example, the type locality of *Begonia bangsamoro* was also the same site of discovery for *Doliops cabrasae,* a beetle named after Analyn Anzano Cabras (Davao, Mindanao, Philippines) in "appreciation of cooperation" (Barševskis, 2017). Whilst it is not clear how the beetle specimens were legally obtained and deposited in Latvia, the locals of Wao and the local government unit are not aware of the existence of the species. In the published article, *Doliops cabrasae* was collected by an anonymous local collector in an unspecified local site without any information on its habitat, ecology, and distribution (Barševskis, 2017). Without the valuable ecological information, *Doliops cabrasae* will remain unknown to the place where it was discovered. Since a number of newly described species are often rare and endangered, adopting a more balanced approach to species naming may help to secure their future, particularly given the current extinction crisis (Pillon, 2021).

On the other hand, a more ethical and culture-sensitive approach in taxonomic naming could also promote social and environmental justice. In Chapter 5, by naming the plant after the Bangsamoro people, the researchers contributed to the societal recognition of the indigenous peoples' rights, and it also opened the opportunity for a meaningful engagement with the indigenous peoples and the government. This collaboration is vital in creating a novel framework for co-designing conservation strategies and management (Hamilton et al., 2020; Rayne et al., 2020). Conservation projects co-led with indigenous peoples could also be advantageous especially in ecosystem restoration and threatened species recovery (Rayne et al., 2020). This approach may be also explored in designing conservation projects to ensure the survival of *Begonia bangsamoro.*

6.2 Conclusion

This study showed that the social and political recognition of indigenous peoples and the protection of their ancestral domains/traditional territories and IKSP are important to achieve the SDGs. Indigenous lands functions as biocultural refugia, a reservoir of ethnobotanical knowledge, and as an integral component of indigenous peoples' identity. As a biocultural refugia, it is associated with the indigenous peoples' knowledge and experiences related to the traditional management of biodiversity and ecosystem services (Barthel et al., 2013). On the other hand, its role as a reservoir of ethnobotanical knowledge is valuable in sustaining food and nutritional security in rural communities. Indigenous peoples' connection with their ancestral domain is also a key component of indigenous identity.

Relevant to the SDGs, the Higaonon tribes' food ethnobotany provided insights into the potential of local plant resources in diversifying the food source and improving the nutrition of Filipinos. Indeed, as a country with exceptional biodiversity, a number of plant species are neglected and underutilised due to the scarcity of ethnobotanical data – a valuable knowledge source available from the indigenous peoples. By bridging indigenous knowledge and science-based knowledge systems, co-production of knowledge with the Higaonon tribe could also potentially improve the level of food safety, particularly with the safe consumption of wild yam (*Dioscorea hispida* Dennst.) and other poorly known edible wild species. It is hoped that this study could pave the way for more collaboration with indigenous peoples (i.e., development and promotion of local food products) which could also strengthen local food security, and provide an additional livelihood to the community – an important step towards achieving SDG 2 (Zero Hunger).

This study also presented the discovery of *Begonia bangsamoro* from Mindanao Island. The discovery of this species highlighted the conservation value of indigenous peoples' land and the potential contribution of the scientific community in upholding social justice as well as in the development of a more inclusive approach to conservation. Named after the Bangsamoro people of the southern Philippines, the unique specific epithet reflects the name and cultural identity of both the people and the Bangsamoro region, and implicitly acknowledges indigenous relationships with the environment. With the support of the Bangsamoro government, the socially just approach in taxonomy showed to have a positive impact on the future of species conservation.

6.3 Recommendations

The ASEAN should consider the establishment of regional policies relating to indigenous peoples to strengthen its commitment and carry out its international obligations on protecting the world's biodiversity and upholding social and environmental justice. On the other hand, indigenous peoples should also strengthen their political structures to be fully recognised and represented in local and international engagements. Research collaborations between scientists and indigenous peoples is highly desirable particularly on documenting indigenous knowledge and biological resources of traditional territories/ancestral domains to protect it against misappropriation and claims of so-called patents of "innovation".

With the inclusion of indigenous studies in the curricula of Philippine universities, the co-production of knowledge with indigenous peoples will hopefully contribute to mainstreaming indigenous peoples' rights, IKSP, rights-based conservation, and localisation of SDGs. Hopefully, this will also lead to the establishment of research centres devoted to indigenous research in the Philippines and other ASEAN countries.

Relevant to the aim of achieving SDG 2, this study also recommends the diversification of staples using locally available and underutilised crops considering the health consequence and environmental impacts of the rice-dependent diet of the majority of Filipinos. Though often classified as NUS, other food plants consumed by the Higaonon tribe may be further studied for nutrient composition analysis. This information could be used by different agencies of the Philippine government (i.e., Department of Health, Department of Agriculture, Bureau of Plant Industry) as well as NGOs in promoting the wider use of NUS to improve the levels of food and nutritional security amongst Filipinos.

Apart from the Higaonon food system, other uses of plant resources (i.e., traditional medicine, construction, livelihood, etc.) should be also explored to better understand the Higaonon tribe's relationship with their ancestral lands. Wild edible plants gathered from the forest are also of particular interest for DNA barcoding and bioprospecting for nutraceutical research.

In the case of *Begonia bangsamoro*, *in-situ* and *ex-situ* conservation strategies should be explored to save the threatened species. This may be achieved by initiating plant translocation, seed banking, and propagation projects in partnership with the local government units, university researchers, and the local community. The local government could facilitate the legal protection of the species whilst the members of the community could be likewise involved in the monitoring and seed collection for conservation projects.

7 References

Abbasi, A. M., Shah, M. H., Li, T., Fu, X., Guo, X., & Liu, R. H. (2015). Ethnomedicinal values, phenolic contents and antioxidant properties of wild culinary vegetables. *Journal of Ethnopharmacology, 162,* 333–345. https://doi.org/10.1016/j.jep.2014.12.051

Abdoellah, O. S., Hadikusumah, H. Y., Takeuchi, K., Okubo, S., & Parikesit. (2006). Commercialization of homegardens in an Indonesian village: Vegetation composition and functional changes. *Agroforestry Systems*, *68*(1), 1–13. https://doi.org/10.1007/s10457-005-7475-x

Abeto, B. R., Calilung, Z., Talubo, J. P., & Cumatang, B. (2004). *Community Mapping in the Philippines: A Case Study on the Ancestral Domain Claim of the Higa-onons in Impasug-ong, Bukidnon*. http://www.iapad.org/wp-content/uploads/2015/07/community_mapping_in_the_philippines.pdf

Abu, R., Reed, M. G., & Jardine, T. D. (2020). Using two-eyed seeing to bridge Western science and Indigenous knowledge systems and understand long-term change in the Saskatchewan River Delta, Canada. *International Journal of Water Resources Development*, *36*(5), 757–776. https://doi.org/10.1080/07900627.2018.1558050

Abubakar, A. U. (2019). The Study Area: Mindanao and the Bangsamoro Conflict Communities. In *Peacebuilding and Sustainable Human Development. The Anthropocene: Politik—Economics—Society—Science, vol 16.* (pp. 87–123). Springer Nature Switzerland. https://doi.org/10.1007/978-3-319-53387-2

Abuza, B. Z., & Lischin, L. (2020). *The Challenges Facing the Philippines' Bangsamoro Autonomous Region at One Year*. https://www.usip.org/publications/2020/06/challenges-facing-philippines-bangsamoro-autonomous-region-one-year

Ahmad, K., & Pieroni, A. (2016). Folk knowledge of wild food plants among the tribal communities of Thakht-e-Sulaiman Hills, North-West Pakistan. *Journal of Ethnobiology and Ethnomedicine*, *12*(17), 1–15. https://doi.org/10.1186/s13002-016-0090-2

AIDS Research Alliance. (n.d.). *Prostratin: A Potential Cure Strategy*. Retrieved November 18, 2020, from https://www.aidsresearch.org/cure-research/prostratin/

Aikenhead, G. S., & Ogawa, M. (2007). Indigenous knowledge and science revisited. *Cultural Studies of Science Education, 2,* 539–620. https://doi.org/10.1007/s11422-007-9067-8

Albuquerque, U. P., & Alves, R. R. N. (2016). *Introduction to Ethnobiology* (U. P. Albuquerque & R. R. Alves (Eds.)). Springer.

Alexander, C., Bynum, N., Johnson, E., King, U., Mustonen, T., Neofotis, P., Oettlé, N., Rosenzweig, C., Sakakibara, C., Shadrin, V., Waterhouse, J., Weeks, B., Alexander, C., Bynum, N., Johnson, E., King, U., Mustonen, T., Neofotis, P., Oettlé, N., … Shadrin, V. (2011). Linking Indigenous and Scientific Knowledge of Climate Change. *BioScience, 61*(6), 477–484. https://doi.org/10.1525/bio.2011.61.6.10

Allen, C., Metternicht, G., & Wiedmann, T. (2018). Initial progress in implementing the Sustainable Development Goals (SDGs): a review of evidence from countries. *Sustainability Science*, *13*(5), 1453–1467. https://doi.org/10.1007/s11625-018-0572-3

Altieri, M. A., & Nicholls, C. I. (2017). The adaptation and mitigation potential of traditional agriculture in a changing climate. *Climatic Change*, *140*(1), 33–45. https://doi.org/10.1007/s10584-013-0909-y

Anaya, S. J. (1996). *Indigenous Peoples in International Law*. Oxford University Press.

Anaya, S. J. (2004). International Human Rights and Indigenous Peoples: the move toward the multicultural state. *Arizona Journal of International & Comparative Law*, *21*(1), 13–60. http://arizonajournal.org/wp-content/uploads/2015/11/Anaya.pdf

Anderson, K. (2015). Colonialism and Cold Genocide : The Case of West Papua. *Genocide Studies and Prevention: An International Journal*, *9*(2), 9–25. https://doi.org/10.5038/1911-9933.9.2.1270

Ang, Y. P., Tandang, D. N., Agcaoili, J. M. M., & Bustamante, R. A. A. (2020). *Begonia cabanillasii* (section Baryandra, Begoniaceae), a new species from El Nido, Palawan, the Philippines. *Phytotaxa*, *453*(3), 244–254. https://doi.org/https://doi.org/10.11646/phytotaxa.453.3.6

Angeles-Agdeppa, I., Denney, L., Toledo, M. B., Obligar, V. A., Jacquier, E. F., Carriquiry, A. L., & Capanzana, M. V. (2019). Inadequate nutrient intakes in Filipino schoolchildren and adolescents are common among those from rural areas and poor families. *Food & Nutrition Research*, *63*(3435), 1–12. https://doi.org/10.29219/fnr.v63.3435

Angeles-Agdeppa, I., Sun, Y., & Tanda, K. V. (2020). Dietary pattern and nutrient intakes in association with non-communicable disease risk factors among Filipino adults: a cross-sectional study. *Nutrition Journal*, *19*(79), 1–13. https://doi.org/https://doi.org/10.1186/s12937-020-00597-x

Anthwal, A., Gupta, N., Sharma, A., Anthwal, S., & Kim, K. H. (2010). Conserving biodiversity through traditional beliefs in sacred groves in Uttarakhand Himalaya, India. *Resources, Conservation and Recycling*, *54*(11), 962–971. https://doi.org/10.1016/j.resconrec.2010.02.003

Antonelli, A., Fry, C., Smith, R. J., Simmonds, M. S. J., Kersey, P. J., Pritchard, H. W., Abbo, M. S., Acedo, C., Adams, J., Ainsworth, A. M., Allkin, B., Annecke, W., Bachman, S. P., Bacon, K., Bárrios, S., Barstow, C., Battison, A., Bell, E., Bensusan, K., … Zhang, B. G. (2020). *State of the World's Plants and Fungi 2020*. https://doi.org/https://doi.org/10.34885/172

Apud Peláez, I. E. (2020). Personality Traits in Former Spanish Substance Users Recovered with Ayahuasca. *Journal of Psychoactive Drugs*, *52*(3), 264–272. https://doi.org/10.1080/02791072.2020.1752960

Armitage, D., Berkes, F., Dale, A., Kocho-Schellenberg, E., & Patton, E. (2011). Co-management and the co-production of knowledge: Learning to adapt in Canada's Arctic. *Global Environmental Change*, *21*(3), 995–1004. https://doi.org/10.1016/j.gloenvcha.2011.04.006

Arsenault, R., Diver, S., McGregor, D., Witham, A., & Bourassa, C. (2018). Shifting the framework of Canadian water governance through Indigenous research methods: Acknowledging the past with an eye on the future. *Water*, *10*(1). https://doi.org/10.3390/w10010049

Artelle, K. A., Zurba, M., Bhattacharrya, J., Chan, D. E., Brown, K., Housty, J., & Moola, F. (2019). Supporting resurgent Indigenous-led governance: A nascent mechanism for just and effective conservation. *Biological Conservation*, *240*, 1–10. https://doi.org/10.1016/j.biocon.2019.108284

Arulandhu, A. J., Staats, M., Hagelaar, R., Peelen, T., & Kok, E. J. (2019). The application of multi-locus DNA metabarcoding in traditional medicines. *Journal of Food Composition and Analysis*, *79*, 87–94. https://doi.org/10.1016/j.jfca.2019.03.007

ASEAN. (2016). *ASEAN Socio-Cultural Community Blueprint 2025*. Association of Southeast Asian Nations. https://asean.org/storage/2016/01/ASCC-Blueprint-2025.pdf

Ashri, A., Yusof, M. S. M., Jamil, M. S., Abdullah, A., Yusoff, S. F. M., Nasir, M. N. M., & Lazim, A. M. (2014). Physicochemical characterization of starch extracted from Malaysian wild yam (Dioscorea hispida Dennst.). *Emirates Journal of Food and Agriculture, 26*(8), 652–658. https://doi.org/10.9755/ejfa.v26i8.17098

Astuti, R., & McGregor, A. (2017). Indigenous land claims or green grabs? Inclusions and exclusions within forest carbon politics in Indonesia. *Journal of Peasant Studies*, *44*(2), 445–466. https://doi.org/10.1080/03066150.2016.1197908

Aswani, S., Lemahieu, A., & Sauer, W. H. H. (2018). Global trends of local ecological knowledge and future implications. *PLoS ONE*, *13*(4), 1–19. https://doi.org/https://doi.org/10.1371/journal.pone.0195440

Atreya, K., Pyakurel, D., Thagunna, K. S., Bhatta, L. D., Uprety, Y., Chaudhary, R. P., Oli, B. N., & Rimal, S. K. (2018). Factors Contributing to the Decline of Traditional Practices in Communities from the Gwallek–Kedar area, Kailash Sacred Landscape, Nepal. *Environmental Management*, *61*(5), 741–755. https://doi.org/10.1007/s00267-018-1009-6

Audefroy, J. F., & Sánchez, B. N. C. (2017). Integrating local knowledge for climate change adaptation in Yucatán, Mexico. *International Journal of Sustainable Built Environment*, *6*(1), 228–237. https://doi.org/10.1016/j.ijsbe.2017.03.007

Azam, F. M. S., Biswas, A., Mannan, A., Afsana, N. A., Jahan, R., & Rahmatullah, M. (2014). Are famine food plants also ethnomedicinal plants? An ethnomedicinal appraisal of famine food plants of two districts of Bangladesh. *Evidence-Based Complementary and Alternative Medicine,* 1–28. https://doi.org/10.1155/2014/741712

Azanza, M. P. V. (2006). Philippine foodborne-disease outbreaks (1995–2004). *Journal of Food Safety 26*, *26*, 92–102. https://doi.org/https://doi.org/10.1111/j.1745-4565.2005.00034.x

Azanza, M. P. V., Membrebe, B. N. Q., Sanchez, R. G. R., Estilo, E. E. C., Dollete, U. G. M., Feliciano, R. J., & Garcia, N. K. A. (2019). Foodborne disease outbreaks in the Philippines (2005–2018). *Philippine Journal of Science*, *148*(2), 317–336.

Baird, I. G. (2011). The Construction of Indigenous People in Cambodia. In L. Yew (Ed.), *Alterities in Asia: Reflection on Identity and Regionalism* (Issue May, pp. 155–176). Routledge.

Baird, I. G. (2015). Translocal assemblages and the circulation of the concept of “indigenous peoples” in Laos. *Political Geography*, *46*, 54–64. https://doi.org/10.1016/j.polgeo.2014.12.001

Baird, I. G. (2016). Indigeneity in Asia: an emerging but contested concept. *Asian Ethnicity*, *17*(4), 501–505. https://doi.org/10.1080/14631369.2016.1193804

Baird, I. G. (2021). Political violence, migration, lack of citizenship, and agrobiodiversity loss in the borderlands of Thailand and Laos. *Geoforum*. https://doi.org/10.1016/j.geoforum.2021.02.018

Baird, I. G., Leepreecha, P., & Yangcheepsutjarit, U. (2017). Who should be considered 'Indigenous'? A survey of ethnic groups in northern Thailand. *Asian Ethnicity*, *18*(4), 543–562. https://doi.org/10.1080/14631369.2016.1268044

Baja-Lapis, A. C. (2010). *A Field Guide to Philippine Rattans*. Department of Environment and Natural Resources, Philippines.

Baldermann, S., Blagojević, L., Frede, K., Klopsch, R., Neugart, S., Neumann, A., Ngwene, B., Norkeweit, J., Schröter, D., Schröter, A., Schweigert, F. J., Wiesner, M., & Schreiner, M. (2016). Are Neglected Plants the Food for the Future ? *Critical Reviews in Plant Sciences*, *35*(2), 106–119. https://doi.org/10.1080/07352689.2016.1201399

Balick, M. J., & Cox, P. A. (1996). *Plants, People, and Culture: The Science of Ethnobotany*. Scientific American Library.

Balick, M. J., & Cox, P. A. (2020). *Plants, People, and Culture: The Science of Ethnobotany* (2nd ed.). Garland Science. https://doi.org/https://doi.org/10.1201/9781003049074

Balilla, V. S., Anwar-Mchenry, J., Mchenry, M. P., & Marris, R. (2012). Aeta Magbukún of Mariveles : Traditional indigenous forest resource use practices and the sustainable economic development challenge in remote Phil. *Journal of Sustainable Forestry*, *31*(7), 687–709. https://doi.org/10.1080/10549811.2012.704775

Bamforth, T. (2015). The social impact of Typhoon Bopha on indigenous communities, livelihoods, and conflict in Mindanao. In M. Companion (Ed.), *Disaster's Impact on Livelihood and Cultural Survival: Losses, Opportunities, and Mitigation* (pp. 199–210). CRC Press. https://books.google.co.uk/books?hl=tl&lr=&id=S3sZBwAAQBAJ&oi=fnd&pg=PA199&dq=typhoon+mindanao+agriculture&ots=f9_NGGvHj-&sig=ynBis4lyvwzfFWNniQ5XaN1_6Gs&redir_esc=y#v=onepage&q=typhoon mindanao agriculture&f=false

Ban, N. C., Frid, A., Reid, M., Edgar, B., Shaw, D., & Siwallace, P. (2018). Incorporate Indigenous perspectives for impactful research and effective management. *Nature Ecology & Evolution*, *2*, 1680–1683. https://doi.org/10.1038/s41559-018-0706-0

Bangsamoro Information Office. (2021a). *MENRE vows to protect Begonia bangsamoro plant*. https://bangsamoro.gov.ph/news/latest-news/menre-vows-to-protect-begonia-bangsamoro-plant/?fbclid=IwAR0mkSVQqgJ_C6v7KzY9ESxIRnYWthb2wTQHC6Pk1U98sSJ6dTBmFEkhuY8

Bangsamoro Information Office. (2021b). *Newly discovered plant in LDS named after the Bangsamoro people*. https://bangsamoro.gov.ph/news/latest-news/newly-discovered-plant-in-lds-named-after-the-bangsamoro-people/

Barbhuiya, A. R., Sahoo, U. K., & Upadhyaya, K. (2016). Plant Diversity in the Indigenous Home Gardens in the Eastern Himalayan Region of Mizoram, Northeast India.

Economic Botany, *70*(2), 115–131. https://doi.org/10.1007/s12231-016-9349-8

Barreau, A., Ibarra, J. T., Wyndham, F. S., Rojas, A., & Kozak, R. A. (2016). *How Can We Teach Our Children if We Cannot Access the Forest?* Generational Change in Mapuche Knowledge of Wild Edible Plants in Andean Temperate Ecosystems of Chile. *Journal of Ethnobiology*, *36*(2), 412–432. https://doi.org/10.2993/0278-0771-36.2.412

Barševskis, A. (2017). Four new species and a new synonymy in the genus Doliops Waterhouse, 1841 (Coleoptera: Cerambycidae) from Philippines. *Baltic Journal of Coleopterology*, *17*(2), 161–173.

Barthel, S., Crumley, C., & Svedin, U. (2013). Bio-cultural refugia-Safeguarding diversity of practices for food security and biodiversity. *Global Environmental Change*, *23*(5), 1142–1152. https://doi.org/10.1016/j.gloenvcha.2013.05.001

Bartlett, C., Marshall, M., & Marshall, A. (2012). Two-Eyed Seeing and other lessons learned within a co-learning journey of bringing together indigenous and mainstream knowledges and ways of knowing. *Journal of Environmental Studies and Sciences*, *2*, 331–340. https://doi.org/10.1007/s13412-012-0086-8

Beentje, H. (2016). *The Kew Plant Glossary: an illustrated dictionary of plant terms* (2nd ed.). Kew Publishing, Royal Botanic Gardens.

Béné, C. (2020). Resilience of local food systems and links to food security – A review of some important concepts in the context of COVID-19 and other shocks. *Food Security*, *12*, 805–822. https://doi.org/https://doi.org/10.1007/s12571-020-01076-1

Benítez, G., Molero-Mesa, J., & González-Tejero, M. R. (2017). Gathering an edible wild plant: food or medicine? A case study on wild edibles and functional foods in Granada, Spain. *Acta Societatis Botanicorum Poloniae*, *86*(3), 1–27. https://doi.org/10.5586/asbp.3550

Benyei, P., Arreola, G., & Reyes-García, V. (2020). Storing and sharing: A review of indigenous and local knowledge conservation initiatives. *Ambio*, *49*, 218–230. https://doi.org/10.1007/s13280-019-01153-6

Berger, D. N., Bulanin, N., García-alix, L., Jensen, M. W., Leth, S., Alvarado, E., Mamo, D., Parellada, A., Marie, L., Petersen, L., Rose, G., Thorsell, S., & Wessendorf, K. (2020). *The Indigenous World 2020* (34th ed.). The International Work Group for Indigenous Affairs.

Berkes, F. (1993). Traditional Ecological Knowledge in Perspective. In J. T. Inglis (Ed.), *Traditional ecological knowledge concepts and Cases* (pp. 55–62). International Program on Traditional Ecological Knowledge International Development Research Centre. http://www.portalces.org/sites/default/files/migrated/docs/1223.pdf#page=68

Bernadas, C. J. N., & Peralta, M. D. (2017). Indigenous Crops and Wild Plants Used as Food by the Pala'wan Tribe in Southern Palawan, Philippines. *Journal of Nature Studies*, *16*(1), 11–17. https://journalofnaturestudies.org/files/JNS16-1/16(1) 11-17 CBernadas & Peralta-fullpaper.pdf

Bertrand, J. (2011). Indigenous peoples rights as a strategy of ethnic accommodation: Contrasting experiences of Cordillerans and Papuans in the Philippines and Indonesia. *Ethnic and Racial Studies*, *34*(5), 850–869. https://doi.org/10.1080/01419870.2010.537358

Beyrer, C., & Kamarulzaman, A. (2017). Ethnic cleansing in Myanmar: the Rohingya crisis and human rights. *The Lancet*, *390*(10102), 1570–1573. https://doi.org/10.1016/S0140-6736(17)32519-9

Bhandari, M. R. A. J., & Kawabata, J. U. N. (2005). Bitterness and Toxicity in Wild Yam (Dioscorea spp.) Tubers of Nepal. *Plant Foods for Human Nutrition, 60,* 129–135. https://doi.org/10.1007/s11130-005-6841-1

Bharucha, Z., & Pretty, J. (2010). The roles and values of wild foods in agricultural systems. *Philosophical Transactions of the Royal Society B: Biological Sciences, 365*(1554), 2913–2926. https://doi.org/10.1098/rstb.2010.0123

Biermann, F., Kanie, N., & Kim, R. E. (2017). Global governance by goal-setting: the novel approach of the UN Sustainable Development Goals. *Current Opinion in Environmental Sustainability, 26–27,* 26–31. https://doi.org/10.1016/j.cosust.2017.01.010

Blackman, A., Corral, L., Lima, E. S., & Asner, G. P. (2017). Titling indigenous communities protects forests in the Peruvian Amazon. *Proceedings of the National Academy of Sciences, 114*(16), 4123–4128. https://doi.org/10.1073/pnas.1603290114

Blesh, J., Hoey, L., Jones, A. D., Friedmann, H., & Perfecto, I. (2019). Development pathways toward "zero hunger." *World Development, 118,* 1–14. https://doi.org/10.1016/j.worlddev.2019.02.004

Bohensky, E. L., & Maru, Y. (2011). Indigenous Knowledge, Science, and Resilience: What Have We Learned from a Decade of International Literature on "Integration"? *Ecology and Society, 16*(4), art6. https://doi.org/10.5751/ES-04342-160406

Bohra-Mishra, P., Oppenheimer, M., Cai, R., Feng, S., & Licker, R. (2017). Climate variability and migration in the Philippines. *Population and Environment, 38*(3), 286–308. https://doi.org/10.1007/s11111-016-0263-x

Borelli, T., Hunter, D., Powell, B., Ulian, T., Mattana, E., Termote, C., Pawera, L., Beltrame, D., Penafiel, D., Tan, A., Taylor, M., & Engels, J. (2020). Born to Eat Wild: An Integrated Conservation Approach to Secure Wild Food Plants for Food. *Plants, 9*(1299), 1–36. https://doi.org/10.3390/plants9101299

Bridgewater, P., & Rotherham, I. D. (2019). A critical perspective on the concept of biocultural diversity and its emerging role in nature and heritage conservation. *People and Nature, 1*(3), 291–304. https://doi.org/10.1002/pan3.10040

Broegaard, R. B., Rasmussen, L. V., Dawson, N., Mertz, O., Vongvisouk, T., & Grogan, K. (2017). Wild food collection and nutrition under commercial agriculture expansion in agriculture-forest landscapes. *Forest Policy and Economics, 84*, 92–101. https://doi.org/10.1016/j.forpol.2016.12.012

Brondizio, E. S., & Tourneau, F.-M. L. (2016). Environmental governance for all. *Science, 352*(6291), 1272–1273. https://doi.org/10.1126/science.aaf5122

Budowle, R., Arthur, M., & Porter, C. (2019). Growing Intergenerational Resilience for Indigenous Food Sovereignty through Home Gardening. *Journal of Agriculture, Food Systems, and Community Development, 9,* 1–21. https://doi.org/10.5304/jafscd.2019.09b.018

Buenavista, D. P., Ang, Y. P., Pranada, M. A. K., Salas, D. S., Mollee, E., & McDonald, M. (2021). *Begonia bangsamoro* (Begoniaceae, section Petermannia), a new species from

Mindanao Island, the Philippines. *Phytotaxa*, *497*(1), 39–48. https://doi.org/10.11646/phytotaxa.497.1.4

Buenavista, D. P., Dinopol, N. M. A., Mollee, E., & McDonald, M. (2021). From poison to food: On the molecular identity and indigenous peoples' utilisation of poisonous " Lab-o " (Wild Yam, Dioscoreaceae) in Bukidnon, Philippines. *Cogent Food & Agriculture*, *7*(1), 1–13. https://doi.org/10.1080/23311932.2020.1870306

Buenavista, D. P., Wynne-Jones, S., & McDonald, M. A. (2018). Asian Indigeneity, Indigenous Knowledge Systems, and Challenges of the 2030 Agenda. *East Asian Community Review*, *1*(3–4), 221–240. https://doi.org/10.1057/s42215-018-00010-0

Buergin, R. (2015). Contested Rights of Local Communities and Indigenous Peoples in Conflicts over Biocultural Diversity: The case of Karen communities in Thung Yai, a World Heritage Site in Thailand. *Modern Asian Studies*, *49*(6), 2022–2062. https://doi.org/10.1017/S0026749X14000390

Bukidnon-Higaonon Community. (2019). *PHI: Integrated Natural Resources and Environmental Management Project: Higaonon Ancestral Domain* (Issue July). https://www.adb.org/sites/default/files/project-documents/41220/41220-013-ipp-en_8.pdf

Burkill, I. H. (1951). Dioscoreaceae. In *Flora Malesiana Series* (pp. 293–336). National Herbarium of the Netherlands. https://repository.naturalis.nl/pub/532592/FM1S1948004001058.pdf

Burton, A., Smith, M., & Falkenberg, T. (2015). Building WHO's global Strategy for Traditional Medicine. *European Journal of Integrative Medicine*, *7*(1), 13–15. https://doi.org/10.1016/j.eujim.2014.12.007

Bussmann, R. W., Panigua-Zambrana, N. Y., Wood, N., Njapit, S. O., Njapit, J. K. O., Osoi, G. S. E., & Kasoe, S. P. (2018). Knowledge Loss and Change Between 2002 and 2017 — a Revisit of Plant Use of the Maasai of Sekenani Valley, Maasai Mara, Kenya. *Economic Botany*, *72*(2), 207–216. https://doi.org/https://doi.org/10.1186/1746-4269-2-22

Bustamante, R. A. A., Tandang, D. N., Pranada, M. C. A. K., & Ang, Y. P. (2020). *Begonia truncatifolia* (Begoniaceae, section Baryandra), a new species from Palawan Island, the Philippines. *Phytotaxa*, *458*(3). https://doi.org/10.11646/phytotaxa.458.3.4

Bvenura, C., & Afolayan, A. J. (2015). The role of wild vegetables in household food security in South Africa: A review. *Food Research International*, *76*(P4), 1001–1011. https://doi.org/10.1016/j.foodres.2015.06.013

Cairns, M. (1997). Ancetral Domain and Natural Park Protection: Mutually Supportive Paradigms? A Case Study of the Mt. Kitanglad Range National Park, Bukidnon, Philippines. *Philippine Quarterly of Culture and Society*, *25*, 31–82. https://www.jstor.org/stable/29792212

Calvet-Mir, L., Riu-Bosoms, C., González-Puente, M., Ruiz-Mallén, I., Reyes-García, V., & Molina, J. L. (2016). The Transmission of Home Garden Knowledge: Safeguarding Biocultural Diversity and Enhancing Social–Ecological Resilience. *Society and Natural Resources*, *29*(5), 556–571. https://doi.org/10.1080/08941920.2015.1094711

Camacho, L. D., Combalicer, M. S., Yeo-Chang, Y., Combalicer, E. A., Carandang, A. P., Camacho, S. C., de Luna, C. C., & Rebugio, L. L. (2012). Traditional forest conservation knowledge/technologies in the Cordillera, Northern Philippines. *Forest Policy and Economics*, *22*, 3–8. https://doi.org/10.1016/j.forpol.2010.06.001

Camacho, L. D., Gevaña, D. T., Carandang, A. P., & Camacho, S. C. (2016). Indigenous knowledge and practices for the sustainable management of Ifugao forests in Cordillera, Philippines. *International Journal of Biodiversity Science, Ecosystem Services and Management*, *12*(1–2), 5–13. https://doi.org/10.1080/21513732.2015.1124453

Cámara-Leret, R., & Bascompte, J. (2021). Language extinction triggers the loss of unique medicinal knowledge. *Proceedings of the National Academy of Sciences*, *118*(24), 1–5. https://doi.org/10.1073/pnas.2103683118/-/DCSupplemental.y

Cámara-Leret, R., & Dennehy, Z. (2019). Information gaps in indigenous and local knowledge for science-policy assessments. *Nature Sustainability*, *2*(8), 736–741. https://doi.org/10.1038/s41893-019-0324-0

Cámara-Leret, R., Fortuna, M. A., & Bascompte, J. (2019). Indigenous knowledge networks in the face of global change. *Proceedings of the National Academy of Sciences*, *116*(20), 9913–9918. https://doi.org/10.1073/pnas.1821843116

Camargo, B. A., & Vázquez-Maguirre, M. (2021). Humanism, dignity and indigenous justice: the mayan train megaproject, Mexico. *Journal of Sustainable Tourism*, *29*(2–3), 371–390. https://doi.org/10.1080/09669582.2020.1758707

Camou-Guerrero, A., Reyes-García, V., Martínez-Ramos, M., & Casas, A. (2008). Knowledge and use value of plant species in a Rarámuri community: A gender perspective for conservation. *Human Ecology*, *36*(2), 259–272. https://doi.org/10.1007/s10745-007-9152-3

Campanaro, A., Tommasi, N., Guzzetti, L., Galimberti, A., Bruni, I., & Labra, M. (2019). DNA barcoding to promote social awareness and identity of neglected, underutilized plant species having valuable nutritional properties. *Food Research International*, *115*, 1–9. https://doi.org/10.1016/j.foodres.2018.07.031

Candelaria, S. M. (2018). The plight of indigenous peoples within the context of conflict mediation, peace talks and human rights in Mindanao, the Philippines. *Thesis Eleven*, *145*(1), 28–37. https://doi.org/10.1177/0725513618763838

Caneva, G., Traversetti, L., Sujarwo, W., & Zuccarello, V. (2017). Sharing Ethnobotanical Knowledge in Traditional Villages: Evidence of Food and Nutraceutical "Core Groups" in Bali, Indonesia. *Economic Botany*, *71*(4), 303–313. https://doi.org/10.1007/s12231-017-9395-x

Capanzana, M. V., & Aguila, D. V. (2020). Philippines Case Study: Government Policies on Nutrition Education. In M. Black, H. Delichatsios, & M. Story (Eds.), *Nestle Nutrition Institute Workshop Series* (Vol. 92, pp. 119–129). Karger AG. https://doi.org/10.1159/000499555

Capistrano, R. C. G. (2010). Reclaiming the ancestral waters of indigenous peoples in the Philippines: The Tagbanua experience with fishing rights and indigenous rights. *Marine Policy*, *34*(3), 453–460. https://doi.org/10.1016/j.marpol.2009.09.012

Carlson, K. M., Gerber, J. S., Mueller, N. D., Herrero, M., Macdonald, G. K., Brauman, K. A., Havlik, P., Connell, C. S. O., Johnson, J. A., Saatchi, S., & West, P. C. (2017).

Greenhouse gas emissions intensity of global croplands. *Nature Climate Change*, *7*, 63–68. https://doi.org/10.1038/NCLIMATE3158

Carmody, R. N., & Wrangham, R. W. (2009). The energetic significance of cooking. *Journal of Human Evolution*, *57*(4), 379–391. https://doi.org/10.1016/j.jhevol.2009.02.011

Carson, S. L., Kentatchime, F., Djomo Nana, E., Njabo, K. Y., Cole, B. L., & Godwin, H. A. (2018). Indigenous Peoples' Concerns About Loss of Forest Knowledge: Implications for Forest Management. *Conservation and Society*, *16*(4), 1–10. https://doi.org/10.4103/cs.cs_17_105

Castillo, R. C. A., & Alvarez-Castillo, F. (2009). The Law is not Enough: Protecting Indigenous Peoples' Rights Against Mining Interests in the Philippines. In R. Wynberg, D. Schroeder, & R. Chennells (Eds.), *Indigenous Peoples, Consent and Benefit Sharing* (pp. 271–284). Springer, Dordrecht. https://doi.org/https://doi.org/10.1007/978-90-481-3123-5

Casumbal-Salazar, M. S. L. (2015). The Indeterminacy of the Philippine Indigenous Subject. *Amerasia Journal*, *41*(1), 74–94. https://doi.org/10.17953/aj.41.1.74

Ceccanti, C., Landi, M., Benvenuti, S., Pardossi, A., & Guidi, L. (2018). Mediterranean Wild Edible Plants: Weeds or "New functional crops"? *Molecules*, *23*(9), 1–15. https://doi.org/10.3390/molecules23092299

Cervantes, F. M. (2018). *Congress grants martial law extension until end of 2019*. https://www.pna.gov.ph/articles/1056438

Cetenta, D. R. M. (2020, November 6). Botanist raises concerns on illegal trade activities of Palawan's endemic plants. *Palawan Daily News*. https://palawandailynews.com/environment/botanist-raises-concerns-on-illegal-trade-activities-of-palawans-endemic-plants/

Chandra, A., McNamara, K. E., Dargusch, P., Caspe, A. M., & Dalabajan, D. (2017). Gendered vulnerabilities of smallholder farmers to climate change in conflict-prone areas: A case study from Mindanao, Philippines. *Journal of Rural Studies*, *50*, 45–59. https://doi.org/10.1016/j.jrurstud.2016.12.011

Chaturvedi, H. C., Jain, M., & Kidwai, N. R. (2007). Cloning of medicinal plants through tissue culture-A review. *Indian Journal of Experimental Biology*, *45*(11), 937–948. nopr.niscair.res.in/bitstream/123456789/5689/1/IJEB 45%2811%29 937-948.pdf

Cheek, M. (2011). Nepenthes robcantleyi sp. nov. (Nepenthaceae) from Mindanao, Philippines. *Nordic Journal of Botany*, *29*(6), 677–681. https://doi.org/10.1111/j.1756-1051.2011.01449.x

Chen, C., Jan, K., Groenigen, V., Yang, H., Hungate, B. A., & Yang, B. (2020). Global warming and shifts in cropping systems together reduce China ' s rice production. *Global Food Security*, *24*, 100359. https://doi.org/10.1016/j.gfs.2020.100359

Chiong-Javier, M. E. (2012). Gendered Networks, Social Capital, and Farm Women's Market Participation in Southern Philippines. In M. E. Chiong-Javier, C. Duque-Piñon, A. R. Mercado, & M. R. Reyes (Eds.), *Holding Their Own: Smallholder Production, Marketing and Women Issues in Philippine Agroforestry* (pp. 54–84). De La Salle University. https://www.dlsu.edu.ph/wp-content/uploads/2019/02/Agroforestry-Publication-2012-entitled_-Holding-Their-Own.pdf

Chowdhury, M. A., Zahra, F.-T.-, Rahman, M. F., & Islam, K. (2018). Village Common Forest Management in Komolchori, Chittagong Hill Tracts, Bangladesh: An Example of Community Based Natural Resources Management. *Small-Scale Forestry*, *17*, 535–553. https://doi.org/10.1007/s11842-018-9402-9

Chua, L. S. L., Kiew, R., & Chan, Y. M. (2009). Assessing conservation status of Peninsular Malaysian Begonias (Begoniaceae). *Blumea: Journal of Plant Taxonomy and Plant Geography, 54*, 94–98. https://doi.org/10.3767/000651909X474131

Cisneros, G. T. (2017). Indigenous Peoples and Mexico's Contributions to the 2030 Agenda. In U. R. Villanueva (Ed.), *Mexico and the Post-2015 Development Agenda. Governance, Development, and Social Inclusion in Latin America*. Palgrave Macmillan. https://doi.org/https://doi.org/10.1057/978-1-137-58582-0_11

Clarke, G. (2001). From ethnocide to ethnodevelopment? Ethnic minorities and indigenous peoples in Southeast Asia. *Third World Quarterly, 22*(3), 413–436. https://doi.org/10.1080/01436590120061688

Climate-Data.org. (2019). *Climate Impasug-ong*.

Colbourne, R., Moroz, P., Hall, C., Lendsay, K., & Anderson, R. B. (2019). Indigenous works and two eyed seeing: mapping the case for indigenous-led research. *Qualitative Research in Organizations and Management*. https://doi.org/10.1108/QROM-04-2019-1754

Cole, F.-C. (1956). The Bukidnon of Mindanao. In P. S. Martin & L. A. Ross (Eds.), *Fieldiana. Anthropology* (Vol. 46). Chicago Natural History Museum. http://www.jstor.org/stable/29782355

Commission on Higher Education. (2019). *CHED Memo Order No. 2, Series of 2019: Integration of Indigenous peoples' (IP) Studies/Education into the Relevant Higher Education Curricula*. Commission on Higher Education. https://ched.gov.ph/wp-content/uploads/CMO-No.-02-Integration-of-Indigenous-peoples-studies-into-the-relevant-Higher-Education-Curricula.pdf

Conklin, H. C. (1954a). An Ethnoecological Approach To Shifting Agriculture. *Transactions of the New York Academy of Sciences*, *17*(2), 133–142. https://doi.org/10.1111/j.2164-0947.1954.tb00402.x

Conklin, H. C. (1954b). *The relation of Hanunóo culture to the plant world*. Yale University.

Conklin, H. C. (1957). *Hanunoo agriculture. A report on an integral system of shifting cultivation in the Philippines*. FAO.

Conselho Indigenista Missionário. (2014). *Brief Report on the Violations of the Human Rights of the Indigenous Kaiowa Guarani Peoples in Mato Grosso Do Sul - Brazil*.

Corbiere, C., Liagre, B., Terro, F., & Beneytout, J. L. (2004). Induction of antiproliferative effect by diosgenin through activation of p53, release of apoptosis-inducing factor (AIF) and modulation of caspase-3 activity in different human cancer cells. *Cell Research*, *14*(3), 188–196. https://doi.org/10.1038/sj.cr.7290219

Cordero, R. L., Suma, M., Krishnan, S., Bauch, C. T., & Anand, M. (2018). Elements of indigenous socio-ecological knowledge show resilience despite ecosystem changes in the forest-grassland mosaics of the Nilgiri Hills, India. *Palgrave Communications*, *4*(105), 1–9. https://doi.org/10.1057/s41599-018-0157-x

Cox, P. A. (2001). Ensuring equitable benefits: The Falealupo covenant and the isolation of anti-viral drug prostratin from a Samoan medicinal plant. *Pharmaceutical Biology*, *39*(SUPPL.), 33–40. https://doi.org/10.1076/phbi.39.7.33.5875

Cox, P. A., & Metcalf, J. S. (2017). Traditional Food Items in Ogimi, Okinawa: L-Serine Content and the Potential for Neuroprotection. *Current Nutrition Reports*, *6*(1), 24–31. https://doi.org/10.1007/s13668-017-0191-0

Cruz-Garcia, G. S., & Price, L. L. (2014). Human-Induced Movement of Wild Food Plant Biodiversity Across Farming Systems is Essential to Ensure Their Availability. *Journal of Ethnobiology*, *34*(1), 68–83. https://doi.org/10.2993/0278-0771-34.1.68

Cruz-Garcia, G. S., & Struik, P. C. (2015). Spatial and seasonal diversity of wild food plants in home gardens of northeast Thailand. *Economic Botany*, *69*(2), 99–113. https://doi.org/10.1007/s12231-015-9309-8

Cuevas, S. M. M., Fernandez, J. E. C., & Olvida, I. de G. (2015). Where Peasants are Kings: Food Sovereignty in the Tagbanua Traditional Subsistence System. *Austrian Journal of South-East Asian Studies, 8*(1), 27–44. https://doi.org/10.14764/10.ASEAS-2015.1-3

Cullen, V. G. (1979). Social Change and Religion Among the Bukidnon. *Philippine Studies*, *27*(2), 160–175. http://www.jstor.org/stable/42632475

Dawe, D. (Ed.). (2010). *The Rice Crisis: Markets, Policies and Food Security* (1st ed.). Earthscan and FAO. http://www.fao.org/3/a-an794e.pdf

Dawe, D., Moya, P. F., & Casiwan, C. B. (2008). *Why Does the Philippines Import Rice? Meeting the challenge of trade liberalization*. International Rice Research Institute. books.irri.org/9712202097_content.pdf

De Alban, J. D. T. (2010). *Spatial analyses of the mining situation in Mindoro Island, Philippines: Input to the institutional position paper on mining of the Mindoro Biodiversity Conservation Foundation Inc.* (Issue July). https://www.researchgate.net/profile/Jose-Don-De-Alban/publication/327221972_Spatial_Analysis_of_Biophysical_and_Socio-Economic_Variables_in_Support_of_Decision-Making_on_Conservation_and_Development_Issues_A_Case_Study_of_Mindoro_Island_Philippines/links

De Candolle, A. (1859). Memoire sur La Famille des Begoniacees. *Annales Des Sciences Naturalles, 4*(11), 129. https://www.biodiversitylibrary.org/item/129892

De Carvalho, S., Goyes, D. R., & Vegh Weis, V. (2021). Politics and Indigenous Victimization: The Case of Brazil. *British Journal of Criminology, 61*(1), 251–271. https://doi.org/10.1093/bjc/azaa060

Degai, T. S., & Petrov, A. N. (2021). Rethinking Arctic sustainable development agenda through indigenizing UN sustainable development goals. *International Journal of Sustainable Development and World Ecology*, *00*(00), 1–6. https://doi.org/10.1080/13504509.2020.1868608

Del-Castillo, Á. M. R., Gonzalez-Aspajo, G., de Fátima Sánchez-Márquez, M., & Kodahl, N. (2019). Ethnobotanical Knowledge in the Peruvian Amazon of the Neglected and Underutilized Crop Sacha Inchi (Plukenetia volubilis L.). *Economic Botany*, *73*(2), 281–287. https://doi.org/10.1007/s12231-019-09459-y

Dela Cruz, E. (2021). *Philippines sees 2021 minimum rice import requirement at 1.69 MLN T.* Thomson Reuters. https://www.agriculture.com/markets/newswire/philippines-sees-2021-minimum-rice-import-requirement-at-169-mln-t

Delang, C. O. (2006a). Not just minor forest products: The economic rationale of wild food plants by subsistence farmers. *Ecological Economics*, *59*, 64–73. https://doi.org/10.1016/j.eco lecon.2005.10.006

Delang, C. O. (2006b). The role of wild food plants in poverty alleviation and biodiversity conservation in tropical countries. *Progress in Development Studies*, *6*(4), 275–286. https://doi.org/https://doi.org/10.1191/1464993406ps143oa

Delina, L. L. (2020). Indigenous environmental defenders and the legacy of Macli-ing Dulag: Anti-dam dissent, assassinations, and protests in the making of Philippine energyscape. *Energy Research and Social Science*, *65*(February), 101463. https://doi.org/10.1016/j.erss.2020.101463

Denham, T. (2011). Early agriculture and plant domestication in New Guinea and Island Southeast Asia. *Current Anthropology*, *52*(4), S379–S395. https://doi.org/10.1086/658682

Department of Environment and Natural Resources. (2017). *DENR Administrave Order No. 2017-11: Updated National List of Threatened Philippine Plants and their Categories*. http://www.bmb.gov.ph/index.php/e-library/laws-and-policies/denr-administrative-orders/dao-2017-2019

Department of Science and Technology-Food and Nutrition Research Institute (DOST-FNRI). (2015). *8th National Nutrition Survey*. http://122.53.86.125/NNS/8thNNS.pdf

Diele-Viegas, L. M., Pereira, E. J. de A. L., & Rocha, C. F. D. (2020). The new Brazilian gold rush: Is Amazonia at risk? *Forest Policy and Economics*, *119*, 102270. https://doi.org/10.1016/j.forpol.2020.102270

Domínguez, L., & Luoma, C. (2020). Decolonising conservation policy: How colonial land and conservation ideologies persist and perpetuate indigenous injustices at the expense of the environment. *Land*, *9*(3), 11–14. https://doi.org/10.3390/land9030065

Doorenbos, J., Sosef, M. S. M., & de Wilde, J. J. F. E. (1998). *The sections of Begonia including descriptions, keys and species lists (Studies in Begoniaceae VI)*. Wageningen Agricultural University Papers. https://library.wur.nl/WebQuery/wurpubs/fulltext/282968

Dove, M. R. (1993). A Revisionist View of Tropical Deforestation and Development. *Environmental Conservation*, *20*(1), 17–24. https://doi.org/10.1017/S0376892900037188

Dressler, W. (2005). Disentangling Tagbanua lifeways, Swidden and Conservation on Palawan Island. *Human Ecology Review*, *12*(1), 21–29. https://www.jstor.org/stable/24707498

Dressler, W. H., & McDermott, M. H. (2010). Indigenous peoples and migrants: Social categories, rights, and policies for protected areas in the Philippine uplands. *Journal of Sustainable Forestry*, *29*(2), 328–361. https://doi.org/10.1080/10549810903550779

Dressler, W. H., Wilson, D., Clendenning, J., Cramb, R., Keenan, R., Mahanty, S., Bruun, T. B., Mertz, O., & Lasco, R. D. (2017). The impact of swidden decline on livelihoods and ecosystem services in Southeast Asia: A review of the evidence from 1990 to 2015. *Ambio*, *46*(3), 291–310. https://doi.org/10.1007/s13280-016-0836-z

Dressler, W., Smith, W., Kull, C. A., Carmenta, R., & Pulhin, J. M. (2020). Recalibrating burdens of blame: Anti-swidden politics and green governance in the Philippine Uplands. *Geoforum*, *June 2019*, 1–12. https://doi.org/10.1016/j.geoforum.2020.01.024

Dryander, J. (1791). XVI. Observations on the Genus of Begonia. *Transactions of the Linnean Society of London*, *1*(1), 155–173. https://doi.org/10.1111/j.1096-3642.1791.tb00396.x

DuBay, S., Palmer, D. H., & Piland, N. (2020). Global Inequity in Scientific Names and Who They Honor. *BioRxiv*, 1–22. https://doi.org/https://doi.org/10.1101/2020.08.09.243238

Duffy, R., Massé, F., Smidt, E., Marijnen, E., Büscher, B., Verweijen, J., Ramutsindela, M., Simlai, T., Joanny, L., & Lunstrum, E. (2019). Why we must question the militarisation of conservation. *Biological Conservation*, *232*, 66–73. https://doi.org/10.1016/j.biocon.2019.01.013

Duncan, T., Rosas, J. V., Carwardine, J., Garnett, S. T., & Robinson, C. J. (2018). Influence of Environmental Governance Regimes on the Capacity of Indigenous Peoples to Particpate in Conservation Managemnet. *Parks*, *24*(November), 87–102. https://doi.org/10.2305/IUCN.CH.2018.PARKS-24-2TD.en

Ebert, A. W. (2014). Potential of underutilized traditional vegetables and legume crops to contribute to food and nutritional security, income and more sustainable production systems. *Sustainability*, *6*(1), 319–335. https://doi.org/10.3390/su6010319

Eder, J. F. (1990). Deforestation and detribalization in the Philippines: The Palawan case. *Population and Environment*, *12*(2), 99–115. https://doi.org/10.1007/BF01261477

Edgerton, R. K. (1983). Social Disintegration on a Contemporary Philippine Frontier: The Case of Bukidnon of Mindanao. *Journal of Contemporary Asia*, *13*(2), 151–175. https://doi.org/https://doi.org/10.1080/00472338380000111

Efferth, T., Banerjee, M., Paul, N. W., Abdelfatah, S., Arend, J., Elhassan, G., Hamdoun, S., Hamm, R., Hong, C., Kadioglu, O., Naß, J., Ochwangi, D., Ooko, E., Ozenver, N., Saeed, M. E. M., Schneider, M., Seo, E., Wu, C., Yan, G., … Titinchi, S. J. J. (2016). Biopiracy of natural products and good bioprospecting practice. *Phytomedicine*, *23*, 166–173. https://doi.org/10.1016/j.phymed.2015.12.006

El Bilali, H., Callenius, C., Strassner, C., & Probst, L. (2019). Food and nutrition security and sustainability transitions in food systems. *Food and Energy Security*, *8*(e00154), 1–20. https://doi.org/10.1002/fes3.154

Eligio, A. M. J. E. (2012). Communication imperatives for indigenous peoples' representation in policy making: Lessons from the IPRA (Indigenous Peoples Rights Act) experience. *Telematics and Informatics*, *29*(3), 324–334. https://doi.org/10.1016/j.tele.2011.10.004

Ely, C. V., Bordignon, S. A. de L., Trevisan, R., & Boldrini, I. I. (2017). Implications of poor taxonomy in conservation. *Journal for Nature Conservation*, *36*, 10–13. https://doi.org/10.1016/j.jnc.2017.01.003

Ember, C. R., Ringen, E. J., Dunnington, J., & Pitek, E. (2020). Resource stress and subsistence diversification across societies. *Nature Sustainability*, 1–9.

https://doi.org/10.1038/s41893-020-0542-5

Ens, E., Scott, M. L., Rangers, Y. M., Moritz, C., & Pirzl, R. (2016). Putting indigenous conservation policy into practice delivers biodiversity and cultural benefits. *Biodiversity and Conservation*, *25*(14), 2889–2906. https://doi.org/10.1007/s10531-016-1207-6

Erduran, S., Kaya, E., & Avraamidou, L. (2020). Does Research on Nature of Science and Social Justice Intersect? Exploring Theoretical and Practical Convergence for Science Education. In H. A. Yacoubian & L. Hansson (Eds.), *Nature of Science for Social Justice. Science: Philosophy, History and Education* (pp. 97–113). Springer Switzerland. https://doi.org/10.1007/978-3-030-47260-3_6

Errico, S. (2017). *The rights of indigenous peoples in Asia: a human rights-based overview of national legal and policy frameworks against the backdrop of country strategies for development and poverty reduction* (1st ed.). International Labour Organization.

Errico, S. (2020). ILO Convention No. 169 in Asia: progress and challenges. *The International Journal of Human Rights*, *24*(2–4), 156–169. https://doi.org/10.1080/13642987.2019.1677611

Erskine, W., Ximenes, A., Glazebrook, D., da Costa, M., Lopes, M., Spyckerelle, L., Williams, R., & Nesbitt, H. (2014). The role of wild foods in food security: the example of Timor-Leste. *Food Security*, *7*(1), 55–65. https://doi.org/10.1007/s12571-014-0406-9

Etchart, L. (2017). The role of indigenous peoples in combating climate change. *Palgrave Communications*, *3*(May), 17085. https://doi.org/10.1057/palcomms.2017.85

Fa, J. E., Watson, J. E. M., Leiper, I., Potapov, P., Evans, T. D., Burgess, N. D., Molnár, Z., Fernández-Llamazares, Á., Duncan, T., Wang, S., Austin, B. J., Jonas, H., Robinson, C. J., Malmer, P., Zander, K. K., Jackson, M. V., Ellis, E., Brondizio, E. S., & Garnett, S. T. (2020). Importance of Indigenous Peoples' lands for the conservation of Intact Forest Landscapes. *Frontiers in Ecology and the Environment*, *18*(3), 135–140. https://doi.org/10.1002/fee.2148

Fabro, K. A. (2020). *Illegal plant trade, tourism threaten new Philippine flowering herbs*. Mongabay: News and Information from Nature's Frontline. https://news.mongabay.com/2020/08/illegal-plant-trade-tourism-threaten-new-philippine-flowering-herbs/

FAO, IFAD, UNICEF, WFP, & WHO. (2020). *The State of Food Security and Nutrition in the World 2020: Transforming food systems for affordable healthy diets*. FAO. https://doi.org/https://doi.org/10.4060/ca9692en

Fauziah, & Mas'udah, S. (2015). Explorations diversity of Dioscorea spp. Varieties from Pasuruan, East Java: Inventory and characterization. *Agrivita*, *37*(3), 193–203. https://doi.org/10.17503/Agrivita-2015-37-3-p193-203

Ferguson, M., Brown, C., Georga, C., Miles, E., Wilson, A., & Brimblecombe, J. (2017). Traditional food availability and consumption in remote Aboriginal communities in the Northern Territory, Australia. *Australian and New Zealand Journal of Public Health*, *41*(3), 294–298. https://doi.org/10.1111/1753-6405.12664

Ferrante, L., Gomes, M., & Fearnside, P. M. (2020). Amazonian indigenous peoples are threatened by Brazil's Highway BR-319. *Land Use Policy*, *94*(February), 104548. https://doi.org/10.1016/j.landusepol.2020.104548

Ferrante, L., Leite, L., Silva Junior, C. A., Lima, M., Coelho Junior, M. G., & Fearnside, P. M. (2020). Brazil's biomes threatened : President Bolsonaro lied to the world. *Ecology & Evolution*, *October*, 2–6.

Figueiredo, E., & Smith, G. F. (2011). Who's in a name: Eponymy of the name Aloe thompsoniae Groenew., with notes on naming species after people. *Bradleya*, *29*, 121–124. https://doi.org/10.25223/brad.n29.2011.a14

Ford, J. D., Cameron, L., Rubis, J., Maillet, M., Nakashima, D., Willox, A. C., & Pearce, T. (2016). Including indigenous knowledge and experience in IPCC assessment reports. *Nature Climate Change*, *6*(4), 349–353. https://doi.org/10.1038/nclimate2954

Frainer, A., Mustonen, T., Hugu, S., Andreeva, T., Arttijeff, E. M., Arttijeff, I. S., Brizoela, F., Coelho-De-Souza, G., Printes, R. B., Prokhorova, E., Sambou, S., Scherer, A., Shadrin, V., & Pecl, G. (2020). Cultural and linguistic diversities are underappreciated pillars of biodiversity. *Proceedings of the National Academy of Sciences of the United States of America*, *117*(43), 26539–26543. https://doi.org/10.1073/pnas.2019469117

Friedman, J., Yaniv, Z., Dafni, A., & Palewitch, D. (1986). A preliminary classification of the healing potential of medicinal plants, based on a rational analysis of an ethnopharmacological field survey among Bedouins in the Negev Desert, Israel. *Journal of Ethnopharmacology*, *16*(2–3), 275–287. https://doi.org/10.1016/0378-8741(86)90094-2

Fukuda-Parr, S. (2016). From the Millennium Development Goals to the Sustainable Development Goals: shifts in purpose, concept, and politics of global goal setting for development. *Gender and Development*, *24*(1), 43–52. https://doi.org/10.1080/13552074.2016.1145895

Fukurai, H. (2018). Fourth World Approaches to International Law (FWAIL) and Asia's Indigenous Struggles and Quests for Recognition under International Law. *Asian Journal of Law and Society*, *5*(01), 221–231. https://doi.org/10.1017/als.2018.10

Fukushima, C., West, R., Pape, T., Penev, L., Schulman, L., & Cardoso, P. (2020). Wildlife collection for scientific purposes. *Conservation Biology*, *0*(0), 1–7. https://doi.org/10.1111/cobi.13572

Fullagar, R., Field, J., Denham, T., & Lentfer, C. (2006). Early and mid Holocene tool-use and processing of taro (Colocasia esculenta), yam (Dioscorea sp.) and other plants at Kuk Swamp in the highlands of Papua New Guinea. *Journal of Archaeological Science*, *33*, 595–614. https://doi.org/10.1016/j.jas.2005.07.020

Gachelin, G., Garner, P., Ferroni, E., Trohler, U., & Chalmers, I. (2017). Evaluating Cinchona bark and quinine for treating and preventing malaria. *Journal of the Royal Society of Medicine*, *110*(1), 31–40. https://doi.org/10.1177/0141076816681421

Gadgil, M., Berkes, F., & Folke, C. (1993). Indigenous Knowledge for Biodiversity Conservation. *Ambio*, *22*(2), 151–156. http://www.jstor.org/stable/4314060

Gale, S. W., Kumar, P., Hinsley, A., Cheuk, M. L., Gao, J., Liu, H., Liu, Z. L., & Williams, S. J. (2019). Quantifying the trade in wild-collected ornamental orchids in South China: Diversity, volume and value gradients underscore the primacy of supply. *Biological Conservation*, *238*, 108204. https://doi.org/10.1016/j.biocon.2019.108204

Gallois, S., Heger, W. T., Andel, T. van, Sonké, B., & Henry, A. G. (2020). From bush mangoes to bouillon cubes: Wild plants and diet among the Baka, forager-horticulturalists from Southeast Cameroon. *Economic Botany, March*. https://doi.org/10.1007/s12231-020-09489-x

García-del-Amo, D., Mortyn, P. G., & Reyes-García, V. (2020). Including indigenous and local knowledge in climate research: an assessment of the opinion of Spanish climate change researchers. *Climatic Change*, 67–88. https://doi.org/10.1007/s10584-019-02628-x

Garnett, S. T., Burgess, N. D., Fa, J. E., Fernández-llamazares, Á., Molnár, Z., Robinson, C. J., Watson, J. E. M., Zander, K. K., Austin, B., Brondizio, E. S., Collier, N. F., Duncan, T., Ellis, E., Geyle, H., Jackson, M. V, Jonas, H., Malmer, P., Mcgowan, B., Sivongxay, A., & Leiper, I. (2018). A spatial overview of the global importance of Indigenous lands for conservation. *Nature Sustainability*, *1*, 369–374. https://doi.org/10.1038/s41893-018-0100-6

Garutsa, T. C., & Nekhwevha, F. H. (2016). Labour-burdened women utilising their marginalised indigenous knowledge in food production processes: The case of Khambashe rural households, Eastern Cape, South Africa. *South African Review of Sociology*, *47*(4), 106–120. https://doi.org/10.1080/21528586.2016.1204243

Gatto, M., Naziri, D., Pedro, J. S., & Béné, C. (2021). Crop resistance and household resilience – the case of cassava and sweetpotato during super-typhoon Ompong in the Philippines. *International Journal of Disaster Risk Reduction*, 102392. https://doi.org/10.1016/j.ijdrr.2021.102392

Gayao, B. T., Meldoz, D. T., & Backian, G. S. (2018). Indigenous knowledge and household food security: the role of root and tuber crops among indigenous peoples in the Northern Philippines. In A. Niehof (Ed.), *Diversity and change in food wellbeing– Cases from Southeast Asia and Nepal* (pp. 43–69). Wageningen Academic Publishers. https://doi.org/10.3920/978-90-8686-864-3

German, M. A. D. (2019). Labels, Stigma Management and Social Identity Formation of a Mountain People in Central Panay, Philippines. *Cankaya University Journal of Humanities and Social Sciences*, *13*(1), 79–92.

Ghosh-Jerath, S., Kapoor, R., Singh, A., Downs, S., Barman, S., & Fanzo, J. (2020). Leveraging Traditional Ecological Knowledge and Access to Nutrient-Rich Indigenous Foods to Help Achieve SDG 2: An Analysis of the Indigenous Foods of Sauria Paharias, a Vulnerable Tribal Community in Jharkhand, India. *Frontiers in Nutrition*, *7*(61), 1–26. https://doi.org/10.3389/fnut.2020.00061

Gillman, L. N., & Wright, S. D. (2020). Restoring indigenous names in taxonomy. *Communications Biology*, *3*(609), 20–22. https://doi.org/10.1038/s42003-020-01344-y

Giovannetti, C., Garcia Arce, S., Rush, B., & Mendive, F. (2020). Pilot Evaluation of a Residential Drug Addiction Treatment Combining Traditional Amazonian Medicine, Ayahuasca and Psychotherapy on Depression and Anxiety. *Journal of Psychoactive Drugs*, *52*(5), 472–481. https://doi.org/10.1080/02791072.2020.1789247

Giraldi, M., & Hanazaki, N. (2014). Use of Cultivated and HarvestedEdible Plants by Caiçaras—What Can Ethnobotany Add to Food Security Discussions? *Human Ecology Review*, *20*(2), 51–73. https://doi.org/10.22459/HER.20.02.2014.03

Girmansyah, D., Susila, & Hughes, M. (2019). A revision of Begonia sect. Petermannia on

Sumatra, Indonesia. *Phytotaxa*, *407*(1), 79–100.

Global Witness. (2016). *On Dangerous Ground: 2015's Deadly Environment: The Killing and Criminalization of Land and Environmental Defenders Worldwide*. https://www.globalwitness.org/en/campaigns/environmental-activists/dangerous-ground/

Global Witness. (2017). *Defenders of the Earth: Global killings of land and environmental defenders in 2016*. https://www.globalwitness.org/en-gb/campaigns/environmental-activists/defenders-earth/

Global Witness. (2020). *Defending tomorrow: The climate crisis andthreats against land and environmental defenders* (Issue July). https://www.globalwitness.org/en/campaigns/environmental-activists/defending-tomorrow/

Gómez-Baggethun, E., Corbera, E., Reyes-García, V., & Corbera, E. (2013). Traditional Ecological Knowledge and Global Environmental Change: Research findings and policy implications. *Ecology and Society*, *18*(4), 72–80. https://doi.org/10.5751/ES-06288-180472

Goodland, R., & Wick, C. (2008). *Philippines: Mining or Food? Case Study 5: Nickel Mining – Mindoro Island*. http://www.piplinks.org/system/files/Mining+or+Food+Case+Study+5.pdf

Goyes, D. R., South, N., Abaibira, M. A., Baicué, P., Cuchimba, A., Tatiana, D., & Ñeñetofe, R. (2021). Genocide and ecocide in four Colombian indigenous communities: the erosion of a way of life and memory. *British Journal of Criminology*, *37*, 1–20. https://doi.org/10.1093/bjc/azaa109

Groenigen, K. J. Van, Kessel, C. Van, & Hungate, B. A. (2012). Increased greenhouse-gas intensity of rice production under future atmospheric conditions. *Nature Climate Change*, *2*(10), 1–4. https://doi.org/10.1038/nclimate1712

Gronemeyer, T., Coritico, F., Wistuba, A., Marwinski, D., Gieray, T., Micheler, M., Mey, F. S., & Amoroso, V. (2014). Four new species of *Nepenthes* l. (Nepenthaceae) from the central mountains of Mindanao, Philippines. *Plants*, *3*(2), 284–303. https://doi.org/10.3390/plants3020284

Grune, T., Lietz, G., Palou, A., Ross, A. C., Stahl, W., Tang, G., Thurnham, D., Yin, S.-A., & Biesalski, H. K. (2010). b-Carotene As an Important Vitamin A Source for Humans. *The Journal of Nutrition*, *140*, 2268–2285. https://doi.org/10.3945/jn.109.119024.ants

Guadalquiver, N. (2020, April 11). "Poisonous" yam downs 80 residents of Sagay City. *Philippine News Agency*. https://www.pna.gov.ph/articles/1099499

Guarani-Kaiowá Community. (2012). *Letter From the Guarani-Kaiowá de Pyelito Kue/Mbarakay-Iguatemi-MS to the Brazilian Government* (p. 2). https://globalvoices.org/2012/10/25/brazil-guarani-kaiowa-indigenous-resistance/#

Gulati, R. (2019). Biopiracy, a biological theft? *International Journal of Legal Studies*, *1*(5), 317–350. https://doi.org/10.5604/01.3001.0013.3244

Guyu, F. D., & Muluneh, W.-T. (2015). Wild foods (plants and animals) in the green famine belt of Ethiopia: Do they contribute to household resilience to seasonal food insecurity? *Forest Ecosystems*, *2*(34), 1–12. https://doi.org/10.1186/s40663-015-0058-z

Hagen, R., van der Ploeg, J., & Minter, T. (2016). How do hunter-gatherers learn? The transmission of indigenous knowledge among the Agta of the Philippines. *Hunter Gatherer Research*, *2*(4), 389–413. https://doi.org/10.3828/hgr.2016.27

Hagen, R. V, & Minter, T. (2020). Displacement in the Name of Development. How Indigenous Rights Legislation Fails to Protect Philippine Hunter-Gatherers. *Society & Natural Resources*, *33*(1), 65–82. https://doi.org/10.1080/08941920.2019.1677970

Haldar, S. (2019). Bioinformatics methods: application toward analyses and interpretation of experimental data. In S. N. Meena & M. M. Naik (Eds.), *Advances in Biological Science Research* (pp. 1–19). Elsevier Inc. https://doi.org/10.1016/B978-0-12-817497-5.00001-X

Hall, N. L., Creamer, S., Anders, W., Slatyer, A., & Hill, P. S. (2020). Water and health interlinkages of the sustainable development goals in remote Indigenous Australia. *Npj Clean Water*, *3*(1), 1–10. https://doi.org/10.1038/s41545-020-0060-z

Hamilton, T. M., Canessa, S., Clark, K., Gleeson, P., Mackenzie, F., Makan, T., Kani, G. M., Oliver, S., Parker, K. A., Ewen, J. G., Hau, T. U. O., & Street, H. (2020). Applying a values-based decision process to facilitate comanagement of threatened species in Aotearoa New Zealand. *Conservation Biology*, *0*(0), 1–12. https://doi.org/10.1111/cobi.13651

Han, J., Pang, X., Liao, B., Yao, H., Song, J., & Chen, S. (2016). An authenticity survey of herbal medicines from markets in China using DNA barcoding. *Scientific Reports*, *6*, 1–9. https://doi.org/10.1038/srep18723

Harijono, E. T., Sunarharum, W. B., & Hartono, M. D. (2013). Hypoglycemic effect of biscuits containing water-soluble polysaccharides from wild yam (Dioscorea hispida Dennts) or lesser yam (Dioscorea esculenta) tubers and alginate. *International Food Research Journal*, *20*(5), 2279–2285.

Hashimoto, N., Noda, T., Kim, S., Sarker, Z. I., Yamauchi, H., Takigawa, S., Han, K.-H., & Fukushima, M. (2009). Yam Contributes to Improvement of Glucose Metabolism in Rats. *Plant Foods for Human Nutrition*, *64*, 193–198. https://doi.org/10.1007/s11130-009-0126-z

Hayward, P., & Kuwahara, S. (2013). Cycads, Sustenance and Cultural Landscapes in the Amami Islands. In K. Kawai, R. Terada, & S. Kuwahara (Eds.), *The Islands of Kagoshima* (Issue March, pp. 29–37). Kagoshima University Research Center for the Pacific Islands. http://cpi.kagoshima-u.ac.jp/The Islands of Kagoshima PDF/5-The_Island_of_Kagoshima.pdf

Hegazy, A. K., Hosni, H. A., Lovett-, L., Kabiel, H. F., Badawy, E. M., & Mwavu, E. N. (2020). Indigenous knowledge of wild plants collected in Darfur, Sudan. *Ethnobotany Research & Applications*, *19*(47), 1–19. https://doi.org/http://dx.doi.org/10.32859/era.19.47.1-19

Heineberg, M. R., & Hanazaki, N. (2019). Dynamics of the botanical knowledge of the Laklãnõ-Xokleng indigenous people in Southern Brazil. *Acta Botanica Brasilica*, *33*(2), 1–15. https://doi.org/10.1590/0102-33062018abb0307

Heinrich, M, & Gibbons, S. (2001). Ethnopharmacology in drug discovery: an analysis of its role and potential contribution. *The Journal of Pharmacy and Pharmacology*, *53*(4), 425–432. https://doi.org/10.1211/0022357011775712

Heinrich, Michael. (2015a). Ethnopharmacology: A short history of a multidisciplinary field of research. In Michael Heinrich & A. K. Jager (Eds.), *Ethnopharmacology* (1st ed., pp. 3–9). John Wiley & Sons, Ltd.

Heinrich, Michael. (2015b). *Ethnopharmacology* (Michael Heinrich & A. K. Jager (Eds.); 1st ed.). John Wiley & Sons Ltd.

Hendry-Hofer, T. B., Ng, P. C., Witeof, A. E., Mahon, S. B., Brenner, M., Boss, G. R., & Bebarta, V. S. (2019). A Review on Ingested Cyanide: Risks, Clinical Presentation, Diagnostics, and Treatment Challenges. *Journal of Medical Toxicology*, *15*, 128–133. https://doi.org/https:// doi.org/10.1007/s13181-018-0688-y

Heywood, V. H. (1999). *Use and potential of wild plants in farm households*. Food and Agriculture Organizations of the United Nations. http://www.fao.org/3/W8801E/W8801E00.htm

Hidayati, S., Franco, F. M., & Bussmann, R. W. (2015). Ready for phase 5 - current status of ethnobiology in Southeast Asia. *Journal of Ethnobiology and Ethnomedicine*, *11*(17), 1–8. https://doi.org/10.1186/s13002-015-0005-7

Hill, R., Adem, C., Alangui, W. V, Molnar, Z., Aumeeruddy-Thomas, Y., Bridgewater, P., Tengo, M., Thaman, R., Yao, C. Y. A., Berkes, F., Carino, J., Cunha, M. C. da, Diaw, M. C., Diaz, S., Figueroa, V. E., Fisher, J., Hardison, P., Ichikawa, K., Kariuki, P., … Xue, D. (2020). Working with indigenous, local and scientific knowledge in assessments of nature and nature’s linkages with people. *Current Opinion in Environmental Sustainability*, *43*, 8–20. https://doi.org/10.1016/j.cosust.2019.12.006

Hitchcock, R. K. (2019). The Impacts of Conservation and Militarization on Indigenous Peoples: A Southern African San Perspective. *Human Nature*, *30*, 217–241. https://doi.org/https://doi.org/10.1007/s12110-019-09339-3 The

Hiwasaki, L., Luna, E., Syamsidik, & Marcal, J. A. (2015). Local and indigenous knowledge on climate-related hazards of coastal and small island communities in Southeast Asia. *Climatic Change*, *128*(1–2), 35–56. https://doi.org/10.1007/s10584-014-1288-8

Ho, C. M. (2006). Biopiracy and Beyond : A Consideration of Socio- Cultural Conflicts with Global Patent Policies. *University of Michigan Journal of Law Reform*, *39*(3), 433–542. https://lawecommons.luc.edu/cgi/viewcontent.cgi?article=1034&context=facpubs

Hollingsworth, P. M., Li, D. Z., Van Der Bank, M., & Twyford, A. D. (2016). Telling plant species apart with DNA: From barcodes to genomes. *Philosophical Transactions of the Royal Society B: Biological Sciences*, *371*, 1–9. https://doi.org/10.1098/rstb.2015.0338

Howes, M.-J. R., Quave, C. L., Collemare, J., Tatsis, E. C., Twilley, D., Lulekal, E., Farlow, A., Li, L., Cazar, M.-E., Leaman, D. J., Prescott, T. A. K., Milliken, W., Martin, C., Canha, M. N. De, Lall, N., Qin, H., Walker, B. E., Vásquez-Londoño, C., Allkin, B., … Lughadha, E. N. (2020). Molecules from nature: Reconciling biodiversity conservation and global healthcare imperatives for sustainable use of medicinal plants and fungi. *Plants, People, Planet*, *2*, 463–481. https://doi.org/10.1002/ppp3.10138

Howitt, R. (2018). Indigenous rights vital to survival. *Nature Sustainability*, *1*(7), 339–340. https://doi.org/10.1038/s41893-018-0105-1

Huesca, E. F. (2016). Plantation Economy, Indigenous People, and Precariousness in the Philippine Uplands: The Mindanao Experience. In P. Carnegie, V. T. King, & I. Zawawi

(Eds.), *Human Insecurities in Southeast Asia, Asia in Transition* (pp. 173–192). Springer Singapore. https://doi.org/10.1007/978-981-10-2245-6

Hughes, A. C. (2017). Understanding the drivers of Southeast Asian biodiversity loss. *Ecosphere*, *8*(1). https://doi.org/10.1002/ecs2.1624

Hughes, M., & Hollingsworth, P. M. (2008). Population genetic divergence corresponds with species-level biodiversity patterns in the large genus Begonia. *Molecular Ecology*, *17*(11), 2643–2651. https://doi.org/10.1111/j.1365-294X.2008.03788.x

Hummel, S., & Lake, F. K. (2015). Forest Site Classification for Cultural Plant Harvest by Tribal Weavers Can Inform Management. *Journal of Forestry*, *113*(1), 30–39. https://doi.org/10.5849/jof.13-082

Humphreys, A. M., Govaerts, R., Ficinski, S. Z., Lughadha, E. N., & Vorontsova, M. S. (2019). Global dataset shows geography and life form predict modern plant extinction and rediscovery. *Nature Ecology and Evolution*, *3*, 1043–1047. https://doi.org/10.1038/s41559-019-0906-2

Hunn, E. (2007). Ethnobiology in four phases. *Journal of Ethnobiology*, *27*(1), 1–10. https://doi.org/10.2993/0278-0771(2007)27[1:EIFP]2.0.CO;2

Hunter, D., Borelli, T., Beltrame, D. M. O., Oliveira, C. N. S., Coradin, L., Wasike, V. W., Wasilwa, L., Mwai, J., Manjella, A., Samarasinghe, G. W. L., Madhujith, T., Nadeeshani, H. V. H., Tan, A., Ay, S. T., Güzelsoy, N., Lauridsen, N., Gee, E., & Tartanac, F. (2019). The potential of neglected and underutilized species for improving diets and nutrition. *Planta*, *250*, 709–729. https://doi.org/10.1007/s00425-019-03169-4

Hunter, M. (1991). *Racist Relics: An Ugly Blight On Our Botanical Nomenclature*. The Scientist. https://www.the-scientist.com/opinion-old/racist-relics-an-ugly-blight-on-our-botanical-nomenclature-60358

Idohou, R., Fandohan, B., Salako, V. K., Kassa, B., Gbèdomon, R. C., Yédomonhan, H., Glèlè Kakaï, R. L., & Assogbadjo, A. E. (2014). Biodiversity conservation in home gardens: traditional knowledge, use patterns and implications for management. *International Journal of Biodiversity Science, Ecosystem Services & Management*, *10*(2), 89–100. https://doi.org/10.1080/21513732.2014.910554

IIFB, FPP, & SCBD. (2020). *Local Biodiversity Outlooks 2: The contributions of indigenous peoples and local communities to the implementation of the Strategic Plan for Biodiversity 2011–2020 and to renewing nature and cultures. A complement to the fifth edition of the Global Biodiv*. Forest Peoples Programme. www.localbiodiversityoutlooks.net

Imbong, J. D. (2020). “Bungkalan” and the Manobo-Pulangihon tribe’s resistance to corporate land-grab in Bukidnon, Mindanao. *AlterNative*, 1–9. https://doi.org/10.1177/1177180120967724

Ingty, T. (2017). High mountain communities and climate change: adaptation, traditional ecological knowledge, and institutions. *Climatic Change*, *145*(1–2), 41–55. https://doi.org/10.1007/s10584-017-2080-3

Intergovernmental Panel on Climate Change. (2019). *IPCC Special Report on Climate Change, Desertification, Land Degradation, Sustainable Land Management, Food Security, and Greenhouse gas fluxes in Terrestrial Ecosystems*.

https://www.ipcc.ch/site/assets/uploads/2019/08/4.-SPM_Approved_Microsite_FINAL.pdf

International Fund for Agricultural Development. (2021). *Indigenous Peoples Assistance Facility*. https://www.ifad.org/en/ipaf

International Labour Office. (2018). *Social Protection for Indigenous Peoples* (pp. 1–10).

IUCN Standards and Petitions Committee. (2019). *Guidelines for Using the IUCN Red List Categories and Criteria Version 14* (Vol. 1, Issue August). http://www.iucnredlist.org/documents/RedListGuidelines.pdf.

Iwasaki-Goodman, M. (2017). Transmitting Ainu traditional food knowledge from mothers to their daughters. *Maternal and Child Nutrition*, *13*(June 2017), 1–9. https://doi.org/10.1111/mcn.12555

IWGIA. (2017). *The Indigenous World 2017* (K. Broch Hansen, K. Jepsen, & P. Leiva Jacquelin (Eds.)). The International Work Group for Indigenous Affairs (IWGIA). https://www.iwgia.org/images/documents/indigenous-world/indigenous-world-2017.pdf

IWGIA. (2018). *The Indigenous World 2018* (P. Jacquelin-Andersen (Ed.)). The International Work Group for Indigenous Affairs (IWGIA). https://doi.org/10.4135/9781446201077.n34

Jackson, M. (2020). *Racism in Taxonomy: What's in a Name?* Hoyt Arboretum. https://www.hoytarboretum.org/racism-in-taxonomy-whats-in-a-name/

Jerusalem, J. (2019). *Bombs discovered in NPA lair after firefight in Bukidnon*. Philippine News Agency. https://www.pna.gov.ph/articles/1076881

Jerusalem, J., & Madera, M. (2019). *PNP decries Bukidnon NPA attack that killed cop, hurt another*. Philippine News Agency. https://www.pna.gov.ph/articles/1063025

Jesus, M., Martins, A. P. J., Gallardo, E., & Silvestre, S. (2016). Diosgenin: Recent Highlights on Pharmacology and Analytical Methodology. *Journal of Analytical Methods in Chemistry*, *2016*. https://doi.org/10.1155/2016/4156293

Jha, K. K. (2015). Non-timber Forest Products, Their Vulnerability and Conservation in a Designated UNESCO Heritage Site of Arunanchal Pradesh, India. *Notulae Scientia Biologicae*, *7*(74), 444–455. https://doi.org/10.15835/nsb.7.4.9701

Jianchu, X., & Mikesell, S. (2003). Indigenous Knowledge for Sustainable Livelihoods and Resources Governance in MMSEA Region. In X. Jianchu & S. Mikesell (Eds.), *Proceedings of the III Symposium on MMSEA 25–28 August 2002, Lijiang, P.R. China* (Issue July, pp. 1–7). Yunnan Science and Technology Press.

Jiménez-Garrido, D. F., Gómez-Sousa, M., Ona, G., Santos, R. G. Dos, Hallak, J. E. C., Alcázar-Córcoles, M. Á., & Bouso, J. C. (2020). Effects of ayahuasca on mental health and quality of life in naïve users: A longitudinal and cross- sectional study combination. *Scientific Reports*, *10*(4075), 1–12. https://doi.org/10.1038/s41598-020-61169-x

Joa, B., Winkel, G., & Primmer, E. (2018). The unknown known – A review of local ecological knowledge in relation to forest biodiversity conservation. *Land Use Policy*, *79*(May), 520–530. https://doi.org/10.1016/j.landusepol.2018.09.001

Johnson-Jennings, M. D., Jennings, D. R., Paul, K., & Little, M. M. (2020). Identifying needs and uses of digital Indigenous food knowledge and practices for an Indigenous Food Wisdom Repository. *AlterNative*, *16*(4), 290–299. https://doi.org/10.1177/1177180120954446

Johnson, H. E., Banack, S. A., & Cox, P. A. (2008). Variability in content of the anti-AIDS drug candidate prostratin in Samoan populations of Homalanthus nutans. *Journal of Natural Products*, *71*(12), 2041–2044. https://doi.org/10.1021/np800295m

Jones, A. W., & Kennedy, R. S. (2008). Evolution in a tropical archipelago: Comparative phylogeography of Philippine fauna and flora reveals complex patterns of colonization and diversification. *Biological Journal of the Linnean Society*, *95*(3), 620–639. https://doi.org/10.1111/j.1095-8312.2008.01073.x

Jones, D. A. (1998). Why are so many plants cyanogenic? *Phytochemistry*, *47*(2), 155–162. https://doi.org/10.1016/s0031-9422(97)00425-1

Joshi, B. K., Shrestha, R., Gautam, I. P., Poudel, A. P., & Gotame, T. P. (2019). *Neglected and Underutilized Species (NUS), and Future Smart Food (FSF) in Nepal*. National Agriculture Genetic Resources Center.

Ju, Y., Zhuo, J., Liu, B., & Long, C. (2013). Eating from the wild: Diversity of wild edible plants used by Tibetans in Shangri-la region, Yunnan, China. *Journal of Ethnobiology and Ethnomedicine*, *9*(1), 1–22. https://doi.org/10.1186/1746-4269-9-28

Kadykalo, A. N., Cooke, S. J., & Young, N. (2021). The role of western-based scientific, Indigenous and local knowledge in wildlife management and conservation. *People and Nature*, 610–626. https://doi.org/10.1002/pan3.10194

Kahane, R., Hodgkin, T., Jaenicke, H., Hoogendoorn, C., Hermann, M., Dyno Keatinge, J. D. H., D'Arros Hughes, J., Padulosi, S., & Looney, N. (2013). Agrobiodiversity for food security, health and income. *Agronomy for Sustainable Development*, *33*(4), 671–693. https://doi.org/10.1007/s13593-013-0147-8

Kalinaw News: The Official Online Press of the Philippine Army. (2018). *Army Team securing Civilians fired upon by NPA Terrorists: December 20, 2018*. https://www.kalinawnews.com/army-team-securing-civilians-fired-upon-by-npa-terrorists/

Kalinaw News: The Official Online Press of the Philippine Army. (2019). *4 NPA Terrorists; 2 Army Troopers Died in Clash: 14 February 2019*. https://www.kalinawnews.com/4-npa-terrorists-2-army-troopers-died-in-clash/

Kamal, A. G., Linklater, R., Thompson, S., Dipple, J., & Ithinto Mechisowin Committee. (2015). A Recipe for Change: Reclamation of Indigenous Food Sovereignty in O-Pipon-Na-Piwin Cree Nation. *Globalizations*, *12*(4), 559–575. https://doi.org/10.1080/14747731.2015.1039761

Kang, K. S., & Taek Heo, S. (2015). A case of life-threatening acute kidney injury with toxic encephalopathy caused by Dioscorea quinqueloba. *Yonsei Medical Journal*, *56*(1), 304–306. https://doi.org/10.3349/ymj.2015.56.1.304

Kang, Y., Łuczaj, Ł. J., & Ye, S. (2012). The highly toxic Aconitum carmichaelii Debeaux as a root vegetable in the Qinling Mountains (Shaanxi, China). *Genetic Resources and Crop Evolution*, *59*(7), 1569–1575. https://doi.org/10.1007/s10722-012-9853-3

Kapepiso, F. S., & Higgs, R. (2020). Tracing the curation of Indigenous knowledge in a biopiracy case. *AlterNative*, 1–7. https://doi.org/10.1177/1177180120903502

Karaffa, P. T., Draheim, M. M., & Parsons, E. C. M. (2012). What's in a Name? Do Species' Names Impact Student Support for Conservation? *Human Dimensions of Wildlife*, *17*(4), 308–310. https://doi.org/10.1080/10871209.2012.676708

Karki, M., Hill, R., Xue, D., Alangui, W., Ichikawa, K., & Bridgewater, P. (2017). Knowing our Lands and Resources: Indigenous and Local Knowledge and Practices related to Biodiversity and Ecosystem Services in Asia. In *Knowledges of Nature*. UNESCO. www.unesco.org/new/links/ipbes-pubs%5Cnhttp://www.unesco.org/new/fileadmin/MULTIMEDIA/HQ/SC/temp/LINKS/IPBES_AP_2017_V3LR.pdf

Keating, N. B. (2013). Kuy alterities: The struggle to conceptualise and claim Indigenous land rights in neoliberal Cambodia. *Asia Pacific Viewpoint*, *54*(3), 309–322. https://doi.org/10.1111/apv.12026

Kennedy, G., Ballard, T., & Dop, M. (2010). Guidelines for measuring household and individual dietary diversity. In *FAO*. FAO. https://doi.org/613.2KEN

Kenney-Lazar, M., & Ishikawa, N. (2019). Mega-Plantations in Southeast Asia: Landscapes of Displacement. *Environment and Society: Advances in Research*, *10*, 63–82. https://doi.org/10.3167/ares.2019.100105

Kiew, R. (2004). Begonia sizemoreae Kiew (Begoniaceae). A handsome new Begonia from Vietnam. *Gardens' Bulletin Singapore*, *56*, 95–100.

Kik, A., Adamec, M., Aikhenvald, A. Y., Bajzekova, J., Baro, N., Bowern, C., Colwell, R. K., Drozd, P., Duda, P., Ibalim, S., Jorge, L. R., Mogina, J., Ruli, B., Sam, K., Sarvasy, H., Saulei, S., Weiblen, G. D., Zrzavy, J., & Novotny, V. (2021a). Language and ethnobiological skills decline precipitously in Papua New Guinea, the world's most linguistically diverse nation. *Proceedings of the National Academy of Sciences*, *118*(22), 1–8. https://doi.org/10.1073/pnas.2100096118

Kik, A., Adamec, M., Aikhenvald, A. Y., Bajzekova, J., Baro, N., Bowern, C., Colwell, R. K., Drozd, P., Duda, P., Ibalim, S., Jorge, L. R., Mogina, J., Ruli, B., Sam, K., Sarvasy, H., Saulei, S., Weiblen, G. D., Zrzavy, J., & Novotny, V. (2021b). The world's hotspot of linguistic and biocultural diversity under threat. *BioRxiv*, 1–14. https://doi.org/: https://doi.org/10.1101/2021.04.12.439439

Kim, S., Li, G., & Son, Y. (2017). The contribution of traditional ecological knowledge and practices to forest management: The case of Northeast Asia. *Forests*, *8*(12), 1–14. https://doi.org/10.3390/f8120496

Kingsbury, B. (1998). "Indigenous Peoples" in International Law: A Constructivist Approach to the Asian Controversy. *The American Journal of International Law*, *92*(3), 414–457. https://www.jstor.org/stable/2997916

Klotzsch, J. F. (1854). *Begoniaceen-Gattungen und Arten*. Abhandlungen der Königlichen Akademie der Wissenschaften zu Berlin. https://www.biodiversitylibrary.org/item/92694

Koehler, G. (2016). Assessing the SDGs from the standpoint of eco-social policy: using the SDGs subversively. *Journal of International and Comparative Social Policy*, *32*(2), 149–164. https://doi.org/10.1080/21699763.2016.1198715

Koirala, P., Pandit, B., Phuyal, P., & Zafren, K. (2017). Yarsagumba Fungus: Health Problems in the Himalayan Gold Rush. *Wilderness and Environmental Medicine*, *28*(3), 267–270. https://doi.org/10.1016/j.wem.2017.04.007

Kolås, Å. (2017). Framing the tribal: ethnic violence in Northeast India. *Asian Ethnicity*, *18*(1), 22–37. https://doi.org/10.1080/14631369.2015.1062050

Kopnina, H. (2016). The victims of unsustainability: A challenge to sustainable development goals. *International Journal of Sustainable Development and World Ecology*, *23*(2), 113–121. https://doi.org/10.1080/13504509.2015.1111269

Kresnadipayana, D., & Waty, H. I. (2019). The concentration of NaCl soaking to decreasing cyanide levels in Gadung (Dioscorea hispida Dennst). *Jurnal Teknologi Laboratorium*, *8*(1), 36–40. https://doi.org/10.29238/teknolabjournal.v8i1.156

Kress, W. J., Wurdack, K. J., Zimmer, E. A., Weigt, L. A., & Janzen, D. H. (2005). Use of DNA barcodes to identify flowering plants. *Proceedings of the National Academy of Sciences of the United States of America*, *102*(23), 8369–8374. https://doi.org/10.1073/pnas.0503123102

Ku, S. M., Peng, C. I., & Liu, Y. (2004). Notes on Begonia (sect. Coelocentrum, Begoniaceae) from Guangxi, China, with the report of two new species. *Botanical Bulletin of Academia Sinica*, *45*(4), 353–367. https://doi.org/10.7016/BBAS.200410.0353

Kuhnlein, H. V. (2002). Micronutrient nutrition and traditional food systems of indigenous peoples. *FAO Corporate Document Repository*, *May*, 1–11. http://www.fao.org/docrep/005/y8346m/y8346m05.htm

Kuhnlein, H. V. (2014). How Ethnobiology Can Contribute to Food Security. *Journal of Ethnobiology*, *34*(1), 12–27. https://doi.org/10.2993/0278-0771-34.1.12

Kuhnlein, H. V., Erasmus, B., & Spigelski, D. (2009). *Indigenous Peoples' food systems: the many dimensions of culture, diversity and environment for nutrition and health*. FAO. http://www.fao.org/3/i0370e/i0370e.pdf

Kuhnlein, H. V., Smitasiri, S., Yesudas, S., Bhattacharjee, L., Dan, L., & Ahmed, S. (2006). *Documenting Traditional Food Systems of Indigenous peoples: International Case Studies* (Issue April). Ste-Anne-de-Bellevue: Centre for Indigen-ous Peoples' Nutrition and Environment. https://www.mcgill.ca/cine/files/cine/ProcedureManual_Steps.pdf

Kumar, B. M., & Nair, P. K. R. (2004). The enigma of tropical homegardens. *Agroforestry Systems*, *61–62*(1–3), 135–152. https://doi.org/10.1023/B:AGFO.0000028995.13227.ca

Kumar, J. U. S., Seethapathy, V. K. G. S., Ravikanth, R. G. G., & Shaanker, R. U. (2018). Assessment of adulteration in raw herbal trade of important medicinal plants of India using DNA barcoding. *3 Biotech*, *8*(3), 1–8. https://doi.org/10.1007/s13205-018-1169-3

Kumar, S., Das, G., Shin, H., & Patra, J. K. (2017). Dioscorea spp. (A Wild Edible Tuber): A Study on Its Ethnopharmacological Potential and Traditional Use by the Local People of Similipal Biosphere. *Frontiers in Pharmacology*, *8*(52), 1–17. https://doi.org/10.3389/fphar.2017.00052

Kumoro, A. C., Retnowati, D. S., & Budiyati, C. S. (2011). Removal of Cyanides from Gadung (Dioscorea hispida Dennst.) Tuber Chips using Leaching and Steaming Techniques. *Journal of Applied Sciences Research*, *7*(12), 2140–2146.

http://eprints.undip.ac.id/32458/

Kurashima, N., Fortini, L., & Ticktin, T. (2019). The potential of indigenous agricultural food production under climate change in Hawaiʻi. *Nature Sustainability, 2*, 191–199. https://doi.org/10.1038/s41893-019-0226-1

Labate, B. C., & Cavnar, C. (2014). The therapeutic use of Ayahuasca. In *The Therapeutic Use of Ayahuasca*. Springer-Verlag Berlin Heidelberg. https://doi.org/10.1007/978-3-642-40426-9

Laborde, B. D., Martin, W., Swinnen, J., & Vos, R. (2020). COVID-19 risks to global food security. *Science*, *369*(6503), 500–502. https://doi.org/10.1126/science.abc4765

Lacuna-Richman, C. (2003). Ethnicity and the utilization of non-wood forest products: Findings from three Philippine villages. *Silva Fennica*, *37*(1), 129–148. https://doi.org/10.14214/sf.516

Lacuna-Richman, C. (2004). Subsistence strategies of an indigenous minority in the Philippines: nonwood forest product use by the Tagbanua of Narra, Palawan. *Economic Botany*, *58*(2), 266–285. https://doi.org/10.1663/0013-0001(2004)058[0266:SSOAIM]2.0.CO;2

Lam, D. P. M., Hinz, E., Lang, D. J., Tengö, M., Wehrden, H. von, & Martín-López, B. (2020). Indigenous and local knowledge in sustainability transformations research: a literature review. *Ecology and Society*, *25*(1), 1–26. https://doi.org/10.5751/ES-11305-250103

Lao, M. M. (1987). The Economy of the Bukidnon Plateau During the American Period. *Philippine Studies*, *35*(3), 316–331. https://www.jstor.org/stable/42633025

Larsen, P. B., Billon, P. Le, Menton, M., Aylwin, J., Boyd, D., Forst, M., Lambrick, F., & Santos, C. (2020). Understanding and responding to the environmental human rights defenders crisis : The case for conservation action. *Conservation Letters*, *e12777*, 1–7. https://doi.org/10.1111/conl.12777

Larson, A. M., Cronkleton, P. J., & Pulhin, J. M. (2015). Formalizing Indigenous Commons: The Role of 'Authority ' in the Formation of Territories in Nicaragua, Bolivia, and the Philippines. *World Development*, *70*, 228–238. https://doi.org/10.1016/j.worlddev.2015.02.004

Law, Y.-H. (2019). New tarantula highlights illegal trade in spiders. *Science*, *363*(6430), 914–916. https://doi.org/10.1126/science.363.6430.914

Law, Y.-H. (2021). Illicit centipede spurs taxonomy journal debate. *Science*, *371*(6530), 662. https://doi.org/10.1126/science.371.6530.662

Le Couteur, D. G., Solon-Biet, S., Wahl, D., Cogger, V. C., Willcox, B. J., Willcox, D. C., Raubenheimer, D., & Simpson, S. J. (2016). Dietary protein, ageing and the Okinawan ratio. *Age and Ageing*, *45*(4), 443–447. https://doi.org/10.1093/ageing/afw069

Leadership Council of the Sustainable Development Solutions Network. (2015). Indicators and a Monitoring Framework for the Sustainable Development Goals: Launching a data revolution for the SDGs. In *A Report by the Leadership Council of the Sustainable Development Solutions Network*. http://unsdsn.org/wp-content/uploads/2015/03/150320-SDSN-Indicator-Report.pdf

Lebot, V., Malapa, R., & Abraham, K. (2017). The Pacific yam (Dioscorea nummularia Lam.), an under-exploited tuber crop from Melanesia. *Genetic Resources and Crop Evolution*, *64*(1), 217–235. https://doi.org/10.1007/s10722-016-0475-z

Leiper, I., Zander, K. K., Robinson, C. J., Carwadine, J., Moggridge, B. J., & Garnett, S. T. (2018). Quantifying current and potential contributions of Australian indigenous peoples to threatened species management. *Conservation Biology*, *00*(0), 1–10. https://doi.org/10.1111/cobi.13178

Li, F., Fernandez, P. P., Rajendran, P., Hui, K. M., & Sethi, G. (2010). Diosgenin, a steroidal saponin, inhibits STAT3 signaling pathway leading to suppression of proliferation and chemosensitization of human hepatocellular carcinoma cells. *Cancer Letters*, *292*(2), 197–207. https://doi.org/10.1016/j.canlet.2009.12.003

Li, M., But, P. P., & Shaw, P. (2011). Identification of herbal medicinal materials using DNA barcodes. *Journal of Systematics and Evolution*, *49*(3), 271–283. https://doi.org/10.1111/j.1759-6831.2011.00132.x

Li, T. M. (2002). Ethnic cleansing, recursive knowledge, and the dilemmas of sedentarism. *International Social Science Journal*, *54*(3), 361–371. https://doi.org/10.1111/1468-2451.00388

Li, X., & Siddique, K. H. M. (2018). *Future Smart Food: Rediscovering hidden treasures of neglected and underutilized species for Zero Hunger in Asia*. Food and Agriculture Organization of the United Nations. http://www.fao.org/3/I8907EN/i8907en.pdf

Li, X., Yadav, R., & Siddique, K. H. M. (2020). Neglected and Underutilized Crop Species : The Key to Improving Dietary Diversity and Fighting Hunger and Malnutrition in Asia and the Pacific. *Frontiers in Nutrition*, *7*, 1–12. https://doi.org/10.3389/fnut.2020.593711

Liddell, J. L., McKinley, C. E., & Lilly, J. M. (2021). Historic and Contemporary Environmental Justice Issues among Native Americans in the Gulf Coast Region of the United States. *Sudies in Social Justice*, *15*(1), 1–24.

Liljeblad, J., & Verschuuren, B. (2019). *Indigenous Perspectives on Sacred Natural Sites: Culture, Governance and Conservation* (J. Liljeblad & B. Verschuuren (Eds.)). Routledge.

Lim, T. K. (2016). Dioscorea hispida. In *Edible Medicinal and Non-Medicinal Plants: Volume 10, Modified Stems, Roots, Bulbs* (Vol. 10, pp. 1–659). Springer, Dordrecht. https://doi.org/10.1007/978-94-017-7276-1

Lin, B., & Zhang, Y. Y. (2020). Impact of the COVID-19 pandemic on agricultural exports. *Journal of Integrative Agriculture*, *19*(12), 2937–2945. https://doi.org/10.1016/S2095-3119(20)63430-X

Lin, C. W., Chung, S. W., & Peng, C. I. (2017). Eleven new species of Begonia (Begoniaceae) from Sarawak, Borneo. *Taiwania*, *62*(3), 219–251. https://doi.org/10.6165/tai.2017.62.219

Lingga, A. S. M. (2004). Understanding Bangsamoro Independence as a Mode of Self-Determination. *Mindanao Journal*, *27*, 3–12.

Linnaeus, C. (1753). *Species Plantarum 2: 1056.* https://www.biodiversitylibrary.org/item/13830

Local Government of Wao, L. del S. (n.d.). *Historical Background, Geography, and Land Resources*. Retrieved December 10, 2020, from https://www.wowwaolanaodelsur.com/

Local Government Unit of Impasug-ong. (2014). *The Official Website of LGU Impasug-ong, Bukidnon*.

Loperena, C. A. (2016). Conservation by racialized dispossession : The making of an eco-destination on Honduras's North Coast. *Geoforum*, *69*, 184–193. https://doi.org/10.1016/j.geoforum.2015.07.004

Lulekal, E., Asfaw, Z., Kelbessa, E., & Damme, P. Van. (2011). Wild edible plants in Ethiopia: a review on their potential to combat food insecurity. *Afrika Focus*, *24*(2), 71–121. https://doi.org/10.21825/af

Lynch, F., & Clotet, J. M. (1967). The Bukidnon of North-Central Mindanao in 1889. *Philippine Studies*, *15*(3), 464–482. http://www.jstor.org/stable/42720220

Lynch, R. (1955). Some Changes in Bukidnon between 1910 and 1950. *Anthropological Quarterly*, *28*(3), 95–115. https://doi.org/https://doi.org/10.2307/3316585

Mace, G. M. (2004). The role of taxonomy in species conservation. *Philosophical Transactions of the Royal Society B: Biological Sciences*, *359*, 711–719. https://doi.org/10.1098/rstb.2003.1454

Major, K., Smith, D., Migliano, A. B., & Major, K. (2018). Co-Managers or Co-Residents? Indigenous Peoples' Participation in the Management of Protected Areas: a Case Study of the Agta in the Philippines. *Human Ecology*, *46*(485–495). https://doi.org/https://doi.org/10.1007/s10745-018-0007-x

Maldonado, J., Bennett, T. M. B., Chief, K., Cochran, P., Cozzetto, K., Gough, B., Redsteer, M. H., Lynn, K., Maynard, N., & Voggesser, G. (2016). Engagement with indigenous peoples and honoring traditional knowledge systems. *Climatic Change*, *135*(1), 111–126. https://doi.org/10.1007/s10584-015-1535-7

Mandia, E. H. (2004). The Alangan Mangyan of Mt. Halcon, Oriental Mindoro: their ethnobotany. *Philippine Quarterly of Culture and Society*, *32*(2), 96–117. https://doi.org/10.2307/29792551

Maneenoon, K., Sirirugsa, P., & Sridith, K. (2008). Ethnobotany of Dioscorea L. (Dioscoreaceae), a major food plant of the Sakai tribe at Banthad Range, Peninsular Thailand. *Ethnobotany Research and Applications*, *6*, 385–393. https://doi.org/10.17348/ERA.6.0.385-394

Maohong, B. (2012). Deforestation in the Philippines, 1946–1995. *Philippine Studies*, *60*(1), 117–130.

Maraseni, T. N., Deo, R. C., Qu, J., Gentle, P., & Neupane, P. R. (2017). An international comparison of rice consumption behaviours and greenhouse gas emissions from rice production. *Journal of Cleaner Production*, *172*(20), 2288–2300. https://doi.org/10.1016/j.jclepro.2017.11.182

Marcial, D. E., Onte, M. B., & Mana-ay, A. K. (2017). Developing Online Database of Food Recipes with Indigenous Ingredients. *International Journal of Scientific Engineering and Science*, *1*(10), 50–54. http://ijses.com/

Maroyi, A. (2014). Not just minor wild edible forest products: Consumption of pteridophytes in sub-Saharan Africa. *Journal of Ethnobiology and Ethnomedicine*, *10*(1), 1–9. https://doi.org/10.1186/1746-4269-10-78

Martin, A., Armijos, M. T., Coolsaet, B., Dawson, N., A. S. Edwards, G., Few, R., Gross-Camp, N., Rodriguez, I., Schroeder, H., G. L. Tebboth, M., & White, C. S. (2020). Environmental Justice and Transformations to Sustainability. *Environment*, *62*(6), 19–30. https://doi.org/10.1080/00139157.2020.1820294

Martin, A., Coolsaet, B., Corbera, E., Dawson, N. M., Fraser, J. A., Lehman, I., & Rodriguez, I. (2016). Justice and conservation: The need to incorporate recognition. *Biological Conservation*, *197*, 254–261. https://doi.org/10.1016/j.biocon.2016.03.021

Maru, Y., Gebrekirstos, A., & Haile, G. (2020). Indigenous ways of environmental protection in Gedeo community, Southern Ethiopia: A socio-ecological perspective. *Cogent Food & Agriculture*, *6*(1), 1766732. https://doi.org/10.1080/23311932.2020.1766732

Massarella, K., Sallu, S. M., & Ensor, J. E. (2020). Reproducing injustice: Why recognition matters in conservation project evaluation. *Global Environmental Change*, *65*, 102181. https://doi.org/10.1016/j.gloenvcha.2020.102181

Mastrángelo, M. E., Pérez-Harguindeguy, N., Enrico, L., Bennett, E., Lavorel, S., Cumming, G. S., Abeygunawardane, D., Amarilla, L. D., Burkhard, B., Egoh, B. N., Frishkoff, L., Galetto, L., Huber, S., Karp, D. S., Ke, A., Kowaljow, E., Kronenburg-García, A., Locatelli, B., Martín-López, B., … Zoeller, K. (2019). Key knowledge gaps to achieve global sustainability goals. *Nature Sustainability*, *2*(12), 1115–1121. https://doi.org/10.1038/s41893-019-0412-1

McDermott, C. L., Acheampong, E., Arora-Jonsson, S., Asare, R., Jong, W. de, Hirons, M., Khatun, K., Menton, M., Nunan, F., Poudyal, M., & Setyowati, A. (2020). SDG 16: Peace, Justice and Strong Institutions – A Political Ecology Perspective. In P. Katila, C. J. P. Colfer, W. De Jong, G. Galloway, P. Pacheco, & Winke (Eds.), *Sustainable Development Goals: Their Impacts on Forests and - People Research* (pp. 510–540). Cambridge University Press. https://doi.org/10.1017/9781108765015

McGregor, D., Whitaker, S., & Sritharan, M. (2020). Indigenous environmental justice and sustainability. *Current Opinion in Environmental Sustainability*, *43*(May 2019), 35–40. https://doi.org/10.1016/j.cosust.2020.01.007

McHenry, M. P., Anwar-McHenry, J., Balilla, V. S., & Parkinson, R. M. (2013). The Indigenous Aetas of Bataan, Philippines: Extraordinary genetic origins, modern history and land rights. *Singapore Journal of Tropical Geography*, *34*(3), 292–306. https://doi.org/10.1111/sjtg.12038

McKivett, A., Hudson, J. N., Mcdermott, D., & Paul, D. (2020). Two-eyed seeing: A useful gaze in Indigenous medical education research. *Medical Education*, *54*, 217–224. https://doi.org/10.1111/medu.14026

Meijknecht, A., & de Vries, B. S. (2010). Is There a Place for Minorities' and Indigenous Peoples' Rights within ASEAN?: Asian Values, ASEAN Values and the Protection of Southeast Asian Minorities and Indigenous Peoples. *International Journal on Minority and Group Rights*, *17*(1), 75–110. https://doi.org/10.1163/157181110X12595859744204

Meldrum, G., Moura, D., Beltrame, D. O., Samarasinghe, G., Sidib, A., & Tartanac, F. (2020). Local Solutions for Sustainable Food Systems: The Contribution of Orphan Crops and Wild Edible Species. *Agronomy*, *10*(231), 1–25.

https://doi.org/10.3390/agronomy10020231

Menton, M., Larrea, C., Latorre, S., Martinez, J., Mika, A., Leah, P., & Mariana, T. (2020). Environmental justice and the SDGs : from synergies to gaps and contradictions. *Sustainability Science*, *15*, 1621–1636. https://doi.org/10.1007/s11625-020-00789-8

Mercer, J., Kelman, I., Taranis, L., & Suchet-pearson, S. (2010). Framework for integrating indigenous and scientific knowledge for disaster risk reduction. *Disasters*, *34*(1), 214–239. https://doi.org/https://doi.org/10.1111/j.1467-7717.2009.01126.x

Merlan, F. (2009). Indigeneity. *Current Anthropology*, *50*(3), 303–333. https://doi.org/10.1086/597667

Meshnick, S. R., & Dobson, M. J. (2001). The History of Antimalarial Drugs. In P. J. Rosenthal (Ed.), *Antimalarial Chemotherapy. Infectious Disease* (pp. 15–25). Humana Press. https://doi.org/https://doi.org/10.1007/978-1-59259-111-4_2

Miller, J., Funk, V., Wagner, W., Barrie, F. R., Hoch, P. C., & Herendeen, P. S. (2011). Outcomes of the 2011 Botanical Nomenclature Section at the XVIII International Botanical Congress. *PhytoKeys*, *5*(0), 1. https://doi.org/10.3897/phytokeys.5.1850

Milow, P., Malek, S., Mohammad, N. S., & Ong, H. C. (2013). Diversity of Plants Tended or Cultivated in Orang Asli Homegardens in Negeri Sembilan, Peninsular Malaysia. *Human Ecology*, *41*(2), 325–331. https://doi.org/10.1007/s10745-012-9555-7

Milton, A. H., Rahman, M., Hussain, S., Jindal, C., Choudhury, S., Akter, S., Ferdousi, S., Mouly, T. A., Hall, J., & Efird, J. T. (2017). Trapped in statelessness: Rohingya refugees in Bangladesh. *International Journal of Environmental Research and Public Health*, *14*(8), 1–8. https://doi.org/10.3390/ijerph14080942

Minin, E. Di, Tenkanen, H., & Toivonen, T. (2015). Prospects and challenges for social media data in conservation science. *Frontiers in Environmental Science*, *3*(SEP), 1–6. https://doi.org/10.3389/fenvs.2015.00063

Misbahuzzaman, K., & Smith-Hall, C. (2015). Role of Forest Income in Rural Household Livelihoods: The Case of Village Common Forest Communities in the Chittagong Hill Tracts, Bangladesh. *Small-Scale Forestry*, *14*(3), 315–330. https://doi.org/10.1007/s11842-015-9290-1

Mistry, J., & Berardi, A. (2016). Bridging indigenous and scientific knowledge. *Science*, *352*(6291), 1274–1275. https://doi.org/10.1126/science.aaf1160

Miyagawa, S. (2002). Utilization of Plant Resources as Famine Foods in Northeast Thailand. *Japanese Journal of Tropical Agriculture*, *46*(3), 136–142. https://doi.org/10.11248/JSTA1957.46.136

Miyan, M. A. (2015). Droughts in asian least developed countries: Vulnerability and sustainability. *Weather and Climate Extremes*, *7*, 8–23. https://doi.org/10.1016/j.wace.2014.06.003

Moonlight, P. W., Ardi, W. H., Padilla, L. A., Chung, K., Fuller, D., Girmansyah, D., Hollands, R., Jara-muñoz, A., Kiew, R., Leong, W., Liu, Y., Mahardika, A., Marasinghe, L. D. K., Connor, M. O., Peng, C., Pérez, Á. J., Phutthai, T., Pullan, M., Rajbhandary, S., … Hughes, M. (2018). Dividing and conquering the fastest-growing genus: Towards a natural sectional classification of the mega-diverse genus *Begonia* (Begoniaceae). *Taxon*, *67*(2), 267–323. https://doi.org/https://doi.org/10.12705/672.3

Mulyoutami, E., Rismawan, R., & Joshi, L. (2009). Local knowledge and management of simpukng (forest gardens) among the Dayak people in East Kalimantan, Indonesia. *Forest Ecology and Management*, *257*(10), 2054–2061. https://doi.org/10.1016/j.foreco.2009.01.042

Mustafa, M. A., Mayes, S., & Massawe, F. (2019). Crop Diversification Through a Wider Use of Underutilised Crops: A Strategy to Ensure Food and Nutrition Security in the Face of Climate Change. In A. Sarkar, S. R. Sensarma, & G. W. VanLoon (Eds.), *Sustainable Solutions for Food Security* (pp. 125–149). Springer Nature Switzerland AG. https://doi.org/https://doi.org/10.1007/978-3-319-77878-5_7

Myers, N., Mittermeier, R. A., Mittermeier, C. G., da Fonseca, G. A. B., & Kent, J. (2000). Biodiversity hotspots for conservation priorities. *Nature*, *403*(6772), 853–858. https://doi.org/10.1038/35002501

Nababan, A., & Sombolinggi, R. (2017). Indonesia. In K. Broch Hansen, K. Jepsen, & P. Leiva Jacquelin (Eds.), *The Indigenous World 2017* (pp. 336–345). The International Work Group for Indigenous Affairs (IWGIA).

Nadasdy, P. (1999). The Politics of Tek: Power and the “Integration” of Knowledge. *Arctic Anthropology*, *36*(1), 1–18. http://www.jstor.org/stable/40316502

Nagai, F. (2019). Implementing the rights of indigenous peoples in Japan: implications and challenges of forest certification for the Ainu. *International Journal of Human Rights*, *23*(1–2), 249–266. https://doi.org/10.1080/13642987.2019.1581770

Narciso, J. O., & Nyström, L. (2020). Breathing New Life to Ancient Crops: Promoting the Ancient Philippine Grain “Kabog Millet” as an Alternative to Rice. *Foods*, *9*(12), 1727. https://doi.org/10.3390/foods9121727

National Commission of Indigenous Peoples. (2018). *Master List of Approved CADTs*. https://www.doe.gov.ph/eicc/list-process-certificate-ancestral-domain-titles-cadts-region?ckattempt=1

Nelson, G. L. M., Zamora, O. B., Guzman, L. E. P. de, Tatlonghari, R. V., Espaldon, M. V. O., & Brillon, J. A. (2019). The Indigenous Practices and Climate Change Responses of Ati and Suludnon Farmers in Iloilo, Philippines. *Journal of Environmental Science and Management*, *22*(1), 87–98.

Neyra-Cabatac, N. M., Pulhin, J. M., & Cabanilla, D. B. (2012). Indigenous agroforestry in a changing context: The case of the Erumanen ne Menuvu in Southern Philippines. *Forest Policy and Economics*, *22*, 18–27. https://doi.org/10.1016/j.forpol.2012.01.007

Nicolson, N., Challis, K., Tucker, A., & Knapp, S. (2017). Impact of e-publication changes in the International Code of Nomenclature for algae, fungi and plants (Melbourne Code, 2012) - Did we need to “run for our lives”? *BMC Evolutionary Biology*, *17*(1), 1–8. https://doi.org/10.1186/s12862-017-0961-8

Niwano, Y., Beppu, F., Shimada, T., Kyan, R., Yasura, K., Tamaki, M., Nishino, M., Midorikawa, Y., & Hamada, H. (2009). Extensive screening for plant foodstuffs in Okinawa, Japan with anti-obese activity on adipocytes in vitro. *Plant Foods for Human Nutrition*, *64*(1), 6–10. https://doi.org/10.1007/s11130-008-0102-z

Nkomwa, E. C., Joshua, M. K., Ngongondo, C., Monjerezi, M., & Chipungu, F. (2014). Assessing indigenous knowledge systems and climate change adaptation strategies in agriculture: A case study of Chagaka Village, Chikhwawa, Southern Malawi. *Physics and Chemistry of the Earth*, *67*(69), 164–172. https://doi.org/10.1016/j.pce.2013.10.002

Norström, A. V., Cvitanovic, C., Löf, M. F., West, S., Wyborn, C., Balvanera, P., Bednarek, A. T., Bennett, E. M., Biggs, R., de Bremond, A., Campbell, B. M., Canadell, J. G., Carpenter, S. R., Folke, C., Fulton, E. A., Gaffney, O., Gelcich, S., Jouffray, J. B., Leach, M., … Österblom, H. (2020). Principles for knowledge co-production in sustainability research. *Nature Sustainability*, *3*(3), 182–190. https://doi.org/10.1038/s41893-019-0448-2

Novellino, D. (2000). Recognition of ancestral domain claims on Palawan island, the Philippines: is there a future? *Land Reform:Land Settlement and Cooperatives*, *1*, 56–73. http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.472.8856&rep=rep1&type=pdf

Novellino, D. (2010). From indigenous customary practices to policy interventions: The ecolocal and sociocultural underpinnings of the NTFP trade on Palawan Island, the Philippines. In Sarah A. Laird, R. J. McLain, & R. P. Wynberg (Eds.), *Wild Product Governance: Finding Policies that Work for Non-Timber Forest Products* (pp. 183–197). Earthscan. https://doi.org/10.4324/9781849775199

Nyadanu, D., & Lowor, S. T. (2014). Promoting competitiveness of neglected and underutilized crop species: comparative analysis of nutritional composition of indigenous and exotic leafy and fruit vegetables in Ghana. *Genetic Resources and Crop Evolution*, *62*(1), 131–140. https://doi.org/10.1007/s10722-014-0162-x

OECD. (2019). *The Illegal Wildlife Trade in Southeast Asia: Institutional Capacities in Indonesia, Singapore, Thailand and Viet Nam*. OECD Publishing. https://doi.org/10.1787/14fe3297-en

Office of the United Nations High Commissioner for Human Rights. (2008). *Claiming the Millennium Development Goals: A human rights approach*. http://www.gbv.de/dms/zbw/573252092.pdf

Office of the United Nations High Commissioner for Human Rights. (2013). *Indigenous Peoples and the United Nations Human Rights System Fact Sheet No.9/Rev.2* (p. 44). Office of the United Nations High Commissioner for Human Rights. https://doi.org/10.2307/2949826

Ollitrault, P., & Navarro, L. (2012). Citrus. In M. L. Badenes & D. H. Byrne (Eds.), *Fruit Breeding, Handbook of Plant Breeding 8* (pp. 623–662). Springer. https://doi.org/10.1007/978-1-4419-0763-9

Ong, H. G., & Kim, Y. D. (2017). The role of wild edible plants in household food security among transitioning hunter-gatherers: evidence from the Philippines. *Food Security*, *9*, 11–24. https://doi.org/10.1007/s12571-016-0630-6

Oniang'o, R., Allotey, J., and Malaba, S. J. (2004). Contribution of Indigenous Knowledge and Practices in Food Technology to the Attainment of Food Security in Africa. *Concise Reviews in Food Science*, *69*(3), 87–91. https://doi.org/https://doi.org/10.1111/j.1365-2621.2004.tb13346.x

Osakada, Y. (2020). An examination of arguments over the Ainu Policy Promotion Act of Japan based on the UN Declaration on the Rights of Indigenous Peoples. *International Journal of Human Rights*, *0*(0), 1–17. https://doi.org/10.1080/13642987.2020.1811692

Padulosi, S., Thompson, J., & Rudebjer, P. (2013). *Fighting poverty, hunger and malnutrition with neglected and underutilized species (NUS): needs, challenges and the way forward*. Biodiversity International. https://www.bioversityinternational.org/e-library/publications/detail/fighting-poverty-hunger-and-malnutrition-with-neglected-and-underutilized-species/

Palhares, R. M., Drummond, M. G., Dos Santos Alves Figueiredo Brasil, B., Cosenza, G. P., Das Graças Lins Brandão, M., & Oliveira, G. (2015). Medicinal plants recommended by the world health organization: DNA barcode identification associated with chemical analyses guarantees their quality. *PLoS ONE*, *10*(5), 1–29. https://doi.org/10.1371/journal.pone.0127866

Paredes, O. (2006). True Believers: Higaunon and Manobo Evangelical Protestant Conversion in Historical and Anthropological Perspective. *Philippine Studies*, *54*(4), 521–559. https://www.jstor.org/stable/42633890

Paredes, O. (2013). *A Mountain of Difference: The Lumad in Early Colonial Mindanao*. Cornell Southeast Asia Program Publications.

Parrotta, J. A., Hin Fui, L., Jinlong, L., Ramakrishnan, P. S., & Yeo-Chang, Y. (2009). Traditional forest-related knowledge and sustainable forest management in Asia. *Forest Ecology and Management*, *257*(10), 1987–1988. https://doi.org/10.1016/S0378-1127(09)00221-7

Parsons, M., Fisher, K., & Nalau, J. (2016). Alternative approaches to co-design: insights from indigenous/academic research collaborations. *Current Opinion in Environmental Sustainability*, *20*, 99–105. https://doi.org/10.1016/j.cosust.2016.07.001

Pawera, L., Khomsan, A., Zuhud, E. A. M., Hunter, D., & International, B. (2020). Wild Food Plants and Trends in Their Use: From Knowledge and Perceptions to Drivers of Change in West Sumatra, Indonesia. *Foods*, *9*(1240), 1–22. https://doi.org/10.3390/foods9091240

Pedersen, H. A. (2011). Three New Species of Dendrochilum with Notes on the Practice of Formally Describing Cultivated Species of Unknown Provenance. *Malesian Orchid Journal*, *7*, 117–124.

Pedersen, H. A., Gravendeel, B., & Mudiana, D. (2004). Three new species of Dendrochilum (Orchidaceae) and their phylogenetic positions according to plastid and nuclear ribosomal its sequences. *Blumea: Journal of Plant Taxonomy and Plant Geography*, *49*(2–3), 351–360. https://doi.org/10.3767/000651904X484315

Pelser, P. B., Barcelona, J. F., & Nickrent, D. L. (2011). *Co's Digital Flora of the Philippines*. Co's Digital Flora of the Philippines. https://www.philippineplants.org/

Peng, C. I., Rubite, R. R., & Lin, C. W. (2017). Begonia polyclada (sect. Petermannia, Begoniaceae), a gracile new species from Luzon, Philippines. *Phytotaxa*, *296*(1), 093–097. https://doi.org/10.11646/phytotaxa.296.1.8

Peng, G. J., Chang, M. H., Fang, M., Liao, C. D., Tsai, C. F., Tseng, S. H., Kao, Y. M., Chou, H. K., & Cheng, H. F. (2017). Incidents of major food adulteration in Taiwan between 2011 and 2015. *Food Control*, *72*, 145–152. https://doi.org/10.1016/j.foodcont.2016.07.043

Pereira, L. M., Calderón-Contreras, R., Norström, A. V, Espinosa, D., Willis, J., Lara, L. G., Khan, Z., Rusch, L., Palacios, E. C., & Amaya, O. P. (2019). Chefs as change-makers from the kitchen: indigenous knowledge and traditional food as sustainability innovations. *Global Sustainability*, *2*(e16), 1–9. https://doi.org/https://doi.org/10.1017/S2059479819000139

Perez, P. L., & Bukluran. (2018). Living with the problem of national parks: Indigenous critique of Philippine environmental policy. *Thesis Eleven*, *145*(1), 58–76. https://doi.org/10.1177/0725513618763840

Phelps, J., & Webb, E. L. (2015). “Invisible” wildlife trades: Southeast Asia’s undocumented illegal trade in wild ornamental plants. *Biological Conservation*, *186*, 296–305. https://doi.org/10.1016/j.biocon.2015.03.030

Phelps, Jacob. (2015). *A Blooming Trade: Illegal trade of ornamental orchids in mainland Southeast Asia (Thailand, Lao PDR, Myanmar)*.

Republic Act No. 8371, 1 (1997) (testimony of Philippine Congress). https://www.officialgazette.gov.ph/1997/10/29/republic-act-no-8371/

Republic Act No. 11054 - An Act Providing for the Organic Law for the Bangsamoro Autonomous Region in Muslim Mindanao, Repealing for the Purpose Republic Act No. 6734, Entitled "An Act Providing for An Organic Act for the Autonomous Region in Muslim Minda, 109 (2018) (testimony of Philippine Congress). http://legacy.senate.gov.ph/republic_acts/ra 11054.pdf

Philippine Congress. (2020). *Republic Act No. 11469: An act declaring the existence of a national emergency arising from the coronavirus disease 2019 (covid-19) situation and a national policy in connection therewith, and authorizing the president of the republic of the philippines f*. https://www.officialgazette.gov.ph/downloads/2020/03mar/20200324-RA-11469-RRD.pdf

Proclamation No. 216 Declaring a state of martial law and suspension of the privilege of the writ of habeas corpus in the whole of Mindanao, (2017) (testimony of Philippine President Rodrigo Duterte). https://www.officialgazette.gov.ph/downloads/2017/05may/20170523-PROC-216-RRD.pdf

Philippine Statistics Authority. (2010). *A Filipino family consumed 8.9 kg of ordinary rice a week in 2006 (Results from the 2006 Family Income and Expenditure Survey (FIES)*. https://psa.gov.ph/content/filipino-family-consumed-89-kg-ordinary-rice-week-2006-results-2006-family-income-and

Philippine Statistics Authority. (2015). *Total Population by Province, City, Municipality and Barangay in Region 10 as of August 1, 2015*.

Philippine Statistics Authority. (2018). *2017 Commodity Fact Sheets* (Issue November). https://psa.gov.ph/sites/default/files/CommodityFactSheets_2017.pdf

Phillips, O., & Gentry, A. H. (1993). The useful plants of Tambopata, Peru: I. Statistical hypotheses tests with a new quantitative technique. *Economic Botany*, *47*(1), 15–32. https://doi.org/10.1007/BF02862203

Pieroni, A., Sõukand, R., & Bussmann, R. W. (2021). The Inextricable Link Between Food and Linguistic Diversity: Wild Food Plants among Diverse Minorities in Northeast

Georgia, Caucasus. *Economic Botany*, *74*(4), 379–397. https://doi.org/10.1007/s12231-020-09510-3

Pillon, Y. (2021). The inequity of species names: The flora of New Caledonia as a case study. *Biological Conservation*, *253*, 108934. https://doi.org/10.1016/j.biocon.2020.108934

Pinyopusarerk, K., Tran, T. T. H., & Tran, V. D. (2014). Making community forest management work in northern Vietnam by pioneering participatory action. *Land Use Policy*, *38*, 257–263. https://doi.org/10.1016/j.landusepol.2013.11.019

Poffenberger, M. (2006). People in the forest: community forestry experiences from Southeast Asia. *International Journal of Environment and Sustainable Development*, *5*(1), 57–69. https://doi.org/10.1504/IJESD.2006.008683

Poffenberger, M., & McGean, B. (1993). *Upland Philippine Communities: The Guardians of the Final Forest Frontiers*.

Ponman, B. E., & Bussmann, R. (2012). *Medicinal plants and the legacy of Richard E. Schultes: Proceedings of the Botany 2011 Symposium honoring Dr. Richard E. Schultes*. The William L. Brown Center, Missouri Botanical Garden. https://www.nybg.org/files/scientists/mbalick/Balick_preprint.pdf

Prance, G. T., Balee, W., Boom, B. M., & Carneiro, R. L. (1987). Quantitative Ethnobotany and the Case for Conservation in Amazonia. *Conservation Biology*, *1*(4), 296–310. https://doi.org/10.1111/j.1523-1739.1987.tb00050.x

Prance, Ghillean T. (2001). Richard Evans Schultes (12 January 1915-10 April 2001): A Tribute. *Economic Botany*, *55*(3), 347–362. https://doi.org/https://doi.org/10.1007/BF02866558

Price, E. J., Wi, P., Sarasan, V., & Fraser, P. D. (2016). Metabolite profiling of Dioscorea (yam) species reveals underutilised biodiversity and renewable sources for high-value compounds. *Scientific Reports*, *6*(29136), 1–10. https://doi.org/10.1038/srep29136

Prill-Brett, J. (2007). Contested domains: The indigenous peoples rights act (IPRA) and legal pluralism in the Northern Philippines. *Journal of Legal Pluralism and Unofficial Law*, *39*(55), 11–36. https://doi.org/10.1080/07329113.2007.10756606

Punchay, K., Inta, A., Tiansawat, P., & Balslev, H. (2020). Traditional knowledge of wild food plants of Thai Karen and Lawa (Thailand). *Genetic Resources and Crop Evolution*, *0123456789*(Bandyopadhyay 2018). https://doi.org/10.1007/s10722-020-00910-x

Puppim de Oliveira, J. A., Balaban, O., Doll, C. N. H., Moreno-Peñaranda, R., Gasparatos, A., Iossifova, D., & Suwa, A. (2011). Cities and biodiversity: Perspectives and governance challenges for implementing the convention on biological diversity (CBD) at the city level. *Biological Conservation*, *144*(5), 1302–1313. https://doi.org/10.1016/j.biocon.2010.12.007

Putri, W. K., Hakim, L., & Indriyani, S. (2017). Plants Diversity for Ethnic Food and the Potentiality of Ethno-culinary Tourism Development in Kemiren Village, Banyuwangi, Indonesia. *Journal of Indonesian Tourism and Development Studies*, *5*(3), 161–168. https://doi.org/10.21776/ub.jitode.2017.005.03.04

Quave, C. L., & Pieroni, A. (2015). A reservoir of ethnobotanical knowledge informs resilient food security and health strategies in the Balkans. *Nature Plants*, *1*, 1–6. https://doi.org/10.1038/nplants.2014.21

Rachkeeree, A., Kantadoung, K., Suksathan, R., Puangpradab, R., Page, P. A., & Sommano, S. R. (2018). Nutritional Compositions and Phytochemical Properties of the Edible Flowers from Selected Zingiberaceae Found in Thailand. *Frontiers in Nutrition*, *5*(3), 1–10. https://doi.org/10.3389/fnut.2018.00003

Rahman, H., & Alam, K. (2016). Forest Dependent Indigenous Communities' Perception and Adaptation to Climate Change through Local Knowledge in the Protected Area—A Bangladesh Case Study. *Climate*, *4*(12), 1–25. https://doi.org/10.3390/cli4010012

Rai, R. K., Neupane, P., & Dhakal, A. (2016). Is the contribution of community forest users financially efficient? A household level benefit-cost analysis of community forest management in Nepal. *International Journal of the Commons*, *10*(1), 142–157. https://doi.org/10.18352/ijc.594

Raman, V., Galal, A. M., Avula, B., Sagi, S., Smillie, T. J., & Khan, I. A. (2014). Application of anatomy and HPTLC in characterizing species of Dioscorea (Dioscoreaceae). *Journal of Natural Medicines*, *68*, 686–698. https://doi.org/10.1007/s11418-014-0849-5

Rambaree, K., Båld, M., & Backlund Rambaree, B. (2020). Worlds apart! Environmental injustices in Mauritius, Peru and Sweden. *International Social Work*, 1–15. https://doi.org/10.1177/0020872819889391

Ramírez, G. Z. (2005). Conservation of the Biological and Cultural Diversity of the Colombian Amazon Piedmont: Dr. Schultes' Legacy. *Ethnobotany Research & Applications*, *3*, 179–188. https://doi.org/10.17348/ERA.3.0.179-188

Ratcliffe, R. (2020, September 14). Coronavirus pandemic fuelling plant poaching in Philippines. *The Guardian*. https://www.theguardian.com/world/2020/sep/14/coronavirus-pandemic-fuelling-plant-poaching-philippines

Raymond, C. M., Giusti, M., & Barthel, S. (2018). An embodied perspective on the co-production of cultural ecosystem services: toward embodied ecosystems. *Journal of Environmental Planning and Management*, *61*(5–6), 778–799. https://doi.org/10.1080/09640568.2017.1312300

Rayne, A., Byrnes, G., Collier-Robinson, L., Hollows, J., McIntosh, A., Ramsden, M., Rupene, M., Tamati-Elliffe, P., Thoms, C., & Steeves, T. E. (2020). Centring Indigenous knowledge systems to re-imagine conservation translocations. *People and Nature*, *2*(3), 512–526. https://doi.org/10.1002/pan3.10126

Reid, A. J., Eckert, L. E., Lane, J. F., Young, N., Hinch, S. G., Darimont, C. T., Cooke, S. J., Ban, N. C., & Marshall, A. (2020). "Two-Eyed Seeing": An Indigenous framework to transform fisheries research and management. *Fish and Fisheries*, *August*, 1–19. https://doi.org/10.1111/faf.12516

Remigio, A. A. (1993). Philippine Forest Resource Policy in the Marcos and Aquino Governments: A Comparative Assessment. *Global Ecology and Biogeography Letters*, *3*, 192–212. http://www.jstor.org/stable/2997769

Rerkasem, K., Yimyam, N., & Rerkasem, B. (2009). Land use transformation in the mountainous mainland Southeast Asia region and the role of indigenous knowledge and skills in forest management. *Forest Ecology and Management*, *257*(10), 2035–2043. https://doi.org/10.1016/j.foreco.2008.11.008

Reuters. (2020a). *More than half of Philippines' 2020 rice import orders yet to be delivered - minister*. https://www.agriculture.com/markets/newswire/more-than-half-of-philippines-2020-rice-import-orders-yet-to-be-delivered-minister

Reuters. (2020b). *Philippines plans rice imports to boost stocks for coronavirus fight*. Bangkok Post. https://www.bangkokpost.com/business/1890160/philippines-plans-rice-imports-to-boost-stocks-for-coronavirus-fight

Reyes-García, V., & Benyei, P. (2019). Indigenous knowledge for conservation. *Nature Sustainability*, *2*, 657–658. https://doi.org/10.1038/s41893-019-0341-z

Reyes-Garcia, V., Fernandez-Llamazares, A., Aumeeruddy-Thomas, Y., Benyei, P., Bussmann, R. W., Diamond, S. K., Garcia-del-Amo, D., Guadilla-Saez, S., Hanazaki, N., Guadilla-sa, S., Kosoy, N., Lavides, M., Luz, A. C., Mcelwee, P., Meretsky, V. J., Newberry, T., Molna, Z., Ruiz-Mallen, I., Salpeteur, M., … Brondizio, E. S. (2021). Recognizing Indigenous peoples' and local communities' rights and agency in the post-2020 Biodiversity Agenda. *Ambio*. https://doi.org/10.1007/s13280-021-01561-7

Reyes-García, V., Guèze, M., Luz, A. C., Paneque-Gálvez, J., Macía, M. J., Orta-Martínez, M., Pino, J., & Rubio-Campillo, X. (2013). Evidence of traditional knowledge loss among a contemporary indigenous society. *Evolution and Human Behavior*, *34*(4), 249–257. https://doi.org/10.1016/j.evolhumbehav.2013.03.002

Ribeiro, H. M., & Morato, J. R. (2020). Social environmental injustices against indigenous peoples: the Belo Monte dam. *Disaster Prevention and Management: An International Journal*, *29*(6), 865–876. https://doi.org/10.1108/DPM-02-2020-0033

Rivier, L., & Lindgren, J. (1972). "Ayahuasca," the South American Hallucinogenic Drink: an Ethnobotanical and Chemical Investigation. *Economic Botany*, *26*(2), 101–129. https://doi.org/https://doi.org/10.1007/BF02860772

Robinson, D. F. (2010). Traditional Knowledge and Biological Product Derivative Patents: Benefit-Sharing and Patent Issues Relating to The Camu Camu Patents Kakadu Plum and Açaí Plant Extracts. *Traditional Knowledge Bulletin – Topical Issues Series*, 1–14.

Robinson, D., Raven, M., & Hunter, J. (2018). The limits of ABS laws Why Gumbi Gumbi and other bush foods and medicines need specific indigenous knowledge protections. In C. Lawson & K. Adhikari (Eds.), *Biodiversity, Genetic Resources and Intellectual Property: Developments in Access and Benefit Sharing* (1st ed., pp. 185–207). Taylor & Francis. https://doi.org/10.4324/9781315098517

Rolnik, A., & Olas, B. (2020). Vegetables from the Cucurbitaceae family and their products: Positive effect on human health. *Nutrition*, *78*, 110788. https://doi.org/10.1016/j.nut.2020.110788

Rosales, C. A. (2019). Sorcery, Rights, and Cosmopolitics among the Tau-Buhid Mangyan in Mts. Iglit-Baco National Park. *Aghamtao*, *27*(1), 110–159.

Roy, E. (2016). *Harold Colyer Conklin, 1926-2016*. Obituaries. Royal Anthropological Institute. http://www.therai.org.uk/archives-and-manuscripts/obituaries/harold-colyer-conklin

Rubite, R. R. (2013). Begonia section Petermannia of Luzon Island, the Philippines. *Philippine Journal of Science*, *142*, 183–197.

Rubite, R. R., Hughes, M., Blanc, P., Chung, K. F., Yang, H. A., Kono, Y., Alejandro, G. J.

D., Layola, L. B. De, Virata, A. G. N., & Peng, C. I. (2015). Three new species of Begonia endemic to the Puerto Princesa Subterranean River National Park , Palawan. *Botanical Studies*, *56*(19), 1–14. https://doi.org/10.1186/s40529-015-0099-1

Rule, M. G. Q., Ang, Y. P., Rubite, R. R., Docot, R. V. A., & Bustamante, R. A. A. (2020). *Begonia makuruyot* (Begoniaceae, section Baryandra), a new species from Surigao del Norte Province, Philippines. *Phytotaxa*, *470*(3), 226–234. https://doi.org/https://doi.org/10.11646/phytotaxa.470.3.2

Russell, W. M. S. (1988). Population, swidden farming and the tropical environment. *Population and Environment*, *10*(2), 77–94. https://doi.org/10.1007/BF01359134

Sablad, J. A. (2020). *21 families evacuate as clash between NPA, Army continues*. Sun Star Cagayan de Oro. https://www.sunstar.com.ph/article/1845117/Cagayan-De-Oro/Local-News/21-families-evacuate-as-clash-between-NPA-Army-continues

Sahoo, S., Puyravaud, J.-P., & Davidar, P. (2013). Local knowledge suggests significant wildlife decline and forest loss in insurgent affected Similipal Tiger Reserve, India. *Tropical Conservation Science*, *6*(2), 230–240. https://doi.org/10.1177/194008291300600205

Saleha, S., Saidi, N., Saiful, Murniana, Rasnovi, S., & Iqbalsyah, T. M. (2018). Nutritional Composition of Dioscorea hispida from different locations around Leuser Ecosystem Area. *Jurnal Natural*, *18*(1), 1–6. https://doi.org/10.24815/jn.v18i1.8504

Salen, P., & De Lorgeril, M. (2011). The Okinawan Diet: A modern view of an ancestral healthy lifestyle. In A. Simopoulos (Ed.), *Healthy Agriculture, Healthy Nutrition, Healthy People. World Review of Nutrition and Dietetics* (Vol. 102, pp. 114–123). Karger. https://doi.org/10.1159/000327799

Samuel, J., Flores, W., & Frisancho, A. (2020). Social exclusion and universal health coverage: health care rights and citizen-led accountability in Guatemala and Peru. *International Journal for Equity in Health*, *19*(1), 1–9. https://doi.org/10.1186/s12939-020-01308-y

Samuels, J. (2015). Biodiversity of food species of the solanaceae family: A preliminary taxonomic inventory of subfamily Solanoideae. *Resources*, *4*(2), 277–322. https://doi.org/10.3390/resources4020277

Sarkar, D., Walker-Swaney, J., & Shetty, K. (2020). Food diversity and indigenous food systems to combat diet-linked chronic diseases. *Current Developments in Nutrition*, *4*, 3–11. https://doi.org/10.1093/CDN/NZZ099

Sasiwatpaisit, N., Thitikornpong, W., Palanuvej, C., & Ruangrungsi, N. (2014). Dioscorine content in Dioscorea hispida dried tubers in Thailand by TLC-densitometry and TLC image analysis. *Journal of Chemical and Pharmaceutical Research*, *6*(4), 803–806.

Saynes-Vásquez, A., Caballero, J., Meave, J. A., & Chiang, F. (2013). Cultural change and loss of ethnoecological knowledge among the Isthmus Zapotecs of Mexico. *Journal of Ethnobiology and Ethnomedicine*, *9*(1), 1–10. https://doi.org/10.1186/1746-4269-9-40

Schleicher, J., Schaafsma, M., & Vira, B. (2018). Will the Sustainable Development Goals address the links between poverty and the natural environment? *Current Opinion in Environmental Sustainability*, *34*, 43–47. https://doi.org/10.1016/j.cosust.2018.09.004

Schlosberg, D. (2007). *Defining Environmental Justice: Theories, Movements, and Nature*.

Oxford University Press.

Schlosberg, D. (2013). Theorising environmental justice: The expanding sphere of a discourse. *Environmental Politics*, *22*(1), 37–55. https://doi.org/10.1080/09644016.2013.755387

Schlosberg, D., & Carruthers, D. (2010). Indigenous struggles, environmental justice, and community capabilities. *Global Environmental Politics*, *10*(4), 12–35. https://doi.org/10.1162/GLEP_a_00029

Sealza, I. S. (1994). From Staple to Cash Crop: A Survey study of the Plantation Industry and Occupational Diversification in Bukidnon Province. *Philipine Sociological Review*, *1/4*(1), 91–104.

Secretariat of the Convention on Biological Diversity. (1992). *Convention on Biological Diversity*. Secretariat of the Convention on Biological Diversity. https://www.cbd.int/doc/legal/cbd-en.pdf

Secretariat of the Convention on Biological Diversity. (2011). *Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization to the Convention on Biological Diversity*. Secretariat of the Convention on Biological Diversity. https://www.iucn.org/theme/global-policy/our-work/convention-biological-diversity-cbd/nagoya-protocol

Sethi, G., Shanmugam, M. K., Warrier, S., Merarchi, M., Arfuso, F., Kumar, A. P., & Bishayee, A. (2018). Pro-apoptotic and anti-cancer properties of diosgenin: A comprehensive and critical review. *Nutrients*, *10*(645), 1–12. https://doi.org/10.3390/nu10050645

Seyler, B. C., Gaoue, O. G., Tang, Y., Duffy, D. C., & Aba, E. (2020). Collapse of orchid populations altered traditional knowledge and cultural valuation in Sichuan, China. *Anthropocene*, *29*, 100236. https://doi.org/10.1016/j.ancene.2020.100236

Shanthakumari, S., Mohan, V. R., & Britto, J. de. (2008). Nutritional evaluation and elimination of toxic principles in wild yam (Dioscorea spp.). *Tropical and Subtropical Agroecosystems*, *8*(3), 319–325.

Sharma, L. N., & Bastakoti, R. (2009). Ethnobotany of Dioscorea L . with emphasis on food value in Chepang communities in Dhading district, central Nepal. *Botanica Orientalis*, *6*, 12–17. https://doi.org/10.3126/BOTOR.V6I0.2905

Shen, L., Xu, J., Luo, L., Hu, H., Meng, X., Li, X., & Chen, S. (2018). Predicting the potential global distribution of diosgenin - contained Dioscorea species. *Chinese Medicine*, 1–10. https://doi.org/10.1186/s13020-018-0215-8

Sheng-Ji, P. (2001). Ethnobotanical Approaches of Traditional Medicine Studies: Some Experiences From Asia. *Pharmaceutical Biology*, *39*(sup1), 74–79. https://doi.org/10.1076/phbi.39.s1.74.0005

Shin, T., Fujikawa, K., Moe, A. Z., & Uchiyama, H. (2018). Traditional knowledge of wild edible plants with special emphasis on medicinal uses in Southern Shan State, Myanmar. *Journal of Ethnobiology and Ethnomedicine*, *14*(48), 1–13. https://doi.org/10.1186/s13002-018-0248-1

Shiro, C., Furtad, J. I., Shen, L., & Yan, M. (2007). Coping with pressures of modernization by traditional farmers: A strategy for sustainable rural development in Yunnan, China.

Journal of Mountain Science, *4*(1), 057–070. https://doi.org/10.1007/s11629-007-0057-9

Sho, H. (2001). History and characteristics of Okinawan longevity food. *Asia Pacific Journal of Clinical Nutrition*, *10*(2), 159–164. https://doi.org/10.1111/j.1440-6047.2001.00235.x

Short, E., & George, A. (2013). A Primer of Botanical Latin with Vocabulary. In *A Primer of Botanical Latin with Vocabulary*. Cambridge University Press. https://doi.org/10.1017/CBO9781139525268

Shrestha, U. B., Dhital, K. R., & Gautam, A. P. (2017). Economic dependence of mountain communities on Chinese caterpillar fungus Ophiocordyceps sinensis (yarsagumba): a case from western Nepal. *Oryx*, 1–9. https://doi.org/10.1017/S0030605317000461

Siddique, K. H. M., Li, X., & Gruber, K. (2021). Rediscovering Asia's forgotten crops to fight chronic and hidden hunger. *Nature Plants*, *7*(2), 116–122. https://doi.org/10.1038/s41477-021-00850-z

Singh, A. B., & Teron, R. (2017). Ethnic food habits of the Angami Nagas of Nagaland state, India. *International Food Research Journal*, *24*(3), 1061–1066.

Singh, K. N., & Kaushal, R. (2007). Comprehensive notes on commercial utilization, characteristics and status of steroid yielding plants in India. *Ethnobotanical Leaflets*, *11*, 45–51.

Singh, R. K., Pretty, J., & Pilgrim, S. (2010). Traditional knowledge and biocultural diversity: Learning from tribal communities for sustainable development in northeast India. *Journal of Environmental Planning and Management*, *53*(4), 511–533. https://doi.org/10.1080/09640561003722343

Singh, Y. D., Panda, M. K., & Satapathy, K. B. (2020). Ethnomedicine for Drug Discovery. In J. K. Patra, A. C. Shukla, & G. Das (Eds.), *Advances in Pharmaceutical Biotechnology: Recent Progress and Future Applications* (pp. 15–28). Springer Singapore. https://doi.org/https://doi.org/10.1007/978-981-15-2195-9_2

Sircar, B., & Mandal, S. (2017). Screening of Elaeocarpus floribundus fruit extracts for bioactive phytocomponents and antibacterial activity against food-borne bacteria. *International Journal of Research in Medical Sciences*, *55*(8), 3665–3671. https://doi.org/10.18203/2320-6012.ijrms20173582

Skinner, K., Tait Neufeld, H., Murray, E., Hajto, S., Andrews, L., & Garrett, A. (2021). Sharing Indigenous Foods Through Stories and Recipes. *Canadian Journal of Dietetic Practice and Research*, *82*(1), 11–15. https://doi.org/10.3148/cjdpr-2020-020

Smith, W., & Dressler, W. (2020). Forged in flames: indigeneity, forest fire and geographies of blame in the Philippines. *Postcolonial Studies*, *23*(4), 527–545. https://doi.org/10.1080/13688790.2020.1745620

Son, H. N., Kingsbury, A., & Hoa, H. T. (2021). Indigenous knowledge and the enhancement of community resilience to climate change in the Northern Mountainous Region of Vietnam. *Agroecology and Sustainable Food Systems*, *45*(4), 499–522. https://doi.org/10.1080/21683565.2020.1829777

Sõukand, R., & Pieroni, A. (2019a). Resilience in the mountains: biocultural refugia of wild food in the Greater Caucasus Range, Azerbaijan. *Biodiversity and Conservation*, *0123456789*. https://doi.org/10.1007/s10531-019-01835-3

Sõukand, R., & Pieroni, A. (2019b). Resilience in the mountains: biocultural refugia of wild food in the Greater Caucasus Range, Azerbaijan. *Biodiversity and Conservation*, *28*(13), 3529–3545. https://doi.org/10.1007/s10531-019-01835-3

Spencer, J. E. (1975). The rise of maize as a major crop plant in the Philippines. *Journal of Historical Geography*, *1*(1), 1–16. https://doi.org/10.1016/0305-7488(75)90071-7

Sriapha, C., Tongpoo, A., Wongvisavakorn, S., Rittilert, P., Trakulsrichai, S., Srisuma, S., & Wananukul, W. (2015). Plant Poisoning in Thailand: A 10-Year Analysis from Ramathibodi Poison Center. *Southeast Asian Journal of Tropical Medicine and Public Health*, *46*(6), 1063–1076.

Srirama, R., Santhosh Kumar, J. U., Seethapathy, G. S., Newmaster, S. G., Ragupathy, S., Ganeshaiah, K. N., Uma Shaanker, R., & Ravikanth, G. (2017). Species Adulteration in the Herbal Trade: Causes, Consequences and Mitigation. *Drug Safety*, *40*(8), 651–661. https://doi.org/10.1007/s40264-017-0527-0

Srithi, K., Balslev, H., Wangpakapattanawong, P., Srisanga, P., & Trisonthi, C. (2009). Medicinal plant knowledge and its erosion among the Mien (Yao) in northern Thailand. *Journal of Ethnopharmacology*, *123*(2), 335–342. https://doi.org/10.1016/j.jep.2009.02.035

Srithi, K., Trisonthi, C., Wangpakapattanawong, P., Srisanga, P., & Balslev, H. (2012). Plant Diversity in Hmong and Mien Homegardens in Northern Thailand. *Economic Botany*, *66*(2), 192–206. https://doi.org/10.1007/s12231-012-9199-y

Stafford-Smith, M., Griggs, D., Gaffney, O., Ullah, F., Reyers, B., Kanie, N., Stigson, B., Shrivastava, P., Leach, M., & O'Connell, D. (2017). Integration: the key to implementing the Sustainable Development Goals. *Sustainability Science*, *12*(6), 911–919. https://doi.org/10.1007/s11625-016-0383-3

Stearn, W. T. (1983). *Botanical Latin: History, Grammar, Syntax, Terminology and Vocabulary* (3rd ed.). David and Charles.

Strobel, M., Tinz, J., & Biesalski, H. K. (2007). The importance of β-carotene as a source of vitamin A with special regard to pregnant and breastfeeding women. *European Journal of Nutrition*, *46*(SUPPL. 1), 1–20. https://doi.org/10.1007/s00394-007-1001-z

Suarez, R. K., & Sajise, P. E. (2010). Deforestation, Swidden Agriculture and Philippine Biodiversity. *Philippine Science Letters*, *3*(1), 91–99.

Sujarwo, W., Arinasa, I. B. K., Salomone, F., Caneva, G., & Fattorini, S. (2014). Cultural Erosion of Balinese Indigenous Knowledge of Food and Nutraceutical Plants. *Economic Botany*, *68*(4), 426–437. https://doi.org/10.1007/s12231-014-9288-1

Suk, A. N. (2016). Community-based efforts in health promotion in indigenous villages on the Thailand-Myanmar border. *Reviews on Environmental Health*, *31*(1), 163–167. https://doi.org/10.1515/reveh-2015-0063

Sulistyo, B. P., Boos, R., Cootes, J. E., & Gravendeel, B. (2015). Dendrochilum hampelii (Coelogyninae, Epidendroideae, Orchidaceae) traded as 'Big Pink' is a new species, not a hybrid: evidence from nrITS, matK and ycf1 sequence data. *PhytoKeys*, *56*, 83–97. https://doi.org/10.3897/phytokeys.56.5432

Sun, X.-Q., Zhu, Y.-J., Guo, J.-L., Peng, B., Bai, M., & Hang, Y. (2012). DNA Barcoding the Dioscorea in China, a Vital Group in the Evolution of Monocotyledon: Use of matK

Gene for Species Discrimination. *Plos One*, *7*(2), 1–7. https://doi.org/10.1371/journal.pone.0032057

Sylvander, N. (2021). ‘Territorial cleansing’ for whom? Indigenous rights, conservation, and state territorialization in the Bosawas Biosphere Reserve, Nicaragua. *Geoforum*, *121*, 23–32. https://doi.org/10.1016/j.geoforum.2021.02.013

Tamayo, E. (Ed.). (2010). *Traditional Livelihoods and Peoples*. Asia Indigenous Peoples Pact (AIPP) Foundation. http://www.iwgia.org/publications/search-pubs?publication_id=663

Tan, J. P., Tam, S. M., & Kiew, R. (2018). Begonia yenyeniae (Begoniaceae), a new species from Endau Rompin National Park, Johor, Malaysia. *PhytoKeys*, *110*, 23–37. https://doi.org/10.3897/phytokeys.110.25846

Tangan, F. T. (2007). Wild Food Plants as Alternative Fallow Species in the Cordillera Region, the Philippines. In M. Cairns (Ed.), *Voices from the Forest: Integrating Indigenous Knowledge into Sustainable Upland Farming* (pp. 96–102). Resources of the Future Press.

Tauli-Corpuz, Vicky, Alcorn, J., Molnar, A., Healy, C., & Barrow, E. (2020). Cornered by PAs: Adopting rights-based approaches to enable cost-effective conservation and climate action. *World Development*, *130*, 104923. https://doi.org/10.1016/j.worlddev.2020.104923

Tauli-Corpuz, Victoria. (2016). *Report of the Special Rapporteur of the Human Rights Council on the rights of indigenous peoples A/71/229*. https://www.un.org/development/desa/indigenouspeoples/wp-content/uploads/sites/19/2019/01/N1624109.pdf

Tengö, M., Brondizio, E. S., Elmqvist, T., Malmer, P., & Spierenburg, M. (2014). Connecting diverse knowledge systems for enhanced ecosystem governance: The multiple evidence base approach. *Ambio*, *43*(5), 579–591. https://doi.org/10.1007/s13280-014-0501-3

Tengö, M., Hill, R., Malmer, P., Raymond, C. M., Spierenburg, M., Danielsen, F., Elmqvist, T., & Folke, C. (2017). Weaving knowledge systems in IPBES, CBD and beyond—lessons learned for sustainability. *Current Opinion in Environmental Sustainability*, *26–27*(February), 17–25. https://doi.org/10.1016/j.cosust.2016.12.005

Termote, C., Van Damme, P., & Djailo, B. D. a. (2011). Eating from the wild: Turumbu, Mbole and Bali traditional knowledge on non-cultivated edible plants, District Tshopo, DRCongo. *Genetic Resources and Crop Evolution*, *58*(4), 585–618. https://doi.org/10.1007/s10722-010-9602-4

Thakur, D., Sharma, A., & Uniyal, S. K. (2017). Why they eat, what they eat: patterns of wild edible plants consumption in a tribal area of Western Himalaya. *Journal of Ethnobiology and Ethnomedicine*, *13*(70), 1–12. https://doi.org/10.1186/s13002-017-0198-z

The SGP The GEF Small Grants Programme. (2021). *Indigenous peoples*. https://sgp.undp.org/our-approach-153/indigenous-peoples.html

The Wold Bank. (2005). *Going, Going, Gone: The Illegal Trade in Wildlife in East and Southeast Asia*.

Thomas, D. C., Hughes, M., Phutthai, T., Ardi, W. H., & Rajbhandary, S. (2012). West to east dispersal and subsequent rapid diversification of the mega-diverse genus Begonia

(Begoniaceae) in the Malesian archipelago. *Journal of Biogeography*, *39*, 98–113. https://doi.org/10.1111/j.1365-2699.2011.02596.x

Tian, D., Xiao, Y., Tong, Y., Fu, N., Liu, Q., & Li, C. (2018). Diversity and conservation of Chinese wild begonias. *Plant Diversity*, *40*, 75–90. https://doi.org/10.1016/j.pld.2018.06.002

Timsuksai, P., Tien, N. D., & Rambo, A. T. (2015). Homegardens of the Cao Lan, a Tai-speaking ethnic minority in Vietnam's Northern mountains. *Southeast Asian Studies*, *4*(2), 365–383. https://doi.org/https://doi.org/10.20495/seas.4.2_365

Tnah, L. H., Lee, S. L., Tan, A. L., Lee, C. T., Ng, K. K. S., Ng, C. H., & Nurul Farhanah, Z. (2019). DNA barcode database of common herbal plants in the tropics: a resource for herbal product authentication. *Food Control*, *95*, 318–326. https://doi.org/10.1016/j.foodcont.2018.08.022

Tohda, C., Urano, T., Umezaki, M., Nemere, I., & Kuboyama, T. (2012). Diosgenin is an exogenous activator of 1,25D 3-MARRS/Pdia3/ERp57 and improves Alzheimer's disease pathologies in 5XFAD mice. *Scientific Reports*, *2*(535), 1–11. https://doi.org/10.1038/srep00535

Tohda, C., Yang, X., Matsui, M., Inada, Y., Kadomoto, E., Nakada, S., Watari, H., & Shibahara, N. (2017). Diosgenin-rich yam extract enhances cognitive function: A placebo-controlled, randomized, double-blind, crossover study of healthy adults. *Nutrients*, *9*(1160), 1–13. https://doi.org/10.3390/nu9101160

Toyota, M. (2005). Subjects of the Nation Without Citizenship: The Case of the 'Hill Tribes in Northern Thailand. In W. Kymlicka & H. Baogang (Eds.), *Multiculturalism in Asia* (1st ed.). Oxford University Press. https://books.google.co.uk/books?id=NWYTDAAAQBAJ&printsec=frontcover#v=onepage&q&f=false

Trimanto, & Hapsari, L. (2015). Diversity and Utilization of Dioscorea spp. Tuber as Alternative Food Source in Nganjuk Regency, East Java. *Agrivita*, *37*(2), 97–107. https://doi.org/http://doi.org/10.17503/agrivita.v37i2.504

Tuan, N. H., & Averyanov, L. V. (2017). Two endangered ornamental orchid species, Bulbophyllum coweniorum and Esmeralda bella (Orchidaceae), new in the flora of Vietnam. *Turczaninowia*, *20*(1), 68–74. https://doi.org/10.14258/turczaninowia.20.1.5

Tuomisto, H. L., Scheelbeek, P. F. D., Chalabi, Z., Green, R., Smith, R. D., Haines, A., & Dangour, A. D. (2017). Effects of environmental change on agriculture, nutrition and health: A framework with a focus on fruits and vegetables. *Wellcome Open Research*, *2*(21), 1–32. https://doi.org/https://doi.org/10.12688/wellcomeopenres.11190.2

Tupper, K. W. (2006). The globalization of ayahuasca: Harm reduction or benefit maximization? *International Journal of Drug Policy*, *19*(4), 297–303. https://doi.org/10.1016/j.drugpo.2006.11.001

Turland, N. J., Wiersema, J. H., Barrie, F. R., Greuter, W., Hawksworth, D. L., Herendeen, P. S., Knapp, S., W.-H., K., Li, D.-Z., Marhold, K., May, T. W., McNeill, J., Monro, A. M., Prado, J., Price, M. J., & Smith, G. F. (Eds.). (2018). *International Code of Nomenclature for algae, fungi, and plants (Shenzhen Code) adopted by the Nineteenth International Botanical Congress Shenzhen, China, July 2017. Regnum Vegetabile 159.* Glashütten: Koeltz Botanical Books. https://doi.org/https://doi.org/10.12705/Code.2018

Turner, S. (2012). Making a living the Hmong way: An actor-oriented livelihoods approach to everyday politics and resistance in upland Vietnam. *Annals of the Association of American Geographers*, *102*(2), 403–422. https://doi.org/10.1080/00045608.2011.596392

Turreira-García, N., Theilade, I., Meilby, H., & Sørensen, M. (2015). Wild edible plant knowledge, distribution and transmission: A case study of the Achí Mayans of Guatemala. *Journal of Ethnobiology and Ethnomedicine*, *11*(1), 1–17. https://doi.org/10.1186/s13002-015-0024-4

Turvey, S. T., Bryant, J. V, & McClune, K. A. (2018). Differential loss of components of traditional ecological knowledge following a primate extinction. *Royal Society Open Science*, *5*(172352), 1–13.

Ulian, T., Diazgranados, M., Pironon, S., Padulosi, S., Ondo, I., Suzanne, O. A. P., & Philippa, S. (2020). Unlocking plant resources to support food security and promote sustainable agriculture. *Plants, People, Planet*, *2*, 421–445. https://doi.org/10.1002/ppp3.10145

UN Department of Public Information. (2014). *Indigenous Peoples in the Asian region: Thirteenth Session of the UN Permanent Forum on Indigenous Issues*. *May*, 1–2. http://www.iss.nl/ikdm/IKDM/IKDM/3-3/articles/agrawal.html

United Nations. (2008). United Nations Declaration on the Rights of Indigenous Peoples. *United Nations General Assembly*, *Resolution 61/295*, 10. https://doi.org/10.1093/iclqaj/24.3.577

United Nations. (2012). The Future we want. Resolution. A/RES/66/288. In *Resolution adopted by the General Assembly on 27 July 2012* (Issue 27 July 2012). https://doi.org/A/RES/66/288*

United Nations. (2015). Transforming our world: the 2030 Agenda for Sustainable Development. *General Assembley 70 Session*, *16301*(October), 1–35. https://doi.org/10.1007/s13398-014-0173-7.2

United Nations Development Programme. (2010). Indigenous Peoples of the Philippines. *Fast Fact*. http://www.ph.undp.org/content/dam/philippines/docs/Governance/fastFacts6 - Indigenous Peoples in the Philippines rev 1.5.pdf

United Nations Statistical Commission. (2016). *Report of the Inter-Agency and Expert Group on Sustainable Development Goal Indicators*. https://doi.org/10.1093/oxfordhb/9780199560103.003.0007

Utami, R., Khalid, N., Sukari, M. A., Rahmani, M., & Abdul, A. B. (2006). Phenolic contents , antioxidant and cytotoxic activities of Elaeocarpus floribundus Blume. *Pakistan Journal of Pharmaceutical Sciences*, *26*(2), 245–250.

van den Burg, M. P., & Weissgold, B. J. (2020). Illegal trade of morphologically distinct populations prior to taxonomic assessment and elevation, with recommendations for future prevention. *Journal for Nature Conservation*, *57*, 125887. https://doi.org/10.1016/j.jnc.2020.125887

van der Ploeg, J., Masipiqueña, A., van Weerd, M., & Persoon, G. (2011). Illegal logging in the Northern Sierra Madre Natural Park, the Philippines. *Conservation and Society*, *9*(3), 202. https://doi.org/10.4103/0972-4923.86991

Veale, A. J., Lange, P. De, Buckley, T. R., Cracknell, M., Hohaia, H., Parry, K., Raharaha-nehemia, K., Reihana, K., Seldon, D., Tawiri, K., & Walker, L. (2019). Using te reo Māori and ta re Moriori in taxonomy. *New Zealand Journal of Ecology*, *43*(3), 1–11. https://doi.org/https://dx.doi.org/10.20417/nzjecol.43.30

Vermeulen, J. J., & Lamb, A. (2011). Endangered even before formally described: Bulbophyllum kubahense n. sp., a beautiful and assumedly narrowly endemic orchid from Borneo. *Plant Systematics and Evolution*, *292*, 51–53. https://doi.org/10.1007/s00606-010-0414-y

Vermeulen, J. J., Phelps, J., & Thavipoke, P. (2014). Notes on Bulbophyllum (Dendrobiinae; Epidendroideae; Orchidaceae): two new species and the dilemmas of species discovery via illegal trade. *Phytotaxa*, *184*(1), 12–22. https://doi.org/http://dx.doi.org/10.11646/phytotaxa.184.1.2

Verschuuren, B. (2006). An overview of cultural and spiritual values in ecosystem management and conservation strategies. *Endogenous Developement and Biocultural Diversity*, *May*, 299–325. http://www.bioculturaldiversity.net/downloads/papers participants/verschuuren.pdf

Verschuuren, B., Mallarach, J.-M., Bernbaum, E., Spoon, J., Brown, S., Borde, R., Brown, J., Calamia, M., Mitchell, N., Infield, M., & Lee, E. (2021). *Cultural and spiritual significance of nature. Guidance for protected and conserved area governance and management. Best Practice Protected Area Guidelines Series No. 32*. IUCN.

Villamor, G. B., & Lasco, R. D. (2009). Rewarding upland people for forest conservation: Experience and lessons learned from case studies in the Philippines. *Journal of Sustainable Forestry*, *28*(3–5), 304–321. https://doi.org/10.1080/10549810902791499

Vinceti, B., Termote, C., Ickowitz, A., Powell, B., Kehlenbeck, K., & Hunter, D. (2013). The contribution of forests and trees to sustainable diets. *Sustainability*, *5*(11), 4797–4824. https://doi.org/10.3390/su5114797

Voeks, R. A., & Leony, A. (2004). Forgetting the forest: assessing medicinal plant erosion in eastern Brazil. *Economic Botany*, *58*(2004), 94–106. https://doi.org/10.1663/0013-0001(2004)58[S294:FTFAMP]2.0.CO;2

Walker, R., & Simmons, C. (2018). Endangered amazon: An indigenous tribe fights back against hydropower development in the tapajós valley. *Environment*, *60*(2), 5–15. https://doi.org/10.1080/00139157.2018.1418994

Walker, R. T. (2020). Collision Course: Development Pushes Amazonia Toward Its Tipping Point. *Environment*, *63*(1), 15–25. https://doi.org/10.1080/00139157.2021.1842711

Walker, W. S., Gorelik, S. R., Baccini, A., Aragon-Osejo, J. L., Josse, C., Meyer, C., Macedo, M. N., Augusto, C., Rios, S., Katan, T., Souza, A. A. de, Cuellar, S., Llanos, A., Zager, I., Mirabal, G. D., Solvik, K. K., Farina, M. K., Moutinho, P., & Schwartzman, S. (2020). The role of forest conversion, degradation, and disturbance in the carbon dynamics of Amazon indigenous territories and protected areas. *Proceedings of the National Academy of Sciences*, *117*(6), 3015–3025. https://doi.org/10.1073/pnas.1913321117

Wang, Y. J., Pan, K. L., Hsieh, T. C., Chang, T. Y., Lin, W. H., & Hsu, J. T. A. (2011). Diosgenin, a plant-derived sapogenin, exhibits antiviral activity in vitro against Hepatitis C virus. *Journal of Natural Products*, *74*(4), 580–584.

https://doi.org/10.1021/np100578u

Warburg, O. (1904). Begoniaceae. In J. Perkins (Ed.), *Fragmenta Florae Philippinae: Vol. Fasciculus* (p. 54). Gebrüder Borntraeger.

Warren, J. F. (2018). Typhoons and droughts: Food shortages and famine in the Philippines since the seventeenth century. *International Review of Environmental History*, *4*(2), 27–44. https://doi.org/10.22459/ireh.04.02.2018.04

Wehi, P. M., Carter, L., Harawira, T. W., Fitzgerald, G., Whaanga, H., Macleod, C. J., & Lloyd, K. (2019). Enhancing awareness and adoption of cultural values through use of Māori bird names in science communication and environmental reporting. *New Zealand Journal of Ecology*, *43*(3), 1–9. https://doi.org/https://dx.doi.org/10.20417/nzjecol.43.35

Westra, L. (2012). Environmental justice and the rights of indigenous peoples: International and domestic legal perspectives. In *Environmental Justice and the Rights of Indigenous Peoples: International and Domestic Legal Perspectives*. Earthscan. https://doi.org/10.4324/9781849771177

Wetzlmaier, M. (2012). Cultural Impacts of Mining in Indigenous Peoples' Ancestral Domains in the Philippines. *ASEAS - Austrian Journal of South-East Asian Studies*, *5*(2), 335–345. https://doi.org/10.4232/10.ASEAS-5.2-9

Whaanga, H., Papa, W., Wehi, P., & Roa, T. (2013). The use of the Māori language in species nomenclature. *Journal of Marine and Island Cultures*, *2*(2), 78–84. https://doi.org/10.1016/j.imic.2013.11.007

Whitney, C. W. (2020). *EthnobotanyR* (3.6.3). https://github.com/CWWhitney/ethnobotanyR/tree/master/data

WHO. (2011). Traditional medicines: global situation, issues and challenges. In M. M. Robinson & X. Zhang (Eds.), *The world medicines situation 2011* (3rd ed.). World Health Organization Press. http://digicollection.org/hss/documents/s18063en/s18063en.pdf

WHO. (2013). WHO Traditional Medicine Strategy 2014-2023. In *2013*. World Health Organization Press. http://apps.who.int/iris/bitstream/10665/92455/1/9789241506090_eng.pdf?ua=1

Wijaya, S. (2019). Indonesian food culture mapping: A starter contribution to promote Indonesian culinary tourism. *Journal of Ethnic Foods*, *6*(1), 1–10. https://doi.org/10.1186/s42779-019-0009-3

Wilder, B. T., O'Meara, C., Monti, L., & Nabhan, G. P. (2016). The Importance of Indigenous Knowledge in Curbing the Loss of Language and Biodiversity. *BioScience*, *66*(6), 499–509. https://doi.org/10.1093/biosci/biw026

Wilkin, P., Schols, P., Chase, M. W., Chayamarit, K., Furness, C. A., Huysmans, S., Rakotonasolo, F., Smets, E., & Thapyai, C. (2005). A Plastid Gene Phylogeny Of the Yam Genus, Dioscorea: Roots, Fruits and Madagascar. *Systematic Botany*, *30*(4), 736–749. https://doi.org/10.1600/0363644054223657

Willcox, B. J., Willcox, D. C., Todoriki, H., Fujiyoshi, A., Yano, K., He, Q., Curb, J. D., & Suzuki, M. (2007). Caloric restriction, the traditional okinawan diet, and healthy aging: The diet of the world's longest-lived people and its potential impact on morbidity and life span. *Annals of the New York Academy of Sciences*, *1114*, 434–455.

https://doi.org/10.1196/annals.1396.037

Willcox, D. C., Scapagnini, G., & Willcox, B. J. (2014). Healthy aging diets other than the Mediterranean: A Focus on the Okinawan Diet. *Mechanisms of Ageing and Development*, *136–137*, 148–162. https://doi.org/10.1016/j.mad.2014.01.002

Wilson, T., & Shukla, S. (2020). Pathways to Revitalization of Indigenous Food Systems: Decolonizing Diets through Indigenous-focused Food Guides. *Journal of Agriculture, Food Systems, and Community Development*, *9*(4), 1–8. https://doi.org/10.5304/jafscd.2020.094.003

World Bank. (1991). Operational Directive 4.20: Indigenous Peoples. In *World Bank Operational Manual* (p. 6). https://www.ifc.org/wps/wcm/connect/4da94701-07cc-4df3-9798-947704a738d4/OD420_IndigenousPeoples.pdf?MOD=AJPERES&CVID=jqewORB

World Bank. (2021). *Indigenous peoples*. https://www.worldbank.org/en/topic/indigenouspeoples#2

Wrangham, R., & Conklin-Brittain, N. Lou. (2003). Cooking as a biological trait. *Comparative Biochemistry and Physiology - A Molecular and Integrative Physiology*, *136*(1), 35–46. https://doi.org/10.1016/S1095-6433(03)00020-5

Wright, A. L., Gabel, C., Ballantyne, M., Jack, S. M., & Wahoush, O. (2019). Using Two-Eyed Seeing in Research With Indigenous People: An Integrative Review. *International Journal of Qualitative Methods*, *18*, 1–19. https://doi.org/10.1177/1609406919869695

Wu, Y., Xie, L., Huang, S. L., Li, P., Yuan, Z., & Liu, W. (2018). Using social media to strengthen public awareness of wildlife conservation. *Ocean and Coastal Management*, *153*, 76–83. https://doi.org/10.1016/j.ocecoaman.2017.12.010

Xhauflair, H., Revel, N., Vitales, T. J., Callado, J. R., Tandang, D., Gaillard, C., Forestier, H., Dizon, E., & Pawlik, A. (2017). What plants might potentially have been used in the forests of prehistoric Southeast Asia? An insight from the resources used nowadays by local communities in the forested highlands of Palawan Island. *Quaternary International*, *448*, 169–189. https://doi.org/10.1016/j.quaint.2017.02.011

Xia, W., Zhang, B., Xing, D., Li, Y., Wu, W., Xiao, Y., Sun, J., Dou, Y., Tang, W., Zhang, J., Huang, X., Xu, Y., Xie, J., Wang, J., & Huang, D. (2019). Development of high-resolution DNA barcodes for Dioscorea species discrimination and phylogenetic analysis. *Ecology and Evolution*, 1–11. https://doi.org/10.1002/ece3.5605

Yamashiro, S., Noguchi, K., Matsuzaki, T., Miyagi, K., Nakasone, J., Sakanashi, M., Sakanashi, M., Kukita, I., Aniya, Y., & Sakanashi, M. (2003). Cardioprotective effects of extracts from Psidium guajava L. and Limonium wrightii, Okinawan Medicinal Plants, against ischemia-reperfusion injury in perfused rat hearts. *Pharmacology*, *67*(3), 128–135. https://doi.org/10.1159/000067799

Yang, J., Wang, Y.-C., Wang, D., & Guo, L. (2018). Application of Traditional Knowledge of Hani People in Biodiversity Conservation. *Sustainability*, *10*(4555), 2–3. https://doi.org/10.3390/su10124555

Yeh, J. H., Lin, S., Lai, S., Huang, Y., Yi-fong, C., Lee, Y., & Berkes, F. (2021). Taiwanese Indigenous Cultural Heritage and Revitalization: Community Practices and Local Development. *Sustainability*, *13*(1799), 1–16. https://doi.org/https://doi.org/10.3390/

su13041799

Yenagi, N., Handigol, S., Ravi, B., Mal, S., Padulosi, & Indian, J. (2010). Nutritional and Technological Advancements in the Promotion of Ethnic and Novel Foods Using the Genetic Diversity of Minor Millets in India. *Indian J. Plant Genet. Resour.*, *23*(1), 82–86. https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.1054.1158&rep=rep1&type=pdf

Yonehara, A., Saito, O., Hayashi, K., Nagao, M., Yanagisawa, R., & Matsuyama, K. (2017). The role of evaluation in achieving the SDGs. *Sustainability Science*, *12*(6), 969–973. https://doi.org/10.1007/s11625-017-0479-4

Yuan, J., & Liu, J. (2009). Fengshui forest management by the Buyi ethnic minority in China. *Forest Ecology and Management*, *257*(10), 2002–2009. https://doi.org/10.1016/j.foreco.2009.01.040

Zeng, Z., Estes, L., Ziegler, A. D., Chen, A., Searchinger, T., Hua, F., Guan, K., Jintrawet, A., & F. Wood, E. (2018). Highland cropland expansion and forest loss in Southeast Asia in the twenty-first century. *Nature Geoscience*, *11*, 556–562. https://doi.org/10.1038/s41561-018-0166-9

Annexes

Annex 1 Field Data Collection Sheets

Field Data Collection Sheet (afp8e0@bangor.ac.uk)

PRIFYSGOL BANGOR UNIVERSITY

Informant No: ______
Date: _____________ Community/Village: ________________

PERSONAL & SOCIO-ECONOMIC PROFILE

Name: __________________________________ Age: _____ Sex: _____ No. of children: _______
Place of Birth: _______________________ Ethnic group: ______________ Household size: __________
Education: ___ none ___ primary ___secondary ___tertiary
Main Occupation: ____ farmer ____ teacher ____ gov't employee ____others, pls specify__________
Monthly Income: ____< 1,000 ____ 1- 5,000 ___6-10,000 ___ 11 -15, 000 ___16-20,000 ____>20,000

1. Research Questions on Food Plants:

   - What are the edible plants in the uplands and for what use?
   - Does indigenous peoples gather edible plants from different sites in the upland?
   - Which species is managed (cultivated) and collected from the wild?
   - What is the seasonal availability and patterns of consumption of edible plants?
   - Who possess vast knowledge on edible plants in the indigenous community? Is it influenced by gender, age or occupation?

Local/Vernacular Name	Life Form **Code:** **T**- Tree **S**-Shrub **H**- Herb **C**-Climbers	Is it cultivated or wild? **Code:** **C**-Cultivated **W**- Wild	Where to harvest/gather this plant? **Code: HG**-home gardens, **FA**-farms, **F**- forests, **G**- grassland **R**- Riverine **SA**- Shared areas. Specify if not on the List	What plant part is edible? **Code**: **WH**-whole plant, **L**- leaves, **F**- fruits, **R**- roots, **ST**- stems, **SH**-shoots, **SE**-seeds, **BA**-bark **F**-Flowers **E**-Exudates	How do you consume it? **Code:** **ER**-eaten raw, **CV**-cooked vegetables, **SE**- seasoning, **MF**-Medicinal food, **SN**-Snack, **BE**-beverage
1.					
2.					
3.					
4.					
5.					
6.					
7.					
8.					
9.					
10.					
11.					
12.					
13.					
14.					
15.					
16.					

Palid sa Katugotan alang sa Pagpabalo ug Pagpananghid para sa mga Mu-apil sa Pagtu-on

Taytol sa Panukiduki: Mga Kahibalo bahin sa Tanum ug mga Potensyal nga Kama-ayuhan sa mga Tanum nga ginagamit sa mga Lokal nga Lumulupyo sa Mindanao, Pilipinas

Introduksiyon
Ako si Dave Buenavista, usa ka estudyante nga kamulo ga himo ug panukiduki alang sa akong panginahanglanon sa akong eskwela sa Unibersidad sa Bangor sa UK. Kini nga panukiduki kay bahin sa mga kahibalo sa mga Lumad sa nga tanum nga makita sa inyung Barangay sa Dumalaguing, Bukid sa Tago diri sa Bukidnon. Ako ga himo ug interbyu o pakighisgot dinhi sa inyung lugar sunod sa duh aka bulan ug ako mu-imbita ka ninyo sa pag-apil sa kini nga panukiduki. Kung kamo na-ay pangutana o wala nasabtan, pwede mangutana bisag kanus-a.

Katuyu-an sa Pagtu-on
Naay mga isyu bahin sa bahad sa pagkadaot sa atong kina-iyahan sa bukid sa Tago tungod kay wala kini gita-an ug balor ug para sa tinguha nga kini mahimung Protektado nga Lugar alang sa mga Lumad. Ang akong panukiduki ga to-o nga kamo makatabang sa kini nga tinguha kung kamo mo mutudlo sa inyung mga kahibalo bahin sa mga gamit sa mga tanum sa inyung balay, barangay ug sa kultura sa Higaonon.

Kami mubisita ug ka-usa alang sa inyung partisipaskon sa kini nga panukiduki. Kung kamo ga uyon sa nga mu-apil sa kini nga pagtu-on, makig-estorya mi ninyo karon bahin sa inyung kahibalo sa magamit nga tanum (sama sa maka-on, ma tambal, magamit sa mga pagpatukod, mga gina-gama' ug uban pa) nga makita nato sa inyung lugar. Pagkahuman sa among panukiduki, kami magpabalo pud ninyo bahin sa among mga pinasi-una ga resulta nga atong hisgutan apil ang uban sa grupo.

Buluntaryo nga Pag-apil
Kami ga imbitar ka ninyo sa pag-apil sa kini nga panukiduki tungod kami gatuo nga ang inyung ka-agi ug kahibalo maka tabang namo ug pagsabot sa importansya bahina ning mga tanum. Ang inyung pag-apil sa kini nga panukiduki kay buluntaryo lamang ug dili kamo mubalibad kung kamo dili uyon.

Pag gamitan sa mga impormasyon
Apil aning surbi ang pagpanguta bahin sa inyung impormasyon sa panimalay – kini nga impormasyon among himuong kompidensyal ug dili kini mahibaw-an sa uban. Kung kamu nay dili gusto tubangon sa interbyu, pwede mo mu-ingon aron mudiretso mi sa sunod nga pangutana. Walay uban nga makabalo sa inyung impormasyon ug mga tubag sa among interbyu kung dili apil sa among panukiduki.

Benepisyo/pinansyal nga bahin
Walay mawadat nga pinansyal o kwarta sa inyung pag apil pero kamo maka tabang ug dako alng sa pagtu-on bahin sa importansya sa tanum para sa mga Higaonon ug uban pang lumad.

Pagpabalo sa resulta
Ang resulta sa kini nga pagtu-on among ipa mantala aron ma hibaw-an sa uban nga interesado sa pagtu-on sa panukiduki pero kini nga pag mantala dili muhatag ug personal nga impormasyon. Kini nga panukiduki kay para lamang sa akademikong pagtuon ug walay komersyal nga interes.

- *Pwede kamu mangutana ug bisan unsa bahin sa kini nga pagtu-on. Na-a ba mo mga pangutana?*

Pirma:

Ga uyon ka ba nga mu-apil sa kini nga pagtu-on? Oo/ Dili

____

Annex 2. DNA sequence alignment of three samples of *Dioscorea*

DR1_R AATTTTATTT CTTCCTCTGT TTTTTTGAGG ATCCACTGAG ATAATGAGAA AGATTTCTAC
DR2_R AATTTTATTT CTTCCTCTGT TTTTTTGAGG ATCCACTGAG ATAATGAGAA AGATTTCTAC
DR3_R AATTTTATTT CTTCCTCTGT TTTTTTGAGG ATCCACTGAG ATAATGAGAA AGATTTCTAC

DR1_R ATATCCAACC AAATCGATGA ATAATATCCA AATCTGATAA ATTTGTCCAT ATTGACTTAC
DR2_R ATATCCAACC AAATCGATGA ATAATATCCA AATCTGATAA ATTTGTCCAT ATTGACTTAC
DR3_R ATATCCAACC AAATCGATGA ATAATATCCA AATCTGATAA ATTTGTCCAT ATTGACTTAC

DR1_R TAATGGGATG CCCGGATACG GTACAAAATT TCGCTTTAGA CAATGATCGA ATAAGAGCAA
DR2_R TAATGGGATG CCCGGATACG GTACAAAATT TCGCTTTAGA CAATGATCGA ATAAGAGCAA
DR3_R TAATGGGATG CCCGGATACG GTACAAAATT TCGCTTTAGA CAATGATCGA ATAAGAGCAA

DR1_R TAACTGAAAC TCTGGTATCA AATTTCTTAG TAAGAGTATC TATTATAAAT GAATTTTCTA
DR2_R TAACTGAAAC TCTGGTATCA AATTTCTTAG TAAGAGTATC TATTATAAAT GAATTTTCTA
DR3_R TAACTGAAAC TCTGGTATCA AATTTCTTAG TAAGAGTATC TATTATAAAT GAATTTTCTA

DR1_R GCATTTGACT CCTTATCACG GAAGGATTTA TTAGTACATT TGAAAGATAA CCCAGAAAAC
DR2_R GCATTTGACT CCTTATCACG GAAGGATTTA TTAGTACATT TGAAAGATAA CCCAGAAAAC
DR3_R GCATTTGACT CCTTATCACG GAAGGATTTA TTAGTACATT TGAAAGATAA CCCAGAAAAC

DR1_R AGAAGGAATA ATTTGATAAT TGGTTTATAT GAATCCTATG CGGATGAGAC CAAAATTGAA
DR2_R AGAAGGAATA ATTTGATAAT TGGTTTATAT GAATCCTATG CGGATGAGAC CAAAATTGAA
DR3_R AGAAGGAATA ATTTGATAAT TGGTTTATAT GAATCCTATG CGGATGAGAC CAAAATTGAA

DR1_R AATAATATTG CCAAAAATGA ACAAGATAAG ATCTCCATTT CCTCATCAAA AGACGAGTTC
DR2_R AATAATATTG CCAAAAATGA ACAAGATAAG ATCTCCATTT CCTCATCAAA AGACGAGTTC
DR3_R AATAATATTG CCAAAAATGA ACAAGATAAG ATCTCCATTT CCTCATCAAA AGACGAGTTC

DR1_R CCTTTGACAC CAGAATTGCT TTTCCTTGAT ATCGAACATA ATGCAGAAAA GGATCTTTGA
DR2_R CCTTTGACAC CAGAATTGCT TTTCCTTGAT ATCGAACATA ATGCAGAAAA GGATCTTTGA
DR3_R CCTTTGACAC CAGAATTGCT TTTCCTTGAT ATCGAACATA ATGCAGAAAA GGATCTTTGA

DR1_R AGAACCATTG GGTCTTCTGA AAATAATTAC AACACACTAC TAAAAAATGT CCCATTTTTC
DR2_R AGAACCATTG GGTCTTCTGA AAATAATTAC AACACACTAC TAAAAAATGT CCCATTTTTC

DR3_R AGAACCATTG GGTCTTCTGA AAATAATTAC AACACACTAC TAAAAAATGT CCCATTTTTC

DR1_R CATAGAAATG GGTTCGCTCA AGAAAGACTC GAGAGGACCT TGATCGTAAA TAAGAGGATT
DR2_R CATAGAAATG GGTTCGCTCA AGAAAGACTC GAGAGGACCT TGATCGTAAA TAAGAGGATT
DR3_R CATAGAAATG GGTTCGCTCA AGAAAGACTC GAGAGGACCT TGATCGTAAA TAAGAGGATT

DR1_R GTTTATGAAA AAAAACTAAT ACAAATTCAC ATTCAAATAC ATAAGAATTA TATAGGAATC
DR2_R GTTTATGAAA AAAAACTAAT ACAAATTCAC ATTCAAATAC ATAAGAATTA TATAGGAATC
DR3_R GTTTATGAAA AAAAACTAAT ACAAATTCAC ATTCAAATAC ATAAGAATTA TATAGGAATC

DR1_R GAAAAAATCT TTTATTTTCT TTTGAAATTG AAATCACGTA AATAGGTTTT TTCGGAGTAA
DR2_R GAAAAAATCT TTTATTTTCT TTTGAAATTG AAATCACGTA AATAGGTTTT TTCGGAGTAA
DR3_R GAAAAAATCT TTTATTTTCT TTTGAAATTG AAATCACGTA AATAGGTTTT TTCGGAGTAA

DR1_R TGAAACTATT CGAATTATGA TATTCGTGGA GAAAGAATCG CAATAAATGC AAAGAGGAAA
DR2_R TGAAACTATT CGAATTATGA TATTCGTGGA GAAAGAATCG CAATAAATGC AAAGAGGAAA
DR3_R TGAAACTATT CGAATTATGA TATTCGTGGA GAAAGAATCG CAATAAATGC AAAGAGGAAA

DR1_R CATCTTGAGT CCAACATTGA AGTATTTGAA CCAAGATTTC CAGATGGATG GGATGGGGTA
DR2_R CATCTTGAGT CCAACATTGA AGTATTTGAA CCAAGATTTC CAGATGGATG GGATGGGGTA
DR3_R CATCTTGAGT CCAACATTGA AGTATTTGAA CCAAGATTTC CAGATGGATG GGATGGGGTA

DR1_R TTAATATATC TGACACATAA TTTAAATGTG ATGATTTATC CTCTAAGAAG GGAAATATTG
DR2_R TTAATATATC TGACACATAA TTTAAATGTG ATGATTTATC CTCTAAGAAG GGAAATATTG
DR3_R TTAATATATC TGACACATAA TTTAAATGTG ATGATTTATC CTCTAAGAAG GGAAATATTG

DR1_R ATGGAAATAA ATGGAAAGGG GGGGGAGTGG GGGGGTGTTG GGGGAGGGGG GTGGCGGGGG
DR2_R ATGGAAATAA ATGGAAAGGG GGGGGAGTGG GGGGGTGTTG GGGGAGGGGG GTGGCGGGGG
DR3_R ATGGAAATAA ATGGAAAGGG GGGGGAGTGG GGGGGTGTTG GGGGAGGGGG GTGGCGGGGG

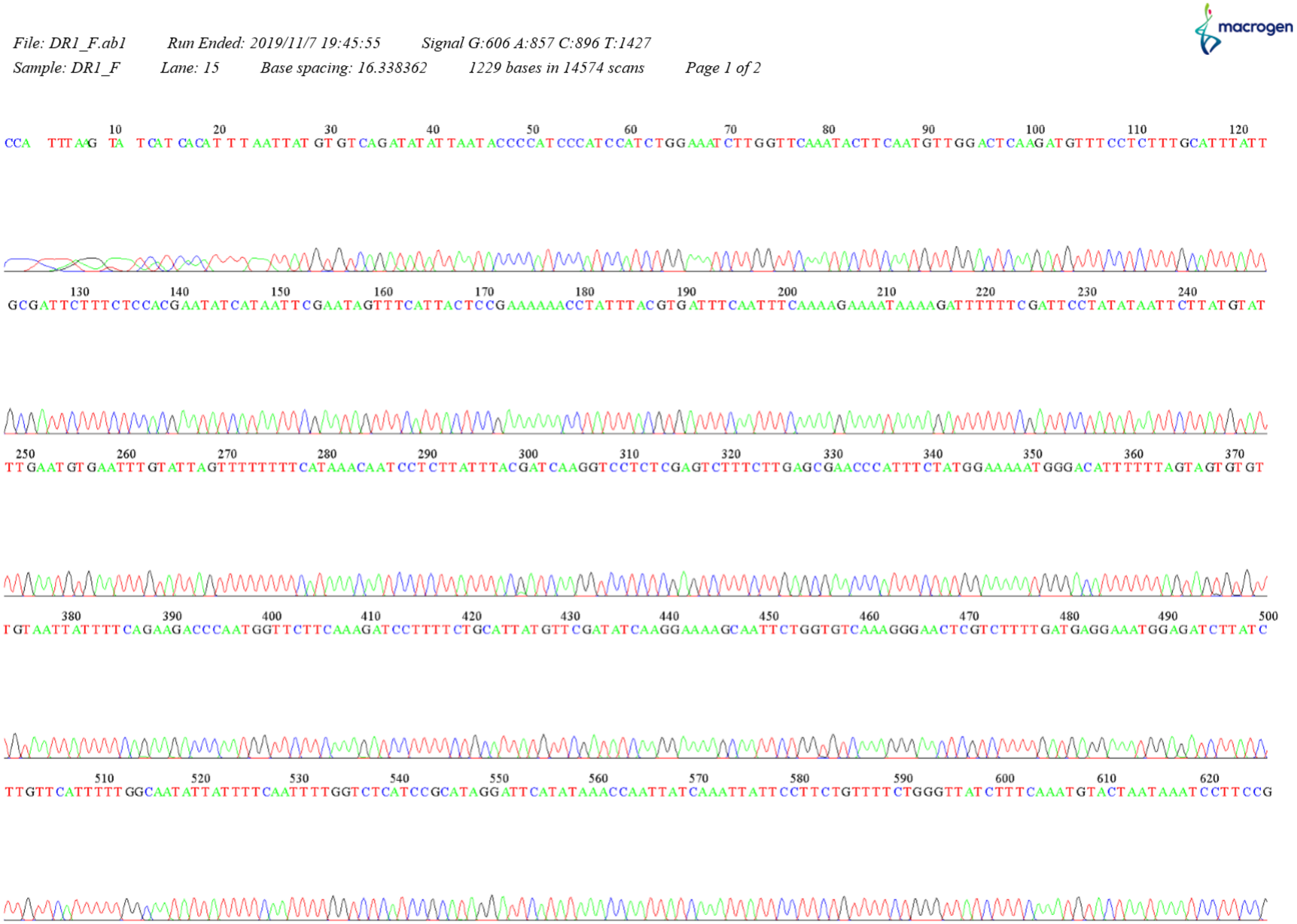
DR1_R TGGGGGAGGG GGGGGGGGGT GAGGGGGGGT GGGGTGGGTA GAGGGGGATG GGGGGGTGGG
DR2_R TGGGGGAGGG GGGGGGGGGT GAGGGGGGGT GGGGTGGGTA GAGGGGGATG GGGGGGTGGG
DR3_R TGGGGGAGGG GGGGGGGGGT GAGGGGGGGT GGGGTGGGTA GAGGGGGATG GGGGGGTGGG

DR1_R GGGGGGGGTG AGGGAGGGGG GGGGGGACTG GGGGGAGTGG AGGGGGGGGG GGTGGAGAGG
DR2_R GGGGGGGGTG AGGGAGGGGG GGGGGGACTG GGGGGAGTGG AGGGGGGGGG GGTGGAGAGG
DR3_R GGGGGGGGTG AGGGAGGGGG GGGGGGACTG GGGGGAGTGG AGGGGGGGGG GGTGGAGAGG

DR1_R	AGGGGGGGGG GCGGGGAGTG GGGGATGAGG AGGGCGGGGG GGGGGAGATG GTGGGAGGGA
DR2_R	AGGGGGGGGG GCGGGGAGTG GGGGATGAGG AGGGCGGGGG GGGGGAGATG GTGGGAGGGA
DR3_R	AGGGGGGGGG GCGGGGAGTG GGGGATGAGG AGGGCGGGGG GGGGGAGATG GTGGGAGGGA

DR1_R	GAGGG
DR2_R	GAGGG
DR3_R	GAGGG

Annex 3 Electropherogram from *Dioscorea hispida* Dennst. *matK* sequence

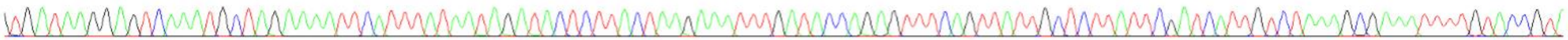


File: DR1_F.ab1　　*Run Ended: 2019/11/7 19:45:55*　　*Signal G:606 A:857 C:896 T:1427*

Sample: DR1_F　　*Lane: 15*　　*Base spacing: 16.338362*　　*1229 bases in 14574 scans*　　*Page 2 of 2*

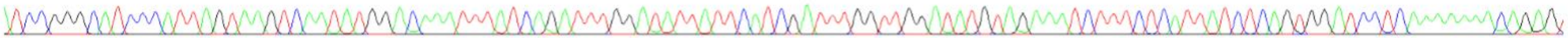
630 640 650 660 670 680 690 700 710 720 730 740

TGATAAGGAGTCAAATGCTAGAAAATTCATTTATAATAGATACTCTTACTAAGAAATTTGATACCAGAGTTTCAGTTATTGCTCTTATTCGATCATTGTCTAAAGCGAAATTTTGTACCGT



750 760 770 780 790 800 810 820 830 840 850 860 870

ATCCGGGCATCCCATTAGTAAGTCAATATGGACAAATTTATCAGATTTGGATATTATTCATCGATTTGGTTGGATATGTAGAAATCTTTCTCATTATCTCAGTGGATCCTCAAAAAAACAGAG



880 890 900 910 920 930 940 950 960 970 980 990

TTTGTATAGAATAAAGTATATACTTCACTCTCGGGGGTGTTAAAAGAAAAAAAAAAAAAAAATGTTAGATGAATTAAGGTAGGTTAGGGGGAGGATAAGAAGGGTGGATGAGAGGGGTAGGTAT

1000 1010 1020 1030 1040 1050 1060 1070 1080 1090 1100 1110 1120

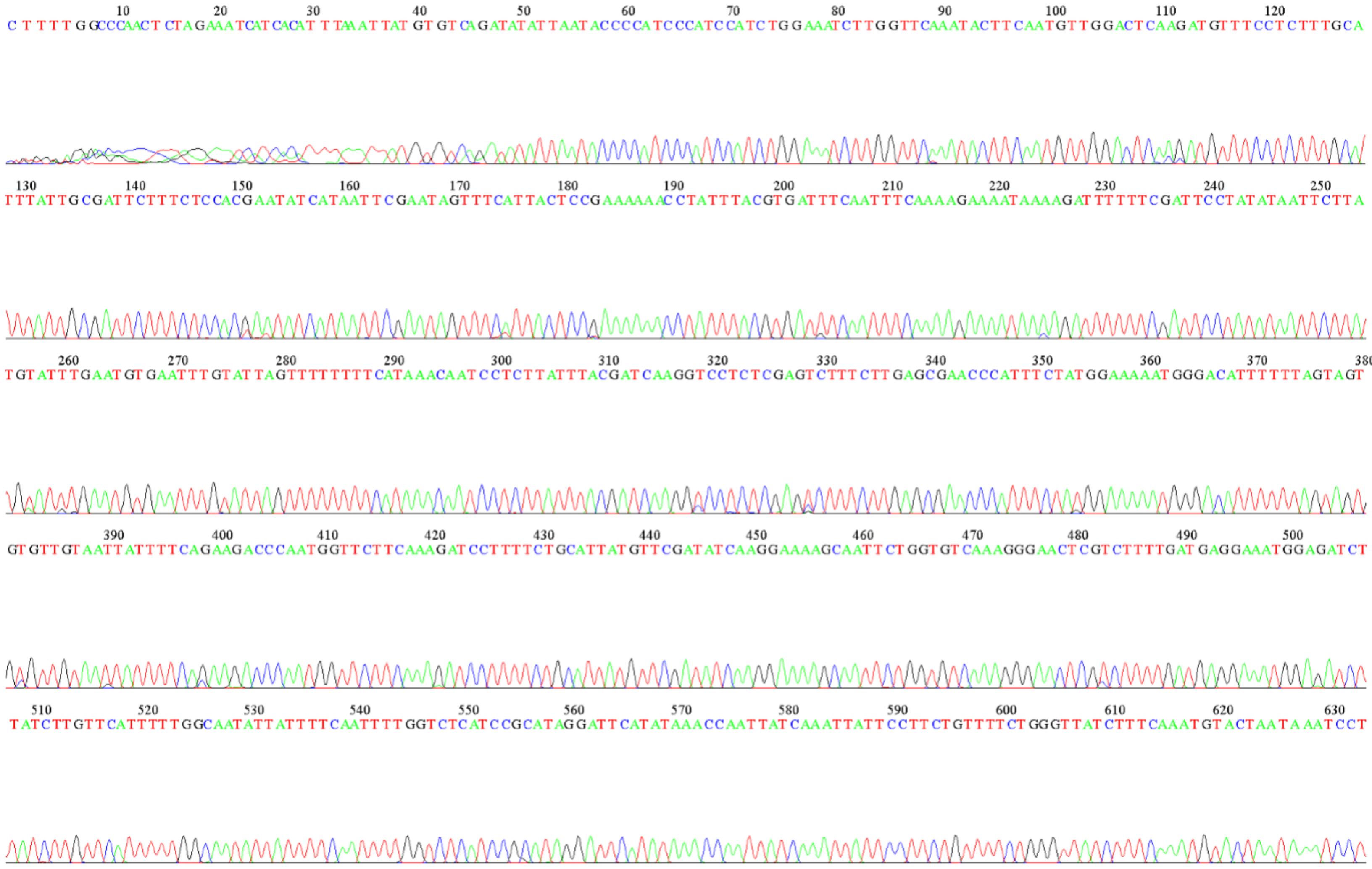
GGTGGTGAATGAGTGGAAAGAATAGTGTGGTAGGTGTGAGGAAATGGAGGAGGGTAAGGGAGGGGAGGAAGAAGAAAGGGGGGAGGTGTGGGGAAGTGAGGATGAGGAAGGGGAAGAAAGGATGATATA

1130 1140 1150 1160 1170 1180 1190 1200 1210 1220

GTGGTGGTGGGTAAAGGAGTAGGAGGGAGGGGGGGCGGGTGGATAAGAGGGGGAAGGGGGATGGGGGTGTAGAGGGAAAGCGAGGGCGACGGGGGGCGTAGG

File: DR2_F.ab1 *Run Ended: 2019/11/7 19:45:55* *Signal G:115 A:123 C:120 T:171*

Sample: DR2_F *Lane: 11* *Base spacing: 17.062868* *1219 bases in 14689 scans* *Page 1 of 2*

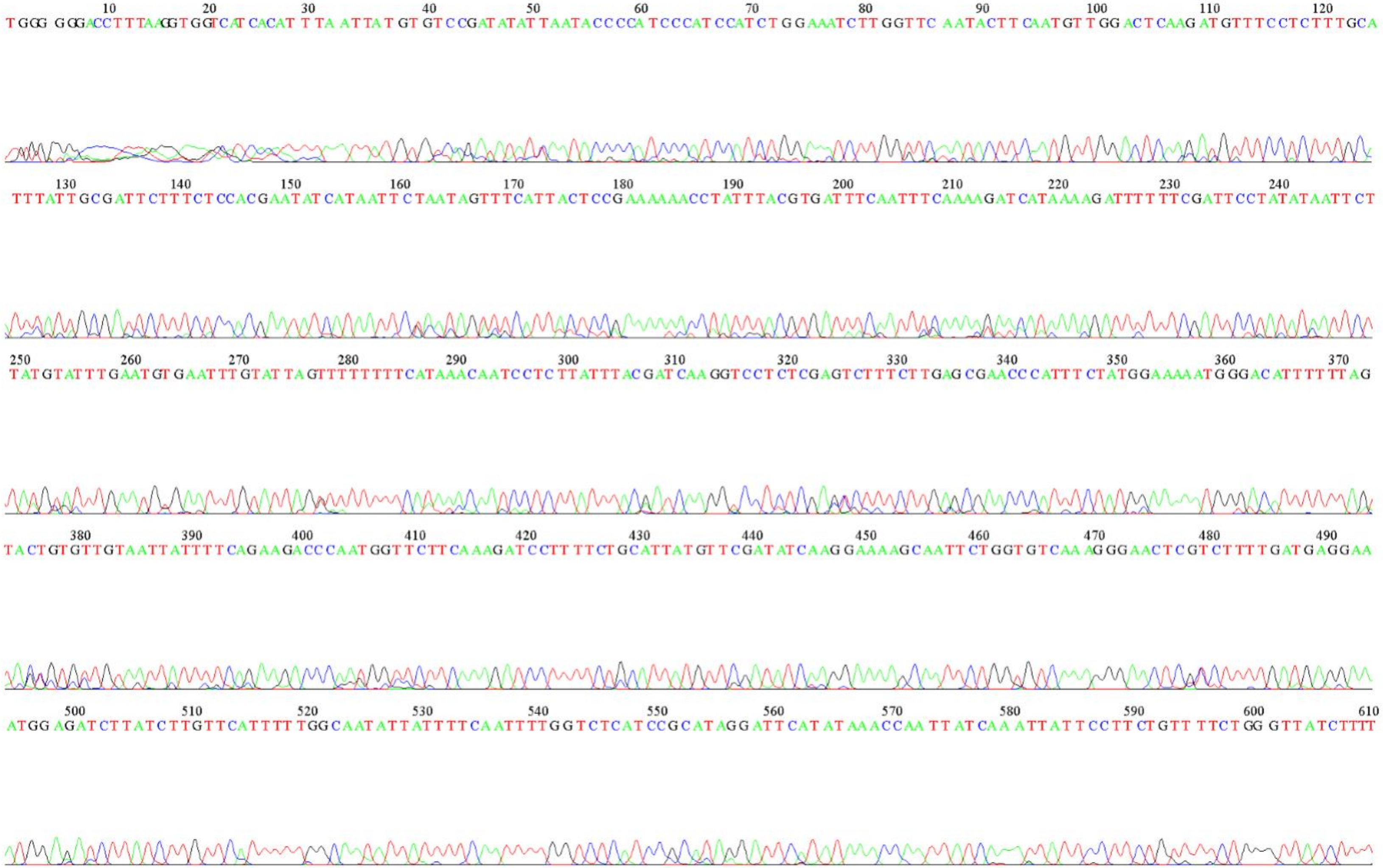


File: DR2_F.ab1 Run Ended: 2019/11/7 19:45:55 Signal G:115 A:123 C:120 T:171

Sample: DR2_F Lane: 11 Base spacing: 17.062868 1219 bases in 14689 scans Page 2 of 2

File: DR3_F.ab1 Run Ended: 2019/11/7 19:45:55 Signal G:86 A:87 C:92 T:122

Sample: DR3_F Lane: 7 Base spacing: 16.467289 1709 bases in 18368 scans Page 1 of 2

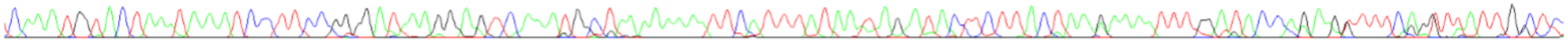


File: DR3_F.ab1 *Run Ended: 2019/11/7 19:45:55* *Signal G:86 A:87 C:92 T:122*

Sample: DR3_F *Lane: 7* *Base spacing: 16.467289* *1709 bases in 18368 scans*

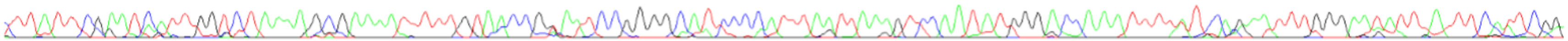
620 630 640 650 660 670 680 690 700 710 720

CAAATGTACTAATAAATCCTTCCGGGATAAGGAGTCAAATGCTAAAAAAATTCATTTATAAATAGATACTTCTTACTAAAGAAAATTTTGATACCAGAGTTTTCAGTTTATTGCTC



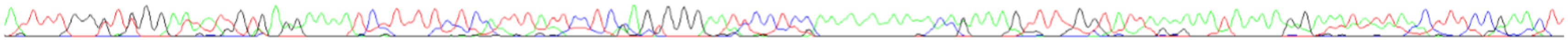
730 740 750 760 770 780 790 800 810 820 830 840 850

CTTATTCGAATCATTGGTCTAAAAGCGAAAATTTTTGTAACCGTAATCCGGGGCATCCCCATTTAATTAAAGTCCAATATGGGACCAAATTTTTTCAGAATTTGGGAATATTTATTTCATTCGG



860 870 880 890 900 910 920 930 940 950 960 970

ATTTTGGGGTGGGAATATGTGAGGAAAATCTTTTTCCTCATTTATTCCTCCAGTGGGAATTCCTCCAAAAAAAAACAGAAAGTTTTGGTATTAAAAAAATAAAAGGAAATATTAACTTTCCGAACT



980 990 1000 1010 1020 1030 1040 1050 1060 1070 1080 1090 1100 1110

TTTCGCGGGGTGCCTTAAAAAAAAAAGACTTAGGGCCCAGGTCGAGTTGAGTAGTTGGTAGAGGATGTTGACAGAGAGAGCGGATGGGAGGAGGGAGGAGTAGAGAGATAGGGAGAGAGAGCAAGCGGCAGGCT

1120 1130 1140 1150 1160 1170 1180 1190 1200 1210 1220 1230 1240 1250 1260 1270

GGGCCGGCGGAAGTGAGAGGTAGAGCAAGTATGCAGACGAGAGGAGGTGCGCGGTCAGGGGCACTGATGGTGGAGAGAGATATATGTAGTAGGGAGTAGGGGACAGCGCGGAGTAGGCTAGAGATGAGGTGGGAGTGGAGGAGATTGAGAGAGCG

Annex 4 Holotype of *Begonia bangsamoro* sp. nov. deposited in the Botany and National Herbarium Division of the National Museum of the Philippines, Manila.