Institute of Biodiversity and Environmental Conservation

Utilization Pattern and Value of Medicinal and Food Plants Use in the Bidayuh Communities in Bau, Kuching, and Serian Districts of Sarawak

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Utilization Pattern and Value of Medicinal and Food Plants Use in the Bidayuh Communities in Bau, Kuching, and Serian Districts of Sarawak

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DECLARATION

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Malaysia Sarawak. Except where due acknowledgements have been made, the work is that of the author alone. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

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ABSTRACT

Bidayuh communities are recognized for their skills in the usage of wild plants for food and traditional medicine. The research was conducted from April 2019 until the end of 2021. The research is done to (1) to gather the pattern of use of medicinal and food plants among Bidayuh communities in Siburan district (Serian Division), Padawan sub-district, and Bau district (in Kuching Division), (2) compare and describe the use practices such as plant parts used and methods of preparation of plants documented, and (3) estimate the annual value of the use of the food and traditional medicinal plants in the communities. Household surveys were conducted on 226 households based on stratified random sampling. Key informant in-depth interviews and group meetings were used to gather further information. A total of 43 medicinal plant species used to treat 25 ailments have been recorded from all districts. Five primary ailments are fever (11 plant species), wound (10 plant species), post-partum care (eight plant species), hypertension (seven plant species), and diseases of the skin (seven plant species). For the food plants, 74 species were recorded from the three districts. The plants are mostly consumed directly as *ulam* or ripe fruit (36 plant species), cooked as vegetables (28 plant species), and others are made as *tuak* or condiment (10 plant species).

Keywords: Wild plant; medicine; food; annual value; Bidayuh communities

Corak Penggunaan dan Nilai Tumbuhan Ubat dan Makanan dalam Komuniti Bidayuh di Daerah Bau, Kuching dan Serian Sarawak

ABSTRAK

Komuniti Bidayuh terkenal dengan kemahiran mereka dalam pengunaan tumbuhan liar sebagai makanan dan ubat tradisional. Kajian ini telah dilaksanakan pada April 2019 sehingga pada penghujung tahun 2021. Objektif kajian adalah untuk (1) mengumpul corak penggunaan tumbuhan ubat dan makanan yang digunakan oleh komuniti Bidayuh yang terdapat di daerah Siburan (Bahagian Serian), daerah kecil Padawan dan daerah Bau (Bahagian Kuching), (2) membuat bandingan dan huraian cara penggunaan tumbuhan seperti bahagian tumbuhan yang digunakan dan pendokumentasian cara penyediaan tumbuhan, dan (3) menganggar nilai tahunan pengunaan tumbuhan makanan dan ubat dalam kalangan komuniti. Tinjauan isi rumah telah dijalankan ke atas 226 isi rumah berdasarkan persampelan rawak berstrata. Temu bual mendalam secara indivual dan kumpulan digunakan untuk mengumpul maklumat lanjut. Sebanyak 43 spesies tumbuhan ubatan yang digunakan untuk merawat 25 penyakit telah direkodkan dari semua daerah. Lima penyakit utama ialah demam (11 spesies tumbuhan), luka (10 spesies tumbuhan), penjagaan selepas bersalin (lapan spesies tumbuhan), hipertensi (tujuh spesies tumbuhan), dan penyakit kulit (tujuh spesies tumbuhan). Bagi tumbuhan makanan, 74 spesies direkodkan dari ketiga-tiga daerah. Tumbuhan tersebut kebanyakannya dimakan secara langsung sebagai ulam atau buah yang telah matang (36 spesies tumbuhan), dimasak sebagai sayur-sayuran (31 spesies tumbuhan), dan yang lain dibuat sebagai tuak atau perasa (10 spesies tumbuhan).

Kata kunci: *Tumbuhan liar; ubat; makanan; nilai tahunan; komuniti Bidayuh*

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LIST OF ABBREVIATIONS

FAO	Food and Agriculture Organization
NTFP	Non- timber Forest Product
TK	Traditional Knowledge
SPSS	Statistical Program for Social Science
TM	Traditional Medicine
TEK	Traditional Ecological Knowledge
WIPO	World Intellectual Property Organization
WHO	World Health Organization

CHAPTER 1

INTRODUCTION

1.1 Brief Background

The field of ethnobotany focuses on the study of medicinal and food plants used by local communities worldwide. This chapter provides an overview of recent trends related to these plants, focusing on global, Malaysia and Sarawak (study sites), including the Padawan sub-district, Siburan district, and Bau district. In Malaysia, indigenous people have a long-standing tradition of using plants for food, medicine, construction, fuel, and ceremonial purposes. In Sarawak, particularly in the selected study sites (Padawan sub-district, Siburan district, and Bau district), the Bidayuh community has a profound connection to plants. Numerous studies have extensively documented the traditional uses of plants for medicine, food, and ceremonies in the daily lives of the community. These plants are typically gathered from nearby community forests or cultivated near their homes.

1.2 Study Background

The term "Ethnobotany" was first introduced in the late eighteenth century by a botany professor who studied plants' used by primitive and aboriginal people. Later, the modern-day ethnobotanical study started, which led to various definitions of ethnobotany by multiple researchers. Yet, in short, ethnobotany is the study of the relationship between plants and people. The people described in ethnobotany are indigenous people who follow traditional, nonindustrial routines in the area they occupied for generations (Balick et al., 2002). Traditional knowledge is the evidence of the well-aged traditions and practices of the indigenous community, which include understanding, knowledge, and experiences of the community. Often, this knowledge is passed down orally through generations and rarely put

in any standard form of documentation. The World Health Organization (WHO) estimated about 60% of the world's population relies on traditional medicine (TM) for their primary healthcare essentials (Gyasi et al., 2011). WHO defines TM often includes medication remedies such as herbal medicines (plants), animal parts, and minerals (WHO, 2005). People worldwide have been associated with healing plants since ancient, particularly the indigenous people in developing countries. They have been consuming and using herbal medicine (plants) not just for health but in their culture, practices, and daily livelihood. Traditional medicine is a valuable ancient knowledge of the people who have survived and evolved over the millennia, such as Ayurveda medicine and Traditional Chinese Medicine. These practices are still used and accepted to date, commonly known as alternative medicine or complementary medicine.

People have depended on wild-growing plants in their nourishment since prehistoric and continue to rely on these plants for nutritional consumption till today (Grivetti & Ogle, 2000; Turner et al., 2011; Khan et al., 2017). Wild harvested plant foods consist of underground parts; shoots and leafy greens; fleshy fruits; grains, nuts, and seed; and mushrooms, lichens, algae, and other species. These species involve specific traditional knowledge of the locals concerning collecting, preparation, cooking, and other forms of processing (Turner et al., 2011). Other than offer nourishment, these harvested wild plants provide cash income for the local people and have vital importance in safeguarding global food security (Uprety et al., 2012). Consuming wild edible is part of the food habits of people in countless families and communities around the world and closely associated with practically all features of their socio-cultural, spiritual life and health. Furthermore, wild food plants have a vital role in meeting the nutritional necessity of the indigenous population in remote parts of the country Khan et al. (2017).

Sarawak is located on one of the largest islands in Asia-Pacific county known as Borneo, one of the 13 Biodiversity Hotspots of the world (Jong et al., 2013). The massive tropical rainforest of Sarawak has contributed to the rich biodiversity of Malaysia's tropical rainforest. There are five types of natural forests that occur in Sarawak: Hill Mixed Dipterocarp Forest, Peat Swamp Forest, and Mangrove Forest, which are three prime forest types. Subsequently, by a slightly small extent, the Kerangas and Montane Forests. Aside from being lavish and having extensive biodiversity, Sarawak is also ethnically and culturally diverse. Rainforest plays a vital role in the Indigenous community's livelihood, such as a source of nourishment, lodging, covers, utensils, and religious and healing purposes (Jong et al., 2013). In Sarawak, the various studies on traditional medicinal plants used by the indigenous community are still ongoing. Based on Runi and Lee's (2001) study, the Sarawak Forest Department has been collecting information on the use of medicinal plants by the various communities in the state. Studies show that Bidayuh is the third largest community after Orang Ulu and Iban, and it uses medicinal plants.

Aside from providing medicinal plants to the communities, the Sarawak rainforest has been a significant source of the indigenous community's diet. Studies by (Shaffiq et al., 2013) stated that the locals collect, hunt and consume wild fruits, mushrooms, wild vegetables, and animals as a food source. In addition to the food the rainforest supplies, the communities also cultivate wild fruits and vegetables in their orchards and home gardens. According to (Anupunt et al., 2003), more than 55% of the Asian fruit species were collected from forests and other non-cultivated areas.

The Bidayuh communities that settle in Kuching and Serian division, predominately in the Padawan sub-district, Bau district, and Siburan district, respectively, had been using

forest products for decades. Several studies focus on the utilization of non-timber forest products, specifically plants used in traditional medicine and as food by the Bidayuh community. A recent study by Naming (2015) of the Bidayuh Tebia of Kampung Kiding in Padawan sub-district documented a total of 35 species of medicinal plants from 25 families. Some of these species were medicinal plants for external use (27 species), internal use (6 species), for the healing of disease caused by "black magic" or spirits, and one species for preventing hair fall and itchy scalp. These medicinal plants were collected from the agroforestry site, old rubber farms, and secondary forest. In addition to ongoing documentation on the valuable plants used by the Singai Bidayuh in Bau, so far, there are 52 identified and recorded wild plant species used for medicinal purposes and nourishment (Ripen & Noweg, 2017).

Over the years, the demand for medicinal and aromatic plants increases as the markets expand and new end-usage was established. Since approximately 80 percent population of the developing countries still depend on traditional medicines for their main well-being essentials, WHO estimated about US$ 60 billion of international trade in medicinal plants in the year 2010 and will be reaching up to US$ 5 trillion by the year 2050. Meanwhile, in Asia only, the demand for the herbal market had nearly doubled during the late 1990s due to expansion in the population (Nirmal et al., 2013). Over 56 000 tons of medicinal plants were used annually by some 48 million consumers, with the consumers obtaining their plant materials from local healers, traders and collecting the plants themselves. It shows about 49 000 tons (87 percent) are wild plants, and the rest 7 000 tons (13 percent) being cultivated (Hishe et al., 2016).

Meanwhile, the trade value of wild food plants was not as established compared to medicinal plants since no comprehensive global estimation of the economic value of wild food plants was recorded. Many studies were done in many parts of the world that specifically focus on particular communities or regions. Based on one of the studies done in European countries, the provisional calculations estimated that the market value of wild plants in the European countries is summed up to at least 1.66 billion Euros or approximately US$ 1.89 billion (Schunko & Vogl, 2018).

1.3 Problem Statement

Bidayuh communities are familiar with the traditional uses of medicinal and food plants. However, this understanding was only passed down through generations through conventional methods or oral tradition. The use of medicinal and food plants tends to be confined to the elderly members of the community and traditional herbal medicine experts. However, there is a developing trend; an even younger and more affluent population is beginning to appreciate wild food plants and herbal medicine. Observation in the Bidayuh community indicates that traditional medicinal plants are now quite common. In contrast, food plants are only seen in the small community market due to changes in people's preferences and dietary habits and the time required to collect wild plants. The use of these plants tends to differ according to the livelihood of the Bidayuh community.

Between the Bidayuh alone, the diverse Bidayuh group has a different culture. The Bidayuh from Serian originated from the Upper Kapuas River of the Kalimantan. Meanwhile, the Bidayuh in Padawan mainly migrated from Gunung Sungkong, and the Bidayuh in Bau migrated from Kabupaten Bengkayang in Indonesia. A search for more details on the practices of food and medicinal plants, such as plant parts used and methods

of preparation for medicine or culinary purposes, between the Bidayuh group needs more documentation. Past studies have only focused on one or a particular Bidayuh community. It shows that the documentation of the traditional knowledge of these medicinal and food plants is far from complete. In the meantime, the valuation of food and traditional medicinal plants used by the Bidayuh community will help create incentives within the Bidayuh community to protect and conserve their nearby forest community. Hence, this study is preserving their ancestor's traditional knowledge and safeguarding their valuable natural resources.

1.4 Objectives

In general, the study's objective is to expand on the previous documentation and assess the pattern of use and value of traditional medicinal and food plants. It also aims to document the valuable traditional knowledge in the Bidayuh communities in Siburan district (Serian Division), Padawan sub-district, and Bau district (Kuching Division). The specific objectives of the study are as follows:

i. To gather the pattern of use of medicinal and food plants among Bidayuh communities in Siburan district (Serian Division), Padawan sub-district, and Bau district (in Kuching Division),

ii. To compare and describe the use practices such as plant parts used and methods of preparation of plants documented, and

iii. To estimate the annual value of the use of the food and traditional medicinal plants in the communities.

1.5 Study Justification

Currently, traditional knowledge of plants among the natives is under threat due to the modernization and globalization of the native livelihood alone. Awareness among the newer generations is deteriorating over time. Thus, it becomes a pressure in need of conservation predominantly on behalf of the native's community resources. Documenting the utilizations and selection of plant species commonly used in traditional medicine and diet by the Bidayuh community will help create awareness of the significance of community resources and the safeguarding of their ancestor knowledge in the uses of the plants. It helps to initiate conservation within a practice by involving the local herbal practitioners and the surrounding communities, which will help to provide and share information on the importance of medicinal and food plant conservation within the community.

Consequently, the study will help protect traditional knowledge and provide environmental services to the community and its surroundings. Meanwhile, it is crucial to ponder on the three concepts, such as values, goals, and decision-making for management and planning of resource use. Positive values within the community will help create better goals for managing sustainable community resources for future cohorts by thorough observation and consideration that lead to community and environmental benefits.

1.6 Study Limitation

The study focuses on only a few selected Bidayuh communities in the Kuching and Serian regions. The results obtained are limited to these specific groups and cannot represent the entire Bidayuh community. The information collected through interviews and observations on medicinal and food plants is inadequate due to time constraints.

CHAPTER 2

LITERATURE REVIEW

2.1 General Introduction

This chapter will focus on the various aspects of the ethnobotanical study of medicinal and food plants from past findings.

2.2 Community Forestry and Ethnobotany

People have depended on plants since the earliest civilization ever recorded. Humanity has relied on the unique qualities of plants in numerous parts of their life up to this point for aesthetic purposes: as a source of nutrients, for their medicinal properties, for lodging, and more. They had cultivated practices, rituals, and culture for generations in their local environment. Often, these groups of people are known as the indigenous community or indigenous people.

As cited by Charnley and Poe (2007), FAO stated that forests shelter 30 per cent of the earth's land region, totalling about four billion hectares. In the brief five-year interlude between 2000 and 2005, experts estimate an average net loss of about 7.3 million hectares per annum of forest occurred. Almost (79.5 per cent) 5.8 million hectares of the damage were the primary forest due to forest conversion to the agriculture industry. Estimated about 400 – 500 million people live in and around the world's forest, and people in the rural and urban areas have depend on forest resources. People living in communities within and around the forests use products from the forest to nourish, fuel, remedy, and buildings such as constructing houses or huts and even sustain their income (Charnley & Poe, 2007).

Meanwhile, Belcher et al. (2005) study shows forests offer livelihoods and food for about 300 million people in the form of non-timber products (NTFP). NTFP and food security have a significant relationship with rural *communities*. There are several ethnobotanical findings and records around the world. For example, studies done by (Grivetti & Ogle, 2000) show that more than 7000 species of wild plants, were used as food by people.

2.3 Types of Plant Resources Used by the Local Communities

Traditional ecological knowledge (TEK) is one of the vital elements in the management of nature, closely linked to the protection of ecosystems and species. The natives establish this TEK through adaptive practices with natural resources. Common examples of plant resources are plants such as medicine, nourishment, fodder, fuelwood, and other general uses such as construction and shelter. According to Hanazaki et al. (2013), more studies focused of medicinal plants than other plant resources. The primary factor influencing ethnobotanical knowledge on medicinal plants is age. Older people tend to have higher medicinal plant knowledge than the younger generation, as they lack interest concerning these resources and related practices. Also, due to the type of health facilities predominating among the youth, accessibility for modern medicine, and change in lifestyle and the environment regarding the availability of plant resources.

Meanwhile, for food plants, there seems to be a lack of evidence of knowledge oddities between different age groups; the knowledge of these types of plant resources is inclined to be more consistently distributed within the population. People commonly have extensive contact with and depend on food plants since they are juvenile, and people usually experiment with food plants more frequently than with medicinal plants (Hanazaki et al., 2013). Fodder trees play an essential role in Africa, mainly among the dairy farmers who

have fed tree foliage to their livestock since ancient. Many of the fodder trees are also multi-purpose. The locals used them as firewood and soil erosion control (Franzel et al., 2014). In Southeast Asia, Bharucha and Pretty (2010) stated, that fodder is not often collected for livestock, yet they allowed the herd to forage freely. In many developing countries, fuelwood is one of the necessities used by the indigenous community, especially in rural areas. Firewood is often collected from forests daily; it is generally as fallen branches, litter, and deadwood (De Beer & McDermott, 1996)

2.4 Local Communities Use of Plant Resources

People use plant resources for remedies, the supply of foods and spices, the construction of buildings, and other general uses. Native in Eastern Tanzania has been using tree species in the tropical woodlands for charcoal, firewood, medicine, and poles for the principal applications. Results from the survey show wooden sticks are used in about 98% of the houses and storage constructions; wild foods were valuable, especially during the drought periods, and high-quality timber trees have been decreased due to the pit-sawing industry. The utilization of plant resources by the natives is expected in developing countries. Experts worldwide were doing extensive research and recordings on the uses of forest products by the indigenous communities. In Asia, over 90 species of edible wild plants were recorded from 4 villages in the Mekong Delta and Central Highlands of Vietnam. These plants are used as foods, medicines, and livestock feeds (Ogle et al., 2003). In Nepal, 62 wild food plants are recorded in nine villages in the Dolakha district. Most of the documented plants are consumed by the locals as snacks and a supplementary preceding to the yield of primary foods (Shrestha & Dhillion, 2006). In a study by Saha and Sundriyal (2012), a total of 343 non-timber forest products recorded used by the tribes that settled in the Eastern Himalayan region of India, is comprised of medicinal (163 species), edible fruits (75

species), and vegetables (65 species) Findings in the rural communities in the West Africa savanna show several 90 species were recognized as plants for remedy (61%), firewood (41%), construction (39%) and foods (32%) (Heubach et al., 2013). Whereas in a well-developed country, the usage of plants was also studied concerning the preservation of ethnobotanical traditions of the local community. A total of 58 medicinal plant species belonging to 30 families used in Valvestino, Italy, have been documented (Vitalini et al., 2009). Most of these plants were prepared as infusion and decoction by the locals.

2.5 Medicinal Plant

Medicinal plants play a vital role in maintaining human health for a generation as they contain significant constituent benefits to humans, such as antioxidants, a phytochemical present in plants. Verma and Singh (2008) stated that medicinal plants have been the main remedies in traditional medicine practices since ancient times and have survived in more significant parts of the world. Approximately 80% of the world population uses these medicinal plants in the health care systems, predominantly in developing nations.

According to Fernando and Pillay (2004) they detailed four leading causes for this widespread acceptance. First, medicinal plants have been consumed for indefinable times and have shown reliability and positivity in treating and preventing disease. Most medicinal plants are not toxic and hence give rise to few side-effects, yet even some adverse effects do happen. They are much less severe comparing those caused by chemical-produced medications. People choose to seek traditional medicinal plants as they consider natural medicines to have little to no adverse effects and are holistic, more reliable and effective than human-made drugs. People who live in rural and mountain areas have more access to local medicinal plants (Fernando & Pillay, 2004).

People in developing countries such as Malaysia, people value medicinal plants as remedies to treat diseases and illnesses. Back in time, the natives not only used medicinal plants for the primary health care of a community but also practiced in the healing process, such as in prayers and rituals as remedies for spiritual illness. Like any other native groups living in the rural parts of Sarawak, the Bidayuh had been using plants in their livelihood since antiquity. They have easy access and rely upon forest products for food sources, ornaments, religious cultures, traditional medicines, and some selling them at the nearby community market (Noweg & Jihen, 2005).

2.6 Food Plant

People worldwide have relied on food plants cultivated or collected in the forest as their daily dietary requirements. The term "wild food" is expected in the livelihood of many rural communities, shifting cultivation, continuous croppers, or hunter-gatherers. Wild food plants describe all plant resources outside agriculture ranges collected and harvested for human consumption. Wild edible plants were selected through trial and error and were later domesticated by the man. Common plant parts such as fruit, leaves, flowers, stems, roots, and seeds are usually categorized as "fruit" or "vegetable" in a culinary sense, preferably in botanical terms. People widely accept fruits and vegetables as a vital mechanism of a healthy diet (Agudo & Joint, 2005).

Being the largest continent globally with a rich diversity of plants, Asia has yielded a wide variety of native tropical and sub-tropical fruit tree species only. Anupunt et al. *(*2003) stated that approximately 500 species of fruits are recognized in the Asian region, and 20 species are commonly cultivated. Also detailed, the predominant species are banana, pineapple, mango, citrus, and papaya. According to a study by Milow et al. (2014), about

520 species of plants produce edible fruits or seeds in Malaysia. Still, there are also underutilized fruit plants that are grown locally for consumption or medicinal purposes.

Sarawak's diverse biodiversity of indigenous fruit and vegetables has provided the natives with an excellent food source and income in the rural area. These indigenous fruits and vegetables are nutritious and have the potential to be promoted to the comprehensive consumer.

2.7 Traditional Knowledge of the Healing and Food Plant

According to Antons (2013), World Intellectual Property Organization (WIPO) explains traditional knowledge (TK) is expertise, know-how, abilities, and practices that are established, continued, and passed to the next generations within a native group, often creating part of its cultural or mystical uniqueness. Moreover, it covers many technical fields such as agriculture, environmental and medicinal knowledge, and even knowledge linked to genetic supplies. For TK, in a general phrase, it comprises the experience itself and traditional cultural terms, involving distinctive signs and symbols associated with traditional knowledge. Traditional knowledge is closely linked with the conservation of biodiversity. Several studies have shown TK is related and vital in protecting biodiversity by keeping its richness and evenness in its natural ecosystem (Antons, 2013).

Step back in time when sicknesses were supposed was caused by spiritual and paranormal reasons. Herbs or plants that cured ailments were believed to propel out wicked spirits and someway are sacred. Hence, these plants were continued used by the indigenous community until the present. Throughout TK and native's understanding, their elders can

help create a significant foundation for recent research, especially in finding cures for ailments that cannot be healed by human-made medicines yet.

People have relied on plants as a dietary supplement, while the native community depends on the forest for its food supply. Hence, traditional food knowledge is vital to the culture and uniqueness of the indigenous inhabitants. Yet, this knowledge has been threatened by massive-scale plantation principles and the globalizing of trade (Sayok & Teucher, 2018). Traditional food knowledge of the natives consists of the know-how to identify, collect, use, and consume plants, especially wild plants. Like medicinal plants, the TK of the food plans is currently deteriorating over time as awareness of the importance of this knowledge was absent among the younger generation. Sayok and Teucher (2018) findings show that the increase in the percentage of plant-based food is much smaller in their dishes than in the olden days.

2.8 The Bidayuh and Plants

Sarawak is located in Borneo, covering an area of about 124 500 square kilometres, roughly similar to the total size of the 11 states creating Peninsular Malaysia. According to "The Future of the Dayak Bidayuhs," the Bidayuh are the fourth largest tribe in Sarawak, after the Ibans, Chinese, and the Malays. In the Bidayuh language, "Bi" means "people," and "Dayuh" means "land." Therefore, "Bidayuh" means "people of the land". Chang (2002) stated that they mainly originated from Sungkung, Bugau, and other parts of Kalimantan Indonesia. Chang added the Bidayuh settled around Gunung Penrissen, primarily at Rabak Mikabuh in Kuching district, at Gunung Singai, Gunung Serembu and Bung Bratak in Bau district and around Kampung Gahat Mawang and Kampung Kujang Mawang in Serian district when they first arrived. The Bidayuh population later spread to Kuching and

Samarahan divisions. However, they can be found throughout Sarawak today. There are at least 29 groups of Bidayuh in Sarawak. However, four major distinctive dialect groups consist of Bukar-Sadong of Serian district, Jagoi-Singai of Bau district, Biatah of Kuching, Selakau-Lara (or Selako-Rara) of Lundu district. Every dialect mentioned before can further be divided into sub-dialects. For instance, the Jagoi-Singai, it has sub-dialects of Jagoi-Bratak, Singai, Serumbu (or Broih) and Krokong-Tringgus (Minos, 2000).

Like other tribes in Sarawak, the Bidayuh believed in the customary and superstitious omen and faith. Forest products such as plants are essential for community life. Back then, commonly, the Bidayuh assumed that much of the severe sickness was triggered by evil demons, who either wounded, he/she within, remained in the body to cause harm or stole one of his seven souls who, combined, sustained his/her life (Goodenough, 1959). Chang (2002) also stated the Bidayuh community from Serian believed in witchcraft-related to sickness. The natives cure their patients by extracting the evil spirit causing illness through spells and dancing with the help of herbal medicines.

The relationship between the Bidayuh and plants is not only for preserving physical and spiritual beings, also, for protection and nourishment. For example, paddy planting was an essential work in the community's cultural heritage in the early days. But recently, large areas of the Native Customary Rights Land of the Bidayuh in Kuching and Samarahan have been implanted with cash crops such as oil palm (*Elaeis guineensis*), cocoa (*Theobroma cacao*), tea (*Camellia* sp.), coffee (*Coffea* sp.), rubber *(Hevea brasiliensis*) and paddy (*Oryza sativa*) (Chang, 2002).

2.9 Previous Recording and Documentation of Medicinal and Food Plants Uses

2.9.1 General

Sharanappa and Vidyasagar (2014) assessed that 70% to 80% of the people globally rely primarily on the traditional healthcare system and generally on herbal medicines. They are also estimated that about 64 percent of the worldwide populace depends on conventional medicine. Nearly 8000 plants all over the earth have been recognized for their ethnomedicinal status. Milow et al. (2014) stated that food plants are not only for sustenance, but people have been using them in their religion, culture, and everyday living. Unfortunately, the recording and documentation of these plants worldwide were still far from complete, although much effort has been carried out in many parts of the world today.

2.9.2 Medicinal Plant of the Indigenous Community Worldwide

People relied on plants either as medicine or just as a health supplement to treat physical and mental ailments or spiritual illnesses. The usage of medicinal plants or herbs can be dated to the early age of human civilization. Ayurvedic treatment and traditional Chinese medicine are among the oldest documentation of medicinal plants that have survived for centuries. Studies on utilization and traditional knowledge of medicinal plants were extensively done in developing countries since most people in developing countries, especially in rural areas, have insufficient access to modern medical care or Western forms of treatment. The study was done in Canhane village, province of Gaza. Mozambique, one of the African countries, recorded 53 plant species, and half of the recorded plants were used for stomach- and intestine-related illnesses. About 15 per cent of the 5 500 plant species are used by rural communities for medical purposes and carry an essential role in primary fitness care (Ribeiro et al., 2010). Documentation of medicinal plants was also being done in well-

developed countries. In Canada, 546 medicinal plant taxa, mainly herbs as the primary source and tailed by shrubs, were used by the Aboriginal people of the Canadian boreal forest. The plants were used to treat 28 ailments; most plant species were used for gastrointestinal illnesses, followed by musculoskeletal disorders (Uprety et al., 2012).

2.9.3 Medicinal Plant Used in Peninsular Malaysia, Sabah and Sarawak

Based on the previous studies on the traditional medicinal plants used by the natives, they were the majority between the Orang Asli and Malay communities of Peninsular Malaysia, the Kadazandusun community of Sabah, and the Iban community of Sarawak. According to Naming (2015), other natives have scarce publications on their knowledge of medicinal plants, and sometimes, papers on how specific communities use plants for medicine are non-existent or lacking. Jamal (2006) also specified that the recording and documentation of the medicinal plants were only focused on popular medicinal plants. Medicinal plants, such as male aphrodisiac of *Eurycoma longifolia* Jack. (tongkat ali), *Labisia pumila* (kacip fatimah), *Andrographis paniculata* (hempedu bumi), *Orthosiphon stamineus* (misai kucing), *Centella asiatica* (pegaga), *Phyllanthus niruri* (dukung anak), and *Momordica charantia* (peria) were plants that are currently undergoing extensive research.

Studies were done by Ong et al. (2011a) and Ong et al. (2011b) show records of the medicinal plants used by several Orang Asli communities of Selangor, Perak, Kedah, Negeri Sembilan, and Pahang. Findings by Ong et al. (2011a) and Ong et al. (2011b) were on the traditional knowledge of medicinal plants among the Malay communities of Terengganu. Another study related to the use of medicinal plants by the Malay community was on medicinal plants for postnatal care done by Jamal et al. (2011). Some findings on the use of medicinal plants in Sabah, done by Kulip (2005), managed to record 338 medicinal plants

from the study on the comparison of medicinal plants used by two indigenous communities Kadazandusun and Murut. There were numerous studies on the use of medicinal plants by the natives in Sarawak had been documented for the past years, for examples, Kedit (1982) done a documentation in the Gunung Mulu area of Sarawak with 38 species of medicinal plants identified being used by the Penans. Also, there were several project reports and theses deposited in UNIMAS reporting on the general recording of medicinal plants used by the Iban and Bidayuh communities, by Mohamad (2003), Denis (2004), Baling (2012) and recent findings by Naming (2015). Based on the conclusions by Naming (2015) shows 38 plant species from 25 families were reported to be used for medicinal purposes by the Bidayuh community of Kampung Kiding in Padawan Sarawak.

2.9.4 Food Plant of the Indigenous Community Worldwide

Based on a study of edible wild plants in some selected districts of Ethiopia by Addis et al. (2005), recorded 152 plant parts from 130 species were identified and consumed in the study sites. These wild plant species were eaten during food shortages and famine. The scarcity of available edible food is prevailing in the African region. A study done in Spain by Tardío et al. (2006) documented 419 plant species belonging to 67 families. These plant species were grouped into seven categories; green vegetables were the largest group, followed by wild fruits, plants used as condiments, sweets, preservatives, and other uses. According to Guarrera and Savo (2016), wild food plants are part of the Mediterranean diet. Wild plants are consumed in countless ways, either for their taste, effects on health, or nutritional value. Guarrera and Savo had listed a total of 276 wild taxa used in traditional vegetable mixtures belonging to 40 families, with wild plants used as vegetables showing the highest number of users. A study by Cruz-Garcia (2011) recorded 87 wild food plant species consisting of trees, terrestrial and aquatic herbs, climbers, shrubs, bamboo, and a

rattan. These plants grow in anthropogenic ecosystems such as rice fields, home gardens, secondary forests, upland fields, swamps, and roadsides. Over two-thirds of the recorded plant species have other uses besides being consumed.

2.9.5 Food Plant Used in Peninsular Malaysia, Sabah and Sarawak

The identification and documentation concerning food value either from the forest or cultivated in the home garden or orchard is an ongoing project in Malaysia. The findings were not only focused on their uses but also the valuation for the reference in environmental impact assessment and conservation of Malaysian food plants. For example, studies on the significance of underutilized tropical fruits and their valuation were reported in several findings, such as Milow et al. (2014). These underutilized plants often grew wild in the forests, and only a small extent of the species was cultivated in the orchards and home gardens. Other findings were on the wild edible tubers and ulam that are commonly consumed as a part of a meal either in the raw form or after a short blanching process (Bachok et al., 2014; Nashriyah et al., 2011). The study was done by Noweg et al. (2003) for communities bordering the Crocker Range National Park, focusing on forest plants as vegetables. They recorded six species of fern, seven species of palm and bamboo; five species of wild banana; 4 species of ginger, and another ten species of low herbaceous plants. Documentation of forest produce as nourishment by the native communities had been done relatively well in Sarawak. Studies by Mertz and Christensen (1997) were engrossed in the wild fruits. Some findings on the wild vegetables, were found by Noweg et al. (1992), Mertz and Christensen (1997), and Noweg et al. (2003). Noweg et al. (2003) stated that the type and intensity of gathering depend on the product categories, the community involved and the location of the gathering in the private areas.

2.10 Methods of Valuation of Traditional Medicine and Food Plants Used

Kengen (1997) defines values as critical not just in economics but also in philosophy in treating ethics. The value classifications are varied and complex for the work; meanwhile, valuation is understood in its economic sense, such as the monetary values. The study of traditional medicinal plants has been done in many parts of the globe. People currently realize the importance of the relationship between the natives and plants, especially in the utilization of plants by the natives. Given and Harris (1994) mention that forest natives in many parts of the tropics can generally distinguish the common plants growing in their area and have used them for various purposes.

Since the plant has played a significant role in human life from a monetary viewpoint, it is crucial to identify and determine the input and output information needs and constrain to evaluate the traditional medicinal plants used. Consideration is vital to identify the categories of direct input and output categories of the valuation method. For example, human resources should be studied in the direct input categories by collecting the traditional medicinal plants that distinctive should be made between males, females, unskilled, and skilled workers in obtaining the plants. Besides, the raw materials and supplies of the traditional medicinal plants must be considered, such as the availability of medicinal plants in their natural environment. The direct output category is for the commercialization of traditional medicinal plants such as the fruits, roots, leaves, and other parts of the medicinal plants commonly used by the locals.

2.11 Direct Market Value

Martin (2004) explains that economic evaluation has persistently become a vital part of research on how the native people use plants. Some researchers state in their efforts as

economic botany, placing the importance on discovering plant advantages that are significance in worldwide or local markets, therefore providing for state and community improvement. In general, direct market values are the sequels of the partnership between consumers and producers throughout the request and supply of things and amenities. The that direct market value methods value the different goods and services substituted in the marketplace with the implied theory that market values accurately reveal economic shortage and economic efficiency values. Ellerman et al. (2001) stated direct marketing does need a transformation in the effort by the producers. Also, they have to emphasize the production of their market rather than produce a service, which explaines the difference between marketing and selling. Producers set the prices in their market by taking chances to add value to products by direct marketing when producers assume the marketing parts conventionally made by others (Ellerman et al., 2001).

Therefore, direct marketing on traditional medicinal and food plants can describe the market channels available to producers, such as the roadside community markets. This alternative eradicate the demand for transportation because products are usually sold near the community village itself. The roadside community markets offer producers chances to broaden their role as sellers by buying products in large quantities and selling them retail, hence giving the local roadside marketers an opening to develop their market further than what they collected from the nearby community forests and grow themselves (Ellerman et al., 2001).

2.12 Contingent Valuation

Researchers in ethnobotany studies have commonly used contingent valuation, which measures the supplies and services provided by environments. Mitchell and Carson

(2013) stated that resource economists established the contingent valuation (CV) method to measure the benefits of difficult-to-value environmental services. CV also uses surveys to create open markets for the goods so that respondents can directly specify their willingness to pay for changes in the supply of non-marketed goods under defined contingencies (Mitchell & Carson, 2013). Meanwhile, Bush et al. (2011) explain that CV is principally appealing because it can approximate values where markets do not exist or where market data cannot be related and severe limitations of market price valuation approaches. They explained that the CV method is widely used to measure use values, existence values, option values, and indirect use values. CV method is part of a broad group of survey-based valuation methods known as 'stated preference' techniques, where respondents to estimate questions are asked to directly state their value or preference in the context of a constructed market (Bush et al., 2011).

Since the contingent valuation method has become one of the most commonly used non-market valuation techniques for the past years, there is still discussion on evaluating the evaluation systems in a study done by Carson et al. (2001) detailed that deliberation over CV and the validity of the passive use-value. Due to its elasticity and capability to evaluate total cost, including passive use-value. Contingent value use and the addition of passive use value in benefit-cost analyses and environmental litigation are the subject of contentious debate (Carson et al., 2001). Despite the problems, there were many efforts made to validate the method. Carson’s (2000) study shows that validity of contingent value can be achieved through the matters of survey design, sample size, and sampling procedure by taking second place in the implementation of experimental methods using split samples to test for such things as strategic performance and the outcome on the mean willingness to pay amounts of varying such design qualities as the starting point.

Still, there are several limitations in the contingent valuation method that must be considered when applying the technique. Based on Sagoff (1988), the main concern was related to the reliability and validity of its results due to several errors or biases that can arise when operating the CV method. Sagoff detailed the most important preferences are when the respondents are questioned about their willingness to pay hypothetically. However, they tend to give higher values than what they would pay in the actual situation. The other common bias is when the respondents may give different willingness-to-pay amounts depending on the specific payment method. Also, when the respondents expressed value for the goods or amenities, they might occasionally express their feelings about the situations or the valuation exercise. The starting value in the willingness-to-pay query suggests a benefit for good; hence a starting value well above the respondent's true willingness-to-pay amount will raise the stated willingness-to-pay amount while starting value well below it will lean to lessen it. Another limitation is that strategic bias occurs when the respondent does not offer a true answer to affect an outcome, such as providing a good. A non-response bias is concerned with the limitation of the contingent valuation method because persons who do not participate in the survey tend to have different values than persons who do take part in it (Sagoff, 1988).

2.13 Opportunity Cost

Jantzen (2006) defines opportunity cost as the value of the next-highest-valued alternative use of that resource. While Kengen (1997) explained, it is a technique to approximate the value of opportunities sacrificed in providing goods or services by supposing that the value of the desired products or services is at a minimum equal to the value of the best alternative forgone to acquire it. Martin (2004) states opportunity cost is a value that economist suggests on the temporary solutions by directing the inquiry by asking

how much it would cost to substitute for the item. According to Kengen (1997), there are several considerations when using the opportunity cost technique that includes an opportunity cost of time by considering the social impacts. Besides, it is products to believe in the opportunity cost of resources and services used, weighing the environmental effects. Another consideration is that it is often site-specific, requiring surveys with data requirements, which may be high, and the data collection may be costly and time-consuming. Also, it involves assumptions about the value of alternative forgone for which scientific information may be no better than for the value of goods and services itself (Kengen, 1997). Martin (2004) explains opportunity cost with an example: if a plant claimed to cure headaches actually worked, how much would people have to pay for a similar medicine at the pharmacy? Another case is if a person, instead of using a local medicinal herb, would walk to a hospital to consult a doctor and buy medicine, how much time, energy, and money would be consumed? (Martin, 2004). Hence, obtaining an opportunity cost involves extensive data collection. This is because the approach covers the importance of the existing activities and non-marketed resources that are often neglected that add to the environment's total value.

2.14 Replacement Cost

Dixon et al. (2013) explained that the replacement cost method considers the expenses of substituting ecosystem services with artificial alternatives. The fundamental idea behind this method is that the costs incurred should not exceed the benefits gained from the ecosystem service in question. However, the limitation of the replacement cost is that expenditures for replacements are not always a reliable measure of the benefits derived from ecosystem services. Consequently, this can lead to underestimating the ecosystem's overall

value. Therefore, the replacement cost is more appropriate for estimating the economic value of a single ecosystem service or a limited number of services.

Another limitation derives from the challenge of finding perfect substitutes for these ecosystem services. Despite these drawbacks, one of the primary advantages of the replacement cost is that cost information is readily accessible and the process is less time-consuming compared to other valuation techniques (Gunatilake & Vieth, 2000). According to Notaro and Paletto (2012), the replacement cost is particularly well-suited due to its ease of application. Calculating the cost of producing forest services tends to be simpler than determining the value of those services, as readily available economic data can be utilized, and the results can be produced relatively quickly.

2.15 Methods of Study and Collection of Data

Ethnobotanical data are commonly collected using semi-structured interviews, group discussions, guided field walks, and observation with the respondent or informant (Addis et al., 2005; Bekalo et al., 2009; Mesfin et al., 2013). The respondents or participants are among the local healers (experts in medicine) and knowledgeable elders familiar with the uses and practices of plants. For better understanding and observation of the uses or practices the informant is invited to the respondent's house or field (Vitalini et al., 2009). The information documented usually focuses on the local name of the plants, collection of plants, method of preparation, route of management, use, cultivation status, other additional uses of the plants, conservation, and threats to the plants (Bekalo et al., 2009; Mesfin et al., 2013). Interviews are often done using the common language of the locals and, for the ethical purposes, data iscollected with the permission of the informants and the approval of the local administration (Abiyot et al., 2018).

CHAPTER 3

METHODOLOGY

3.1 General Introduction

This chapter comprises methods used in data collection followed by data analysis to evaluate medicinal and food plant use.

3.2 Site Selection

Sites selection mainly focuses on the Bidayuh settlements in the Bau district, the Padawan sub-district in the Kuching Division, and the Siburan sub-district in the Serian division. The accessibility of the community influenced the selection of this study site to the local community forests as they usually collected the food and medicinal plants from the nearby forest, and some were cultivated near their houses.

Figure 3.1 shows location of Sarawak in Malaysia (Tang et al., 2024) and Figure 3.2 shows the location of study areas consisting of Bau, Padawan sub-district, and Siburan.

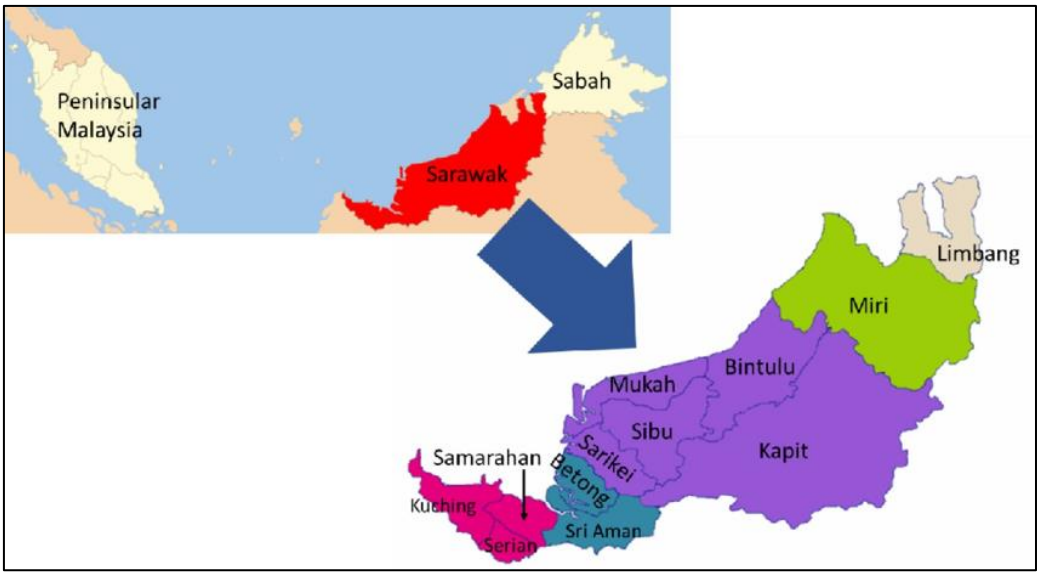

Figure 3.1: Location of Sarawak in Malaysia and the 12 divisions of Sarawak state

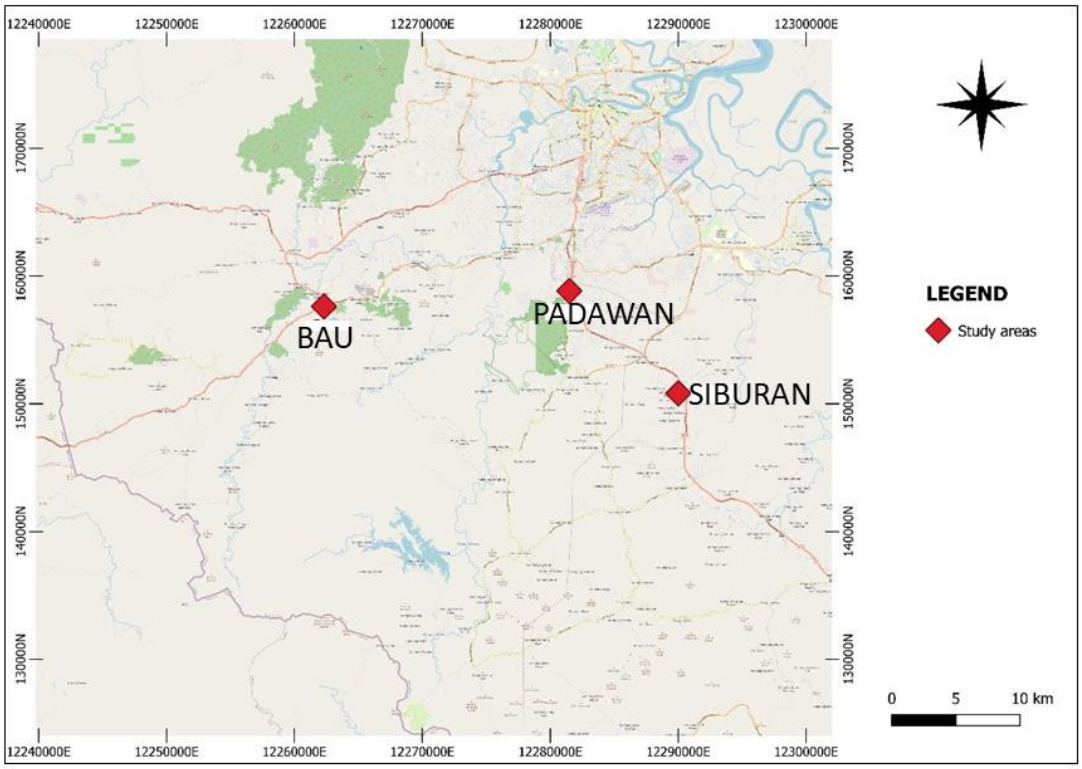

Figure 3.2: The location of study areas consisting of Bau, Padawan sub-district, and Siburan

3.3 Study Sites

3.3.1 Padawan Sub-district of Kuching Division

Padawan sub-district is about 18 kilometres from Kuching town and can be easily accessed using Penrissen/Tun Hussien Onn road via Kota Padawan or the Outer Ring. It has an area of 1 413.82 km^2, covering the suburbs of Kuching, the proper subdistrict, and the Padawan sub-district is under the administration of Padawan Municipal Council. A significant part of Padawan's rural area comprises the rich biodiversity of vegetation where the Bidayuh community lives. Often, their settlements were surrounded by a mix of Primary forest, Secondary forest, Limestone forest, Mixed dipterocarp forest, Kerangas forest, and Agroforestry.

3.3.2 Siburan District of Serian Division

Siburan (N 1.3619°, E 110.4045°) is a small town in the Serian division, located approximately 29 kilometres south-south-east of the state capital Kuching. The Siburan district was gazetted under the Serian division in 2015. Siburan town can be accessed from the Kuching-Serian highway, and the Bidayuh settlements can be found close to the city. Quite similar to Bidayuh settlements in Padawan, the vegetation in the surrounding area is composed of primary forest, secondary forest, mixed dipterocarp forest, and agroforestry.

3.3.3 Bau District of Kuching Division

Bau was once a gold mining town. About 34 kilometres from the Kuching capital, can easily access Bau town from Kuching city. Bau covers an area of 884.4 km^2 and shares a mutual boundary with Kalimantan, Indonesia. Like the Bidayuh settlements in Padawan and Siburan, the Bidayuh villages in Bau are also surrounded by their community forests.

This community forest consists of Primary forest, Secondary forest, Mixed dipterocarp forest, Kerangas forest, Limestone forest, and Agroforestry.

3.4 Data Collection and Study Instrument

3.4.1 Questionnaire

The study was conducted by using a structured questionnaire with several sections comprising demographic details of the respondents (above 35-year-old as they were assumed to know how to utilise food and medicinal plants), the introduction of the medicinal and food plants, such as how many times the plants are being collected in a month or year, purpose to collect food and medicinal plants and period for them if indulged in selling the plants at the market. The latter section is further divided into 2, medicinal and food plants. For medicinal plants, the local name of the plants, parts of the plants used to treat illnesses, types of diseases treated, method of preparations, application, dosages, selling status, cultivation status, the estimated quantity of collection and selling price of the medicinal plants as the traditional medicine were recorded. The food plants section, including the local name, part used, processing status, method of preparation, selling status, cultivation status, estimated quantity of collection, and selling price, were documented in the questionnaire. The study was conducted from April 2019 until the end of 2021.

3.4.2 In-Depth Interview

The study was conducted by using a mixture of structured questionnaires and interviews that included a pre-determined set of questions with the adult villagers, local healers, and herbalists during each visit using the method of ethnobotanical inquiry, observation, and participation either at the respondent's home or nearby community markets which was done around evening from 7 pm to 9 pm as most of the villagers are working in

their farm almost every day from early morning to 6 pm. However, the interviews were sometimes done in the afternoon during the weekend by making an appointment with the villagers at the designated time as shown in Figure 3.3. For interviews at the community markets were usually completed during the weekends, as most community markets are only available during that period.

Figure 3.3: Interviews with the local community during the weekend

3.4.3 Sample Population

A household survey was conducted at 23 villages in Padawan, Siburan, and Bau, with 3223 households. Fifteen villages were chosen to represent the Bidayuh community in the Padawan sub-district (Kuching division) and Siburan district (Serian division). The Bidayuh in the Siburan district were chosen to see whether they still utilise wild food and medicinal plants despite living near the town area. Meanwhile, the remaining eight villages are to study the Bidayuh in Bau. Tables 3.1, 3.2, and 3.3 show the number of households according to the chosen Bidayuh villages in Padawan, Siburan, and Bau, respectively.

Table 3.1: The number of households for eight chosen villages in Padawan sub-district, Kuching division

Village name	Number of households	Number of respondents
Kampung Assum	32	6
Kampung Annah Sadir	86	10
Kampung Simuti	54	6
Kampung Sibakar	45	6
Kampung Sigandar	30	5
Kampung Payang	80	7
Kampung Simpok	660	9
Kampung Serumah	85	9
Total	1072	58

Table 3.2: The number of households for seven chosen villages in Siburan district, Serian division

Village name	Number of households	Number of respondents
Kampung Krian	88	8
Kampung Pesang	66	8
Kampung Begu	80	8
Kampung Peraya	110	10
Kampung Stabut	93	9
Kampung Chupak	60	6
Kampung Skuduk	94	9
Total	591	58

Table 3.3: The number of households for eight chosen villages in Bau district, Kuching Division

Village name	Number of households	Number of respondents
Kampung Stass	298	20
Kampung Duyoh	208	15
Kampung Serasot	188	23
Kampung Gumbang	100	12
Kampung Tringgus	250	7
Kampung Stenggang	306	13
Kampung Skio	75	7
Kampung Podam	135	13
Total	1560	110

3.4.4 Sample size, Sample distribution, and Allocations

To obtain a sufficient population sample size for this study, it was assumed the population homogeneity with similar background and experience was 85 percent. At a 95 percent confidence level and with a margin of error of 5 percent, hence the sample size was determined:

Initial sample estimate, n:

$$n = \frac{Z^2 \times p\,(1-p)}{c^2} \qquad \text{Equation 3.1}$$

$$= \frac{(\pm 1.96)^{\,2} \times (0.85)(1-0.85)}{(0.05)^2}$$

$$= 195$$

where,

Z = Z value (±1.96 for 95 percent confidence level)

p = percentage of estimated population homogeneity

c = margin of error

By using the above formula, n was shown to be 195.

Hence the final sample size, n_1, was:

$$n_1 = \frac{N \times n}{N + n} \qquad \text{Equation 3.2}$$

$$n_1 = \frac{3223 \times 195}{3223 + 195}$$

$$= 184$$

The 184 households were allocated between the sample villages of the Bidayuh community in the study sites based on their sufficient population size.

** When present later, homogeneity can be 90%

**Field data collection has collected 226 respondents

3.4.5 Data Analysis

Data obtained from the questionnaire surveys and interviews were recorded in a field notebook and on the questionnaire sheets. The data was sorted and posted into an Excel statistics sheet and further processed using the Statistical Program for Social Science (SPSS) version 22.0 by considering the study's objectives.

3.4.6 Valuation on Medicinal and Food Plant

For estimating the use-value of both medicinal and food plants, three methods were used. These three methods are shown as follows:

a. Direct Market Value

Throughout the study, market visits were made in local markets in Padawan sub-district, Siburan, and Bau districts. Interviews were conducted with people selling medicinal and food plants from the forests. For example, the price of wild vegetables in the market is RM2 per bundle. The price is stated in the direct value given by the seller.

b. Replacement cost

The method was us to estimate the value of the utilization of medicinal or food plants that do not have direct market value. The price of the wild medicinal plant used to treat stomachache is the same as the cost of medicine for stomachache that is bought from the clinic or pharmacy. Meanwhile, the price of wild food plants was replaced by the number of cash that could be saved by not buying domesticated food crops in the market and used the

costs of marketed food plants to estimate the value of wild food plants with similar characteristics.

c. Opportunity cost

For this method, the monetary value of time was estimated by taking notes during the time spent gathering wild food and medicinal plants within the forest and used the local wage rate paid to agricultural laborers for an 8-hours working day.

CHAPTER 4

RESULTS AND DISCUSSION

4.1 General Introduction

The results of the findings from the questionnaire interview are presented in this chapter. Further details on the discussion of identification and documentation of both medicinal and food plants used by the Bidayuh in Padawan sub-district (Kuching division), Siburan district (Serian division), and Bau district (Kuching division). Also covered in this section the respondents' socio-demographic characteristics and the total annual value of use for both medicinal and food plants.

4.1.1 Identification and Documentation of Medicinal and Food Plant

This study recorded 43 wild plant species belonging to 31 families with medicinal use and 74 wild food plant species belonging to 43 families used by the locals in the Padawan sub-district, Siburan district, and Bau district. Wild plants are defined as plants that grow in a natural habitat, such as forests or cultivated plants that grow unattended by humans. Table 4.1 and Table 4.2 shows the recorded medicinal and food plant species used respectively among the Bidayuh in Padawan, Siburan, and Bau communities. Meanwhile, Table 4.3 and Table 4.4 show the medicinal and food plants used by the Bidayuh community in Padawan, Siburan, and Bau.

Table 4.1: Medicinal plants used by the Bidayuh community in Padawan sub-district, Siburan and Bau district

No	Family	Botanical name	Local name (Bidayuh)		
			District/ Sub-district		
			Padawan	Siburan	Bau
1.	Acanthaceae	*Andrographis paniculata* (Burm.f.) Nees	Peden	Peden	Pudun tana
		Clinacanthus nutans (Burm. f.) Lindau	Belalai gajah	Belalai gajah	Belalai gajah
2.	Achariaceae	*Pangium edule Reinw.*	Peyang	Peyang	Poyang
3.	Annonaceae	*Goniothalamus velutinus* Airy Shaw	Marik	Namai	Kinamai
		Polyalthia lapadantha Diels	Nahai	Nahai	Senaie
4.	Apiaceae	*Centella asiatica* (L.) Urb.	Pigaga	Pigaga	Pigaga
5.	Apocynaceae	*Willughbeia* sp.	Generit	***	***
		Hoya sp.	Dewūn kapal	Dewūn kapal	Dowont kapal
6.	Araceae	*Homalomena propinqua* Schott.	Tingon adud	***	Tingon adud
7.	Arecaceae	*Plectocomiopsis geminiflora* (Griff.) Becc.	Mua’	Mua’	Mua’
8.	Asteraceae	*Blumea balsamifera* (L.) DC.	Sosoh	Sosoh	Sisuoh
9.	Blechnaceae	*Blechnum orientale* L.	Pakuh reyan/Kerayan	Pakuh reyan/Kerayan	Sonuh
10.	Clusiaceae	*Garcinia mangostana* L.	Sikuk	Sikuk	Sikuk

Table 4.1 continued

No	Family	Botanical name	Local name (Bidayuh)		
			District/ Sub-district		
			Padawan	Siburan	Bau
11.	Davalliaceae	*Nephrolepis biserrata* (Sw.) Schott	Pakuh dengat/busik	Pakuh	Pokuh kubuh
12.	Dilleniaceae	*Dillenia suffruticosa* (Griff.) Martelli	Buan	Buan	Buan
13.	Euphorbiaceae	*Pterococcus corniculatus* Pax and K.Hoffm	Gatung	Gatung	Gratung
14.	Fabaceae	*Cassia alata* L.	Suluok	Suluok	Suruok
		Parkia speciosa Hassk.	Putah	Putah	Potah
		Peltophorum inerme Naves *ex* Backer	Mariputi	***	***
15.	Lamiaceae	*Clerodendrum villosum* Blume	Pitian	Pitian	Pitien
		Orthosiphon aristatus (Blume) Miq.	Misai kucing	Misai kucing	Misai kucing
16.	Melastomataceae	*Melastoma malabathricum* L.	Resak	Resak	Rusak
17.	Meliaceae	*Lansium domesticum* Corrêa	Riset	Riset	Lasot
18.	Menispermaceae	*Pcynarrhena tumefacta* Miers ex J.D. Hooker & Thomson	Peroh	Peroh	Sisong
19.	Musaceae	*Musa* sp.	Keri/Giang	***	***

Table 4.1 continued

No	Family	Botanical name	Local name (Bidayuh)		
			District/ Sub-district		
			Padawan	Siburan	Bau
20.	Phyllanthaceae	*Phyllanthus urinaria* var. hookeri (Müll.Arg.) Hook. f	Dukung anak	***	***
		Baccaurea sp.	Pakung	***	***
21.	Piperaceae	*Piper betle* L.	Baid	Baid	Boid
		Piper porphyrophyllum N.E.Br.	Papar daiya	***	Popar doya'
22.	Poaceae	*Imperata cylindrica* (L.) Raeusch.	Pedang	***	***
23.	Polygalaceae	*Xanthophyllum amoenum* Chodat	Menyerin	Menyerin	Bijolin
24.	Primulaceae	*Labisia pumila* (Blume) Benth. ex Hook. *f.*	Kacip fatima	Kacip fatima	Kacip fatima
25.	Rubiaceae	*Trigonopleura malayana*	Gamber	Gamber	Gamber
26.	Selaginellaceae	*Selaginella* sp.	Mirigu	Mirigu	Sangirigu
27.	Simaroubaceae	*Eurycoma longifolia* Jack	Tongkat ali	Tongkat ali	Tongkat ali
28.	Smilacaceae	*Smilax blumei*	***	***	Beit tibug
		Smilax myosotiflora A.DC.	Makso/Maso	Makso/Maso	***
		Smilax sp.	Keram	***	***

Table 4.1 continued

No	Family	Botanical name	Local name (Bidayuh)		
			District/ Sub-district		
			Padawan	Siburan	Bau
		Smilax odoratissima Blume	Prongang	***	Prongang
29.	Solanaceae	*Physalis minima* L.	***	***	Latuok
30.	Verbenaceae	*Vitex* sp.	ngiwat	***	ngiliwat
31.	Zingiberaceae	*Etlingera elatior* (Jack) R.M.Sm.	Keroh	Keroh	Sikoroh
		Boesenbergia stenophylla R.M.Sm.	Jerangau	Jerangau	Gerangau

*** - There is no available plant name for that particular district/sub-district

Table 4.2: Wild food plants used by the Bidayuh community in Padawan sub-district, Siburan and Bau district

No	Family	Botanical name	Local name (Bidayuh)		
			District/ Sub-district		
			Padawan	Siburan	Bau
1.	Apiaceae	*Eryngium foetidum* L.	***	***	Sipongu
		Centella asiatica (L.) Urb.	Pigaga	Pigaga	Pigaga
2.	Apocynaceae	*Hoya* sp.	Taang	Taang	Kala’
3	Alangiaceae	*Alangium javanicum var. ebenaceum* (C.B.Clarke) Berhaman	***	***	Moran
4.	Alismataceae	*Limnocharis flava* (L.) Buchenau	Samsir	Samsir	Paluh
5.	Anacardiaceae	*Mangifera foetida* Lour.	***	***	Masang
		Mangifera pajang Kosterm.	Bowang	***	Bowang
		Mangifera quadrifida Jack	***	***	Ramuk
		Pentaspadon motleyi Hook.f.	***	***	Proju
6.	Arecaceae	*Calamus* sp.	Asam belayan	Asam belayan	Gerayan
		Eleiodoxa conferta (Griff.) Burret	***	***	Buun
		Oncosperma tigillarium (Jack.) Ridl.	Umbung nibung	Umbung nibung	Umbung nibung

Table 4.2 continued

No	Family	Botanical name	Local name (Bidayuh)		
			District/ Sub-district		
			Padawan	Siburan	Bau
	Arecaceae	*Plectocomiopsis geminiflora* (Griff.) Becc.	Mua’	Mua’	Mua’
		Salacca affinis Griff.	***	***	Trisum
		Salacca zalacca (Gaertn.) Voss	Salak	Salak	***
7.	Athyriaceae	*Diplazium esculentum* (Retz.) Sw.	Pakuh	Pakuh	Pokuh
8.	Auriculariaceae	*Auricularia auricula-judae* (Fr.) Quel.	Kulat kabir	Kulat kabir	Kulat kabir
9.	Begoniaceae	*Begonia chlorosticia* Sands	Dewūn kuru	Dewūn kuru	Dowon kuru
10.	Blechnaceae	*Stenochlaena palustris* (Burm.f.) Bedd.	Tikas	Tikas	Tiokas
11.	Bombacaceae	*Durio* zibenthinus	Dian	Dian	Dien
12.	Burseraceae	*Canarium odontophyllum* Miq.	Dabai	Dabai	Dabai
		Dacryodes rostrata (Blume) H.J.Lam	Kemayau	Kemayau	Kemayau
13.	Clusiaceae	*Garcinia mangostana* L.	Sikuk	Sikuk	Sikuk

Table 4.2 continued

No	Family	Botanical name	Local name (Bidayuh)		
			District/ Sub-district		
			Padawan	Siburan	Bau
	Clusiaceae	*Garcinia nitida* Pierre	***	Kandis	Konis
		Garcinia parvifolia Miq.	***	***	Toruk
14.	Compositae	*Cosmos caudatus* Kunth	Ulam raja	Ulam raja	Santek manis
		Schizophyllum commune Fr.	Kulat korang	Kulat korang	Kulat sikorang
15.	Dilleniaceae	*Dillenia suffruticosa* (Griff.) Martelli	Buwan	Buwan	Buan
16.	Dipterocarpaceae	*Shorea macrophylla* (de Vr.) Ashton	Satong	Satong	Kabang
17.	Elaeocarpaceae	*Elaeocarpus sphaeroblastus* Stapf ex Ridl.	Tamang	Tamang	Tamang
18.	Euphorbiaceae	*Elateriospermum tapos* Blume	Repi	***	Ropi
		Ostodes pauciflora Merr.	Breti	Breti	Broti
		Plukenetia corniculata Sm.	Gatung	Gatung	Gratung
19.	Fabaceae	*Archidendron jiringa* (Jack) I.C.Nielsen	Jering	Jering	Joring

Table 4.2 continued

No	Family	Botanical name	Local name (Bidayuh)		
			District/ Sub-district		
			Padawan	Siburan	Bau
		Parkia speciosa Hassk.	Putah	Putah	Potah
20.	Fagaceae	*Castanopsis motleyana* King	***	***	Bongan
21.	Flacourtiaceae	*Pangium edule* Reinw.	Peyang	Peyang	Poyang
22.	Gnetaceae	*Gnetum gnemon* L.	Dedah	Dedah	Dodah
23.	Hygrophoraceae	*Hygrocybe punicea* (Fr.Fr.) Kummer	Kulat stipu’	Kulat stipu’	Kulat tipu’
24.	Lauraceae	*Litsea garciae* S.Vidal	Taang	Taang	Kala’
25.	Lycoperdaceae	*Calostoma* sp.	Kulat boton planuk	***	***
26.	Lyophyllaceae	*Termitomyces striatus* (Beeli). R. Heim	Kulat simuan	Kulat simuan	Kulat dudu
27.	Melastomataceae	*Melastoma malabathricum* L.	Resak	Resak	Rusak
28.	Meliaceae	*Lansium domesticum* Corrêa	Riset	Riset	Lasot
29.	Menispermaceae	*Pycnarrhena tumefacta* Miers	Peroh	Peroh	Sisong
30.	Moraceae	*Artocarpus elasticus* Reinw. ex Blume	Bayuh	***	Boyuh
		Artocarpus kemando Miq.	***	***	Puduh

Table 4.2 continued

No	Family	Botanical name	Local name (Bidayuh)		
			District/ Sub-district		
			Padawan	Siburan	Bau
	Moraceae	*Artocarpus heterophyllus* Lam.	Naka	Naka	Naka
		Artocarpus integer (Thunb.) Merr.	Cempedak	Cempedak	Tibodak
		Artocarpus nitidus. Borneensis (Merr.) F.M.Jarrett	***	***	Koron
		Artocarpus odoratissimus Blanco	Terap	Terap	Prutan
		Ficus grossularioides Burm. f.	***	***	Lokan
31.	Myrtaceae	*Syzygium polyanthum* (Wight) Walp.	***	***	Bungkang
32.	Nephrolepidaceae	*Nephrolepis biserrata* (Sw.) Schott	Pakuh dengat/busik	Pakuh	Pokuh kubuh
33.	Phyllanthaceae	*Baccaurea costulata* (Miq.) Mull.Arg.	Tijirak	Tijirak	Pijirak
		Baccaurea motleyana (Müll.Arg.) Müll.Arg.	Rame	Rame	Rame
		Baccaurea angulata Merr.	Grumbing	Grumbing	Grumbing
		Baccaurea bracteata Mull.	Tapui	Tapui	Topui

Table 4.2 continued

No	Family	Botanical name	Local name (Bidayuh)		
			District/ Sub-district		
			Padawan	Siburan	Bau
	Phyllanthaceae	*Baccaurea macrocarpa Muell*	***	***	Bitongon
34.	Poaceae	*Dendrocalamus asper*	Umbung patung	Umbung patung	Umbung patung
		Gigantochloa levis (Blanco) Merr	Umbung tering	Umbung tering	Umbung toring
35.	Polygonaceae	*Polygonum minus* Huds.	Kesum	***	***
36.	Polyporaceae	*Lestinus strigosus (Schw.) Fr.*	***	***	Kulat sibuluh
37.	Putranjivaceae	*Drypetes* sp.	Sabi	Sabi	Ngisabi
38.	Sapindaceae	*Dimocarpus longan* Lour.	Longan	Longan	Longan
		Nephelium cuspidatum Blume	***	***	Porot
		Nephelium lappaceum L.	Rimutan	Rimutan	Rimutan

Table 4.2 continued

No	Family	Botanical name	Local name (Bidayuh)		
			District/ Sub-district		
			Padawan	Siburan	Bau
	Sapindaceae	*Pometia pinnata* J.R. Forst. & G. Forst.	Kristal	Kristal	Kristal
39.	Smilacaceae	*Smilax odoratissima* Blume	***	***	Pronggang
40.	Solanaceae	*Solanum lasiocarpum* Dunal	Tiung asuom	Tiung asuom	Tiung asuom
		Solanum torvum Sw.	Tiung pipit	Tiung pipit	Tiung pipit
41.	Tricholomataceae	*Clitocybe fragrans* (With.) P. Kumm.	***	***	Kulat toin siyuok
42.	Zingiberaceae	*Etlingera coccinea* (Blume) S.Sakai & Nagam.	Tepus	Tepus	Tipu’
		Etlingera elatior (Jack) R.M.Sm.	Keroh	Keroh	Sikoroh

*** - There is no available plant name for that particular district/sub-district

Table 4.3: Medicinal plants usage by the Bidayuh community in Padawan, Siburan, and Bau

No	Local name	Genus	Species	Part used	Uses	Preparations
1.	Baid (Pa/Si), Boid (Ba)	*Piper*	*betle*	Leaf	For stomach-ache, flatulence toothache, fever	1.Crushed leaves and mix with oil, massage stomach to reduce the discomfort. 2.To treat fever. Boil leaves and used the warm solution for bathing. Chewed leaves to treat toothache
2.	Beit tibug (Ba)	*Smilax*	*blumei*	Leaf	To treat blood cloth	The boiled solution of the leaves to make tea and drink it to treat blood cloth.
3.	Belalai gajah (Pa/Si/Ba)	*Clinacanthus*	*nutans*	Leaf	For hypertension	Drink decoction to treat hypertension.
4.	Buan (Pa/Si/Ba)	*Dillenia*	*suffruticosa*	Young shoot	To treat the wound and stop bleeding	Young shoot is chewed, then the paste is used externally to treat the wound and stop bleeding.
5.	Dewun kapal (Pa/Si), Dowon kapal (Ba)	*Hoya*	sp.	Leaf	For hypertension	Eaten as *ulam.*
6.	Dukung anak (Pa)	*Phyllanthus*	*urinaria*	Whole plant	For headache	The entire plant is warm over a fire and used to mitigate headaches.
7.	Gamber	*Trigonopleura*	*malayana*	Leaf	To alleviate muscle ache, sprain	Used poultice to relieve muscle pain and injury.
8.	Gatung (Pa/Si), Gratung (Ba)	*Pterococcus*	*corniculatus*	Young leaf	For hypertension	Cooked and eaten as a vegetable dish.
9.	Generit	*Willughbeia*	sp.	Leaf	To treat skin disease, wound	Massage the leaves on the affected skin.
10.	Giang/Keri (Pa)	*Musa*	sp.	Pseudo-stem	To stop bleeding	Apply sap on the wound to stop bleeding.

Table 4.3 continued

No	Local name	Genus	Species	Part used	Uses	Preparations
11.	Jerangau (Pa/Si), Gerangau (Ba)	*Boesenbergia*	*stenophylla*	Rhizome	Antidote for poison, to prevent drunkenness	1.Boil the rhizome and drink decoction as an antidote for poison. 2.Boil the rhizome and drink decoction before consuming alcohol.
12.	Kacip fatima(Pa/Si/Ba)	*Labisia*	*pumila*	Leaf	For mother after childbirth care	Dried leaves are pounded and apply to the stomach of the mother.
13.	Keram (Pa)	*Smilax*	sp.	Root	For fever	A boiled solution of the leaves with *Blume balsamifera* to mitigate fever.
14.	Keroh (Pa/Si), Sikoroh (Ba)	*Etlingera*	*elatior*	Leaf	To treat skin disease	Boiled leaves as used the warm solution for bathing.
15.	Latuok (Ba)	*Physalis*	*minima*	Leaf	For toothache	The boiled solution of the leave is used to rinse the mouth to heal a toothache.
16.	Makso/Maso (Pa/Si)	*Smilax*	*myosotiflora*	Leaf	For fever	Boiled solution of the leaves of *Blume balsamifera* and *Imperata cylindrica* to mitigate the heat.
17.	Marik(Pa), Namai (Si), Kinamai (Ba)	*Goniothalamus*	*velutinus*	Bark	Mosquito repellent, keep away evil spirits	The bark is burnt as a mosquito repellent and to keep away evil spirits.
18.	Mariputi (Pa)	*Peltophorum*	*inerme*	Leaf	To treat wound	Pounded leaves are applied to the injury.
19.	Menyerin (Pa/Si/Ba)	*Xanthophyllum*	*amoenum*	Fruit	Used as shampoo	Dried fruit walls are used as a shampoo.
20.	Mirigu (Pa/Si), Sangirigu (Ba)	*Selaginella*	sp.	Whole plant	For wound and skin disease	1.The whole is used to cover the wound. 2.Massage the whole plant on the affected skin.

Table 4.3 continued

No	Local name	Genus	Species	Part used	Uses	Preparations
21.	Misai kucing (Pa/Si/Ba)	*Orthosiphon*	*aristatus*	Leaf	For hypertension, diabetes	Drink decoction to treat hypertension and diabetes.
22.	Mua (Pa/Si/Ba)	*Plectocomiopsis*	*geminiflora*	Leaf	For hypertension	Cooked and eaten as a vegetable dish.
23.	Nahai (Pa/Si), Senaie (Ba)	*Polyalthia*	*lapadantha*	Leaf	To treat sore eye	Saps from the pounded leaves are applied to treat the sore eye.
24.	Ngiwat (Pa), Ngiliwat (Ba)	*Vitex*	sp.	Leaf	Post childbirth care for mother, to treat a wound	1.Leaves are wrapped around the mother's stomach after childbirth. 2.Apply crushed leaves on the wound. The leaves must be taken using the mouth.
25.	Pakuh dengat/busik (Pa)/ Pakuh (Si)/ Pokuh kubuh (Ba)	*Nephrolepis*	*biserrata*	Frond	To enhance the production of mother's milk after childbirth.	Cooked and eaten as a vegetable dish.
26.	Pakuh reyan/ Kerayan (Pa/Si), Sonuh (Ba)	*Blechnum*	*orientale*	Frond	To treat burn, skin disease, e.g. boil	Apply sap on the affected skin.
27.	Pakung (Pa)	*Baccaurea*	sp.	Leaf	To treat wound	Apply pounded leaves on the affected skin.
28.	Papar daiya (Pa), Popar doya' (Ba)	*Piper*	*porphyrophyllum*	Leaf	For stomach-ache, to treat blood cloth	1.The leave is warm over the fire and applies poultice on the stomach to ease stomachache. 2.Used pounded leaves and massage on the affected body part.

Table 4.3 continued

No	Local name	Genus	Species	Part used	Uses	Preparations
29	Pedang (Pa)	*Imperata*	*cylindrica*	Whole plant	For fever	Boiled solution of the leaves of *Blume balsamifera* and *Smilax myosotiflora* to mitigate the heat.
30.	Peden (Pa/Si), Pudun tana' (Ba)	*Andrographis*	*paniculata*	Leaf	For hypertension, skin disease	1.Drink decoction of the leaves for hypertension 2.Boiled solution of the leaves to treat affected skin.
31.	Peroh (Pa/Si), Sisong (Ba)	*Pycnarrhena*	*tumefacta*	Leaf	To mitigate fever	Cooked and eaten as a vegetable dish.
32.	Peyang (Pa/Si), Poyang (Ba)	*Pangium*	*edule*	Fruit	To treat head lice, itchiness	1.Burnt fruit walls and wrap the head for an hour. 2.Grated fruits wall mix with a little bit of water is used to treat hives.
33.	Pigaga (Pa/Si/Ba)	*Centella*	*asiatica*	Leaf	For hypertension	Eaten as *ulam*
34.	Pitian (Pa/Si), Pitien (Ba)	*Clerodendrum*	*villosum*	Leaf	To treat skin disease, new-born jaundice, fever	A boiled solution of the leaves to treat affected skin or to mitigate fever/newborn jaundice.
35.	Pronggang (Pa/Ba)	*Smilax*	*odoratissima*	Root	To treat wound	Apply pounded leaves on the wound.
36.	Putah (Pa/Si), Potah (Ba)	*Parkia*	*speciosa*	Fruit	For diabetes	Eaten as *ulam.*

Table 4.3 continued

No	Local name	Genus	Species	Part used	Uses	Preparations
37.	Resak (Pa/Si), Rusak (Ba)	*Melastoma*	*malabathricum*	Leaf, Fruit	For diarrhea, toothache, stop bleeding, oral thrush in baby	1. To mitigate diarrhea, boil some leaves to make tea. 2. Chewed leaves to treat toothache. 3. Chewed young leaves and apply the 4. paste to the wound to stop bleeding. To treat thrush. Crushed ripe fruits and apply paste inside the baby's mouth.
38.	Riset (Pa/Si), Lasot (Ba)	*Lansium*	*domesticum*	Bark	For fever, skin disease, diarrhea	1. A boiled solution of the bark is either drink or used for bathing to alleviate fever and skin disease. 2. Drink as a tea to treat diarrhea.
39.	Sikuk (Pa/Si/Ba)	*Garcinia*	*mangostana*	Fruit	To treat skin disease	Boil leaves with *Blumea balsamifera* and bark of *Lansium domesticum* and used the warm solution for bathing.
40.	Solok (Pa/Si), Suruok (Ba)	*Cassia*	*alata*	Young shoot, Leaf	To treat skin disease, fever	1.Apply sap on the affected skin 2.To treat fever. Boil leaves and used the warm solution for bathing.
41.	Sosoh (Pa/Si), Sisuoh (Ba)	*Blumea*	*balsamifera*	Whole plant	Used by mother after childbirth	The entire plant is dried for a few days under the sun. Boil the plant in a big pot and use the warm solution for bathing.
42.	Tingon adud (Pa/Ba)	*Homalomena*	*propinqua*	Leaf	For stomach ache	The leaves are warm over the fire; a poultice is used to alleviate stomach aches.

Table 4.3 continued

No	Local name	Genus	Species	Part used	Uses	Preparations
43.	Tongkat ali (Pa/Si/Ba)	*Eurycoma*	*longifolia*	Root	For hypertension	Drink as a tea for hypertension

Pa: Padawan, Si: Siburan, Ba: Ba

Table 4.4: Used of wild plants food usage by the Bidayuh community in Padawan, Siburan, and Bau

No	Local name	Genus	Species	Part used	Uses	Preparations
1.	Asam belayan (Pa/Si), Gerayan (Ba)	*Calamus*	sp.	Fruit	Condiment	Often used in cooking to enhance flavour.
2.	Bayuh (Pa), Boyuh (Ba)	*Artocarpus*	*elasticus*	Fruit	Directly consumed	Ripe fruit can be consumed directly.
3.	Bitongon (Ba)	*Baccaurea*	*macrocarpa*	Fruit	Consumed directly	Ripe fruit can be consumed directly.
4.	Bongan	*Castanopsis*	*motleyana*	Seed	Consumed directly	The nuts can either be consumed directly or boiled.
5.	Bowang (Pa/Ba)	*Mangifera*	*pajang*	Fruit	Directly consumed	Ripe fruit can be consumed directly.
6.	Breti (Pa/Si), Broti (Ba)	*Ostodes*	*pauciflora*	Seed	Consumed directly	The seeds are boiled before it can consume.
7.	Bungkang (Ba)	*Syzygium*	*polyanthum*	Leaf	Condiment	It was mixed in cooking to enhance flavour, especially in cooking *pansuh*.
8.	Buun (Ba)	*Eleiodoxa*	*conferta*	Fruit	Consumed as *ulam*	Ripe fruit are consumed as *ulam.*
9.	Buwan (Pa/Si), Buan (Ba)	*Dillenia*	*suffruticosa*	Young leaf	Consumed as *ulam* or cooked as a vegetable dish	It is often consumed as *ulam* or by cooking as a vegetable dish.

Table 4.4 continued

No	Local name	Genus	Species	Part used	Uses	Preparations
10.	Cempedak (Pa/Si) Tibodak (Ba)	*Artocarpus*	*integer*	Fruit	Consumed directly	Ripe fruit can be consumed directly.
11.	Dabai (Pa/Si/Ba)	*Canarium*	*odontophyllum*	Fruit	Directly consumed	Ripe fruit can be consumed directly by soaking it in warm water for a few minutes.
12.	Dedah (Pa/Si), Dodah (Ba)	*Gnetum*	*gnemon*	Leaf	Cooked as a vegetable dish	Consumed by cooking it as a vegetable dish.
13.	Dewun kuru (Pa/Si), Dowon kuru (Ba)`	*Begonia*	*chlorosticia*	Leaf	Condiment	Often used in cooking to enhance flavour.
14.	Dian (Pa/Si), Dien (Ba)	*Durio*	zibenthinus	Fruit	Directly consumed	Ripe fruit can be consumed directly.
15.	Dowon kapal	*Hoya*	sp.	Leaf	Consumed as *ulam* or cooked as a vegetable dish	They are often consumed as *ulam* or by cooking as a vegetable dish.
16.	Gatung (Pa/Si/Ba)	*Pterococcus*	*corniculatus*	Leaf	Cooked as vegetable dish	Often consumed by cooking it as a vegetable dish.
17.	Grumbing (Pa/Si/Ba)	*Baccaurea*	*angulata*	Fruit	Directly consumed	Ripe fruit can be consumed directly.
18.	Jering (Pa/Si), Joring (Ba)	*Archidendron*	*jiringa*	Seed	Consumed directly, cooked as a vegetable dish	The nuts can be eaten as *ulam* or cooked as a vegetable dish.

Table 4.4 continued

No	Local name	Genus	Species	Part used	Uses	Preparations
19.	Kemayau (Pa/Si/Ba)	*Dacryodes*	*rostrata*	Fruit	Directly consumed, cooked as a dish	Ripe fruit can be consumed directly by soaking it in boiling water or cooked as a dish.
20.	Keroh (Pa/Si), Sikoroh (Ba)	*Etlingera*	*elatior*	Flower	Cooked as a vegetable dish, condiment	Cooked as a vegetable dish or mixed to add flavour in cooking.
21.	Kesum (Pa)	*Polygonum*	*minus*	Leaf	Condiment	Usually used in cooking to enhance flavour.
22.	Kristal (Pa/Si/Ba)	*Pometia*	*pinnata*	Fruit	Directly consumed	Ripe fruit can be consumed directly.
23.	Konis (Ba)	*Garcinia*	*nitida*	Fruit	Condiment	Usually used in cooking to enhance flavour.
24.	Koron (Ba)	*Artocarpus*	*nitidus*	Fruit	Directly consumed	Ripe fruit can be consumed directly.
25.	Kulat boton planuk (Pa)	*Calostoma*	sp.	Fungi	Cooked as a vegetable dish	The fungi can be consumed by cooking it as a vegetable dish.
26.	Kulat Kabir (Pa/Si/Ba)	*Auricularia*	*auricula-judae*	Fungi	Cooked as a vegetable dish	The fungi can be consumed by cooking it as a vegetable dish.
27.	Kulat korang (Pa/Si), Kulat sikorang (Ba)	*Schizophyllum*	*commune*	Fungi	Cooked as a vegetable dish	The fungi can be consumed by cooking it as a vegetable dish.
28.	Kulat Sibuluh (Ba)	*Lestinus*	*strigosus*	Fungi	Cooked as a vegetable dish	The fungi can be consumed by cooking it as a vegetable dish.

Table 4.4 continued

No	Local name	Genus	Species	Part used	Uses	Preparations
29.	Kulat simuan (Pa/Si), Kulat dudu (Ba)	*Termitomyces*	*striatus*	Fungi	Cooked as a vegetable dish	The fungi can be consumed by cooking it as a vegetable dish.
30.	Kulat stipu (Pa/Si), Kulat Tipu' (Ba)	*Hygrocybe*	*punicea*	Fungi	Cooked as a vegetable dish	It can be consumed by cooking it as a vegetable dish.
31.	Kulat toin siyuok	*Clitocybe*	*fragrans*	Fungi	Cooked as a vegetable dish	The fungi can be consumed by cooking it as a vegetable dish.
32.	Lokan (Ba)	*Ficus*	*grossularioides*	Fruit	Directly consumed	Ripe fruit can be consumed directly.
33.	Longan (Pa/Si/Ba)	*Dimocarpus*	*longan*	Fruit	Directly consumed	Ripe fruit can be consumed directly.
34.	Masang (Ba)	*Mangifera*	*foetida*	Fruit	Directly consumed	Ripe fruit can be consumed directly.
35.	Moran	*Alangium*	*javanicum*	Fruit	Directly consumed	Ripe fruit can be consumed directly.
36.	Mua' (Pa/Si/Ba)	*Plectocomiopsis*	*geminiflora*	Inner shoot	Cooked as a vegetable dish	Consumed by cooking it as a vegetable dish.
37.	Naka	*Artocarpus*	*heterophyllus*	Fruit	Directly consumed	Ripe fruit can be consumed directly.
38.	Pakuh (Pa/Si), Pokuh (Ba)	*Diplazium*	*esculentum*	Frond	Cooked as a vegetable dish	The fronds are usually consumed by cooking it as a vegetable dish.

Table 4.4 continued

No	Local name	Genus	Species	Part used	Uses	Preparations
39.	Pakuh dengat/busik (Pa), Pakuh (Si), Pokuh (Ba)	*Nephrolepis*	*biserrata*	Frond	Cooked as vegetable dish	The fronds are usually consumed by cooking it as a vegetable dish.
40.	Peroh (Pa/Si), Sisong (Ba)	*Pycnarrhena*	*tumefacta*	Leaf	Condiment	Dry or fresh leaves are used as condiment.
41.	Peyang (Pa/Si), Poyang (Ba)	*Pangium*	*edule*	Fruit	Cooked as a vegetable dish	It is only safe to be consumed after boiling the seeds. Next, removed the seed coat and soaked the kernel overnight under running water or changed water several times. Then it can be cooked as a vegetable dish.
42.	Pigaga (Pa/Si/Ba)	*Centella*	*asiatica*	Leaf	Consumed as *ulam*	Often consumed as *ulam*.
43.	Porot (Ba)	*Nephelium*	*cuspidatum*	Fruit	Directly consumed	Ripe fruit can be consumed directly.
44.	Proju (Ba)	*Pentaspadon*	*motleyi*	Seed	Cooked as a vegetable dish	Often cooked with other vegetable dishes.
45.	Pronggang (Ba)	*Smilax*	*odoratissima*	Young shoot	Cooked as a vegetable dish	The shoots are usually cooked with other vegetable dishes.
46.	Puduh (Ba)	*Artocarpus*	*kemando*	Fruit	Directly consumed	Ripe fruit can be consumed directly.
47.	Putah (Pa/Si), Potah (Ba)	*Parkia*	*speciosa*	Seed	Consumed directly,	The nuts can be eaten as *ulam* or cooked as a vegetable dish.

Table 4.4 continued

No	Local name	Genus	Species	Part used	Uses	Preparations
					cooked as a vegetable dish	
48.	Rame (Pa/Si/Ba)	*Baccaurea*	*motleyana*	Fruit	Consumed directly	Ripe fruit can be consumed directly.
49.	Ramuk (Ba)	*Mangifera*	*quadrifida*	Fruit	Directly consumed	Green and ripe fruit can be consumed directly with *sambal belacan* or make pickle.
50.	Repi (Pa), Ropi (Ba)	*Elateriospermum*	*tapos*	Seed	Consumed as vegetable dish	The seed is only safe to be consumed after boiling it. Next, removed the seed coat and soaked the kernel overnight under running water or changed
51.	Resak (Pa/Si), Rusak (Ba)	*Melastoma*	*malabathricum*	Fruit	Directly consumed	Ripe fruit can be consumed directly.
52.	Rimutan (Pa/Si/Ba)	*Nephelium*	*lappaceum*	Fruit	Directly consumed	Ripe fruit can be consumed directly.
53.	Riset (Pa/Si), Lasot (Ba)	*Lansium*	*domesticum*	Fruit	Directly consumed	Ripe fruit can be consumed directly.
54.	Sabi (Pa/Si), Ngisabi (Ba)	*Drypetes*	sp.	Young leaf	Cooked as a vegetable dish	Prepare by cutting the leaves into small pieces and soaking them in boiling water. Then mixed it with rice and salt and stored it inside a bottle or container. The leaves can be cooked as a

Table 4.4 continued

No	Local name	Genus	Species	Part used	Uses	Preparations
						vegetable dish after a week of fermentation.
55.	Salak (Pa/Si)	*Salacca*	*zalacca*	Fruit	Directly consumed	Ripe fruit can be consumed directly.
56.	Samsir (Pa/Si), Paluh (Ba)	*Limnocharis*	*flava*	Stalk	Cooked as a vegetable dish	The stalks are usually consumed by cooking them as a vegetable dish.
57.	Satong (Pa/Si), Kabang (Ba)	*Shorea*	*macrophylla*	Seed	Produce oil for cooking or can be consumed directly	The extracted oil can be consumed by mixing it with rice or used in cooking.
58.	Sikuk (Pa/Si/Ba)	*Garcinia*	*mangostana*	Fruit	Directly consumed	Ripe fruit can be consumed directly.
59.	Sipongu (Ba)	*Eryngium*	*foetidum*	Leaf	Condiment	Usually used in cooking to enhance flavour.
60.	Taang (Pa/Si), Kala' (Ba)	*Litsea*	*garciae*	Fruit	Directly consumed	Ripe fruit can be consumed directly by soaking it in warm water for a few minutes.
61.	Tamang (Pa/Si/Ba)	*Elaeocarpus*	*sphaeroblastus*	Fruit	Directly consumed	Ripe fruit can be consumed directly.

Table 4.4 continued

No	Local name	Genus	Species	Part used	Uses	Preparations
62.	Tapui (Pa/Si), Topui (Ba)	*Baccaurea*	*bracteata*	Fruit	Consumed directly, Make *tuak*	Ripe fruit can be directly consumed. Juice from the fruit was extracted and mixed with *koong* to make *tuak*.
63.	Tepus (Pa/Si), Tipu' (Ba)	*Etlingera*	*coccinea*	Inner shoot	Condiment	It is mixed in cooking to enhance flavour, especially in cooking *pansuh*.
64.	Terap (Pa/Si), Prutan (Ba)	*Artocarpus*	*odoratissimus*	Fruit	Directly consumed	Ripe fruit can be consumed directly.
65.	Tijirak (Pa/Si), Pijirak (Ba)	*Baccaurea*	*costulata*	Fruit	Directly consumed	Ripe fruit can be consumed directly.
66.	Tikas (Pa/Si), Tiokas (Ba)	*Dendrocalamus*	*asper*	Frond	Cooked as a vegetable dish	The fronds are usually consumed by cooking it as a vegetable dish.
67.	Tiung asuom (Pa/Si/Ba)	*Solanum*	*lasiocarpum*	Fruit	Cooked as vegetable dish	Cooked as a vegetable dish or mixed to add flavour in cooking.
68.	Tiung pipit (Pa/Si/Ba)	*Solanum*	*torvum*	Fruit	Consumed as *ulam* or cooked as a vegetable dish	Consumed as *ulam* or cooked with other vegetable dishes.
69.	Toruk	*Garcinia*	*parvifolia*	Fruit	Condiment	Usually used in cooking to enhance flavour.
70.	Trisum (Ba)	*Salacca*	*affinis*	Fruit	Directly consumed	Ripe fruit can be consumed directly.

Table 4.4 continued

No	Local name	Genus	Species	Part used	Uses	Preparations
71.	Ulam raja (Pa/Si), Santek manis (Ba)	*Cosmos*	*caudatus*	Leaf	Consumed as *ulam* or cooked as vegetable dish	Often consumed as *ulam* or by cooking it as a vegetable dish.
72.	Umbung nibung (Pa/Si/Ba)	*Oncosperma*	*tigillarium*	Inner shoot	Cooked as a vegetable dish	Consumed by cooking it as a vegetable dish.
73.	Umbung patung (Pa/Si/Ba)	*Dendrocalamus*	*asper*	Young stem	Cooked as a vegetable dish	The young stem is often consumed by cooking it as a vegetable dish.
74.	Umbung tering (Pa/Si), Umbung toring (Ba)	*Gigantochloa*	*levis*	Inner shoot	Cooked as a vegetable dish	Consumed by cooking it as a vegetable dish.

Pa: Padawan, Si: Siburan, Ba: Bau

4.1.2 Socio-demographic Characteristics of the Respondents

4.1.2.1 Population Structures

For this study, the demographic information was about gender, age, family (household) size, family (household) monthly income, educational background, and primary occupation. A total of 226 respondents answered the questionnaires. The details of the socio-demographic of the respondents are shown in Table 4.5.

Table 4.5: Distribution of respondents according to socio-demographic variables

Socio-demographic variables	Characteristics	Number of respondents	Percentage (%)
Gender	Female	109	48.2
	Male	116	51.3
Age (years)	30-40	3	1.3
	41-50	32	14.2
	51-60	61	27.0
	61-70	93	41.2
	71-80	29	12.8
	80 and above	8	3.5
Family size	1-2	44	19.5
	3-4	49	21.7
	5-6	61	27.0
	7-8	43	19.0
	9-10	10	4.4
	10 and above	19	8.4
Monthly income (RM)	RM100-RM500	64	28.3
	RM501-RM1000	79	35.0
	RM1001-RM1500	15	6.6
	RM1501-RM2000	30	13.3
	RM2001-RM2500	2	0.9
	RM2501-RM3000	13	5.8
	RM3001-RM3500	2	0.9
	RM3501-RM4000	6	2.7
	RM4001-RM4500	0	0
	RM4501-RM5000	7	3.0
	RM5001 and above	8	3.5
Educational background	None (never go to school)	75	33.2
	Primary School	78	34.5
	Secondary School	66	29.2
	College	2	0.9
	University	3	1.3
	Others	2	0.9
Primary occupation	Housewife	39	17.3
	Farmer	129	57.1
	Business operator	10	4.4
	Government employee	17	7.5
	Non-government employee	8	3.5
	Retiree	23	10.2

a. Gender and Age of Respondents

The majority of the responders were male. Table 4.5 displays 109 (48.4%) female, and 116 (51.6%) are male. Most of the respondent's age was between 61 to 70 years old (41.2%).

b. Family Size (Household size)

Table 4.5 shows that the most common family size was 5 to 6 individuals, with 61% from all interviewed households. The second highest family size 3-4 individuals (49%). This is followed by 1-2 individuals (44%) and 7-8 individuals (43%). The least family size, 9-10 individuals, consists of 10% of the overall household.

c. Monthly Income

Based on Table 4.5, about 79 individuals (35.0%) of the respondents earned between RM501-RM1000 and 64 individuals (28.3%), making RM100 to RM500, respectively. Most of the respondents earn RM1000 or below. The third highest, 13.3% or 30 individuals, are making between RM1501 to RM2000.

d. Educational Background

Table 4.5 displays 78 individuals, or 34.5% of respondents, received their education up to primary school. The second highest, 73 individuals (33.2%), do not have their formal education. They are followed by 66 individuals (29.2%) who have attended school up to the secondary level.

e. Primary Occupation

The majority of the respondents are farmers, with 129 out of 226 respondents, or 57.1%, as shown in Table 4.5. They mostly stay in the villages. The least number are the respondents who work in the non-government sector, with eight individuals, or 3.5%.

4.1.2.2 Socio-demographic profile of respondents from the selected sub-districts/ districts of Padawan, Bau and Siburan.

Table 4.6: Socio-demographic profile of respondents from the three districts

Socio-demographic		Districts			Total (%)
		Padawan (%)	Bau (%)	Siburan (%)	
Age	30-45	1.7	8.2	5.2	5.8
	46-59	39.7	34.5	24.1	33.2
	60 and above	58.6	57.3	70.7	61.1
	Total	100	100	100	100
Gender	Male	65.5	47.3	46.6	51.8
	Female	34.5	52.7	53.4	48.2
	Total	100	100	100	100
Education level	No formal education	32.8	33.6	32.8	33.2
	Primary school	46.6	27.3	36.2	34.5
	Secondary school	20.7	33.6	29.3	29.2
	College	0.0	1.8	0.0	0.9
	University	0.0	1.8	1.7	1.3
	Others	0.0	1.8	0.0	0.9
	Total	100	100	100	100
Income	< RM 2, 500	91.4	81.8	81.0	84.1
	RM 2, 501 – RM 3, 169	3.4	5.5	8.6	5.8
	RM 2, 501 – RM 3, 169	3.4	5.5	8.6	5.8
	RM 3, 170 – RM 3, 969	0.0	3.6	1.7	2.2
	RM 3, 970 – RM 4, 849	1.7	1.8	0.0	1.3
	RM 4, 850 – RM 5, 879	1.7	3.6	3.4	3.1

Table 4.6 continued

	RM 5, 880 – RM 7, 099	0.0	0.9	1.7	0.9
	RM 7, 110 – RM 8, 699	0.0	1.8	1.7	1.3
	> RM 8, 700	1.7	0.9	1.7	1.3
	Total	100	100	100	100

The socio-demographic profile displays that there are more respondents from the old age group (more than 60), of which 58.6% are from Padawan, 57.3% from Bau, and 70.7% from Siburan (Table 4.6). The gender analysis shows more male respondents in the Padawan sub-districts (65.5%) than in the other two districts. A majority of the respondents in Bau (52.7%) and Siburan (53.4%) districts are female. As for the education level, the majority of the respondents in Padawan sub-districts (46.6%) and Siburan (34.5%) districts are primary school graduates. However, the majority of the respondents from the Bau district (33.6%) do not have any education and secondary school graduates. Besides, most of the respondents from the three selected districts come from the B40 groups (< RM 2, 500) in which 91.4% from Padawan, 81.8% from Bau, and 81.0% from Siburan

4.2 Medicinal Plant

4.2.1 Medicinal Plant Data Analysis

Table 4.7: Comparisons of the common medicinal plant species used, types of ailments treated, plant parts used, preparation and utilization method

No	Family	Species	Locality			Types of ailments treated	Part used	Preparation method	Utilization method
			Kuching Division		Serian Division				
			Padawan Sub-district	Bau District	Siburan District				
1.	Acanthaceae	*Andrographis paniculata*		/		Fever	Leaves	Boil	Bath
			/	/	/	Hypertension	Leaves	Blanch	Eat
			/			Itchy skin	Leaves	Boil	Bath
					/	Sore eye	Leaves	Boil	Rinse
		Clinacanthus nutans			/	Cancer	Leaves	Cook	Eat
2.	Achariaceae	*Pangium edule*	/			Remove lice	Leaves	Burn	Wrap
				/		Itchy skin	Fruit	Scrap skin	Rub/Patch
				/		Wound	Fruit	Scrap skin	Rub/Patch
3.	Annonaceae	*Goniothalamus velutinus*	/	/	/	Mosquito repellent, Insecticides	Bark, Leaves	Burn	-
		Polyalthia lapadantha	/	/	/	Sore eye	Leaves	Crush	Drip
4.	Apiaceae	*Centella asiatica*		/		Hypertension	Leaves	Crush	Drink

Table 4.7 continued

No	Family	Species	Locality			Types of ailments treated	Part used	Preparation method	Utilization method
			Kuching Division		Serian Division				
			Padawan Sub-District	Bau District	Siburan District				
5.	Apocynaceae	*Willughbeia* sp.	/			Hives	Leaves	Crush	Rub
			/			Ring worm	Leaves	Crush	Rub
		Hoya sp.	/	/		Hypertension	Leaves	Blanch	Eat
6.	Araceae	*Homalomena propinqua*	/			Stomachache	Leaves	Warm	Patch
7.	Arecaceae	*Plectocomiopsis geminiflora*	/			Diabetes	Heart of palm	Blanch	Eat
					/	Hypertension	Heart of palm	Cook	Eat
8.	Asteraceae	*Blumea balsamifera*	/	/	/	Post-partum	Whole plants	Boil	Bath
					/	Fever	Whole plants	Boil	Bath
				/		Flatulence	Whole plants	Boil	Bath

Table 4.7 continued

No	Family	Species	Locality			Types of ailments treated	Part used	Preparation method	Utilization method
			Kuching Division		Serian Divison				
			Padawan Sub-district	Bau District	Siburan District				
9.	Blechnaceae	*Blechnum orientale*	/	/	/	To extract pus from boil	Fronds	Crush	Patch
			/			Wound	Fronds	Crush	Patch
10.	Clusiaceae	*Garcinia mangostana*	/			Hives	Bark	Boil	Bath
				/		Fever	Leaves	Boil	Bath
11.	Davalliaceae	*Nephrolepis biserrata*	/	/	/	Enhance lactation	Fronds	Cook	Eat
12.	Dilleniaceae	*Dillenia suffruticosa*		/	/	Wound	Leaves	Crush	Patch
13.	Euphorbiaceae	*Pterococcus corniculatus*	/			Hypertension	Leaves	Cook	Eat
14.	Fabaceae	*Cassia alata*	/	/	/	Ring worm	Leaves	Crush	Rub
			/			Fever	Leaves	Boil	Bath
		Parkia speciosa	/			Diabetes	Fruit	Boil	Eat
		Peltophorum inerme	/			Wound	Leaves	Crush	Patch

Table 4.7 continued

No	Family	Species	Locality	Types of ailments treated	Part used	Types of ailments treated	Part used	Preparation method	Utilization method
			Kuching Division		Serian Division				
			Padawan Sub-district	Bau District	Siburan District				
15.	Lamiaceae	*Clerodendrum villosum*	/			Itchy skin	Leaves	Boil	Bath
		Orthosiphon aristatus		/	/	Diabetes	Leaves	Boil	Drink
					/	Hypertension	Leaves	Boil	Drink
16.	Melastomataceae	*Melastoma malabathricum*	/			Post-partum	Leaves	Boil	Bath
			/			Baby's thrush	Fruit	Crush	Rub
					/	Diarrhea/Stomachache	Leaves, Root	Boil	Drink
				/		Wound	Leaves	Crush	Patch
17.	Meliaceae	*Lansium domesticum*	/			Itchy skin	Fruit	Boil	Bath
				/		Fever	Bark	Boil	Bath
				/		Diarrhea	Fruit	Boil	Drink

Table 4.7 continued

No	Family	Species	Locality	Types of ailments treated	Part used	Types of ailments treated	Part used	Preparation method	Utilization method
			Kuching Division		Serian Division				
			Padawan Sub-district	Bau District	Siburan District				
18.	Menispermaceae	*Pcynarrhena tumefacta*	/			Fever	Leaves	Cook	Eat
19.	Musaceae	*Musa* sp.	/			Wound	Stem	Crush	Patch
20.	Phyllanthaceae	*Phyllanthus urinaria*	/			Headache	Leaves	Warm	Patch
		Baccaurea sp.	/			Post-partum	Leaves	Crush	Wrap
21.	Piperaceae	*Piper betle*	/	/	/	Toothache	Leaves	Chew	-
				/		Joint discomfort	Leaves	Warm	Massage
					/	Fever	Leaves	Boil	Bath
					/	Itchy skin	Leaves	Crush	Rub
		Piper porphyrophyllum	/			Post-partum	Leaves	Warm	Wrap
			/			Stomachache	Leaves	Warm	Wrap

Table 4.7 continued

No	Family	Species	Locality	Types of ailments treated	Part used	Types of ailments treated	Part used	Preparation method	Utilization method
			Kuching Division		Serian Division				
			Padawan Sub-district	Bau District	Siburan District				
				/		Blood clot/bruises	Crush	Crush	Massage
22.	Poaceae	*Imperata cylindrica*	/		/	Fever	Whole plants	Boil	Bath
23.	Polygalaceae	*Xanthophyllum amoenum*	/		/	Shampoo	Fruit	-	Rub
24.	Primulaceae	*Labisia pumila* (Blume) Benth. ex. Hook.*f.*	/			Post-partum	Leaves	Crush	Rub
				/		Drink supplement for women	Leaves	Boil	Drink
25.	Rubiaceae	*Trigonopleura malayana*		/	/	Toothache	Bark	Chew	-
26.	Selaginellaceae	*Selaginella* sp.	/	/		Wound	Whole plant	Crush	Patch

Table 4.7 continued

No	Family	Species	Locality	Types of ailments treated	Part used	Types of ailments treated	Part used	Preparation method	Utilization method
			/	/		Itchy skin	Whole plant	Crush	Rub
27.	Simaroubaceae	*Eurycoma longifolia*	/			Itchy skin	Bark	Scrap	Rub
				/		Hypertension	Root	Boil	Drink
28.	Smilacaceae	*Smilax blumei*		/		Stomachache	Leaves	Boil	Drink
		Smilax myosotiflora			/	Fever	Leaves	Boil	Bath
		Smilax sp.	/			Wound	Leaves	Crush	Patch
			/	/		Fever	Leaves	Boil	Bath
		Smilax odoratissima			/	Wound	Leaves	Crush	Patch
29.	Solanaceaae	Physalis minima		/		Toothache	Leaves	Boil	Rinse
30.	Verbenaceae	Vitex sp.	/			Post-partum	Leaves	Warm	Patch
			/			Bruises	Bark	Crush	Massage
				/		Wound	Leaves	Crush	Patch
31.	Zingiberaceae	Etlingera elatior			/	Hives	Leaves	Boil	Bath
					/	Fever	Leaves	Boil	Bath

Table 4.7 continued

No	Family	Species	Locality	Types of ailments treated	Part used	Types of ailments treated	Part used	Preparation method	Utilization method
		Boesenbergia stenophylla			/	Antidote for poison	Rhizome	Boil	Drink

4.2.1.1 Comparison on the medicinal plant's utilization in Padawan, Bau, and Siburan

A total of 43 common medicinal plants species from 31 families used for the treatment of 25 different ailments categories from all three districts has been recorded as shown in Table 4.7. The medicinal plant species used, types of ailments treated, plant parts used, and preparation and utilization methods were compared between the three selected districts. Five primary ailments are fever (11 species), wound (10 species), post-partum care (eight species), hypertension (seven species), and itchy skin (seven species). It is also found that one plant species is used to treat several ailments such as *Andrographis paniculata*. The leaves are boiled for bathing to treat fever and itchy skin or boiled and rinse to treat sore eyes. The leaves are also being blanch in hot water and eaten to treat hypertension.

Plants component such as leaves, fronds, fruits, bark, root, rhizome, and heart of palm are the common parts used by the community members from all three districts. The leaves are the most frequently used plant parts. Also, in some situations the whole plants are used as medicine, for example, the whole plants of *Blumea balsamifera* are boiled and used in the bath as a post-partum bath, to treat fever.

The most common preparation methods are boiling and crushing. Boiled medicinal plants are usually used in the bath or to be drink. For example, *Garcinia mangostana* is boiled and used in the bath for postpartum mothers. Fresh leaves of *Orthosiphon aristatus* are boiled and drank to treat hypertension. Besides that, plants that have been prepared by crushing were frequently used externally. For example, *Polyalthia lapadantha* is used by crushing the leaves to obtain the sap. The sap then will be dripped onto the eyes to treat sore eyes.

Patching and rubbing are the typical utilization methods used by the Bidayuh communities in Padawan. Besides, patching, bathing, and drinking are the regular methods used by the Bidayuh in Bau. Meanwhile, in Siburan, the common methods used are bathing and rubbing.

4.2.1.2 Comparison of the number of medicinal plants collected in a year and total medicinal plant species collected between Padawan sub-district, Bau, and Siburan districts

Table 4.8: Kruskal-Wallis H test to determine the difference in number of medicinal plants collected in a year and total medicinal plant species collected between Padawan sub-district, Bau, and Siburan districts

	Number of medicinal plants collected in a year	**Total medicinal plant species collected**
Chi-square	8.55	5.36
Df	2	2
Significance (p-value)	0.01*	0.07
*p-value significant at 0.05 level		

Table 4.9: Mean rank analysis of number of medicinal plants collected in a year and total medicinal plant species collected between districts

Districts/Sub-district	**Number of medicinal plants collected in a year**		**Total medicinal plant species collected**	
	N	**Mean rank**	**N**	**Mean rank**
Padawan	58	106.16	58	129.90
Bau	110	125.65	110	109.97
Siburan	58	97.78	58	103.80
Total	226		226	

The Kruskal-Wallis H test result (Table 4.8) shows that there is a significant difference in the number of medicinal plants collected in a year between the three districts,

X^2 (2) = 8.55, p = 0.01. The highest mean rank of the number of medicinal plants collected in a year is 125.65 for Padawan sub-district (Table 4.9). Meanwhile, the lowest mean rank is 97.78 for Siburan. However, there is no significant difference in the total medicinal plant species collected between the districts based on the mean rank analysis.

4.2.1.3 The Differences in Number of Medicinal Plants Collected in a Year and Total Medicinal Plant Species Collected Between Different Socio-Economics Factors

Table 4.10: Kruskal-Wallis H test to determine the differences in number of medicinal plants collected in a year and total medicinal plant species collected between age, gender, education level, and income

Socio-economic factors		Number of medicinal plants collected in a year	Total medicinal plant species collected
Age	Chi-square	1.52	1.85
	df	2	2
	Significance (p-value)	0.47	0.40
Gender	Chi-square	0.99	3.70
	df	1	1
	Significance (p-value)	0.32	0.06
Education level	Chi-square	5.69	21.87
	df	5	5
	Significance (p-value)	0.34	0.00*
Income	Chi-square	7.36	4.93
	df	7	7
	Significance (p-value)	0.39	0.67
*p-value is significant at 0.05 level			

Table 4.11: Mean rank analysis of number of medicinal plants collected in a year and total medicinal plant species collected between age, gender, education level, and income

Socio-economic factors		Number of medicinal plants collected in a year		Total medicinal plant species collected	
		N	**Mean rank**	**N**	**Mean rank**
Age	35-45	13	129.23	13	111.27
	46-59	75	117.24	75	105.49
	More than 60	138	109.99	138	118.06
	Total	226		226	
Gender	Male	117	117.51	117	121.49
	Female	109	109.20	109	104.93
	Total	226		226	
Education level	Others	2	121.50	2	89.00
	None	75	104.31	75	110.62
	Primary school	78	123.90	78	138.07
	Secondary school	66	109.03	66	89.38
	College	2	164.50	2	69.00
	University	3	131.67	3	123.33
	Total	226		226	
Income	< RM 2, 500	190	114.52	190	115.03
	RM 2, 501 – RM 3, 169	13	104.19	13	92.38
	RM 3, 170 – RM 3, 969	5	158.80	5	109.00
	RM 3, 970 – RM 4, 849	3	94.17	3	95.67
	RM 4, 850 – RM 5, 879	7	75.14	7	115.71
	RM 5, 880 – RM 7, 099	2	121.50	2	168.50
	RM 7, 110 – RM 8, 699	3	146.50	3	135.33
	> RM 8, 700	3	84.00	3	69.50
	Total	226		226	

*p-value is significant at 0.05 level

The Kruskal-Wallis H test (Table 4.10) shows that there is a significant difference in total medicinal plant species collected between different education levels, X^2 (5) = 21.87, p

= 0.00. The highest mean rank of total medicinal plant species collected score is 138.07 for primary school graduates and the lowest 69.00 for college graduates (Table 4.11).

4.3 Discussion (Medicinal Plant)

Compared to the studies conducted by Ripen and Noweg (2016), the total number of plant species recorded is less than the previous study. The former study found a total of 60 medicinal plant species from Jagoi area, located in Bau district. However, the difference in the number of species in this study is due to the comparison of common plant species used in all three districts selected.

The common ailments which are being treated using the medicinal plants found in this study are similar to what was found by Fasihuddin and Laily (1999). They stated that the common ailments treated using medicinal plants by the Bidayuh, Malay, Melanau, Kadayan, Iban, and Kenyah people in Sarawak are skin diseases, wounds, fever, and post-partum care. A similar result was also found in a later study by Toaiang and Sayok (2019) from their study in Jagoi area, in which the common ailments treated using the medicinal plants were fever, skin disease, and wound.

A study by Baling et al. (2017) also found a similar result in which one medicinal plant species can be used to treat several ailments. A similar species found was *Andrographis paniculata,* which is used to treat fever, stomachache, hypertension, and diabetes. They also found that the young leaves of *Blumea balsamifera* are boiled and drank or used in the bath to treat fever and kidney failure, and for a post-partum bath. The common pattern of ailments treated using medicinal plants from the past and current studies is ailments due to inflammation. Medicinal plants contain anti-inflammatory agents which help in reducing the inflammation effects and comforting the patients.

The comparison of types of ailments treated from the study with pre-existing literature also found several common plants used to treat similar ailments such as *Andrographis paniculata* to treat fever and hypertension, *Pangium edul*e to remove lice, itchy skin, and treat wound, and *Plectocomiopsis geminiflora* to treat diabetes. The comparison also found a valuable information in which *Clinacanthus nutans* is used to treat cancer by the Bidayuh in Siburan district. Previously, this plant is commonly used to treat skin rashes, insect, snake bites, lesion, diabetes, and gout. Besides that, there are lack to none past study on the utilization of *Peltophorum inerme.*

Similar to the current study Supiandi et al. (2019) in Indonesia, found that the Dayak community utilizes several plant parts such as leaves, flowers, fruits, rhizome, and even the whole plants. However, leaves are the most used plant parts. The most popular method of utilization is boiling and drinking the plant extract. Leaves are commonly used because it is the main source of food and metabolite production in a plant, which also contains active compound such as anti-inflammatory agents (Mohammad et al., 2018).

The difference in the number of medicinal plants collected in a year between the districts also may be due to the level of traditional knowledge possessed by the locals. The difference may also be contributed by the vegetation types, soil types, and climatic conditions which directly affects the volume of medicinal plants in the area, and the availability of healthcare center of the study areas as found by Kidane et al. (2018).

A similar result of difference in number of medicinal plants collected in a year and total medicinal plant species collected between different socio-economics factors was also found by Fathul Yusro et al. (2021) in Indonesia, in which they found out the respondents

with lower education level has better knowledge of medicinal plants than the ones with higher education level.

Another study by Bouasla and Bouasla (2017) in Algeria found that education level has a significant influence on the frequency of medicinal plants usage. Although they also found that age, gender, and monthly income also influence the frequency of medicinal plants usage. This may also indicate that the more they collected the medicinal plants, the higher the frequency of usage.

Contrastingly, there is no significant difference in the number of medicinal plants collected in a year and total medicinal plant species collected between age, gender, and income. The insignificant result of gender influences toward the number of medicinal plants collected in a year and total medicinal plant species collected may be due to the unfixed roles of men and women in extracting or cultivating the medicinal plants as stated by Astutik et al. (2019). However, women are still considered the most knowledgeable and well-known users of medicinal plants in Southeast Asia. This may be due to the roles of women to maintain their family's health. Another study by Teklehaymanot (2017) in Ethiopia also found that age is a significant factor in the number of medicinal plants collected. The older the respondents are, the greater number of medicinal plants collected. This indicates that older people have higher knowledge of medicinal plants than younger people

4.4 Food Plant

4.4.1 Food Plant Data Analysis

Table 4.12: Comparisons of the common food plant species used, plant parts used, preparation and process method

No	Family	Botanical name	Local name (Bidayuh)			Part used	Uses	Preparation
			District/ Sub-district					
			Padawan	Siburan	Bau			
1.	Apiaceae	*Eryngium foetidum*			/	Leaf	Condiment	Usually used in cooking to enhance flavour.
		Centella asiatica (L.) Urb.	/	/	/	Fruit	Directly consumed	Ripe fruit can be consumed directly.
2.	Apocynaceae	*Hoya* sp.	/	/	/	Leaf	Consumed as *ulam* or cooked as a vegetable dish	They are often consumed as *ulam* or by cooking as a vegetable dish.
3.	Alangiaceae	*Alangium javanicum var. ebenaceum* (C.B.Clarke) Berhaman			/	Fruit	Directly consumed	Ripe fruit can be consumed directly.
4.	Alismataceae	*Limnocharis flava* (L.) Buchenau	/	/	/	Stalk	Cooked as a vegetable dish	The stalks are usually consumed by

Table 4.12 continued

								cooking them as a vegetable dish.
5.	Anacardiaceae	*Mangifera pajang* Kosterm.	/		/	Fruit	Directly consumed	Ripe fruit can be consumed directly.
		Mangifera foetida Lour.			/	Fruit	Directly consumed	Ripe fruit can be consumed directly.
		Mangifera quadrifida Jack			/	Fruit	Directly consumed	Green and ripe fruit can be consumed directly with *sambal belacan* or make pickle.
		Pentaspadon motleyi Hook.f.			/	Seed	Cooked as a vegetable dish	Often cooked with other vegetable dishes.
6.	Arecaceae	*Calamus* sp.	/	/	/	Fruit	Condiment	Often used in cooking to enhance flavour.
		Eleiodoxa conferta (Griff.) Burret			/	Fruit	Consumed as *ulam*	Ripe fruit are consumed as *ulam.*
		Oncosperma tigillarium (Jack.) Ridl.	/	/	/	Inner shoot	Cooked as a vegetable dish	Consumed by cooking it as

Table 4.12 continued

								a vegetable dish.
		Plectocomiopsis geminiflora (Griff.) Becc.	/	/	/	Inner shoot	Cooked as a vegetable dish	Consumed by cooking it as a vegetable dish.
		Salacca affinis Griff.			/	Fruit	Directly consumed	Ripe fruit can be consumed directly.
		Salacca zalacca (Gaertn.) Voss	/	/		Fruit	Directly consumed	Ripe fruit can be consumed directly.
7.	Asteraceae	*Cosmos caudatus* Kunth	/	/	/	Leaf	Consumed as *ulam* or cooked as a vegetable dish	Often consumed as *ulam* or by cooking it as a vegetable dish.
8.	Athyriaceae	*Diplazium esculentum* (Retz.) Sw.	/	/	/	Frond	Cooked as a vegetable dish	The fronds are usually consumed by cooking it as a vegetable dish.
9.	Auriculariaceae	*Auricularia auricula-judae* (Fr.) Quel.	/	/	/	Mushroom	Cooked as a vegetable dish	The fungi can be consumed by cooking it as a vegetable dish.

Table 4.12 continued

10.	Begoniaceae	*Begonia chlorosticia* Sands	/	/	/	Leaf	Condiment	Often used in cooking to enhance flavour.
11.	Blechnaceae	*Stenochlaena palustris (*Burm.f.) Bedd.	/	/	/	Young shoot	Cooked as a vegetable dish	The young shoot are usually consumed by cooking it as a vegetable dish.
12.	Bombacaceae	*Durio* zibenthinus	/	/	/	Fruit	Directly consumed	Ripe fruit can be consumed directly.
13.	Burseraceae	*Canarium odontophyllum* Miq.	/	/	/	Fruit	Directly consumed	Ripe fruit can be consumed directly by soaking it in warm water for a few minutes.
		Dacryodes rostrata (Blume) H.J.Lam	/	/	/	Fruit	Directly consumed, cooked as a vegetable dish	Ripe fruit can be consumed directly by soaking it in boiling water or cooked as a dish.
14.	Clusiaceae	*Garcinia mangostana* L.	/	/	/	Fruit	Directly consumed	Ripe fruit can be consumed directly.

Table 4.12 continued

		Garcinia nitida Pierre		/	/	Fruit	Condiment	Usually used in cooking to enhance flavour.
		Garcinia parvifolia Miq.			/	Fruit	Condiment	Usually used in cooking to enhance flavour.
15.	Dilleniaceae	*Dillenia suffruticosa* (Griff.) Martelli	/	/	/	Young leaf	Consumed as *ulam* or cooked as a vegetable dish	It is often consumed as *ulam* or by cooking as a vegetable dish.
16.	Dipterocarpaceae	*Shorea macrophylla* (de Vr.) Ashton	/	/	/	Seed	Produce oil for cooking or can be consumed directly	The extracted oil can be consumed by mixing it with rice or used in cooking.
17.	Elaeocarpaceae	*Elaeocarpus sphaeroblastus* Stapf ex Ridl.	/	/	/	Fruit	Directly consumed	Ripe fruit can be consumed directly.
18.	Euphorbiaceae	*Elateriospermum tapos* Blume	/		/	Seed	Consumed as a vegetable dish	The seeds are boiled before they can be consumed as a vegetable dish.

Table 4.12 continued

		Ostodes pauciflora Merr.	/	/	/	Seed	Consumed directly	The seeds are boiled before they can be consumed.
		Pterococcus corniculatus Pax. And K.Hoffm	/	/	/	Leaf	Cooked as a vegetable dish	Often consumed by cooking it as a vegetable dish.
19.	Fabaceae	*Archidendron jiringa* (Jack) I.C.Nielsen	/	/	/	Seed	Consumed directly, cooked as a vegetable dish	The nuts can be eaten as *ulam* or cooked as a vegetable dish.
		Parkia speciosa Hassk.	/	/	/	Seed	Consumed directly, cooked as a vegetable dish	The nuts can be eaten as *ulam* or cooked as a vegetable dish.
20.	Fagaceae	*Castanopsis motleyana* King			/	Seed	Consumed directly	The nuts can either be consumed directly or boiled.
21.	Flacourtiaceae	*Pangium edule* Reinw.	/	/	/	Fruit	Cooked as a vegetable dish	Consumed by cooking it as a vegetable dish.

Table 4.12 continued

22.	Gnetaceae	*Gnetum gnemon* L.	/	/	/	Fruit	Cooked as a vegetable dish	Consumed by cooking it as a vegetable dish.
23.	Hygrophoraceae	*Hygrocybe punicea* (Fr.Fr.) Kummer	/	/	/	Mushroom	Cooked as a vegetable dish	It can be consumed by cooking it as a vegetable dish.
24.	Lauraceae	*Litsea garciae* S.Vidal	/	/	/	Fruit	Directly consumed	Ripe fruit can be consumed directly by soaking it in warm water for a few minutes.
25.	Lycoperdaceae	*Calostoma* sp.	/			Mushroom	Cooked as a vegetable dish	The fungi can be consumed by cooking it as vegetable dish.
26.	Lyophyllaceae	*Termitomyces striatus* (Beeli). R. Heim	/	/	/	Mushroom	Cooked as a vegetable dish	The fungi can be consumed by cooking it as a vegetable dish.
27.	Melastomataceae.	*Melastoma malabathricum* L.	/	/	/	Fruit	Directly consumed	Ripe fruit can be consumed directly.

Table 4.12 continued

28.	Meliaceae	*Lansium domesticum* Corrêa	/	/	/	Fruit	Directly consumed	Ripe fruit can be consumed directly.
29.	Menispermaceae	*Pycnarrhena tumefacta* Miers	/	/	/	Leaf	Condiment	Dry or fresh leaves are used as condiment.
30.	Moraceae	*Artocarpus elasticus* Reinw. ex Blume	/		/	Fruit	Directly consumed	Ripe fruit can be consumed directly.
		Artocarpus kemando Miq.			/	Fruit	Directly consumed	Ripe fruit can be consumed directly.
		Artocarpus heterophyllus La m.	/	/	/	Fruit	Directly consumed	Ripe fruit can be consumed directly.
		Artocarpus integer (Thunb.) Merr.	/	/	/	Fruit	Consumed directly	Ripe fruit can be consumed directly.
		Artocarpus nitidus Borneensi s (Merr.) F.M.Jarrett			/	Fruit	Directly consumed	Ripe fruit can be consumed directly.
		Artocarpus odoratissimus Bla nco	/	/	/	Fruit	Directly consumed	Ripe fruit can be consumed directly.
		Ficus grossularioides Burm. f.			/	Fruit	Directly consumed	Ripe fruit can be consumed directly.
31.	Myrtaceae	*Syzygium polyanthum* (Wight) Walp.			/	Inner shoot	Cooked as a vegetable dish	Consumed by cooking it as

Table 4.12 continued

								a vegetable dish.
32.	Nephrolepidaceae	*Nephrolepis biserrata* (Sw.) Schott	/	/	/	Young shoot	Cooked as a vegetable dish	The young shoot are usually consumed by cooking it as a vegetable dish.
33.	Phyllanthaceae	*Baccaurea angulata* Merr.	/	/	/	Fruit	Directly consumed	Ripe fruit can be consumed directly.
		Baccaurea bracteata Mull.	/	/	/	Fruit	Consumed directly, Make *tuak*	Ripe fruit can be directly consumed. Juice from the fruit was extracted and mixed with *koong* to make *tuak*.
		Baccaurea costulata (Miq.) Mull.Arg.	/	/	/	Fruit	Directly consumed	Ripe fruit can be consumed directly.
		Baccaurea macrocarpa Muell			/	Fruit	Consumed directly	Ripe fruit can be consumed directly.
		Baccaurea motleyana (Müll.Arg.) Müll.Arg.	/	/	/	Fruit	Consumed directly	Ripe fruit can be consumed directly.

Table 4.12 continued

34.	Poaceae	*Dendrocalamus asper* (Schult.) Backer	/	/	/	Young stem	Cooked as a vegetable dish	The young stem is often consumed by cooking it as a vegetable dish.
		Gigantochloa levis (Blanco) Merr	/	/	/	Inner shoot	Cooked as a vegetable dish	Consumed by cooking it as a vegetable dish.
35.	Polygonaceae	*Polygonum minus* Huds.	/			Leaf	Condiment	Usually used in cooking to enhance flavour.
36.	Polyporaceae	*Lestinus strigosus (*Schw.) Fr.			/	Mushroom	Cooked as a vegetable dish	The mushroom can be consumed by cooking it as a vegetable dish.
37.	Putranjivaceae	*Drypetes* sp.	/	/	/	Young leaf	Cooked as a vegetable dish	The leaves can be cooked as a vegetable dish after a week of fermentation.
38.	Sapindaceae	*Dimocarpus longan* Lour.	/	/	/	Fruit	Directly consumed	Ripe fruit can be consumed directly.

Table 4.12 continued

		Nephelium cuspidatum Blume			/	Fruit	Directly consumed	Ripe fruit can be consumed directly.
		Nephelium lappaceum L.	/	/	/	Fruit	Directly consumed	Ripe fruit can be consumed directly.
		Pometia pinnata J.R. Forst. & G. Forst.	/	/	/	Fruit	Directly consumed	Ripe fruit can be consumed directly.
39.	Smilacaceae	*Smilax odoratissima* Blume			/	Young shoot	Cooked as a vegetable dish	The shoots are usually cooked with other vegetable dishes.
40.	Schizophyllaceae	*Schizophyllum commune Fr.*	/	/	/	Mushroom	Cooked as a vegetable dish	The mushroom can be consumed by cooking it as a vegetable dish.
41.	Solanaceae	*Solanum lasiocarpum* Dunal	/	/	/	Fruit	Cooked as a vegetable dish	Cooked as a vegetable dish or mixed to add flavour to cooking.
		Solanum torvum Sw.	/	/	/	Fruit	Consumed as *ulam* or cooked as a	Consumed as *ulam* or cooked with

Table 4.12 continued

							vegetable dish	other vegetable dishes.
42.	Tricholomataceae	*Clitocybe fragrans* (With.) P. Kumm.			/	Mushroom	Cooked as a vegetable dish	The mushroom can be consumed by cooking it as a vegetable dish.
43.	Zingiberaceae	*Etlingera coccinea*	/	/	/	Inner shoot	Condiment	It is mixed in cooking to enhance flavour, especially in cooking *pansuh*.
		Etlingera elatior (Jack) R.M.Sm.	/	/	/	Flower	Cooked as a vegetable dish, or condiment	Cooked as a vegetable dish or mixed to add flavour to cooking.

4.4.1.1 Comparison on the food plant's utilization in Padawan, Bau, and Siburan

A total of 74 wild food plant species belonging to 43 families are consumed directly as *ulam* or ripe fruit, and vegetable dishes, made as *tuak* or condiment by the locals in the Padawan sub-district, Siburan district, and Bau district. The food plant species used, plant part used, preparation and process method were compared between the selected three districts. A total of 36 plant species were consumed directly as *ulam* or eaten when they were ripened, especially for fruit plants. Then, a total of 28 plant species were cooked as vegetables and a total of 10 species were made into *tuak* or used as condiments.

Plants parts such as fruits, seeds, inner shoots, leaves and mushrooms are the commonly consumed by the Bidayuh community in the selected study sites. The fruits are the most frequent used plant components. The most common preparation methods are consumed directly as fruit or *ulam* and cooked as a vegetable dish. For example, fruits such as *Artocarpus odoratissimus, Litsea garciae, Dacryodes rostrata* and *Baccaurea angulata* are often eaten directly as it is by the Bidayuh community in the three districts. Besides, the community also directly consumed food plants such as *Archidendron jiringa, Parkia speciosa, Cosmos caudatus*, and *Dillenia suffruticosa* as *ulam*.

Meanwhile, examples of food plants cooked as vegetable dishes by the Bidayuh community consist of *Pangium edule, Diplazium esculentum, Etlingera elatior* and *Limoncharis flava*. The Bidayuh in the three districts also consumed mushrooms in as their usual nourishment intake; examples of mushrooms are *Schizophyllum commune, Auricularia auricula-judae, Lestinus strigosu*s and *Clitocybe fragrans*.

Besides, during the study, *Pycnarrhena tumefacta* or known locally as *peroh* in Bidayuh Padawan and Siburan while in Bau it is known as *sisong* were often use in cooking as condiment or food enhancer were recorded in the three districts.

4.4.1.2 Comparison of the number of food plants collected in a year and total food plant species collected between Padawan sub-district, Bau, and Siburan districts

Table 4.13: Kruskal-Wallis H test to determine the difference in number of food plants collected in a year and total food plant species collected between Padawan sub-district, Bau, and Siburan districts

	Number of food plants collected in a year	**Total food plant species collected**
Chi-square	19.43	5.34
Df	2	2
Significance (p-value)	0.00*	0.07
*p-value significant at 0.05 level		

Table 4.14: Mean rank analysis of number of food plants collected in a year and total food plant species collected between districts

Districts/Sub-district	**Number of food plants collected in a year**		**Total food plant species collected**	
	N	**Mean rank**	**N**	**Mean rank**
Padawan	58	135.73	58	101.07
Bau	110	94.25	110	112.03
Siburan	58	127.78	58	128.72
Total	226		226	

The Kruskal-Wallis H test result (Table 4.13) shows that there is a significant difference in the number of food plants collected in a year between the three districts, X^2 (2) = 19.43, p = 0.01. The highest mean rank of the number of food plants collected in a year is 135.73 for Padawan sub-district (Table 4.14). Meanwhile, the lowest mean rank is 94.25 for

Bau. However, there is no significant difference in the total food plant species collected between the districts based on the mean rank analysis.

4.4.1.3 The Differences in Number of Food Plants Collected in a Year and Total Food Plant Species Collected Between Different Socio-Economics Factors

Table 4.15: Kruskal-Wallis H test to determine the differences in number of food plants collected in a year and total food plant species collected between age, gender, education level, and income

Socio-economic factors		Number of food plants collected in a year	Total food plant species collected
Age	Chi-square	4.89	4.28
	df	2	2
	Significance (p-value)	0.09	0.12
Gender	Chi-square	3.29	8.13
	df	1	1
	Significance (p-value)	0.07	0.00*
Education level	Chi-square	11.52	7.68
	df	5	5
	Significance (p-value)	0.04*	0.18
Income	Chi-square	10.03	11.32
	df	7	7
	Significance (p-value)	0.19	0.134.
*p-value is significant at 0.05 level			

Table 4.16: Mean rank analysis of number of food plants collected in a year and total food plant species collected between age, gender, education level, and income

Socio-economic factors		Number of food plants collected in a year		Total food plant species collected	
		N	**Mean rank**	**N**	**Mean rank**
Age	35-45	13	93.96	13	98.77
	46-59	75	103.24	75	102.96
	More than 60	138	120.92	138	120.62
	Total	226		226	
Gender	Male	117	121.03	117	125.41
	Female	109	105.42	109	100.71
	Total	226		226	
Education level	Others	2	57.00	2	137.75
	None	75	116.33	75	100.20
	Primary school	78	128.51	78	115.51
	Secondary school	66	96.56	66	127.62
	College	2	89.25	2	70.75
	University	3	79.17	3	95.50
	Total	226		226	
Income	< RM 2, 500	190	117.56	190	108.96
	RM 2, 501 – RM 3, 169	13	74.31	13	118.85
	RM 3, 170 – RM 3, 969	5	132.40	5	121.30
	RM 3, 970 – RM 4, 849	3	117.00	3	170.33
	RM 4, 850 – RM 5, 879	7	81.14	7	165.36
	RM 5, 880 – RM 7, 099	2	147.25	2	161.25
	RM 7, 110 – RM 8, 699	3	72.83	3	170.17
	> RM 8, 700	3	84.83	3	98.50
	Total	226		226	

*p-value is significant at 0.05 level

The Kruskal-Wallis H test (Table 4.15) shows that there is a significant difference in number food plant species collected in a year between different education levels, X^2 (5) = 11.52, p = 0.04 and total food plant species collected between different gender, X^2 (5) = 8.13, p = 0.00. The highest mean rank food plant species collected in a year score is 128.51 for primary school graduates and the lowest mean rank is 57.00 for others (Table 4.16). Meanwhile for the highest mean rank for total food plant species collected score is 125.41 and the lowest mean rank is 100.71.

4.5 Discussion (Food Plant)

Comprehesive study on the traditional knowledge of the utilization of food plants especially among the Bidayuh is less likely been recorded for the past years. According to Chai et al. (2008), due to fast depletion of resources, changing in lifelstyle, modernization and lack of interest among younger generations much of the knowledge is gradually being lost before it can be recorded. Besides, based on the study done by Teucher and Sayok (2019), the Bidayuh in Serembu area (Bau district) shows results that idenfication of traditional food plants was weakest and most identified food plants had been seen in markets rather in the forests. The Bidayuh ‘s relationship with food plants had change due to lack of time and most are buying food plants in the market.

Based on a study done by Shaffiq et al. (2018) has identified 49 species of wild plant belonging to 29 families that used for food that consumed raw, boiled, fry or pickled. The study was conducted at native market in Bintulu, Selangau, Sibu and Sarikei. An ethnobotanical study on indigenous food as flavouring and aromatic enhancing plants done by Yusli et al. (2021) in central region of Sarawak recorded 27 plant species from 20 families were identified for their use by native people. The study recorded leaves are the most

common plant part used. The leaves of *Allium tuberosum, Dillenia suffruticosa, Murraya koenigii, Pandanus odorus, Pangium edule, Persicaria odorata, Phacelophrynium maximum, Premna cordifolia, Pycnarrhena tumefacta, Scorodocarpus borneensis, Syzgium polyanthum*, and *Tiliacora traindra* were used by people of the Sarawak Central Region as flavourings or aromatic enhancer (Yusli et al., 2021).

Besides, *Pycnarrhena tumefacta* also had been recorded in other study, such as Mohammed et al. (2020) reported *Pycnarrhena tumefacta* had been used by the Iban, Kenyah, Kayan, Bidayuh and Kelabit as condiment.For the mode of preparation it is varies according to the community's preference for taste and aroma intensity as well as inherited oral knowledge from their elderly (Yusli et al., 2021).

A study by Fugaro and Maryo (2018) shows education level also effect the traditional knowledge about wild food gathering and using habit. An urban dwellers, educated and young people are inexperience in utilizing wild edible plants. The attitude of people towards wild edible plants, the elderly are often more knowledgeable than the educated people who are supposed to possess more knowledge about wild food plants. Which shows as modern knowledge increase the interest of the people to use wild food plants decreases.

Gender also played important role in conserving tradtional knowledge. Women in the community usually have more traditional knowledge of plants as they are responsible for gathering and preparing the plants. Women a responsible for the household's dietary intake are needed them to have good skills on plant identification and uses (Yusli et al., 2021)

4.6 Value of Annual Usage of Medicinal and Food Plants by Bidayuh Communities in Padawan sub-district, Siburan and Bau district

The annual value of the plants used by the Bidayuh communities in Padawan sub-district, Siburan and Bau district is calculated using values obtained from actual usage of using medicinal plant for treatment or consuming food plants in the communities' daily diet. These data were recorded from the households surveyed that had been conducted during the study. Table 4.17 and Table 4.18 shows the average annual value and total annual value of medicinal and food plants respectively used by Bidayuh in Padawan sub-district, Siburan and Bau district.

Below shows the calculation for total annual value and average annual value by Bidayuh communities in Padawan sub-district, Siburan and Bau district.

Where for Medicinal plants,

The total annual value for medicinal plants used by six household respondents = RM310

Household respondents = 6

Average annual value of food plants:

= Total Annual Value/Number of household respondents

= RM310/6

= RM51.67

Where for Food plants,

The total annual value for food plants used by six household respondents = RM790

Household respondents = 6

Average annual value of food plants:

= Total Annual Value/Number of household respondents

= RM790/6

= RM131.67

Table 4.17: Average annual value and total annual value of medicinal plants used by Bidayuh in Padawan sub-district, Siburan and Bau district

District/Sub-district	Villages	Number of respondents	Total Annual Value of Medicinal Plants (RM)	Average Annual Value of Medicinal Plants (RM)
Padawan sub-district	Assum	6	310	51.67
	Annah Sadir	10	4090	409
	Simuti	6	785	130.83
	Sibakar	6	580	96.67
	Sigandar	5	1040	208
	Payang	7	5040	720
	Simpok	9	4130	458.89
	Serumah	9	3080	342.22
Siburan district	Krian	8	2900	362.5
	Pesang	8	1845	230.63
	Begu	8	2865	358.13
	Peraya	10	1230	123
	Stabut	9	4865	540.56
	Chupak	6	2240	373.33
	Skuduk	9	5810	645.56

Table 4.17 continued

Bau district	Stass	20	11820	591
	Duyoh	15	6575	438.33
	Serasot	23	13105	569.78
	Gumbang	12	7955	662.92
	Tringgus	7	2700	385.71
	Stenggang	13	1765	135
	Skio	7	855	122.14
	Podam	13	985	75.77

Table 4.18: Average annual value and total annual value of food plants used by Bidayuh in Padawan sub-district, Siburan and Bau district

District/Sub-district	Name of Villages	Number of respondents	Total Annual Value of Food Plants (RM)	Average Annual Value of Food Plants (RM)
Padawan sub-district	Assum	6	790	131.67
	Annah Sadir	10	6415	641.50
	Simuti	6	4560	760.00
	Sibakar	6	3820	636.67
	Sigandar	5	3370	674.00
	Payang	7	4075	582.14
	Simpok	9	4010	445.56
	Serumah	9	5905	656.11
Siburan district	Krian	8	6150	768.75
	Pesang	8	6315	789.38
	Begu	8	3485	435.63
	Peraya	10	3795	379.50
	Stabut	9	5110	567.78
	Chupak	6	3045	507.50
	Skuduk	9	2245	249.44
Bau district	Stass	20	10090	504.50
	Duyoh	15	8405	560.33
	Serasot	23	10150	441.30

Table 4.18 continued

	Gumbang	12	6315	536.25
	Tringgus	7	4675	667.86
	Stenggang	13	8970	690.00
	Skio	7	3280	468.57
	Podam	13	6595	507.31

The third objective of the study is to estimate the annual value of the use of the food and traditional medicinal plants in the communities. Based on the average annual value per household as shown in Table 4.17 and Table 4.18 the estimated community value is shown in Table 4.19 for medicinal plants and Table 4.20 for food plants. The estimation was made based on different assumption on the percentage of villagers who are consuming food plants in the daily diet. There are four level of percentage of household participation assumed: 2.5%, 5%, 10% and 20%. This assumption is made as the actual percentage of villager's participations or consumptions of medicinal and food plants.

Table 4.19: Total annual use of medicinal plants by village and assumed level of participation in Padawan sub-district, Siburan and Bau district

District/Sub-district	Name of Villages	Number of Resident Households	Value of use for assumed participation level (RM)			
			2.5%	5%	10%	20%
Padawan sub-district	Assum	32	41.34	82.67	165.344	330.69
	Annah Sadir	86	879.35	1758.70	3517.4	7034.80
	Simuti	54	176.62	353.24	706.482	1412.96
	Sibakar	45	108.75	217.51	435.015	870.03
	Sigandar	30	156.00	312.00	624	1248.00
	Payang	80	1440.00	2880.00	5760	11520.00
	Simpok	660	7571.69	15143.37	30286.74	60573.48
	Serumah	85	727.22	1454.44	2908.87	5817.74
Total		1072	11100.97	22201.93	44403.85	88807.7
Siburan district	Krian	88	797.50	1595.00	3190	6380.00
	Pesang	66	380.54	761.08	1522.158	3044.32
	Begu	80	716.26	1432.52	2865.04	5730.08
	Peraya	110	338.25	676.50	1353	2706.00
	Stabut	93	1256.80	2513.60	5027.208	10054.42
	Chupak	60	560.00	1119.99	2239.98	4479.96
	Skuduk	94	1517.07	3034.13	6068.264	12136.53
Total		591	5566.42	11132.82	22265.65	44531.31
Bau district	Stass	298	4402.95	8805.90	17611.8	35223.60
	Duyoh	208	2279.32	4558.63	9117.264	18234.53
	Serasot	188	2677.97	5355.93	10711.86	21423.73
	Gumbang	100	1657.30	3314.60	6629.2	13258.40
	Tringgus	250	2410.69	4821.38	9642.75	19285.50
	Stenggang	306	1032.75	2065.50	4131	8262.00
	Skio	75	229.01	458.03	916.05	1832.10
	Podam	135	255.72	511.45	1022.895	2045.79
Total		1560	14945.71	29891.42	59782.82	119565.7

Table 4.20: Total annual use of food plants by village and assumed level of participation in Padawan sub-district, Siburan and Bau district

District/Sub-district	Name of Villages	Number of Resident Households	Value of use for assumed participation level (RM)			
			2.5%	5%	10%	20%
Padawan sub-district	Assum	32	105.34	210.67	421.34	842.69
	Annah Sadir	86	1379.23	2758.45	5516.90	11033.80
	Simuti	54	1026.00	2052.00	4104.00	8208.00
	Sibakar	45	716.25	1432.51	2865.02	5730.03
	Sigandar	30	505.50	1011.00	2022.00	4044.00
	Payang	80	1164.28	2328.56	4657.12	9314.24
	Simpok	660	7351.74	14703.48	29406.96	58813.92
	Serumah	85	1394.23	2788.47	5576.94	11153.87
Total		1072	13642.57	27285.14	54570.28	109140.6
Siburan district	Krian	88	1691.25	3382.50	6765.00	13530.00
	Pesang	66	1302.48	2604.95	5209.91	10419.82
	Begu	80	871.26	1742.52	3485.04	6970.08
	Peraya	110	1043.63	2087.25	4174.50	8349.00
	Stabut	93	1320.09	2640.18	5280.35	10560.71
	Chupak	60	761.25	1522.50	3045.00	6090.00
	Skuduk	94	586.18	1172.37	2344.74	4689.47
Total		591	7576.14	15152.27	30304.54	60609.08
Bau district	Stass	298	3758.53	7517.05	15034.10	30068.20
	Duyoh	208	2913.72	5827.43	11654.86	23309.73
	Serasot	188	2074.11	4148.22	8296.44	16592.88
	Gumbang	100	1340.63	2681.25	5362.50	10725.00
	Tringgus	250	4174.13	8348.25	16696.50	33393.00
	Stenggang	306	5278.50	10557.00	21114.00	42228.00
	Skio	75	878.57	1757.14	3514.28	7028.55
	Podam	135	1712.17	3424.34	6848.69	13697.37
Total		1560	22130.36	44260.68	88521.37	177042.7

Calculation for value of use of assumed participation level by the Bidayuh communties in Padawan sub-district, Siburan district and Bau district for medicinal and food plants.

(Assumed participation level X Number of resident household) (Average annual value of medicinal or food plants)

Where for medicinal plants,

Assumed participation level = 2.5%

Number of resident households = 32

Average annual value of food plants = 51.67

$= \frac{2.5\ x\ 32}{100}$ x 51.67

= 41.34

Where for food plants,

Assumed participation level = 2.5%

Number of resident households = 32

Average annual value of food plants = 131.67

$= \frac{2.5\ x\ 32}{100}$ x 131.67

= 105.34

Based on the calculation, the value of medicinal plants used varies with different level of participation among the Bidayuh communities in the selected study sites. With a 2.5%, it shows for Padawan sub-district, the estimated value is RM 11,100.97, Siburan district and Bau is RM 5,566.42 and RM 14,945.71 respectively. For the 5% level participation, Padawan sub-district estimated value is RM 22,201.93, Siburan district is RM 11,132.82 and Bau district is RM 29,891.42. For the 10% level of community participation is RM 44,403.85 (Padawan sub-district), RM 22,265.65 (Siburan district) and RM 59,782.82 (Bau district). Finally for the 20% involvement shows RM 88,807.70 (Padawan sub-district), RM 44,531.31 (Siburan district) and RM 119,565.70 (Bau district).

Similar to medicinal plants, based on the calculation the value of food plants used also varies with different level of participation among the Bidayuh communities in Padawan, Siburan and Bau. With a 2.5%, it shows for Padawan sub-district, the estimated value is RM 13,642.57, Siburan district and Bau is RM 7,576.14 and RM 22,130.36 respectively. For the 5% level participation, Padawan sub-district estimated value is RM 27,285.14, Siburan district is RM 15,152.27 and Bau district is RM 44,260.68. For the 10% level of community involvement is RM 54570.28 (Padawan sub-district), RM 30,304.54 (Siburan district) and RM 88,521.37 (Bau district). Finally for the 20% participation shows RM 10,9140.6 (Padawan sub-district), RM 60,609.08 (Siburan district) and RM 17,7042.70 (Bau district).

CHAPTER 5

CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

The pattern of medicinal plant utilization between the three Bidayuh communities in the Padawan sub-district, Bau district, and Siburan district shows little difference. However, there is a difference in the number of medicinal plants collected in a year between the three districts, and the education level factor affects it. Similar to medicinal plants, the wild food plant utilization pattern between the three selected study sites shows only a slight difference. Still, there is a significant difference in the number of food plants collected in a year between the three districts. Education level and gender are two factors that affect this variation.

The Bidayuh communities continue to rely on wild plants for traditional medicine, although these plants are not the primary source of healthcare. They also incorporate wild food plants into their daily diets. However, due to changing lifestyles and modernization, traditional knowledge regarding the use of these resources—both medicinal and nutritional—is increasingly being lost, especially among younger generations.

Currently, the documentation on the use of medicinal and food plants by the Bidayuh communities in Sarawak is incomplete. There is an urgent need for more thorough studies that focus on traditional knowledge related to the use of natural resources for medicine and nutrition. Additionally, efforts should be made to conserve and preserve both this traditional knowledge and the natural resources themselves.

5.2 Recommendations

The current documentation is insufficient to adequately represent the utilization of medicinal and food plants by the Bidayuh communities in Sarawak. There is a pressing need for more comprehensive studies that focus on traditional knowledge, the usage of medicinal and food plants, and the necessary efforts to conserve and preserve this knowledge along with natural resources. Additionally, it is imperative to enhance initiatives aimed at selecting and cultivating wild plant species of significant commercial importance for future agricultural development.

REFERENCES

Abiyot, B., Sebsebe, D., Zerihun, W., Friis, I., & Breugel, P. V. (2018). Intermediate evergreen Afromontane forest (IAF) in northwestern Ethiopia: Observations, description and modelling its potential distribution. *Phytocoenologia*, *48(*4), 351-367. https://doi.org/10.1127/phyto/2018/0207

Addis, G., Urga, K., & Dikasso, D. (2005). Ethnobotanical study of edible wild plants in some selected districts of Ethiopia. *Human Ecology*, *33*, 83-118. https://doi.org/10.1007/s10745-005-16560

Agudo, A., & Joint, F. A. O. (2005). Measuring intake of fruit and vegetables [electronic resource]. World Health Organization.

Antons, C. (2013). Asian borderlands and the legal protection of traditional knowledge and traditional cultural expressions. *Modern Asian Studies*, *47*(4), 1403-1433.

Anupunt, P., Somsri, S., Chaikiattiyos, S., & Kumscha, U. (2002). Native tropical Asian fruits. In XXVI International Horticultural Congress: Asian Plants with Unique Horticultural Potential: Genetic Resources. *Cultural*, *620*, 151-159.

Astutik S, Pretzsch J, & Kimengsi JN. 2019. Asian medicinal plants' production and utilization potentials: A review. *Sustainability*, *11*, 1-33. DOI:10.3390/su11195483.

Bachok, M. F., Mohd Yusof, B. N., Ismail, A., & Hamid, A. A. (2014). Effectiveness of traditional Malaysian vegetables (ulam) in modulating blood glucose levels. *Asia Pacific Journal of Clinical Nutrition*, *23*(3), 369-376. https://doi.org/10.6133/apjcn.2014.23.3.01

Balick, M. J., Arvigo, R., Shropshire, G., Walker, J., Campbell, D., & Romero, L. (2002). The Belize Ethnobotany Project: Safeguarding medicinal plants and traditional knowledge in Belize. In Wootton, J. C., & Iwu, M. M. (Eds.). *Advances in Phytomedicine*, *1*, 267-281.

Baling, J. (2012). *Medicinal plants of the local communities around Gunung Jagoi in Bau district* [Project report (B.Sc.), Universiti Malaysia Sarawak]. UNIMAS.

Baling J., Noweg G.T., Sayok A.K., Wadell I., & Ripen J.E. (2017). Medicinal plants usage of Jagoi Bidayuh community, Bau District, Sarawak, Malaysia. *Journal of Borneo-Kalimantan*, *3*, 67-87. DOI:10.33736/jbk.619.2017.

Bekalo, T. H., Woodmatas, S. D., & Woldemariam, Z. A. (2009). An ethnobotanical study of medicinal plants used by local people in the lowlands of Konta Special Woreda, southern nations, nationalities and peoples regional state, Ethiopia. *Journal of Ethnobiology and Ethnomedicine*, *5*, 1-15. https://doi.org/10.1186/1746- 4269-5-26.

Belcher, B., Ruiz-Pérez, M., & Achdiawan, R. (2005). Global patterns and trends in the use and management of commercial NTFPs: implications for livelihoods and conservation. *World Development*, *33*(9), 1435-1452.

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/0.1098/rstb.2010.0123

Bouasla A & Bouasla I. 2017. Ethnobotanical survey of medicinal plants in northeastern of Algeria. *Phytomedicine*, *36*, 68–81. Doi:10.1016/j.phymed.2017.09.007.

Bush, G., Hanley, N., & Rondeau, D. (2011). Comparing opportunity cost measures of forest conservation in Uganda; implications for assessing the distributional impacts of forest management approaches. *Research Papers in Economics, 1,* 3-36.

Carson, R. T. (2000). *Contingent Valuation: A User's Guide*. American Chemical Society.

Carson, R. T., Flores, N. E., & Meade, N. F. (2001). Contingent valuation: Controversies and evidence. *Environmental and Resource Economics*, *19*, 173-210.https://doi.org/10.1023/A:1011128332243

Cruz-García, G. S., & Price, L. L. (2011). Ethnobotanical investigation of "wild" food plants used by rice farmers in Kalasin, Northeast Thailand. *Journal of Ethnobiology and Ethnomedicine, 7,* 1-21. https://doi.org/10.1186/1746-4269-7-33

Chang, P. F. (2002). *History of Bidayuh in Kuching Division, Sarawak*. Chang Pat Foh.

Chai, P. P., Tipot, E., & Henry, J. (2008). Traditional knowledge on utilization of natural resources among the Penan communities in northern Sarawak, Malaysia. *IUFRO World Series, 21,* 16.

Charnley, S., & Poe, M. R. (2007). Community forestry in theory and practice: Where are we now? *Annual Review of Anthropology*, *36*, 301-336. https://doi.org/10.1146/annurev.anthro.35.081705.123143

Chingonikaya, E. E., Munishi, P. K. T., & Luoga, E. J. (2008). Community Based Forest Management in Tanzania: Does this Change Rural livelihoods? *Journal of the Korean Society of African Studies, 27,* 269-293.

De Beer, J. & McDermott, M. (1996) *The economic value of non-timber forest products in Southeast Asia*. Amsterdam, the Netherlands: IUCN.

Denis, N. (2004). Studies in Medicinal Plants of the Iban Communities in Hulu Samarahan, Serian [Project report (B.Sc.)]. Universiti Malaysia Sarawak.

Dixon, J., Scura, L., Carpenter, R., & Sherman, P. (2013). *Economic Analysis of Environmental Impacts*. Routledge.

Ellerman, J., McFeeters, D., & Fox, J. (2001). Direct Marketing as a Value-Added Opportunity for Agriculture. Fact Sheet AE-8-01. Ohio State University.

Fathul Yusro, Yeni M, & Evy W. (2021). The utilization of medicinal plants to cure gastrointestinal disorders by the Dayak muara tribe in Kuala Dua village, Sanggau Regency. *Jurnal Biologi Tropis*, *21*, 416–426.

Fasihuddin BA & Laily BD. (1999). Medicinal plants used by various ethnic groups in Sarawak. *Malaysian Journal of Science*, *18*, 7-11.

Franzel, S., Carsan, S., Lukuyu, B., Sinja, J., & Wambugu, C. (2014). Fodder trees for improving livestock productivity and smallholder livelihoods in Africa. *Current Opinion in Environmental Sustainability*, *6*, 98-103. https://doi.org/10.1016/j.cosust.2013.11.008

Fernando, G., & Pillay, V. V. (2004). Medicinal Plants in China--A Selection of 150 Commonly Used Species (pp. 13). WHO Regional Publications.

Fugaro, F., & Maryo, M. (2018). Ethnobotanical study of wild edible plants in Kedida Gamella Woreda, Kambatta Tembaro Zone, SNNPRS, Ethiopia. *International Journal of Modern Pharmaceutical Research*, *2*, 1-9.

Goodenough, W. H. (1959). *[Review of Nine Dayak Nights, by W. R. Geddes]. The Journal of American Folklore*, *72*(285), 257–258. https://doi.org/10.2307/538141

Given, D. R., & Harris, W. (1994). *Techniques and methods of ethnobotany: as an aid to the study, evaluation, conservation and sustainable use of biodiversity*. Commonwealth Secretariat Publications.

Grivetti, L. E., & Ogle, B. M. (2000). Value of traditional foods in meeting macro-and micronutrient needs: the wild plant connection. *Nutrition Research Reviews*, *13*(1), 31-46. https://doi.org/10.1079/095442200108728990

Gunatilake, H.M., Vieth, G.R., 2000. Estimation of on-site cost of soil erosion: a comparison of replacement and productivity change methods. *Journal of Soil and Water Conservation*, *55*, 197–204.

Gyasi, R. M., Mensah, C. M., Osei-Wusu Adjei, P., & Agyemang, S. (2011). Public perceptions of the role of traditional medicine in the health care delivery system in Ghana. *Global Journal of Health Science*, *3*(2), 40-49. https://doi.org/10.5539/gjhs.v3n2p40

Hanazaki, N., Herbst, D. F., Marques, M. S., & Vandebroek, I. (2013). Evidence of the shifting baseline syndrome in ethnobotanical research. *Journal of Ethnobiology and Ethnomedicine*, *9*(1), 1-11.

Heubach, K., Wittig, R., Nuppenau, E. A., & Hahn, K. (2013). Local values, social differentiation and conservation efforts: The impact of ethnic affiliation on the valuation of NTFP-species in Northern Benin, West Africa. *Human Ecology*, *41*(4), 513-533. https://doi.org/10.1007/s10745-013-9592-x

Hishe, M., Asfaw, Z., & Giday, M. (2016). Review on value chain analysis of medicinal plants and the associated challenges. *Journal of Medicinal Plants Studies*, *4*(3), 45-55.

Hunde, D., Asfaw, Z., & Kelbessa, E. (2006). Use of traditional medicinal plants by people of Boosat sub district, Central Eastern Ethiopia. *Ethiopian Journal of Health Sciences*, *16*(2), 141-155. https://hdl.handle.net/10520/AJA10291857_70

Jamal, J. A. (2006). Malay traditional medicine: An overview of scientific and technology advancement. *Asia Pacific Tech Monitor*, *23*, 37-49.

Jamal, J. A., Ghafar, Z. A., & Husain, K. (2011). Medicinal plants used for postnatal care in Malay traditional medicine in the Peninsular Malaysia. *Pharmacognosy Journal*, *3*(24), 15-24. https://doi.org/10.5530/pj.2011.24.4

Jantzen, J. (2006). *The economic value of natural and environmental resources*. Institute for Applied Environmental Economics, Netherlands.

Jong, W. W., Tan, P. J., Kamarulzaman, F. A., Mejin, M., Lim, D., Ang, I., & Lee, H. B. (2013). Photodynamic activity of plant extracts from Sarawak, Borneo. *Chemistry and Biodiversity*, *10*(8), 1475-1486. https://doi.org/10.1002/cbdv.201200303

Guarrera, P. M., & Savo, V. (2016). Wild food plants used in traditional vegetable mixtures in Italy. *Journal of Ethnopharmacology*, *185*, 202-234.

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

Kengen, S. (1997). *Forest valuation for decision-making: lessons of experience and proposals for improvement*. Food and Agriculture Organization of the United Nations.

Kedit, P.M. (1982). An Ecological Survey of the Penan. *Sarawak Museum Journal*, *30*, 226-279.

Khan, F. A., Bhat, S. A., & Narayan, S. (2017). Wild edible plants as a food resources: Traditional knowledge. *University of Agricultural Science and Technology*, *1*, 1-20. https://doi.org/10.13140/RG.2.2.34547.53285

Kidane L, Gebremedhin G, & Beyene T. 2018. Ethnobotanical study of medicinal plants in Ganta Afeshum District, Eastern Zone of Tigray, Northern Ethiopia. *Journal of Ethnobiology and Ethnomedicine. 14*, 1-19.

Kulip, J. (2005, February). Similarity of Medicinal Plants Used by Two Native Communities in Sabah, Malaysia. *Acta Horticulturae*, *675*, 81–85. https://doi.org/10.17660/actahortic.2005.675.10

Martin, G. J. (2004). *Ethnobotany: A Methods Manual (Vol. 1)*. Springer.

Mertz, O., & Christensen, H. (1997). Land use and crop diversity in two Iban communities, Sarawak, Malaysia. *Geografisk Tidsskrift-Danish Journal of Geography*, *97*(1), 98-110.

Mesfin, K., Tekle, G., & Tesfay, T. (2013). Ethnobotanical study of traditional medicinal plants used by indigenous people of Gemad District, Northern Ethiopia. *Journal of Medicinal Plants Studies*, *1*(4), 32-37.

Mohammad OF, Shaikh BU, Barlow JW, Hu S, Dong S, Cai Q, Li1 X, and Hu X. 2018. Quantitative ethnobotany of medicinal plants used by indigenous communities in the Bandarban district of Bangladesh. *Frontiers in Phramacology*, *9*, 1-12.

Mohammed, N.K., Muhialdin, B.J., Masri, N.S., Sukor,R., Abd-El Aziem, F. & Meor Hussin, A.S (2020). Chemical compositions, antioxidant andantimicrobial activities

of Tubu (*Pycnarrhena longifolia*) leaves used as ingredient intraditional functional foods. *Food Research*, *4*(3), 823-830.

Milow, P., Malek, S. B., Edo, J., & Ong, H. C. (2014). Malaysian species of plants with edible fruits or seeds and their valuation. *International Journal of Fruit Science*, *14*(1), 1-27. https://doi.org/10.1080/15538362.2013.801698

Minos, P. (2000). *The future of the Dayak Bidayuhs in Malaysia*. Lynch Media & Services.

Mitchell, R. C., & Carson, R. T. (2013). *Using surveys to value public goods: The contingent valuation method.* Resources for the Future.

Mohamad, A. G. (2003). Medicinal plants of the Iban communities in Sabal District, Sarawak [Project report (B.Sc.)]. Universiti Malaysia Sarawak.

Naming, M. (2015) *Assessing the pattern of utilization of wild plants for medicinal purpose The Case of Bidayuh Tebia of Kampung Kiding, Padawan, Sarawak.* [Masters thesis, Universiti Malaysia Sarawak]. UNIMAS.

Nashriyah, M., Athiqah, M. N., Amin, H. S., Norhayati, N., Azhar, A. M., & Khairil, M. (2011). Ethnobotany and distribution of wild edible tubers in Pulau Redang and nearby islands of Terengganu, Malaysia. *International Journal of Nutrition and Food Engineering*, *5*(12), 911-914.

Nirmal, S. A., Pal, S. C., Otimenyin, S. O., Aye, T., Elachouri, M., Kundu, S. K., & Mandal, S. C. (2013). Contribution of herbal products in global market. *Pharmaceutical Review*, *2013*(November-December), 95-104.

Notaro, S., & Paletto, A. (2012). The economic valuation of natural hazards in mountain forests: An approach based on the replacement cost method. *Journal of Forest Economics*, *18*(4), 318-328.

Noweg, T., Abdullah, A. R., & Nidang, D. (2003). Forest plants as vegetables for communities bordering the Crocker Range National Park. *ASEAN Review of Biodiversity and Environmental Conservation*, *2003*(January-March), 1-18.

Noweg, G.T. & Jihen, B. (2005). Wild Plants used as traditional medicine to treat minor illness or ailments in the Bidayuh Community in Bau District. In Alek Tuen (Ed.). *Biological Resources of Western Sarawak*. Institute of Biodiversity and Environmental Conservation, Universiti Malaysia Sarawak.

Ogle, B. M., Tuyet, H. T., Duyet, H. N., & Xuan Dung, N. N. (2003). Food, feed or medicine: the multiple functions of edible wild plants in Vietnam. *Economic Botany*, *57*(1), 103-117. https://doi.org/10.1663/0013-0001(2003)057[0103:FFOMTM]2.0.CO;2

Ong, H. C., Ruzalila, B. N., & Milow, P. (2011). Traditional knowledge of medicinal plants among the Malay villagers in Kampung Tanjung Sabtu, Terengganu, Malaysia. *Indian Journal of Traditional Knowledge*, *10*(3), 460-465.

Ong, H. C., Zuki, R. M., & Milow, P. (2011). Traditional knowledge of medicinal plants among the Malay villagers in Kampung Mak Kemas, Terengganu, Malaysia. *Studies on Ethnomedicine*, *5*(3), 175-185. https://doi.org/10.1080/09735070.2011.11886407

Ong, H. G., & Kim, Y. D. (2014). Quantitative ethnobotanical study of the medicinal plants used by the Ati Negrito indigenous group in Guimaras island, Philippines. *Journal of Ethnopharmacology*, *157*, 228-242.

Ribeiro, A., Romeiras, M. M., Tavares, J., & Faria, M. T. (2010). Ethnobotanical survey in Canhane village, district of Massingir, Mozambique: medicinal plants and traditional knowledge. *Journal of Ethnobiology and Ethnomedicine*, *6*(1), 1-15.

Ripen J.E & Noweg G.T. (2016). Economic valuation of medicinal plants in Jagoi Area, Bau, Malaysia. Procedia - *Social and Behavioral Sciences*, *224*, 124–131. DOI:10.1016/j.sbspro.2016.05.415.

Ripen, J. E., & Noweg, G. T. (2017). Documenting ethnobotanical knowledge of rural community for sustainable benefits. *International Journal of Service Management and Sustainability*, *2*(1), 1-16.

Runi, S. P.; & Lee, H. S. (2001). The use of plants for medicinal purpose in Sarawak. *14th Malaysian Forestry Conference*, *42*(1), 61-73.

Saha, D., & Sundriyal, R. C. (2012). Utilization of non-timber forest products in humid tropics: Implications for management and livelihood. *Forest Policy and Economics*, *14*(1), 28-40.

Sagoff, M. (1988). Some problems with environmental economics. *Environmental Ethics*, *10*(1), 55-74.

Sayok, A. K., & Teucher, U. (2018). Loss of Food Plants Knowledge and Identity among Indigenous Peoples in Malaysia. *Journal of Advance Research in Social and Behavioural Sciences*, *11*(1), 174-188.

Schunko, C., & Vogl, C. R. (2018). Is the commercialization of wild plants by organic producers in Austria neglected or irrelevant? *Sustainability*, *10*(11), 3989.

Shaffiq, S., Sidik, B. J., Harah, Z. M., & Devi, R. S. (2013). Marketable wild fruits of Sarawak, Borneo: Their mode of consumption, uses and sugar profiles. *Indian Journal of Traditional Knowledge*, *12*(2), 195-201.

Shaffiq, S., Sidik, B. J., Zakaria, M. H. & Devi, R, S. (2018). Indigenous plants from native markets, their availability, and utilization. *International Scientific Conference on Indigenous Crops, 1*, 58-61.

Sharanappa, R., & Vidyasagar, G. M. (2014). Documentation of traditional knowledge on medicinal plants used in treating candidiasis in Hyderabad Karnataka region, India. *World Journal of Pharmacy and Pharmaceutical Sciences*, *3*(7), 739-751.

Shrestha, P. M., & Dhillion, S. S. (2006). Diversity and traditional knowledge concerning wild food species in a locally managed forest in Nepal. *Agroforestry Systems*, *66*, 55-63.

Supiandi MI, Mahanal S, Siti Z, Julung H, & Ege B. (2019). Ethnobotany of traditional medicinal plants used by Dayak Desa community in Sintang, West Kalimantan, Indonesia. *Biodiversitas*, *20*, 1264-1270.

Tang, K. H. D., Ukaejiofo, R. U., & Allred, S. (2024). Perceptions of agriculture-related agencies and farmers in the Malaysian Borneo on climate change: an exploratory qualitative study. *International Journal of Global Warming*, *32*(2), 245-265.

Tardío, J., Pardo-de-Santayana, M., & Morales, R. (2006). Ethnobotanical review of wild edible plants in Spain. *Botanical Journal of the Linnean society*, *152*(1), 27-71.

Teklehaymanot T. (2017). An ethnobotanical survey of medicinal and edible plants of Yalo Woreda in Afar regional State, Ethiopia. *Journal of Ethnobiology and Ethnomedicine*, *13*, 1-25.

Teucher, U., & Sayok, A. K. (2019). Food Plant Knowledge Among Bidayuhs of Sarawak. In *Biodiversity and Environmental Conservation* (2nd ed., Vol. 15). essay, UNIMAS Publisher.

Toaiang AA and Sayok AK. (2019). Utilization of non -timber forest products by Duyoh community, Bau District, Sarawak, Malaysia. *International Journal of Contemporary Research and Review, 10*, 20195- 20205.

Turner, N. J., Łuczaj, Ł. J., Migliorini, P., Pieroni, A., Dreon, A. L., Sacchetti, L. E., & Paoletti, M. G. (2011). Edible and tended wild plants, traditional ecological knowledge and agroecology. *Critical Reviews in Plant Sciences*, *30*(1-2), 198-225. https://doi.org/10.1080/07352689.2011.554492

Uprety, Y., Asselin, H., Dhakal, A., & Julien, N. (2012). Traditional use of medicinal plants in the boreal forest of Canada: review and perspectives. *Journal of Ethnobiology and Ethnomedicine*, *8*, 1-14. https://doi.org/10.1186/1746-4269-8-7

Verma, S., & Singh, S. P. (2008). Current and future status of herbal medicines. *Veterinary World*, *1*(11), 347-350. https://doi.org/10.5455/vetworld.2008.347-350

Vitalini, S., Tomè, F., & Fico, G. (2009). Traditional uses of medicinal plants in Valvestino (Italy). *Journal of Ethnopharmacology*, *121*(1), 106-116. https://doi.org/10.1016/j.jep.2008.10.005

World Health Organization. (2005). *National policy on traditional medicine and regulation of herbal medicines: Report of a WHO global survey*. World Health Organization.

Yusli, N. A., Saupi, N., Ramaiya, S. D., & Lirong, Y. A. (2021). An ethnobotanical study on indigenous food flavourings and aromatic enhancing plants used by the native communities of the central region of Sarawak. *Malaysian Applied Biology*, *50*(3), 105-115.

APPENDICES

Journal Publication

1. Patrick, V., Noweg, T., & Nelson, J. (2023). Utilization of traditional medicinal plants by Bidayuh communities in Sarawak, Malaysia. *Journal of Herbs, Spices & Medicinal Plants*, *29*(3), 250-261

Kpg:

Ethnobotanical Survey on Traditional Medicinal and Food Plants Use in Bidayuh Communities

Questionnaire

Pa/Si/Ba

Section A **Respondent background**

Date:

1. Name:
2. Age:
3. Gender: Male/Female
4. Family size:
5. Family income: _____[Agriculture:_____ Salary: _____ Business_____ Others_____]
6. Educational background: None/Primamry/Secondary/College/University/Others_____ (years)
7. Primary occupation: Housewife/Farmer/Bussiness operator/Government employee/Non-Government employee/ Retiree, _____

Section B **Introduction to Medicinal & Food Plants**

Medicinal plants

8. How many times collecting medicinal plants in a month/year (If none: Why?):
9. Collected medicinal plants are for: Personal/ Sell/ Both

9a. How long has the seller indulge himself/herself in selling medicinal plants in the market: _____ months/years

Food plants

10. How many times collecting food plants in a month/year (If none: Why?):

11. Collected food plants are for: Personal/ Sell/ Both

11a. How long has the seller indulge himself/herself in selling food plants in the market: _____ months/years

Section C **Medicinal Plants**

No	Local name	Part used *(r-root, fro-frond, ys-young shoot, fr-fr fruit, f - flower*	Categories of ailments or disease treated	Method of preparation *(i.e. boil)*	App *(i.e: I-internal, E-external, S-supplement, M-Medicine)*	Num. of app/ Dosage(s)	Sell (/) or Not sell (X)	Cult. Status *(F-forest, C-cultivate)*	Estimated quantity of collection (kg)			Stated price (per kg/ bundle/others)	Notes
									Per week	Per month	Per year		

**** *Medicinal plants with no stated price.*

No.	Time required to collect	Time taken to prepare the treatment for each application/dosage	Number of applications/Dosages	Notes

Food Plants

No.	Local name	Part used *(ys- young shoot, yl – young leaves, fr- fruit, f- flower, h- heart of palm, etc.)*	Process (/) or Not process (X)	Method of prepration *(i.e. boil)*	Sell (/) or Not sell (X)	Cultivation status *(F- forest, C- cultivate)*	Estimated quantity of collection (kg)			Stated price (per kg/ bundle/others)	Notes
							Per week	Per month	Per year		