ASSESSING THE PATTERN OF UTILIZATION OF WILD PLANTS FOR MEDICINAL PURPOSE: THE CASE OF BIDAYUH TEBIA OF KAMPUNG KIDING, PADAWAN, SARAWAK

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Margarita Naming

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Assessing the Pattern of Utilization of Wild Plants for Medicinal Purpose: The Case of Bidayuh Tebia of Kampung Kiding, Padawan, Sarawak

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ABSTRACT

Globally, medicinal plants have contributed to the discovery of important compounds with new use and especially for drugs. This gives rise to the world’s interests in exploring and documenting the traditional knowledge of how local and indigenous communities around the world use plant resources. There is a great concern that the knowledge of the communities are diminishing due to the passing of the older generation and the change in land-use and lifestyle of the younger generation. Hence, this study aims to document the knowledge of the community and the distribution pattern of the medicinal plants among the Bidayuh of Kampung Kiding, Sarawak. A total of 35 species of plants belonging to 25 family were documented on its uses for medicinal purposes. Of these, 72% (27 species) of the plant species were medicinal plants for external use, 16% (6 species) for internal use, 8% (3 species) for healing of disease caused by ‘black magic’ or spirits and 3% (1 species) was for preventing hair fall and itchy scalp. Among the three vegetation sites, the agroforestry site recorded the highest number of species (28 species) followed by the old rubber farm (14 species) and secondary forest (13 species). The high number of species in the agroforestry site is due to the accessibility to the area by the community. Hence, more useful plant species are planted. Though, the Shannon-Weiner index showed that the old rubber farm has the highest diversity index, the analysis of variance for diversity indices in the three vegetation types indicates that there is no significant difference (F= 1.4228; P-value of 0.2585). The plant Selaginella sp. recorded the highest number of individual at all three sites. The community of Kampung Kiding value medicinal plants based on the people’s affordability and there is no fix payment for the medicinal plants. For conservation purposes, the community is willing to pay RM30 as labour to maintain medicinal plant in an area.

Key words: medicinal plants, traditional knowledge, Bidayuh, Sarawak, number of species, species diversity, Shannon-Weiner Diversity Index, abundance, value
ABSTRAK

Di peringkat global, tumbuhan perubatan telah menyumbang kepada penemuan sebatian penting sebagai produk baru terutamanya untuk perubatan. Ini mempertingkatkan kepentingan dalam meneroka dan mendokumentasikan pengetahuan tradisional masyarakat asli di dunia ini. Ini melibatkan bagaimana masyarakat asli di seluruh dunia menggunakan sumber tumbuhan. Pada ketika ini, terdapat kebimbangan bahawa pengetahuan masyarakat asli kian berkurang kerana ketiadaan generasi tua yang masih menyimpan pengetahuan ini, dan perubahan dalam penggunaan tanah dan gaya hidup generasi muda. Kajian ini bertujuan untuk mendokumentasikan pengetahuan tradisional dan populasi tumbuhan perubatan di kalangan Bidayuh di Kampung Kiding, Sarawak. Sebanyak 35 spesies tumbuhan daripada 25 famili dengan maklumat kegunaanya dari segi perubatan telah direkod. Daripada jumlah ini, 72% (27 spesies) daripada spesies tumbuhan adalah tumbuhan ubatan untuk kegunaan luaran, 16% (6 spesies) untuk kegunaan dalaman, 8% (3 spesies) untuk menyembuh penyakit yang disebabkan oleh 'ilmu hitam' atau roh-roh dan 3% (1 spesies) adalah untuk mencegah keguguran rambut dan kelelemumur. Antara tiga tapak kajian, bilangan spesies (28 spesies) yang tertinggi adalah di tapak 'agroforestry' diikuti oleh kebun getah tua (14 spesies) dan hutan sekunder (13 spesies). Bilangan spesies di tapak 'agroforestry' adalah tertinggi kerana ia telah ditanam dengan pelbagai tumbuhan berguna. Ini adalah supaya masyarakat kampung lebih senang mendapati dan menggunakan pokok tersebut. Akan tetapi, Indeks Shannon-Weiner menunjukkan bahawa kebun getah lama mempunyai indeks kepelbagaian yang paling tinggi. Walau bagaimanapun, analisis varians bagi indeks kepelbagaian dalam tiga jenis vegetasi menunjukkan bahawa tidak ada perbezaan yang signifikan (F = 1,4228 ; P- nilai 0,2585 ). Species Selaginella sp. mencatatkan jumlah individu yang tertinggi di ketiga-tiga tapak. Masyarakat Kampung Kiding, menilai tumbuhan ubatan berdasarkan kepada kemampuan individu dan tiada bayaran tetap untuk tumbuhan perubatan. Untuk tujuan pemuliharaan, masyarakat sanggup membayar RM30 untuk mengekalkan kawasan tumbuhan ubatan.

Kata kunci: tumbuhan ubatan, pengetahuan tradisional, Bidayuh, Sarawak, bilangan spesies, kepelbagaian spesies, indeks kepelbagaian Shannon-Weiner, kelimpahan, nilai
INTRODUCTION

Traditional knowledge is the experience-based knowledge of a local and indigenous community on how resources are use to ensure the survival of the community. It also includes the knowledge of how the community sustains livelihood while integrating with environment. This knowledge is developed by generations of community members over time, based on the adaption to a community and their surrounding environment and will continuously evolve. Although the traditional knowledge of using plants for medicine was once a major source for the development of new drugs, ethnobotany-driven drug discovery programmes declined in the 20th century (Hansen and Vanfle**t, 2003).

Despite the decline plant-based drug discovery programs, the use of traditional medicine for the treatment of disease remains widespread. Among the developing world, more than 80% of the population continues to depend on traditional medicines for primary health care (Shanley and Luz, 2003). In developing countries, traditional medicines are considered a more affordable source of treatment for disease compared to modern medicine. In recent years, even developed countries have incorporated plant-based natural medicinal products into their health care systems. In the United States of America and Canada, herbal supplements have become more and more popular (Mukhtar et al., 2008; Gurib-Fakim, 2006).

Over more than a decade and as traditional herbal remedies regained popularity in the developed world, biotechnological, pharmaceutical, and human health care industries began to show increasing interest in natural products as sources of new biochemical compounds for drug, chemical and agro-product development. The result was a resurgence of interests in the traditional knowledge of medicinal plants, especially after researcher began to recognize the importance of traditional knowledge. This interest is further
stimulated by the importance of traditional knowledge as a lead in new natural product
development (Mugabe, 1999). Michael Balick found that using traditional knowledge
increased the efficiency of screening plants for medicinal properties by more than 400%
(Nijar, 1996). The identification of novel bioactive compounds from plants is now
providing leads for new drug development (Phillipson, 2007). It is estimated that between
20,000 and 55,000 species of plants have been used medicinally but only a small portion
has been investigated for drug development. More specifically, only 15 to 20% of
terrestrial plants have been evaluated for phytochemical active materials or ingredients.
(Fabricant and Farnsworth, 2001; Soejarto et al., 2005). About 1% has been evaluated and
documented by rigorous scientific investigations for their medicinal or chemical properties
and accepted for commercial purposes (Nijar, 1996; Kartal, 2007). The large numbers of
medicinal plants that have not yet been investigated is now recognized as a potential lead
material for discovery of new drugs.

In light of the pharmaceutical industry’s great interest in traditional medicine, there is
now increasing concern among the indigenous communities regarding the protection of
their traditional knowledge from misappropriation and exploitation. Modern intellectual
property laws have allowed industries to monopolize the benefits derived from the use of
traditional knowledge without acknowledgment or compensation for the communities
(Hansen and Vanfleer, 2003).

Of the 119 drugs developed from higher plants and on the world market today, it is
estimated that 74% were discovered from a pool of traditional herbal medicine (Nijar,
1996; Mugabe, 1999). In the western medicine, at least 7,000 medical compounds used are
derived from plants. The value contributed by medicinal plants from developing countries
to the pharmaceutical industry in the early 1990s was estimated to be at least US$32 billion
per year (Khor, 2002). The world market for herbal medicine has been estimated at
US$60-US$80 billion and a great part of the modern pharmaceutical industry has been developed on the bases of medicinal plants discovered by indigenous communities (Chai, 2006; Kartal, 2006). While developing countries and their indigenous peoples have contributed considerably to the global drug industries, they received little benefit or compensation from such development.

Malaysia, being one of the 12 mega-diverse centers of the world, is blessed with rich plant genetic diversity and many of these plants are used for medicinal purposes. Out of the 12,000 species of vascular plants, it is estimated about 10% have been reported with medicinal value. The market value of herbal products in year 2000 was estimated at US$530 million (Batugal, 2004; Samy, 2005). Since then, the annual growth rate was between 10-15% (Samy, 2005) and by year 2010, the market for herbs and plant-based medicine in Malaysia had increased to US$1.37 billion (Batugal, 2004).

There is a great concern that many of the older generation who holds the traditional knowledge of medicinal plants face various difficulties and the survival of the knowledge is at stake. The survival of the communities is under threat from external social and environmental pressures, migration, the encroachment of modern lifestyles, the disruption of traditional ways of life, and lack of respect and appreciation for their knowledge. In addition, there are also concerns regarding exploitation and lack of fair compensation. (WIPO). Pei et al., (2009) strongly recommended that the knowledge of the people or indigenous or traditional knowledge should be documented and evaluated before it is lost. Indeed, with the current pace of globalization, the traditional knowledge of the world’s indigenous communities needs to be investigated and documented or it will unquestionably be forever lost (Appendino et al., 2010). This knowledge plays an important role in ensuring conservation and sustainable use of forests resources. A study by Maroyi (2013) explained that community often plant useful and medicinal plants in their home gardens to
enable the continuous use of such plant. Some of these plants are endemics to the area and exist in small population.

Grain (2006) also stressed the importance of converting the traditional knowledge of local communities into written documents, drawings or audio recordings. Such extensive documentation is necessary to not only protect the information from being lost but also protect the intellectual property of these communities by establishing the documented information as prior art. With this documentation system in place, we would be better able to prevent the biopiracy of local resources, which are used based on the local knowledge.

Similarly, the ethnic communities in Sarawak that still retain traditional knowledge may lose the knowledge due to changing lifestyles, availability of modern amenities, and diminishing dependence of indigenous communities on natural resources. Thus, it has become increasingly important that traditional knowledge is documented by the respective indigenous communities and retained as heritage so that it will not be lost. Traditional knowledge is a legacy to be handed down through generations and its value cannot be measured by any material or monetary means.

In Mat-Salleh (2001), it was stressed that ethnobotanical studies of the ethnic communities of Malaysia has been limited to Peninsular Malaysia, which covers 61% of 148 publications. Therefore, there are only 20% and 19% publications for Sabah and Sarawak, respectively. Out of these publications, the majority are detailed studies relating to the Malay, Iban, Kadazan/Dusun and Temuan communities. Other communities have very limited publications regarding their knowledge of medicinal plants and sometimes, publications on how certain communities use plants for medicine are of non-existence or lacking.
Objectives

The main purpose of this study is to document the medicinal plants used by the Bidayuh Tebia community in different vegetation types. The study objectives are to estimate the distribution, density and diversity of medicinal plants in different vegetation types. The specific objectives of this study are:

1. To systematically document medicinal plants and its uses among the Bidayuh Tebia Community of Kampung Kiding, Padawan in Sarawak
2. To describe and provide botanical information, uses and preparation of the medicinal plants documented
3. To determine the pattern of distribution of medicinal plants in different vegetation types
4. To estimate the relative frequency of species at different vegetation types
5. To estimate the diversity of these plants species at different vegetation types
6. To estimate the value of medicinal plant to the community

In this study it is hypothesized that there is difference in species diversity between different vegetation types, as stated below:

H₀: there are no differences in species diversity between different vegetation types
H₁: there are differences in species diversity between different vegetation types.
LITERATURE REVIEW

Ethnobotany

The term ‘ethnobotany’ was first coined in 1895 by Harshberger. He simply termed it as ‘the use of plants by aboriginal peoples’ but with the turn of the century, the focus of ethnobotany began to evolve and does not only cover how plants are used but also include how they are managed and the inter-relationships between plants and indigenous peoples (Cotton, 1996; Schultes and Reis, 1995).

Based on Martin (1995), ethnobotany is defined as a study which described how local people interact with the plants. He further explained that ethnobotanists need to understand a broad range of academic discipline as it covers plant taxonomy, ecology, pharmacology, anthropology, linguistics and economic botany. Pei et al. (2009) advocate that ethnobotany is an indicator of sustainable forest use. The documentation and investigation of forests resources which link to traditional knowledge is a quantitative assessment of forest use and management.

Traditional Knowledge & Healthcare

The term “Traditional knowledge (TK)” refers to knowledge possessed by indigenous people, in one or more societies and in one or more forms, including, but not limited to, art, dance and music, medicines and folk remedies, folk culture, biodiversity, knowledge and protection of plant varieties, handicrafts, designs and literature (Ragavan, 2001). Traditional Knowledge of a community is in complete synchronization with their way of life. It is a dynamic entity constantly changing and evolving with generations and time. In many cases, such knowledge is often passed down orally through generations and seldom
put in any formal form of documentation. The Convention on Biological Diversity defines traditional knowledge as “knowledge, innovations and practices of indigenous and local communities”. It is derived from the centuries of experiences gained and modified from customary uses of biological resources and associated cultural practices and traditions. It is collectively owned and is transmitted orally through observations of the environment and self management of resources use which ensure sustainability” (Pei et al., 2009).

In most developing world, there is still lacking of basic health care systems. The World Health Organization (WHO) has indicated that more than half of the world’s population does not have access to adequate health care services (Batugal, 2004). This is due to the fact that poor people neither have access to nor could afford the present health care services. Therefore, medicinal plants offer alternative remedies as these can be used to prevent, alleviate or cure several human diseases. The WHO estimates that more that 80% of the world’s population rely either solely or largely on traditional remedies for health care (Batugal, 2004; Cragg and Newman, 2012).

**Global Use of Medicinal Plants**

According to the World Health Organization (WHO) “a medicinal plant” is any plant which one or more of its parts contains substances that can be used for the therapeutic purposes or which are precursors for the synthesis of useful drugs. This definition distinguishes those plants whose therapeutic properties and constituents have been established scientifically and plants that are regarded as medicinal but which have not yet been subjected to thorough investigation (Okigbo, 2009).

WHO also defines medicinal plant as herbal preparations produced by subjecting plant materials to extraction, fractionation, purification, concentration or other physical or biological processes which may be produced for immediate consumption or as a basis for
herbal products (Okigbo, 2009). The use of medicinal plants by indigenous communities over centuries is considered a ‘clinical trial’. This created a shortcut as biological active compounds are discovered through the utilization of these medicinal plants. Though transforming the knowledge and resources to products are complicated, the studies of pharmacopeias have lead to the discovery of new drugs. Some of the drugs include digoxin, tubocurarine, ephedrine, atropine and quinine. Medicinal plants continue to provide important new leads especially for cancer and HIV/AIDS. In the United States market, several natural product drugs of plant origin have been introduced such as arteether, galantamine, nitisinone, and tiotropium, or are currently involved in late-phase of clinical trials. (Appendino et al., 2010; Balunas and Kinghorn, 2005). Though there are interesting active ingredients discovered, natural product drug development is complicated and requires both funds and time. Based on the USA National Cancer Institute, research from 1960 to 1982 on 35,000 plant samples yielded 114,000 extracts. Of these, only two compounds, taxol and camptothecin were further developed to an advanced stage and subsequently into commercial products (Cragg and Newman, 2012).

Market and Non-market Value of Natural Resources

Benefits of a resource is valued by an economist as direct use value where the resource is a produced as an output or consumed as goods while the indirect use value include protecting of sustaining economic activity. Examples include timber and non-timber products for direct use values in forestry and protection of watersheds and fisheries as indirect use values of trees. The non-use value is meant to satisfy the human’s need. In this situation, it comprise of intangible benefits where certain species of wildlife is protected for posterity purposes. Such is the conservation of pandas and tigers. The types of forest value and valuation technique are shown as Figure 1.
Bishop (1999).

Figure 1 Forest Value and Valuation Techniques

The value of non-timber forest is usually not directly recognizable or reflected in market price. This does not mean that these are not economically valuable. Most times, forests produce which are tradable commodities such as timber or agricultural products decreased the importance of non-timber goods and environmental services. The non-market value especially relating to the environment such as in protecting watersheds, control of flood and others get little focus as direct costs and tangible benefits of these
activities are not seen (Bishop 1999). The economic valuation methods presented by Bishop (1999) include *willingness to pay* by consumer for a particular non-marketed benefit or the willingness to accept monetary compensation when such resources are loss. Though market prices for non-timber forest products exist, the economic value of these resources may be not recognized and undervalued. One may consider the cost of measures taken to prevent or compensate for the loss of a non-market benefit which is also known as the *replacement or relocation cost*. Another method is related to consumer’s expenditure in getting to the site where such resources are found. The travel cost method includes direct transport costs as well as opportunity cost of time spent travelling to the site. Other methods of evaluation which are considered most useful include *opportunity cost* and *cost-effectiveness approaches*. These methods focus on the market costs or the opportunities which are unavoidable in order to protect these benefits derived. Opportunity costs take into account any benefits which are generated if the alternative land uses are foregone due to conservation of the land or its resources.

**Value of Medicinal Plants**

Considering that medicinal plants are also an important source for future ‘blockbuster’ drugs besides as herbal use, the argument to preserve the world’s most species rich ecosystem has become more eminent. It is reported by Pearce and Moran (1994) that in the developed world, 25% of all medical drugs are based on plants and plant derivatives while among the developing and poor countries, dependence on plants are as high as 75%. In developed countries, plant-based products also play an important role in the health care systems. Trivedi (2006) reported that the World Health Organization has listed 21,000 plants species for medicinal purposes in around the world. Based on Cragg and Newman (2012), study on US-based prescription data from year 1993 found that natural products
play an important role in drug treatment. At least 50% of prescribed drugs in the USA had natural product either as the drug or through a synthesis form.

Herbal medicines industry has shown an increased growth in this century and the uses range from herbal medicines, food supplements, cosmetics and perfumery. In the light of investigating plants for ethnopharmacological uses, valuation can also consider the economic value of commercial drugs which are based on plants. This valuation is dependent on whether the compounds derived from plants to develop the drugs can be synthesized or are wholly dependent on natural sources. Such is digitoxin used for treatment of cardiac arrest. It is dependent on the natural extracts from common foxglove, Digitalis purpurea and cannot be reproduced synthetically. Vincristine from Catharanthus roseus which is used in the treatment of leukemia on the other hand can be synthetically substituted. Considering this, the plant-based drugs which are developed solely from natural sources may have higher economic value as compared to plant-based drugs which can be synthetically developed (Pearce and Moran, 1994).

The value of medicinal plants also include as important source where bioactive compounds such as digoxin is isolated and directly as drugs while some are used to produce bioactive compounds which are either novel or known structures. These are lead compounds for semi-synthesis to produce patentable compound or uses such as the discovery of taxol. Some medicinal plants are agents of pharmacological tools while some are used as a whole as herbal remedy, such as Gingko biloba (Fabricant and Farnsworth, 2001).

The trading of medicinal and aromatic plants (MAP) around the world is difficult to assess. The bulk of materials are exported from developing countries as major markets are in the developed countries. It is estimated that there are around “4000 to 6000 botanicals” which are of commercial importance. Based on United Nations Conference on Trade and
Development Commercial Trade (UNCTAD COMTRADE) Database, the import-export of MAP among 12 leading countries from 1991 to 1998 was reported as 342,550 tonnes and valued at USD$1,015,200 and 281,550 tonnes at USD$643,200 respectively. The highest country importing MAP is Hong Kong while the highest exporting country is China (Schippmann et al., 2006). The global market for phytomedicines, pharmaceuticals, essential oils and bio pesticides is huge and continuously expanding. In year 2000, it was estimated that the world market for phytomedicines was USD$18.5 billion (Samy et al., 2005). In 1991, United States reported that for every 10,000 pure compounds, 20 would be tested in animal models and 10 would be clinically evaluated. However, only one would reach US food and Drug Administration approval for marketing. This would take a time frame of 10 years and a cost of USD$231 million (Fabricant and Farnsworth, 2001).

Medicinal Plants Studies in Malaysia/Sarawak

Malaysia

It is estimated that that there is around 8,100 plant species in the rainforests of Malaysia. Of this, 10% has been reported to have some medicinal value. It was estimated that the market value of herbal products in Malaysia in year 2000 was USD$0.53 billion. It is estimated that the annual growth rate of between 10 to 15%. (Samy et al., 2005)

A famous example of a renowned plant from Malaysia is *Eurycoma longifolia* Jack. *E. longifolia* is an herbal medicinal plant of South-East Asian origin, popularly known locally as ‘Tongkat Ali.’ Traditionally, the plant is used for antimalarial, aphrodisiac, anti-diabetic, antimicrobial and anti-pyretic activities, which have also been proven scientifically. Bhat and Karim (2010) reported that the plant parts are rich in various bioactive compounds (like eurycomaoside, eurycolactone, eurycomalactone, eurycomanone, and pasakbumin-B) among which the alkaloids and quassinoids form a
major portion. Though research is ongoing and wide spread, there is still a major gap on its scientific base for commercial utilization (Bhat and Karim, 2010).

**Sarawak**

Mat-Salleh (2000) reported that the earliest record of ethnobotany studies was by Van Steenis in 1958 where he has listed plants used for magic by the Dayak ethnic communities. In 1903, Hose published a paper on the traditional medicine among the Dayak community. This led to several publications on ethnobotanical studies within the Iban community. Besides the Iban community, publications on the Kenyah, Kedayan, Kelabit, Malay and Selako were also found in the late 70s till the mid 90s. However, these were mainly single publications. Chai (2006) also published ethnobotany among several ethnic communities in Sarawak. In 1986, Saigol started studies on a few species of plants with medicinal potential among the ethnic groups of Bidayuh, Iban and Malay. Fasihuddin, Ipor and Din also published a paper on medicinal plants used by various ethnic communities in Sarawak (Mat-Salleh, 2000).

Though numerous studies have been published on the medicinal plants used by selected communities in Sarawak, the most comprehensive was written by Hanna Christensen (2002). Christensen recorded 1,144 species of fungi, lichens, mosses, ferns, gymnosperms, monocotyledons and dicotyledons which are used by the Kelabit of Pa Dalih, Bario and Iban of Nanga Sumpa. In 2006, Chai, published a book on the medicinal plants of Sarawak. Chai (2006) featured 608 species of plants used by 14 communities in Sarawak. The recent study on the medicinal plants of Loagan Bunut National Park has included cytotoxicity screening among the medicinal plants collected (Noweg, 2006). In recent years, since 2001, the State government of Sarawak has initiated a collaborative program in systematically documenting the traditional knowledge with various ethnic
communities in Sarawak. Plant resources collected under this initiative are researched upon and screen for novel compound or use. Through this program, the State government is developing benefits to encourage the conservation of the knowledge and resources through capacity building while potentially creating economic opportunities to the communities (Chuah, et al., 2014; Tu, et al., 2010)

**Ethnobotany and Sustainable Forest Use**

Forest has high economic value to the local people especially in providing food, medicine and livelihood. The management of forest by local people are important as these traditional practices are often favourable towards conservation and sustainable use. Due to the long-established relationship between local people’s needs and the forests, the accumulated knowledge has ensured the sustainable use of these resources. Forests are maintained by the local peoples which ensure the healthy condition.

Pei et al. (2009) concluded an evaluation framework for assessing sustainable use of forests based on ethnobotanical information of various tribes in Yunnan. The Lahu people in Yunnan who have settled over the last 25 years as an agricultural community has caused reduction of their forests and knowledge. In contrast, the Hani people whom retain their knowledge and its resources have contributed towards the protection of the forest. These confirmed that a well maintained traditional knowledge ensures that sustainable management of the forests and its resources, thus reducing forest degradation. The study also showed that commercial harvesting of important medicinal plants cause declination and sometimes extinction of that important species. Thus, maintenance of high commercial value plants by local communities will ensure that the high population of these plant resources. The cultivation of these crops to reduce pressure of wild plant resources is also important to protect the plants and ensure sustainable use of these resources. The
study also reported that a sustainable forest management system should include the local community to ensure its success. In Yunnan, the government and the local communities have established community forests which have abundance of medicinal plants. The strong community relationships have ensure the conservation and sustainable use of medicinal plants.

**Diversity and Abundance of Medicinal Plants**

In the rural community among developing countries, medicinal plants play an important and significant role their lives. These are sources of income through the sale of wild harvested materials. Due to this, the abundance and diversity of medicinal plants species are greatly threatened. The activities of opening old growth forests have also contributed to the loss of medicinal plants. The study of Adnan and Hölscher (2012) reported that the most changes in the structure of Himalayan forests have attributed to anthropogenic activities. The degradation of the Himalayan forests has caused reduction of understory species in terms of its diversity and abundance. However, it is also reported that degraded forests which are left to regenerate has higher probability in the reoccurrence of species which had previously disappeared.

Adnan and Hölscher (2012) indicated that at least 600 plant species which have medicinal used are collected by the locals from the mountain regions in Pakistan. This is to support the livelihood of the people. This activity adds to the degradation of the forests in Pakistan which is currently undergoing a severe deforestation of 1.5% per year. With a current forest cover of 4.8%, Pakistan forest will be reduced to 4.3% at this rate. Thus, there is a great need to expand the forest area so that the livelihood of the people is enhanced. In order to provide information pertaining to conservation and regeneration measures for medicinal plants species in Pakistan, the study by Adnan and Hölscher (2012)