PROSIDING

SEMINAR KEBANGSAAN

SAINS, TEKNOLOGI & SAINS SOSIAL

27 ~ 28 MEI 2002
HOTEL VISTANA, KUANTAN, PAHANG

Anjuran :

Universiti Teknologi MARA
Cawangan Pahang

Dengan Kerjasama

Kerajaan
Negeri Pahang Darul Makmur

JILID 1

HARVESTING MEDICINAL PLANTS IN FOREST AREA OF PENINSULAR MALAYSIA

MOHD AZMI MUHAMMED IDRIS[1] & AWANG NOOR ABD. GHANI[2]
[1] Techno-Economics Division, Forest Research Institute Malaysia (FRIM), 52109, Kepong, Kuala Lumpur.
[2]Faculty of Forestry, Universiti Putra Malaysia (UPM), 43400, Serdang, Selangor.

ABSTRACT

The practice of traditional medicine using medicinal plants from tropical rain forests are still persists despite an advancement of modern medicine. Most of the medicinal plants used by the users, particularly the Malay practitioners, are gathered from the forest. Without proper regulations on management and conservation of medicinal plants, the sustainable harvest of the resources from the forest would be reduced in the future. This may lead to resource depletion and may impose high social cost for the future generation. Increasing demand for medicinal plants in the future will reduce apparent viability of the industry due to high investment cost in management and conservation. Therefore, the government should consider long-term measures to conserve this valuable non-timber forest product. The use of regulations and other measures are vital towards achieving sustainable management of medicinal plants practices. This paper highlights the utilization and harvesting of medicinal plants from the forest, legislation and management aspects related to the resources and also the problem of extinction raised from the over collection by practitioners and industries. Some policy recommendations on medicinal plants resources have also been suggested.

Keywords: *medicinal plants, forest area, utilization, extinction, policy*

INTRODUCTION

Medicinal plants are substitutes for modern medicine and have been widely used by people around the world. It resources are applied in both traditional and modern preparations. Since the herbal products basically ignore the use of chemical and synthetic drug, more people begin to turn towards the use of natural products as remedies for treating or preventing diseases. The harvesting of medicinal plants resources also provides income to the rural people; especially those living near the forest, as full time or part time collectors. In Malaysia, the medicinal plants utilization and practices is believed to vary with races, income, and educational levels, religious and spiritual belief.

The availability of the plant species is noted to be abundant in Malaysian tropical rain forest. Malaysian forest, known as the world's oldest rainforest and fourth on the list of biodiversity in Asia after India, China and Indonesia, comprises a wide range of dissimilar flora. There are over 20,000 plant species (10% of the world's total number of species) can be found and some of which are unique only to Malaysia. However, only 1,200 species of trees, shrubs and herbs were reported to have medicinal properties in Peninsular Malaysia (Soepadmo, 1992). The number of potential species for medicinal purposes could be increased with the application of biodiversity prospecting continuously, focusing for commercially useful plant species and ongoing effort of documentation. Various plant species from families such as Euphorbiaceae, Leguminosae, Graminae, Verbenaceae and others are commonly used to treat various ailments and diseases including diarrhea, skin problems and headache.

Although it had been noted that Malaysian forest blessed with abundant and dissimilar flora which high in biological diversity, its future supply may be depleted due to inefficient harvest and proper monitoring. In the past, rural practitioners such as *bomoh*, healers, *pawang*, and others usually collect small amounts of medicinal plants for traditional purposes. Recent phenomenon has shown that the key players (manufacturers, importer, wholesalers) in traditional medicine have involved in commercialization of medicinal plants. It is expected that the demand for raw materials of medicinal plants increased substantially.

Importing raw material has always been seen as a solution to meet local demand for traditional medicine besides establishing the plantation area. Industries dependency on medicinal plants from imported materials is on increasing trend. A study conducted by University of Malaya (UM) found that about 50% of the raw

materials used by the local herbal industry is imported (Anon, 1999a). Study by Mohamad Setefarzi & Mansor (2001) found that 70% of 50 herbs utilized by industries were imported, while the other 30% were obtained from local resources. Azizol & Nurhanan (2001) further stated that more than 90% of raw materials currently used in the herbal industries are depending on the imported raw material. Another observation by Agriculture Department found that local raw materials only accounted for 10% of herbal preparation products compared with imports of 42% (Anon, 2001).

Even though much of the plant materials are obtained from outside sources, some species are largely supplied from local sources. Some of the medicinal plants that could only be found in the local forest such as tongkat ali (*Eurycoma longifolia*), kacip fatimah (*Labisia pumila*), rancang besi (*Artaboltrys spp*) and so forth. These species are important and crucial for the traditional herbal production for some industries, especially Malay traditional medicine manufacturers. As the demand for the local resources is higher as time passes, these medicinal plants will become scarce or even extinct without proper monitoring for conservation purposes.

UTILIZATION OF MEDICINAL PLANTS FROM THE FOREST

In general, the practice of using medicinal plants in Malaysia had been started for many years. Major utilization of the resources could be classified according to the three main races, namely Malay, Chinese and Indian. In addition, the aborigines (Orang Asli) and other ethnic groups in Sabah and Sarawak such as Kadazan, Dusun, Iban, Bajau and so forth also use the medicinal plants. Besides Chinese and Indian, practitioners from Malay community, aborigines and ethnics in Borneo used medicinal plants mostly gathered from the forest through traditional practices. As for the commercial purposes, Malay traditional medicine industries were found actively harvested from the local resources.

Some medicinal plants normally used by Malay traditional practices were *Acorus calamus* (jerangau), *Orthosiphon aristatus* (misai kucing), *Labisia pumila* (kacip fatimah), *Melaleuca cajaputi* (gelam), *Cymbopogon citratus* (serai wangi), *Curcuma xanthorrhiza* (temu lawak), *Zinziber zerumbet* (lempoyang pahit), *Costus speciosus* (setawar) and *Datura metel* (kecubung) (Latiff, 1997). Rusli et al. (1998) stated that the aborigine's community in Air Hitam Forest Reserve collected about 20 plant species for various purposes. The species normally collected for medicinal purposes are *Eugeisonna utilis* (akar bertam), *Ficus calicarpa* (tengkuk biawak), *Labisia pumila* (kacip fatimah), *Mapina petiolata* (serapat) and *Eurycoma longifolia* (tongkat ali). As for the utilization of medicinal plants from the forest by ethnics in Sabah and Sarawak, previous studies have focused on the uses of the plants by races (Mohd Azmi & Awang Noor, 2001). A comprehensive report on the uses of native medicinal plants of Sarawak by Chai et al. (1989) is the first documented information on the resources ever studies in Sarawak. About 285 species, mostly indigenous and wild, had been recorded.

SUPPLY AND DEMAND OF MEDICINAL PLANTS

Many plant species of medicinal plants are directly collected from forests in Malaysia and their value to the medicinal industries; the nation and the people are very significance. It is difficult to determine the total value of medicinal plants collected from forests or supplied to industries or transacted in the market. This is because there has been no extensive study being carried out at the national level.

A recent study by Mohd Azmi & Norini (2001) on the supply and demand of medicinal plants harvested from the forest can be used as the pioneer study to show the dependence of Malay traditional industries to the local resources. Based on the interviews with 28 collectors in Peninsular Malaysia, it is found that the average monthly harvest is 276 kg green weight of medicinal plants. By assuming ten working months per year, the total amount of harvested material was estimated to be approximately 77,280 kg per year. However, only 67% (52,000 kg per year) of the total collection was supplied to industries and the balance, 33% (25,280 kg) was for the collector's own use (sold either as raw materials or as processed products). Table 1 shows the total collection of plants by collectors in Peninsular Malaysia during the study period (1998/2000).

Table 1. Total collection of medicinal plants by collectors in Peninsular Malaysia[1]

Zones	States	Average trips per month	Average total collection of medicinal plants per month (kg)[2]
North	Kedah	2.3	236.08
	Perlis	0	0
	Penang	0	0
	Average	2.3	236.08
East	Pahang	3.2	72.31
	Terengganu	0.2	40.0
	Kelantan	0	0
	Average	2.9	70.0
South	Malacca	4.0	480.0
	Johore	0.3	260.0
	N.Sembilan	1.6	1366.67
	Average	1.6	850.0
West	Perak	0	0
	Selangor	5.0	200.0
	K.Lumpur	0.2	28.0
	Average	2.6	114.0
Peninsular Malaysia	Average	2.5	275.88

Source: Mohd Azmi & Norini (2001)
[1] Based on 28 collectors interviewed
[2] The quantity of medicinal plants collected is based on green (wet) weight

To estimate the requirement of medicinal plants from the forest by local traditional medicine industries in Peninsular Malaysia, 28 manufacturers had been interviewed. The study found that about 652.52 kg of medicinal plants had been ordered by the industries from the regular supplier per month (Table 2). The majority of the industries (64%) obtained their raw materials from regular suppliers. Five of the manufacturers collected medicinal plants by their own crews and only one manufacturer paid their workers to collect the materials. Using this information and taking the Malay Traditional Medicine Manufacturers Association (PURBATAMA) members (73 manufacturers) as the basis and 10 working months per year, the estimated total amount of medicinal plants needed by the industries was about 476,339 kg per year. These figures did not include unregistered manufacturers since the information was not available. The requirement of medicinal plants from local sources would be more than the real situation if the unregistered manufacturers were taken into account.

Table 2. Quantity of medicinal plants ordered by the industries[1]

Zones	States	Average quantity supplied per month (kg)[2]
North	Kedah	266.00
	Perlis	180.00
	Penang	250.00
	Average	255.27
South	Johor	960.00
	N.Sembilan	350.00
	Malacca	600.00
	Average	718.75
East	Kelantan	303.33
	Terengganu	607.50
	Pahang	160.00
	Average	406.67
Peninsular Malaysia	Average	652.52

Source: Mohd Azmi & Norini (2001)
[1] Based on 28 industries interviewed
[2] The quantity of medicinal plants is based on green (wet) weight

By comparing the estimated amount of medicinal plants could be supplied by collectors (77,280 kg per year) and the estimated requirement of the local sources by industries (476,339 kg per year), it is found that the shortage of raw material supply is critical. Such situation is more critical in the future, as the industries will be expanded due to high demand for traditional medicine.

OVER EXPLOITATION LEADS TO PROBLEM OF EXTINCTION

High demand for medicinal plants in developing countries has been met by indiscriminate harvesting of naturally occurring plants in the forests. As a result, many plant species have become extinct and some even endangered. This is due to the fact that much of the collection done by peoples who are more concerned with immediate monetary returns rather than long term sustainable supply. The problem of over-exploitation occurs due to wasteful method of harvesting and collection as well as no proper management on those resources.

There are many factors contributed to the problem of extinction. These include deforestation (conversion of forested land) and over collection/exploitation of certain potential species (basically raw material for industries). Extensive logging without proper control and illegal logging also could bring the problem become worst. Species with high demand from industries will result in the situation of over-collection when harvesters are competed with each other to collect the species from the forest. Although, the impact of the extinction only can be traced after some times, there is an urgent to prevent species depletion and extinction.

Some studies have shown that species extinction has already occurred. The number of plant species estimated to extinct by the years 2000 – 2050 varies from 5% to 10% or even 25% (refer Mohd Azmi & Awang Noor, 2001). This shows that the probability of large number of plant species to be lost forever from the tropical rain forests is high. According to UNEP/FAO, the tropical rainforests, which contain about half of the world's plants, are declining at an alarming rate of 16.8 million ha per annum (WHO, IUCN, WWF, 1993). The extensive harvesting of plant species, especially medicinal plants from the forest will result in genetic erosion and the knowledge on the potential uses of traditional plant medicine itself.

The over exploitation of medicinal plants from the forest is basically based on the crucial needs of industries to meet their market demand. With promising market value of the traditional medicine products, manufacturers have to provide a sustainable status of their products to consumer. Therefore, consistent supply of the raw material is important in order for the industries to achieve their production target. As for the supply side, collectors or regular suppliers to industries have to compete among themselves and gained as much of the resources as they could to get the high payment offered by industries. The suppliers are paid relatively high prices, ranging from RM9.00 per kg to RM130.00 per kg, depending on states and the difficulty to gained the resources (Mohd Azmi & Norini, 2001). With regular harvesting of medicinal plants and less attempt taken to replant the resources in the forest, the problem of inconsistent supply of medicinal plants to industries will occur.

In the case of Malaysia, over-collection of some species has been observed in Langkawi, Kedah (Latiff, 1989). The popular species being observed are periuk kera (*Nepenthes*) and bunga pakma (*Rafflesia cantleyi*). Other species that might be probably extinct include some highly demanded medicinal plants such as tongkat ali *(Eurycoma longifolia)*, kacip fatimah *(Labisia pumila)*, mengkudu (*Morinda citrifolia)* and lidah buaya (*Aloe vera)* is high without proper management (Anon, 1999b). Soepadmo (1995) also mentioned that medicinal plants species that grows wild in the forest being affected by the problem of over-collection. These species are sandalwood (*Aquilaria malaccensis*), tongkat ali (*Eurycoma longifolia*), penawar hitam (*Goniothalamus giganteus*), tongkat ali hitam (*Goniothalamus macrophyllus*), kacip fatimah (*Labisia photoina*) and rafflesia (*Rafflesia cantleyi*). Mohd Azmi & Norini (2001) also found that medicinal plants such as tongkat ali (*Eurycoma longifolia*), ubi jaga (*Smilax myosotiflora)*, periuk kera (*Nepethes gracilis*), and selayak hitam (*Goniothalamus macrophyllus*) are becoming scarce and collectors faced the difficulty in obtaining the resources to meet the industries requirement.

It is expected that medicinal plants that are harvested for its roots and stems and also occur in solitary is more vulnerable to extinction. The production of those resources (seeds) normally takes a longer period of regeneration. For example, tongkat ali (*Eurycoma longifolia)* flowers only when it is 10 years old, while rancang tembaga (*Artaboltrys sp.*) which is good for boosting sexual potency takes about 20 years to grow

(Anon, 1996). Therefore, some conservation measures on those medicinal plants need to be formulated besides reviewing the policy regarding the harvesting of resources from the forest.

One way to control the problem of extinction is through proper management of the resources in the forest. However, information related to the availability of the resources is also crucial before any recommendations can be made regarding the management of these resources. Regular monitoring and inventory studies could provide early indication on the availability of medicinal plants and therefore could act as guidance for replanting purposes.

To date, scant study had quantified medicinal plants in the forest. Awang Noor & Mohd Shahwahid (1995) suggested using the systematic strip line plots to quantify all the non-timber forest products (NTFPs), including medicinal plants. The method had been modified by Norini & Mohd Azmi (2001) to determine the availability of tongkat ali (*Eurycoma longifolia*) and other medicinal plants in three forest reserves in Kedah. The study revealed that the distribution of tongkat ali (*Eurycoma longifolia*) are more frequently occurred in the low land rather than in the high land for the three sites. Therefore, it can be concluded that tongkat ali is found largely in the low land, which is usually more prone to over exploitation. It is also found that most of the trees were small, probably due to larger tongkat ali had been removed by medicinal plants collectors. In short, by conducting the inventory study, relevant information on availability, distribution and characteristics of medicinal plants can be analyzed and characterized. Therefore, the authority can use it for further monitoring purposes and future management planning.

MEASURES TO ACHIEVE SUSTAINABLE MANAGEMENT OF MEDICINAL PLANTS

With the increasing demand for traditional medicine products in local market, the demand for its raw material will also increase. Although the amount of medicinal plants from the forest is estimated less than the imported raw material, its composition in the products is high in some cases and crucial for most of the industries. Most of the medicinal plants are harvested for the whole tree/herbs, roots and stems and this practice basically will destroy the population of the species in the forest without any appropriate measures being taken. Some conservation measures are suggested in order to avoid the problem of shortage and unsustainable supply of raw material from the forest as well as extinction of certain species.

i)Establish Mechanisms to Monitor Collection

The relevant government agencies should set up proper mechanisms with regard to working permits, royalties or regulations for monitoring the collection of medicinal plants. The collectors or industries that harvested medicinal plants from the forest area need to pay royalties to the Forestry Department (licensing scheme for the extraction of medicinal plants) based on the amount collected. As the royalties collected, the amount of medicinal plants harvested from the forest area can also be determined for future management and conservation.

To avoid the problem of over exploitation, the Forestry Department should determine the maximum amount of medicinal plants that could be harvested for a given time period based on species or as a whole medicinal plants itself to each collector. The authority should also inform the forest area that will be opened for logging and allow collectors or industries to harvest the raw material before the logging operation begins. Therefore, it could generate extra income to the rural people and also give opportunities for industries to explore the potential raw material available in the forest.

Besides that, the Forestry Department also needs to inventory the availability of medicinal plants in the forest area regularly. This measure could directly monitor some of the current medicinal plants species that being extensively harvested. The silviculture treatment and replanting the resources that are being harvested are important to encourage sustainable supply of medicinal plants to the industries

ii)Establish Medicinal Plant Plantation

The only way to avoid over dependence of medicinal plants from the forest is through plantation establishment. The domesticated species may include highly demanded local and potential imported species. The highly demanded medicinal plants by local industries should be identified and be given priority to be planted in

commercial basis through agroforestry or monocrop plantations. Furthermore, research on the compatibility of the imported medicinal plants to be planted locally need to be done.

Due to land constraints and high economic risk when applying the monoculture system, some researchers suggested that agroforestry is the best alternative approach to cultivate medicinal plants over large areas (refer Mohd Azmi et al., 2001). The approach refers to a dynamic system involving integration of agricultural crops and/or livestock with tree planting for the purpose of increased total land productivity. Under the third National Agriculture Policy (1998 - 2010), agroforestry approach has been identified as the most suitable system for the cultivation of herbs (Anon, 1999c).

Some studies have highlighted the importance and benefit of agroforestry systems to investors. However, the economic study related to the plantation of medicinal plants is still lacking. A preliminary study by Mohd Azmi et al., (1998) was conducted on the financial analysis of four selected medicinal plants, namely, turmeric (*Curcuma domestica*), ginger (*Zingiber officinale*), lemon grass (*Cymbopogon citratus*) and Petai (*Parkia speciosa*). The study revealed that in an agroforestry project covering an area of one hectare is expected to generate a net cash flow of RM21, 330. The financial analysis, based on an area of one hectare for a period of 20 years, has demonstrated that the project is viable with an NPV of RM4, 624 at 10% discount rate and IRR of 23.22%. Planting a single species as a monocrop (e.g. petai) is not feasible as it may take few years after planting to generate good returns. It is recommended that planting medicinal plants on an agroforestry basis could prove to be profitable. More financial analysis needs to be carried out based on post project valuation or using actual project's benefit and cost. This will help potential investors to undertake the project more confidently with less risk.

iii)Develop Databases on Demand and Supply of Medicinal Plants

Database on the information of regular collectors of medicinal plants as well as traditional medicine industries for each state needs to be developed. With the establishment of the database, information on the availability of collectors/practitioners could be assessed in order to ensure the sustainability supply of medicinal plant. Industries that require medicinal plants from local resources could establish contact with collectors/practitioners that been registered in the database. Thus, good transaction linkages between collectors/practitioners and industries can be established besides provide information on the scenario of medicinal plant industry and its utilization to the public. With good cooperation between the main players in herbal industries, raw material from local sources could be channeled systematically to the required industries. The Forestry Department could gain information on the supply of raw material from the forest and therefore could monitor harvesting activities.

The database could also be linked and collaborate with five respective organizations of traditional medicine associations in terms of data upgrading for every practitioner and industry in Malaysia. These five organizations are Malay Traditional Medicine Association Malaysia (PUTRAMAS), Federation of Chinese Physicians and Medicine Dealers Association of Malaysia (FCPMDAM), Indian Traditional Medicine Association Malaysia (PEPTIM), Malaysian Society for Complementary Therapies (MSCT) and Malaysian Homeopathic Medical Council. These associations could exchange ideas and opinions regarding the problems and scenario in traditional medicine as well as measures to increase the quality and quantity of traditional medicine products.

iv)Inventorize Medicinal Plant Resources

Medicinal plants should be included as one of the forest resources to be inventorised under the National Forest Inventory (NFI). It is important to estimate the stocking of medicinal plant resources as well as other important characteristics (morphology) of medicinal plants in the forest. The information can be used as a guideline for Forestry Department to determine the optimal stocking and optimal time to harvest medicinal plants. This measure can avoid the problem of over exploitation that involves harvesting of some immature tree/herbs by the collectors. The harvesting of medicinal plants, which are categorized under the endangered species, can also be monitored and controlled. Therefore, besides provide the sustainable supply of resources to the industries; conservation of such species can be developed based on the morphology information and availability of the resources in the forest.

v)Forestry Extension

Forestry extension through forestry education or conservation education has to be intensified in response to the changing scenario of forestry activities and its environment. Current forestry curriculum of many universities worldwide had incorporated the concept of integrated resource management using the multiple-use forestry principle besides the core forestry courses related to the growing and management of trees for economic return. Multiple-use principle in forest management must also include non-wood products and services (water, wildlife, recreation, medicinal plants, educational and aesthetic benefits, etc) and not just timber. This principle is the key pre-requisite to the sustainable forest management (SFM) philosophy. Therefore, the current professional forestry curriculum in universities should include the main elements of SFM in courses related to multiple-use forestry in order to prepare future foresters to manage forest sustainably (Rusli, 1999). Rusli (1999) also stretched that future forestry education need to take cognizant of some changing scenarios such as decreasing resources, increasing environmental pressure, sophistication of learning technology and global implications of forestry issues. Timber as well as the non-timber forest products (NTFPs) should be equally emphasized.

More programmes on conservation education for younger generations should also be introduced to increase the knowledge and appreciation towards forest conservation for the future generations. Conservation education is best incorporated in the primary school curriculum or earlier (Abang Mohd Mokhtar, 1997). This will help to increase awareness on the conservation of natural resources and the conservation practices.

CONCLUSION AND DISCUSSION

Medicinal plants from the forests provide important raw materials used by the people traditionally and to industries. Due to the lack of information and insufficient published data, the amount of raw materials required by practitioners and industries alike cannot be accurately estimated. Therefore, measures related to the management and conservation of highly demanded medicinal plants species are difficult to establish. It is equally important to monitor the availability of raw materials from the forests and to conserve them properly. Detailed information on the supply of and demand for medicinal plants in Malaysia is essential, not only to sustain the industries but also to provide a secondary source of income to the rural people. Proper legislation (in terms of application of permits, royalties, and so on) is urgently needed to make the collection activity a legal operation. Such legislation would help minimize the problems of over collection and forest encroachment.

With the promising future prospect in traditional medicine industry, it could attract many new comers (registered or unregistered) to be involved in the business. As the number of players in the herbal industry increases, the demand for the raw material is predicted to be high. Therefore, some measures are needed for better efficient management and conservation of medicinal plants, in terms of production, controlling and monitoring aspects. This is to ensure sustainable supply and conservation of the resources in the future. Highly demanded medicinal plant species that are mostly imported should be identified, researched and domesticated, whenever possible. This could reduce our foreign dependence on the raw materials.

Agroforestry system is an important solution in planting medicinal plant species. Besides maximizing the land use and generating better return of investment, the consistency in providing raw material gives a good sign for the future prospects of traditional medicine and pharmaceutical industry. With the establishment of many plantation areas, demand for medicinal plants from local sources could be met. There is also a need to control the harvesting of medicinal plants from the forest. By providing proper legislation scheme, the collection of medicinal plants from the forest can be monitored. Regular monitoring and inventory of the resources will help to identify the species that are becoming rare and highly exploited. Silviculture treatment and replanting of those species are very important measures to avoid the problem of extinction.

REFERENCES

1. Abang Mohd Mokhtar, A.P. 1997. Conservation and utilization of the Forest Resources in Sarawak. Workshop on Biodiversity, Conservation and Utilization : Present Status and Future Directions. 27 – 28 th 1997. FRIM, Kuala Lumpur.

2. Anonymous. 1996. New Strait Times 1996. More Turn to Malay Herbal Cures. 14th November.

3. Anonymous. 1999a. The Sun 1999. Tapping Our Herbal Products Markets. 11th October 1999

4. Anonymous. 1999b. Berita Minggu 1999. Kerajaan Bimbang Pokok Herba Pupus. 4th November 1999.

5. Anonymous. 1999c. The Star 1999.Growing Industry. 7th December 1999.

6. Anonymous. 2001. The Sun 2001. Obtain Certification for Herbal Product. 26th September.

7. Awang Noor, A.G. & Mohd Shahwahid, H.O. 1995. Estimation of stumpage values in three concession compartments of Muda/Pedu watershed area. Paper presented at the First Workshop on ``Kajian Kesan Pembalakan Terhadap Waduk di Hutan Simpan Ulu Muda''. Universiti Teknologi Malaysia (UTM), Skudai, Johore. Unpublished article.

8. Azizol, A.K. & Nurhanan Murni, Y. 2001. Herbs and Herbal Products: A New Agricultural Commodity. Paper presented at the CEPP Hands-on Course and Exhibition on Herbal and Phytochemical Processing. 11-13 Jun 2001, Skudai, Johor. Pp:7.

9. Chai, P.P.K, Lee, B.M.H. & Othman, I. 1989. Natural Medicinal Plants of Sarawak. A Sarawak Forest Department Report (No. FB 1). Sarawak Forest Department.

10. Latiff, A. 1989. Some Noteworthy Botanical Aspects of Malaysian Traditional Medicine. In Malaysian Traditional Medicine: Proceedings of the Seminar on Malaysian Traditional Medicine, Kuala Lumpur, June 10-11th., 1988. eds. Soepadmo E., Goh, S.H., Wong W.H., Laily, D., & Chuah, C.H. Institute of Advanced Studies, University of Malaya & Malaysian Institute of Chemistry, Kuala Lumpur. Pp. 1-6.

11. Latiff, A. 1997. Medicinal and Aromatic Plants of Malaysia: Approaches to Exploitation and Conservation. In Medicinal and Aromatic Plants: Strategies and Technologies for Conservation, eds. Kamaruddin, M.S., Natesh, S., Asiah, O. & Azizol A.K. Ministry of Primary Industries Malaysia, Ministry of science, Technology and Environment Malaysia & Forest Research Institute Malaysia (FRIM). Pp. 20-31.

12. Mohamad Setefarzi, M.N. & Mansor, P. 2001. Status Penggunaan Herba oleh pengilang Tempatan dan Potensi Penanaman di Malaysia. In Towards Bringing Science and Herbal Industry. Proceedings of The Seminar on Medicinal & Aromatic Plants. 12-13 September 2000. eds. Chang, Y.S, Mastura, M., Vimala, S. & Zainon, A.S. Forest Research Institute Malaysia (FRIM), Kuala Lumpur. Pp: 112 – 119.

13. Mohd Azmi, M.I., Norini, H. & Ng, L.T. 1998. Medicinal Plants: Trade and Investment Prospects in Malaysia. In Phytochemical and Biopharmaceutins from the Malaysian rain Forest. Eds. Manaf, A.A., Khozirah, S. & Zuriati, Z. Forest Research Institute Malaysia (FRIM) & Persatuan Sebatian Semulajadi Malaysia. Pp: 21-30.

14. Mohd Azmi M. I. & Awang Noor A.G. 2001. The Utilisation and Conservation of medicinal plants in Malaysia: An Overview. In Chang Y.S, Mastura M., Vimala S., & Zainon A.S. (eds). Proceedings of The seminar on Medicinal & Aromatic Plants – Towards Bringing Science and Herbal Industry. 12 – 13 September 2000. FRIM. Pp : 101 - 112.

15. Mohd Azmi M.I. & Norini H. (2001). Supply and Demand of Eurycoma longifolia (Tongkat Ali) Plants With Few Others. Journal of Tropical Medicinal Plants. Vol. 2 No. 1 (June 2001): 145 – 154.

16. Mohd Azmi, M.I., Norini, H. & Lim, H.F. 2001. Policy implications on medicinal plants utilization in Peninsular Malaysia. Pp: 41. Unpublished report.

17. Norini, H. & Mohd Azmi, M.I. 2001. Modified guidelines for the inventory of tongkat ali (Eurycoma longifolia) and other medicinal plants. FRIM Technical Information Handbook No. 31. Forest Research Institute Malaysia (FRIM), 52109, Kepong, Kuala Lumpur. Pp:18.

18. Rusli, M., Awang Noor, A.G. & Abdul Rahim, O. 1998. Indigenous People's Dependence on Non-Wood Forest Products: A Case Study. In Sustainable Management of Non-Wood Forest Products (Proceedings of an International Workshop held at Universiti Putra Malaysia, Serdang 14-17th October 1997, eds. Nair, M.N.B., Mohd Hamami, S., Zaidon, A. F. Universiti Putra Malaysia Press, Serdang, Selangor. Pp. 247-253.

19. Rusli, M. 1999. Professional Forestry Education for SFM. Paper presented at IRIM – FDPM Seminar on SFM :Gearing Towards The Next Millineum. 24 th April 1999. Forest Research Institute Malaysia (FRIM).

20. Soepadmo, E. 1992. Conservation status of medicinal plants in Peninsular Malaysia. In Khozirah Shaari, Azizol Abd. Kadir & Abd. Razak Mohd Ali. Medicinal products from Tropical Rain Forests – Proceeding of the Conference: 13-23. Forest Research Institute Malaysia, Kepong.

21. Soepadmo, E. 1995. Status Pemuliharaan Tumbuhan Ubatan di Semenanjung Malaysia. In Teh K.H.(eds). Prosiding Seminar Kebangsaan Ethnobotani Pertama. Serdang, 16 – 18 September 1991. Perpustakaan Negara Malaysia. Pp: 229 – 244.

22. The World Health Organization (WHO), IUCN &World Wide Fund for Nature (WWF). 1993. Guidelines on the Conservation of Medicinal Plants. IUCN, Gland, Switzerland. 50pp.