BLUMEA 53: 569–601
Published on 31 December 2008 http://dx.doi.org/10.3767/000651908X607521

TRADITIONAL MEDICINAL PLANTS IN BEN EN NATIONAL PARK, VIETNAM

HOANG VAN SAM[1,2], PIETER BAAS[2] & PAUL J.A. KEßLER[3]

SUMMARY

This paper surveys the medicinal plants and their traditional use by local people in Ben En National Park, Vietnam. A total of 230 medicinal plant species (belonging to 200 genera and 84 families) is used by local people for treatment of 68 different diseases. These include species that are collected in the wild (65%) as well as species grown in home gardens. Leaves, stems and roots are most commonly used either fresh or dried or by decocting the dried parts in water. Women are mainly responsible for health care, they have better knowledge of medicinal plants than men, and also collect them more than men at almost every age level. The indigenous knowledge of traditional medicinal plants may be rapidly lost because 43% of the young generation do not know or do not want to learn about medicinal plants, and the remainder knows little about them. Moreover, nowadays local people tend to use western medicine. Eighteen medicinal plant species are commercialized and contribute on average 11% to the income of the households. The majority of medicinal species are used by less than half of the households and 68% of the medicinal plant species have use indices lower than 0.25. Only 6 of the medicinal species of Ben En are listed in the Red data list of Vietnam, but locally 18 medicinal species are endangered because of overharvesting.

A comparison of traditional uses of medicinal plants in Ben En National Park with traditional uses elsewhere in South-East Asia and the Indo-Pacific region shows that the same species may be used for widely different treatments by different ethnic groups.

The conservation, sustainable use and economic potential of medicinal plants is discussed. We argue that their use, cultivation in home gardens, and marketing should be encouraged as an affordable alternative to expensive western medicine.

Key words: Ben En National Park, traditional medicinal plants, disease treatment, conservation.

INTRODUCTION

Man is known to have utilized plants as a source of medicinal drugs for thousands of years. Medicinal plants are potential sources of new drugs and hold a great value for developing pharmaceutical products, phytomedicines, and dietary supplements (King et al. 1999).

An effective way to find new drugs is to follow the indigenous knowledge on medicinal plants (Spjut & Perdue 1976, Mendelsohn & Balick 1995, Swerdlow 2000).

1) Forest Plant Department, Vietnam Forestry University, Xuan Mai, Hanoi, Vietnam; e-mail: samfuv@gmail.com.
2) Nationaal Herbarium Nederland, Leiden University branch, P.O. Box 9514, 2300 RA Leiden, The Netherlands; e-mail: baas@nhn.leidenuniv.nl.
3) Hortus botanicus Leiden, P.O. Box 9516, 2300 RA Leiden, The Netherlands; e-mail: prefect@hortus.leidenuniv.nl.

Using ethnobotany to identify promising plants could substantially reduce the costs for developing at least some pharmaceutical drugs (Mendelsohn 1997). About 80% of the world's population relies on traditional medicine (Farnsworth et al. 1985). Especially in remote areas in developing countries, medicinal plants may form the only available source of health care (Kasparek et al. 1996, Van Andel 2000).

Vietnam is no exception to this phenomenon. The better hospitals are all located in Hanoi, Ho Chi Minh City, and in other main cities. The health care situation in the research area of Ben En National Park is generally much less favourable. The few hospitals and health centres in the interior are often ill-equipped and suffer from lack of trained staff. Only few people can afford to travel to the hospital in the city when they need medical assistance, instead of seeking treatment in local health centres. Most local people do not have health insurance. The majority of the health problems of the local people in Ben En National Park are related to stomach ache, malaria, diarrhoea, wounds, and common colds.

Knowledge of medicinal plants, as once embedded in numerous indigenous cultures, is rapidly disappearing. Year by year, the total sum of human knowledge about the species, distribution, ecology, management, and extraction of medicinal plants is declining: the continuation of a process of loss of local cultural diversity that has been underway for centuries (Hamilton 2003). Although in many communities medicinal plants are the only available source for medical treatment, local indigenous remedies are less used now than before. In many tropical regions indigenous knowledge is at risk of extinction just as is biodiversity itself (Slikkerveer 1999, Van Andel 2000).

Ethnobotanical research can play a key role in the revitalization and revaluation of indigenous knowledge (Martin 1995). For Ben En National Park in particular very few ethnobotanical data exist. Some research has been conducted on biodiversity (Tordoff et al. 2000), and one study just listed plant or animal species, unfortunately without voucher specimens for scientific scrutiny (Anonymous 2000).

To analyse the role of medicinal plants in the indigenous communities in Ben En National Park, this study deals with the variety of medicinal plants and their uses recorded during a one year survey of non-timber forest products in that region.

The main research questions with regard to the use of medicinal plants were:
- Which plant species are being used for which disease?
- Which medicinal plant species are being commercialized in the research area?
- What is the present role of medicinal plants in the health care system of the indigenous communities?
- How does the situation in Ben En National Park compare with other local communities depending on natural forest resources in and beyond Vietnam?

We hope that the documentation of this medicinal plant knowledge contributes to the conservation of both cultural diversity and plant biodiversity in Vietnam in general and Ben En National Park in particular. By compiling and spreading this knowledge we hope to achieve that other ethnic groups in the region benefit from these local and cheap resources.

METHODOLOGY

Household surveys and interviews were carried out in 45 randomly selected households per village (out of a total of about 110–150 households per village). The standard interviews contained specific questions on age, gender, and ethnic background of the gatherers and main users of plant products. Additionally we used the 'walk-in-the-wood' method (Prance et al. 1987), to determine which products are harvested (and for what purpose) in the forests surrounding the villages. These trips were also used to collect voucher specimens for reliable identification of the harvested plants. Special collecting trips were organized with indigenous experts, e.g., traditional doctors, village elders and other local people who knew about medicinal plants. There are five traditional doctors (four females and one male) in the research area. Local names were also being noted during these surveys. Most information was confirmed by other informants. The information was also checked and compared with the 'Vietnam medicinal plants' (Loi 1995), 'Dictionary of medicinal plants of Vietnam' (Chi 1996), 'Plants of Vietnam' (Ho 2000), and the PROSEA (Plant Resources of South-East Asia) Handbooks on 'Medicinal and poisonous plants' (De Padua et al. 1999, Van Valkenburg & Bunyapraphatsara 2001, Lemmens & Bunyapraphatsara 2003).

Market inventories were used to determine the price of the forest products that are for sale. These surveys served as an independent way to determine which products are harvested from the surrounding forest, and to assess local uses of these forest products.

All plants that were considered by local people to have medicinal properties were collected and identified. These plants not only included wild species but also cultivated plants and wild plants that had been taken from the forest and planted in gardens or agricultural fields. Botanical specimens were collected of all useful plants. One voucher of each specimen was deposited at the herbarium of the Vietnam Forestry University, additional vouchers were sent to the National Herbarium of the Netherlands and various specialists for identification.

The importance of medicinal plant species was identified using standard Participatory Rural Appraisal (PRA) techniques (PID & NES 1989, Ngai 2001) where local people were asked to rank a list of regularly used local medicinal plants. The importance of medicinal plants for health care was determined using two criteria: 1) proportion of local people using each listed species; and 2) frequency of use. The importance of medicinal plant species for income generation was determined by calculating the income from each listed species for the local population.

The database resulting from the ethnobotanical inventory was used to calculate a use index (UI) for each species by using the following equation:

$$UI = U_s/N$$

Where U_s is the number of households which mentioned a use for species s; N is the total of households that were interviewed in the research area. This Use Index is a modification from the Use Value (UV) introduced by Phillips & Gentry (1993) and recently used by De Lucena et al. (2007), which is calculated from the relative number of times a species is mentioned by various informants in ethnobotanical inventories.

The market demand, intensity of collection, and abundance in the wild were classified as follows:

Market demand
- High: easy to sell in large amounts.
- Medium: Difficult to sell in large amounts.
- Low: only in very small supply on the market and sometimes left unsold because the demand was not stable.

Collection intensity
- High: local people collect the plants in large amounts because of high demand of the market and/or for personal use.
- Medium: the collected amount is not big because the demand is not high, plants are not abundant, or it is difficult to collect them in large amounts.
- Low: the demand of the market is low or non-existent. People mainly collect for home consumption, but in small amounts.

Abundance in the wild
- High: the species is easy to find and abundant.
- Medium: the species is neither abundant nor rare.
- Low: the species is rare, and although local people can find it with special effort, the species will be endangered if collection continues.

STUDY AREA

Field work was conducted in Ben En National Park 19° 30' to 19° 40' N by 105° 21' to 105° 35' E, situated in the Nhu Thanh and Nhu Xuan districts of Thanh Hoa province, Vietnam (Fig. 1). The highest peak is about 490 m. The core zone of the National Park

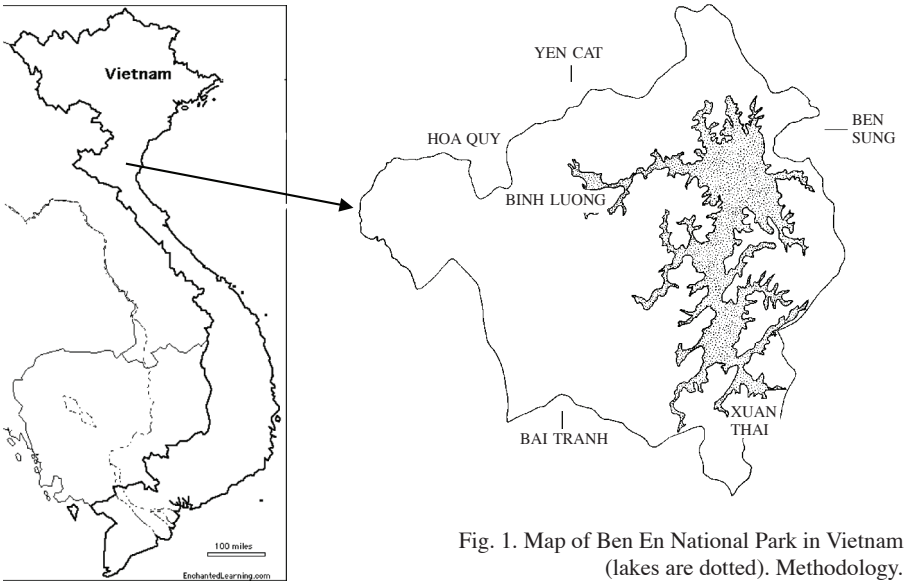

Fig. 1. Map of Ben En National Park in Vietnam (lakes are dotted). Methodology.

covers 15,800 ha, while the buffer zone covers around 12,000 ha. About 18,000 people live in the buffer and core zones of the National Park (Tordoff et al. 2000). The majority of the people living in the national park belong to the Kinh, Thai, Muong, and Tay ethnic groups, although there are also a small number of Tho people. The interviews were carried out in three villages: Xuan Thai, Binh Luong, and Hoa Quy. Additional information on medicinal plants was collected in the markets of Ben Sung and Yen Cat. The vegetation of the core zone is dominated by disturbed tropical evergreen rain forest, which has been affected by human activities, especially logging, which was legal until the park was established in 1991, but has continued illegally up to now. A full account of the vegetation and plant species diversity in the Park will be published in the near future (Hoang et al. in prep.).

RESULTS

Diversity of medicinal plants

A total of 230 medicinal plant species were used by local people in Ben En National Park belonging to 200 genera and 84 families. These species were involved in 313 different treatments and recipes. For most species only one recipe was mentioned; some have multiple medicinal applications. A complete list of species and their local medicinal uses is given in Appendix 1. The total number of vascular plant species in the Park is about 1390 (Hoang et al. 2008).

Most of the medicinal plant species in Ben En National Park are angiosperms, only 2 species belong to the gymnosperms and 9 species are ferns. Sixteen percent of all plant species in the Park are used by local people for medicinal purposes. The number of medicinal plant species used by local people in Ben En National Park is 7.2% of the total medicinal plant species in Vietnam (Chi 1996). Diversity of taxa is shown in Table 1.

Among the 84 families, the top 10 families with the highest number of medicinal species in the area are listed in Table 2.

From the 230 species of medicinal plants recorded in Ben En National Park 65% of the species were collected from the wild. These were all plants naturally occurring in different vegetation types (primary, secondary and logged-over forests, shrubbery, along roads, along streams, and in agricultural fields). Twenty percent of the species were cultivated in home gardens or in fields or even along the village road. This practice helps to develop the medicinal plant resources, and also makes them more widely available, especially when derived from rare and endangered species. Fifteen percent

Table 1. Diversity of taxa.

	Number of medicinal species	Total number of plant species in Ben En	Percentage of medicinal species/total species in Ben En
Ferns	9	86	10
Gymnosperms	2	9	22
Angiosperms	219	1294	17
Total	230	1389	16

Table 2. The 10 families with the highest numbers of medicinal species.

Name of family	Number of genera	Number of species
Euphorbiaceae	9	11
Asteraceae	8	9
Moraceae	5	9
Fabaceae	8	8
Rubiaceae	7	8
Menispermaceae	6	8
Verbenaceae	4	8
Rutaceae	5	7
Araceae	6	6
Apocynaceae	6	6

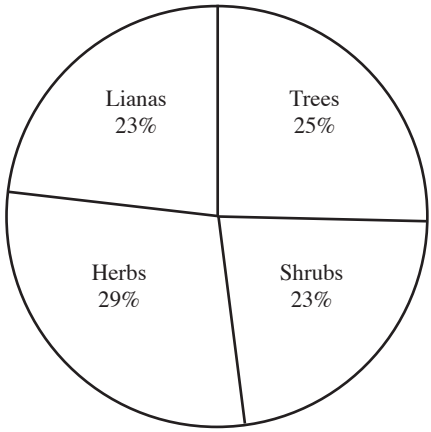

Fig. 2. Percentage of life forms of medicinal plants species used in Ben En National Park.

Table 3. Diverse parts of medicinal plants used by local people.

Parts of plant	Number of species	Percent of total
Leaves	141	61
Root, rhizome	96	42
Stem	64	28
Bark	26	11
Fruit	19	8
Whole plant	14	6
Seed	9	4
Flower	9	4
Tuber	8	3
Bulb	3	1
Latex	2	1

of the species were both taken from the forest, and also grown in the home gardens and agricultural fields. This semi-domestication reduces the need to cover long distances in the forest to search for plants.

Diversity of life forms of medicinal plants

The analysis of the life forms of medicinal plants used by local people in Ben En National Park is shown in Fig. 2. Herbaceous medicinal plants used by local people usually grow on the forest floor, along forest edges and roads, in fields and villages. They are mainly Amaranthaceae, Araceae, Asteraceae, and Zingiberaceae. Next in order of importance are forest trees mainly belonging to Euphorbiaceae, Moraceae, Rubiaceae, and Rutaceae. The smallest groups are formed by lianas and shrubs belonging to mainly Araceae, Asclepiadaceae, Cucurbitaceae, Menispermaceae, and Smilacaceae. Shrubs growing in the forest or along streams mainly are Myrtaceae and Solanaceae.

Diversity of plant parts used

In traditional medicine, different plant parts are used to treat different diseases: different components of one medicinal plant may have different effects. Some medicinal plant species have only one component that can be used, while for other species several components or the whole plant can be used. Of the identified medicinal plants in the research area, the whole plant is used of 14 species, whereas one species provides four useful components, 32 species provide three, 98 species provide two, and 85 species provide one component.

The diversity of parts used is indicated in Table 3. Leaves are most commonly used, either fresh or dried. Stems and roots are also common, either fresh or by decocting the dried root in water. Stems are usually chopped into small pieces and decocted in water. Often, different parts of the plants are combined to treat a disease.

Diseases treated with medicinal plants

The 230 medicinal plants species in Ben En National Park were used for treatment of 68 different diseases. For 20 of these diseases local people use only one medicinal plant for each disease. For example cancer was treated only with *Clausena lansium* (Rutaceae), mumps were exclusively treated with *Momordica cochinchinensis* (Cucurbitaceae), diabetes with *Aralia touranensis* (Araliaceae), aphasia with *Zanthoxylum avicennae* (Rutaceae), paralysis with *Alangium chinense* (Alangiaceae), and abscesses with *Hodgsonia macrocarpa* (Cucurbitaceae). For 12 of the 68 diseases local people used two plant species for treatment of each disease. For example, risk of miscarriage was treated with roots of *Boehmeria nivea* (Urticaceae) or with stems and leaves of *Artemisia vulgaris* (Asteraceae), and constipation was treated with leaves of *Cuscuta chinensis* (Cuscutaceae) or leaves of *Desmos cochinchinensis* (Annonaceae). For 5 diseases local people used three plant species for treatment of each disease. For example, impotence was treated with roots of *Morinda officinalis* (Rubiaceae), roots of *Morinda citrifolia* (Rubiaceae), or leaves and seeds of *Allium odorum* (Alliaceae).

The highest number of species was used to treat fairly common diseases, such as common colds, stomach ache, dysentery, weakness, itches, and diarrhoea (see Fig. 3).

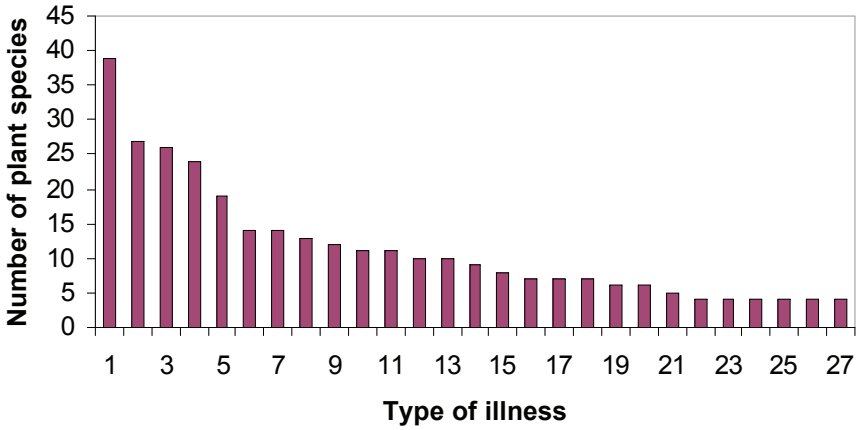

Fig. 3. Number of plant species used for different symptoms or illnesses in Ben En National Park. 1 = Common colds; 2 = stomach ache; 3 = dysentery; 4 = weakness; 5 = itches; 6 = indigestion; 7 = diarrhoea; 8 = malaria; 9 = wounds; 10 = snakebites; 11 = fever; 12 = toothache; 13 = haemostatic; 14 = rheumatism; 15 = bone fractures; 16 = irregular menses; 17 = high blood pressure; 18 = arthritis; 19 = sores; 20 = infection; 21 = urinating problems; 22 = sore throat; 23 = skin diseases; 24 = oedema; 25 = haemorrhage; 26 = detoxification; 27 = burns.

Seven of the most common diseases in the research area are discussed below.

Wounds and cuts

Wounds and cuts can be caused by many agents, for instance spiny lianas, leaves of some grasses, and sharp limestone edges when people walk in the forest, and by knives, scissors, and other sharp utensils. Cuts soon become infected and may develop into deeper wounds and even skin sores. Common treatments include crushing or chewing leaves and covering cuts with them. Some plant species are commonly used for treatment of cuts and wounds, such as the leaves of *Piper betle* (Piperaceae) and leaves of *Microsorum superficiale* (Polypodiaceae), and leaves of *Eclipta prostrata* (Asteraceae).

Stomach ache

Stomach ache can be a symptom of many kinds of disease. Large numbers of medicinal plants are used against it, but only few species were said to cure the complaints completely. The Thai, Tho, and Muong ethnic groups are often quite knowledgeable on the collection and preparation of anti stomach ache plants and actively exchange recipes with other ethnic groups in the region to combat the symptoms. Medicinal plants which are used for the treatment of stomach ache are for example leaves of *Eupatorium odoratum* (Asteraceae), leaves of *Ardisia silvestris* (Myrsinaceae) or rhizomes of *Curcuma zedoaria* (Zingiberaceae).

Diarrhoea

Diarrhoea is associated with several diseases, mostly attributable to poor sanitary practices and infected drinking water. The local people in Ben En National Park prefer to drink rain water rather than boiled water. In the dry season, there is little choice, and

water from Muc Lake (the lake inside the National Park) and streams is used. Many people get diarrhoea in this season. Barks, roots and leaves decoctions are specifically used to treat diarrhoea. *Celosia cristata* (Amaranthaceae) treatment was said to be effective against diarrhoea with blood, which indicates bacterial dysentery. Leaves of *Eupatorium odoratum* (Asteraceae), bark of *Melia azedarach* (Meliaceae), and bark of *Ficus auriculata* (Moraceae) are just three examples of plant species used against diarrhoea in general.

Snakebites

Naja naja, Bugarus fasciatus, and *Ptyas korros* are dangerous, poisonous snakes in Ben En National Park. When a person is bitten, the bite can be deadly within hours. The roots and leaves of *Gnetum montanum* (Gnetaceae), the leaves of *Phyllanthus urinaria* (Euphorbiaceae), and leaves and stems of *Gynura crepidioides* (Asteraceae) are considered to be the most effective medicinal plants to cure snakebites. The skin is sliced open, and some of the crushed or chewed plant parts are applied to the wound. This treatment must be applied as soon as possible after the bite.

Risk of miscarriage

Some medicinal plant species are used to prevent miscarriages. In the research area, pregnant women drink an extract from the leaves and stems of *Artemisia vulgaris* (Asteraceae), mixed with some salt or sugar. Another species said to be effective to prevent miscarriages is *Boehmeria nivea* (Urticaceae): boiled roots of this species are eaten during pregnancy. Muong and Tho ethnic groups claim that the older the roots, the better the effects.

Weakness

Weakness can be caused by insomnia, after giving birth or by excessive fatigue. A total of 24 plant species was used to treat weakness. Most remedies consist of a decoction of leaves and stems that is boiled and drunk as tea, such as a decoction of the stems of *Mucuna pruriens* (Fabaceae), decoction of leaves and stems of *Leonurus sibiricus* (Lamiaceae), or the whole plant of *Marsilea quadrifolia* (Marsileaceae) are used to treat insomnia. Some plants are specially used by women after childbirth, such as the leaves of *Artemisia vulgaris* (Asteraceae), roots and stems of *Jasminum subtriplinerve* (Oleaceae), or the roots of *Polygonum multiflorum* (Polygonaceae), and the stems of *Spatholobus suberectus* (Fabaceae). After sickness or exhaustion local people use the flowers of *Telosma cordata* (Asclepiadaceae), or a decoction of the roots and stems of *Fibraurea recisa* (Menispermaceae).

Common colds

A total of 39 plant species was used to treat common colds. Most remedies consisted of a decoction of leaves, which was boiled and drunk as tea; some plant species are drunk after grinding them together with sugar or salt and a little water. Some plants are specifically used to treat children's colds such as the leaves of *Allium odorum* (Alliaceae), and the leaves of *Ocimum tenuiflorum* (Lamiaceae). Some plant species could treat most kinds of colds, such as the leaves of *Blumea balsamifera* (Asteraceae), the bulbs of *Allium sativum* (Alliaceae), or leaves and roots of *Glycosmis pentaphylla* (Rutaceae). Pneumonia was clearly distinguished from the common colds and treated differently.

Collection and preparation of medicinal plants

Who is collecting medicinal plants?

From interviewing households and key informants, it emerged that women collect medicinal plants more than men at almost every age level, especially in the age classes of over 26 years old. This indicates that women are mainly responsible for health care. From the completed questionnaires it was also evident that women have a better knowledge of medicinal plants than men. Young people are rarely engaged in collecting medicinal plants (Table 4).

Table 4. Percentage of gender and age level of local people in Ben En National harvesting medicinal plants.

Age	Gender	Percentage of individuals collecting medicinal plants
> 50	Male	18
	Female	29
26–50	Male	17
	Female	27
16–25	Male	3
	Female	4
< 16	Male	1
	Female	1
Average % of males = 39		
Average % of females = 61		

Knowledge of plants and preparation

Most of the people interviewed were familiar with the species used for the treatments of common ailments like cold/cough, fever, headache, indigestion, itches, and plant remedies were used on a regular basis. As in other rural communities (On 2003) common knowledge was learned from other community members, especially from elders and local healers who share knowledge of the mode of collection, and the preparation and administration of medicinal plants.

Preparations of plants for medical use included decoction, paste, juice, chewing, and cooking or boiling (Table 5). The most common methods of the collection and preparation of medicinal plants are cutting the leaves, roots, stem or bark into small pieces and boiling them in water. For preparing a decoction, the plant parts are boiled until the liquid is reduced to about half or one third of the volume. Some decoctions are also used as steam baths. For pastes, plant parts are finely crushed or chewed, and then the resulting paste is applied to the affected part. For a juice, the plant part (mostly leaves and fruits) is extracted and drunk. For some remedies plant parts are chewed raw, then swallowed. Some plant materials can also be dried and stored for later use.

Administration of medicines

Medical administrations include oral intake, application to external body parts, rubbing/massage, and inhalation (Table 6). Most of the species were administered orally, mainly as a decoction or extracted from plant parts. A high number of species were

Table 5. Preparation of medicinal plants.

Preparation	Medical remedies (%)
Decoction	50
Paste	24
Juice	14
Chewing	6
Cooking/boiling	4
Powder	2

Table 6. Mode of administration of medical remedies.

Mode	No. of remedies
Oral intake	199
External application	71
Rubbing/massage	14
Inhalation	3

externally applied mostly to treat wounds, snakebites, bleeding and itches. Rubbing applied to treat back pain, muscle pain, and in only three remedies local people applied inhalation, for instance of steam from *Eucalyptus camaldulensis* and bamboo leaves in boiling water, to treat fever or cold.

Commercialization of medicinal plants

A total of 18 medicinal plant species in Ben En National Park are commercialized (Appendix 2); of these *Zingiber officinale* (Zingiberaceae) and *Allium sativum* (Alliaceae) are cultivated species. *Curcuma zedoaria* (Zingiberaceae) is both cultivated and wild. Three wild species in high market demand are *Morinda officinalis* (Rubiaceae), *Amomum villosum* (Zingiberaceae) and *Spatholobus suberectus* (Fabaceae).

Most of the species are sold to traders or in the market of the Nhu Thanh and the Nhu Xuan districts. Traders usually sell roots of *Morinda officinalis,* roots of *Polygonum multiflorum,* roots and stems of *Smilax glabra,* roots of *Gynura japonica* and stems and barks of *Abrus precatorius* to traditional medicine shops in big cities in Vietnam. *Spatholobus suberectus* and *Amomum villosum* are exported to China.

The demand of the market and the collection intensity of *Morinda officinalis* used as aphrodisiac are especially high. From our botanical field surveys (Hoang et al. in prep.) it appeared that this species has become endangered by overcollecting of the entire plant, and will soon be extinct, at least locally, if no attempts are made to get the plant into cultivation.

Importance of medicinal plant species for the local people in Ben En National Park

Importance for health care

The eight most important species for health care by local communities are listed in Table 7. Most of them are used to treat common diseases such as fever, colds, flu, weakness, and for treating women after childbirth.

Five species of these important medicinal plant species are already grown in home gardens, but the number of households planting them is still low (Table 7).

Table 7. The most important medicinal plants for people in Ben En National Park.

Latin name	Common name	Origin	Percentage of households cultivating the species
Asteraceae	Họ Cúc		
Artemisia vulgaris L.	Ngải cứu	Temperate Europe and Asia, wild, cultivated	21
Fabaceae	Họ Đậu		
Spatholobus suberectus Dunn	Huyết rồng Lào	Native, wild	0
Abrus precatorius L.	Cam thảo	India, wild	0
Lamiaceae	Họ Hoa môi		
Leonurus sibiricus L.	Ích mẫu	Siberia, China, wild, cultivated	12
Ocimum tenuiflorum L.	Hương nhu tia	Old World Tropics, wild, cultivated	15
Plantaginaceae	Ho Mã đề		
Plantago asiatica L.	Mã đề	Asia, wild, cultivated	11
Zingiberaceae	Họ Gừng		
Zingiber officinale Blume	Gừng	China, Asia cultivated	25
Amomum villosum Lour.	Sa nhân	China, wild	0

The use index of the medicinal plant species varies widely (Table 8, Appendix 1), from 0.01 to 1, indicating that 2 species are only used by 1% of all households (*Lonicera japonica* (Caprifoliaceae) and *Xylopia vielana* (Annonaceae)), while 4 species are used by all households, all of them are common and cultivated species (*Camellia sinensis* (Theaceae), *Allium fistulosum, Allium sativum* (Alliaceae), and *Zingiber officinale* (Zingiberaceae)). The majority of species are used by less than half of the households, and 68% of the species have use indices lower than 0.25 (Table 8). On average, households use 25 medicinal plant species for disease treatment (Table 8).

Table 8. Use index of medicinal plants.

Use index	Number of medicinal plant species
> 0.75	18
0.51–0.75	16
0.25–0.50	39
< 0.25	157

Importance for income generation

The monetary income value for local people was calculated for each listed species.

A total of 18 medicinal plant species are commercialized in Ben En National Park, but the most important species for local income are *Amomum villosum* (Zingiberaceae) and *Spatholobus suberectus* (Fabaceae). The average income from *Amomum villosum* is US$ 11 per year per household; this is about 2.5% of the total income. *Spatholobus suberectus* yields about US$ 18 per year per household (4.3% of the total income). The other species do not generate much income, though *Morinda officinalis* (Rubiaceae) has a high price but it is very rare in the field and the amount collected by local people is small. Income of local people per household in Ben En National Park is shown in Table 9.

Table 9. Income of local people per household in Ben En National Park.

Resource	Income in US$	Percentage (%)	Remarks
Agriculture	150	36	Crops such as rice and corn
Livestock	100	24	Pigs, chickens, dogs, and cows
Non medicinal useful plants	50	12	Bamboo, rattan, resin, timber, firewood, etc.
Medicinal plants	45	11	See Appendix 2
Others	75	17	Employment, fishing, trading, etc.
Total	420	100	

Comparison with other regional studies on medicinal plants in Vietnam and in the region

To see whether medicinal plants in Ben En National Park had characteristics in common with those of other national parks in Vietnam, the results of this study were compared with the medicinal plant uses recorded by other authors. Both wild and cultivated medicinal species were taken into account (Table 10).

The result of this study was also compared with the medicinal plant uses recorded in the PROSEA Handbooks on Medicinal and poisonous plants (De Padua et al. 1999, Van Valkenburg & Bunyapraphatsara 2001, Lemmens & Bunyapraphatsara 2003) and Van Reede tot Drakestein's Hortus Malabaricus (1668–1692, Manilal 2003). Out of the total

Table 10. Comparison of medicinal plants in Ben En National Park with other regions in Vietnam.

Study	National Park	Ethnic groups	Size of population	Area (km^2)	No. of medicinal plant species
This study	Ben En	Kinh, Muong, Thai, Tay, Tho	18,000	15,800	230
Tran & Ziegler 2001	Banh Ma	Kinh, Ta ku, Van kieu, H Mong	65,000	22,031	432
On 2003	Ba Vi	Dao	46,547	6,768	503
Thin & Nhan 2003	Pu Mat	Kinh, Thai, Kho Mu, Dan Lai, Poong, H Mong, O Du, Tay	93,333	91,113	610
Chi 1996	Entire Vietnam	54 ethnic groups	85,000,000	330,000,000	3200

of 230 medicinal plant species in Ben En National Park 128 species are listed in the PROSEA Handbooks on Medicinal and poisonous plants and 41 species used by local people in Ben En National Park were also used in the 17th century in Southwest India according to Van Reede's Hortus Malabaricus (Manilal 2003). Differences and similarities in the medicinal use of these species will be considered in the discussion.

Public perception and awareness

In the research area many people are able to identify medicinal plants and give recipes, but the young members of the communities demonstrate little interest in learning the traditional ethnomedical lore. About 43% of young people in all households interviewed do not know about medicinal plants and 25% do not want to learn how to use traditional medicinal plants for disease treatment. Moreover, many local people tend to use synthetic medicine instead of medicinal plants. About 47% of the households interviewed prefer to use western medicine if they can afford it.

Most local people in Ben En National Park recognized that medicinal plants are important for the health care of communities, especially for poor people. They also agreed that medicinal plants in Ben En National Park would not be endangered if they

Table 11. Medicinal plants in Ben En National Park listed in the Red data book of Vietnam (Ban 2007) and the Red list of threatened species of IUCN (2006). E = Endangered; LR = Least concern; nl = not listed; T = Threatened; V = Vulnerable.

Species	Family	Threat category in Red data book Vietnam	Threat category in Red list of IUCN 2006
Alstonia scholaris L.	Apocynaceae	nl	LR
Anoectochilus roxburghii (Wall.) Lindl.	Orchidaceae	E	nl
Ardisia silvestris Pit.	Myrsinaceae	V	nl
Caesalpinia sappan L.	Caesalpiniaceae	nl	LR
Cycas pectinata Buch.-Ham.	Cycadaceae	V	V
Drynaria fortunei (Mett.) J.Sm.	Polypodiaceae	T	nl
Polygonum multiflorum Thunb.	Polygonaceae	V	nl
Rauvolfia verticillata (Lour.) Baill.	Apocynaceae	V	nl

Table 12. Medicinal plants considered as threatened species in Ben En National Park. E = Endangered; R = Rare; T = Threatened.

Species	Family	Threat category
Acorus gramineus Sol.	Araceae	R
Anoectochilus roxburghii (Wall.) Lindl.	Orchidaceae	E
Ardisia silvestris Pit.	Myrsinaceae	E
Caesalpinia sappan L.	Caesalpiniaceae	R
Catharanthus roseus L.	Apocynaceae	T
Cibotium barometz (L.) J.Sm.	Dicksoniaceae	T
Cissampelos pareira L.	Menispermaceae	R
Coscinium fenestratum (Gaertn.) Colebr.	Menispermaceae	E
Cycas pectinata Buch.-Ham.	Cycadaceae	T
Drynaria fortunei (Mett.) J.Sm.	Polypodiaceae	R
Fibraurea recisa Pierre	Menispermaceae	T
Morinda citrifolia L.	Rubiaceae	R
Morinda officinalis Haw.	Rubiaceae	E
Polygonum multiflorum Thunb.	Polygonaceae	V
Rauvolfia verticillata (Lour.) Baill.	Apocynaceae	T
Smilax glabra Wall.	Smilacaceae	T
Stephania longa Lour.	Menispermaceae	R
Stephania rotunda Lour.	Menispermaceae	R

are only harvested for local treatment of diseases and not for commercial purposes. About 82% are aware that such practices had caused a decline in the abundance of many species during the last few years, especially of the expensive, economically exploited species.

Conservation status

Three medicinal plant species from Ben En are listed in the Red data list of IUCN (2006). However, there are 6 medicinal plant species used by local communities in Ben En National Park that are listed in the Red Data Book of Vietnam Vol. 2. (Ban 2007) (Table 11). At the local level, 18 medicinal plant species appear to be endangered, rare, or threatened (Table 12).

DISCUSSION

The commercial potential of medicinal plants in Ben En National Park

The diversity of medicinal plants in Ben En National Park could have a much larger potential for the local people in the research area in particular and for Vietnam in general if the medicinal plants would be processed in a more sophisticated manner, e.g. in ready-to-use tonics and powders. On the other hand, the number of commercialized medicinal plant species in Ben En National Park (18 species) is lower than in other regions: for instance, 54 species in Ba Vi National Park (On 2003) are commercialized. Moreover, the prices of commercial medicinal plant species in Ben En are not stable. The two most important species to generate income are *Amomum villosum* and especially *Spatholobus suberectus*. The revenues they generate still depend on the traders. It would be better if local communities organized the market system. Furthermore, local people should understand and establish sustainable harvesting methods, especially for

the species of high value and importance for income generation. Last but not least, the commercially valuable medicinal plant species should be further studied and planted in home gardens.

Loss of traditional knowledge

Traditional medicinal plant species are not only important for health care of local communities but also of some importance to generate income. However, the present knowledge on traditional healing practices is being lost rapidly. Only few of the local people younger than 25 year participate in collecting medicinal plants compared to those older than 50 (Table 4). Furthermore, many young members of the communities do not know about medicinal plants and show little interest in learning the traditional ethnomedical lore. Traditional knowledge of medicinal plants can get easily lost because many local people tend to use synthetic medicine instead of medicinal plants. To protect and develop the valuable knowledge of traditional medicinal plants their use should be encouraged, especially among the younger generation.

Comparisons with other regional studies on medicinal plants in Vietnam and in the region

The general patterns of plant use recorded in Ben En National Park show overlap with other ethnomedicinal studies from other national parks. Many of the recipes and ideas about illnesses and healing in Ben En are similar to those in Ba Vi (On 2003) and Pu Mat (Thin & Nhan 2003). But the comparisons also show that the number of medicinal plant species used by local people in Ben En is smaller than in other national parks in Vietnam (Table 10). The reason may be that the population living in the core and buffer zone of Ben En is much smaller than in other parks. Moreover, this is the first study on medicinal plants in Ben En National Park, while the number of medicinal plants used by local people according to earlier research in other regions also was smaller than according to more recent results, e.g. 200 species found in Ba Vi National Park (On 2000) (now 503 species); 200 species found in Pu Mat National Park (On 2003) (now 610 species). So future research may show the number of medicinal plant species in Ben En to be higher than the 230 species recorded so far.

A total of 172 medicinal plant species in Ben En National Park (about 75%) are also used medicinally by local people in Pu Mat National Park (Thin & Nhan 2003). Out of these 172 species, 138 species show at least one disease treatment overlapping in use and application in the two parks. The ethnic minority groups in the two regions are quite similar; both regions have Kinh, Thai, and Tay groups, and this could account for similar traditional uses. In the remaining 34 species there are no similarities in the medicinal uses, for example *Glochidion velutinum* (Euphorbiaceae) is used in Pu Mat to treat oedema; in Ben En it is used to treat stomach ache and toothache.

The Dao ethnic group in Ba Vi National Park (On 2003) uses 114 of the medicinal plant species (about 49%) recorded here as traditional medicinal plants in Ben En National Park. Out of these 114 medicinal species, 48 overlap in at least one disease treatment between the two parks. In the remaining 68 species there are no similarities in the medicinal uses. For example, *Rauvolfia verticillata* (Apocynaceae) is used in

Ba Vi against diarrhoea; in Ben En it is used to treat sores and itches. *Gymnema inodorum* (Asclepiadaceae) in Ba Vi is used to treat rheumatism; in Ben En it is used to cure indigestion. This huge divergence in traditional use of medicinal plant species in two regions is hard to understand. It raises questions about the efficacy of traditional healing methods on the one hand and on the role of cultural divergence in health care, on the other.

In order to place these patterns in a broader perspective our results on the medicinal uses of plants in the Ben En National Park were also compared with two other detailed sources of information on traditional use of medicinal plants in Asia: Hortus Malabaricus and the three PROSEA handbook volumes on Medicinal and Poisonous Plants from South-East Asia.

The Hortus Malabaricus by Van Reede tot Drakenstein, consulted in the English translation (Manilal 2003), contains a detailed account of 690 species from the Malabar Coast in India (the modern state of Kerala) with information on their medicinal uses contributed and verified by local traditional healers and Brahmins (Heniger 1986). Although the floras of SW India and Vietnam are far apart and very different, 41 species out of the 230 medicinal species from Ben En National Park were also used medicinally in India in the 17th century and documented in the Hortus Malabaricus (the asterisked species in Appendix 1). A very precise comparison of the uses and (presumed) activity of the medicinal preparations is not possible because both Hortus Malabaricus and our own survey suffer from the fact that actual diseases are not properly identified in line with modern medical knowledge, but rather very general symptoms are listed that may be caused by many different diseases (such as stomach ache, headache, fever, swellings, weakness, etc., cf. Appendix 1). Nevertheless, it is most striking that the same species were in most cases apparently used to treat entirely different symptoms by the 17th century inhabitants and doctors of Kerala when compared with the 21st century local healers in Ben En National Park. For instance, out of the 41 species only 9 show some overlap in their use and application between the two regions, usually concerning only general symptoms like headaches, fever or itches. In the remaining 32 species no similarities in the medicinal uses could be detected at all. To give just two examples: *Morinda citrifolia* (Rubiaceae) was used in India to treat gout; in Ben En National Park it is used as an aphrodisiac and to treat sores; *Phyllanthus reticulatus* was used in India as a mouth wash and to treat rheumatism and stomach ailments; in Ben En it is used to cure skin burns. This huge divergence in traditional use of these 41 species raises similar questions about the efficacy and reliability of traditional healing methods in general as signalled above. One might also question the reliability of the informants in both analyses.

A total of 128 medicinal species from Ben En (56% of the species) have also been reviewed in the PROSEA Handbooks on Medicinal and Poisonous Plants from South-East Asia (De Padua et al. 1999, Van Valkenburg & Bunyapraphatsara 2001, Lemmens & Bunyapraphatsara 2003). In the PROSEA Handbooks information on traditional and modern use of medicinal plants is comprehensively abstracted for the whole region from continental South-East Asia (including Vietnam and Thailand) to the Indo-Pacific (Malaysia, Indonesia, the Philippines, Papua New Guinea). Here the overlap with applications documented is much greater. This is not surprising because

widespread medicinal species appear to have a very wide range of traditional uses, often highly divergent from country to country or region to region, which increases the probability that a single traditional use communicated by the local people from Ben En is among the manifold uses documented for the whole of South-East Asia. PROSEA information thus also shows a fairly high overlap with ancient uses documented in Hortus Malabaricus. In over two thirds of the medicinal species from Ben En the local application agrees with one of the numerous applications recorded in the PROSEA Handbooks. Nevertheless, for 35 species the medicinal use reported by village elders, households and local doctors in Ben En appears to be 'new'. For instance *Achyranthes aspera* (Amaranthaceae) used to treat nervous debility in Ben En, is elsewhere used to treat wounds, abscesses and boils, rheumatism, stomach ache, menstruation pains, etc; *Tetracera scandens* (Dilleniaceae) used to treat rheumatism in Ben En, has a very wide range of applications throughout South-East Asia, including the treatment of snakebites, coughs, burns and diarrhoea without any record for rheumatism (Van Valkenburg & Bunyapraphatsara 2001). These and other divergences between our results from the field survey and interviews in Ben En and information documented in the literature suggest that both broad and narrow inventories of medicinal plants may still be very incomplete and that further critical study is needed.

ACKNOWLEDGEMENTS

The authors are grateful to the Vietnamese government for financially supporting Mr. Hoang Van Sam to carry out the project at Leiden University. We are also grateful to the International Foundation of Science (IFS) for financial support to do the field work in Ben En National Park. We would like to thank Prof. J. Slikkerveer for his useful comments. Dr. F.A.C.B. Adema, Dr. M.M.J. van Balgooy, the late Dr. Ding Hou, Dr. H.P. Nooteboom, Prof. P.C. van Welzen, and Dr. W.J.J.O. de Wilde (National Herbarium of the Netherlands, Leiden University branch), Mr. Nguyen Van Huy, Mr. Nguyen Van Nghia, Mr. Tran Ngoc Hai, Mr. Le Mong Chan (Vietnam Forestry University) kindly helped us to identify many species which is gratefully acknowledged. In addition we thank many staff and local people in Ben En National Park for their support, especially Mr. Nguyen Danh Hien, Mr. Luong Xuan Ha, Mr. Dang Huu Nghi, and Mr. Le Dinh Phuong. We also would like to thank Mr. Hoang Van Cuong, Mr. Vu Van Dinh, Mr. Pham Thanh Trang and Miss Nguyen Tuan Phuong, students at the Vietnam Forestry University for their assistance in the field.

We are very grateful to Dr. P.H. Hovenkamp and Dr. T. van Andel for critically reading earlier versions of the manuscript.

REFERENCES

Anonymous. 2000. The list of plants and animals in Ben En National Park. Report from Sub Institute of Forest Inventory and Planning II, Nghe An, Vietnam: 1–28.

Ban, N.T. (ed.). 2007. Red data book of Vietnam. Vol. 2. Science and Techniques Publishing House, Hanoi.

Chi, V.V. 1996. The dictionary of medicinal plants of Vietnam. Medical Publishing House, Hanoi.

De Lucena, R.F.P., E. de Lima Araujo & U.P. de Albuquerque. 2007. Does the local availability of woody Caatinga plants (north-eastern Brazil) explain their use value? Economic Botany 61: 347–361.

De Padua, L.S., N. Bunyapraphatsara & R.H.M.J. Lemmens (eds.). 1999. Plant Resources of South-East Asia No. 12 (1). Medicinal and poisonous plants 1. Backhuys Publishers, Leiden.

Farnsworth, N.R., O. Akerele, A.S. Bingel, D. Soejarto & Z. Guo. 1985. Medicinal plants in therapy. Bulletin of the World Health Organization 63, 6: 965–981.

Hamilton, A. 2003. Medicinal plants and conservation: issues and approaches. International Plants Conservation Unit, WWF-UK. Surrey, United Kingdom.
Heniger, J. 1986. Hendrik Adriaan van Reede tot Drakenstein (1636–1691) and Hortus Malabaricus. Balkema, Rotterdam-Boston.
Ho, P.H. 2000. An illustrated Flora of Vietnam. Youth Publisher. Ho Chi Minh.
Hoang, S.V., P. Baas. & P.J.A. Keßler. 2008. Plant diversity in Vietnam and Ben En National Park. Agricultural Publishing House, Hanoi.
IUCN. 2006. The red list of threatened species. Available from http://www.redlist.org/info/tables/table6a.
Kasparek, M., A. Gröger & U. Schipmann. 1996. Directory for medicinal plants conservation. IUCN/SSC Medicinal Plants Specialist Group. German Federal Agency for Nature Conservation, Bonn.
King, S.R., E.N. Meza, T.J.S. Carlson, J.A. Chinnock, K. Moran & J.R. Borges. 1999. Issues in the commercialization of medicinal plants. Herbal Gram 47: 46–51.
Lemmens, R.H.M.J. & N. Bunyapraphatsara (eds.). 2003. Plant Resources of South-East Asia No. 12 (1). Medicinal and poisonous plants 3. Backhuys Publishers, Leiden.
Loi, D.T. 1995. Medicinal trees and medicaments of Vietnam. 7th ed. Science and Technology Publishing House, Hanoi.
Manilal, K.S. 2003. English translation of Van Reede tot Drakenstein's Hortus Malabaricus Vol. 1–12. (Calicut), India.
Martin, G.J. 1995. Ethnobotany: A methods manual. Chapman & Hall, London.
Mendelsohn, R. 1997. Valuing undiscovered pharmaceuticals in tropical forests. Notes on economic plants. Economic Botany 51, 3: 328.
Mendelsohn, R. & M.J. Balick. 1995. The value of undiscovered pharmaceuticals in tropical forests. Economic Botany 49: 223–228.
Ngai, N.B. 2001. Methodology of rural appraisal. An introductory guide. Vietnam Forestry University, Hatay.
On, T.V. 2000. Medicinal plants in Ba Vi National Park. Hanoi Pharmacy University, Hanoi.
On, T.V. 2003. A survey of medicinal plants in Ba Vi National Park: Methology and implication for conservation and sustainable use. PhD thesis. Hanoi Pharmacy University, Hanoi.
Phillips, O. & A.H. Gentry. 1993. The useful plants of Tambopata, Peru: Statistical hypotheses tests with a new quantitative technique. Economic Botany 47: 15–32.
PID & NES. 1989. An introduction to participation, rural appraisal for rural resources management. Program for International Development, Clark University, Worcester Mass. and National Environment Secretariat, Ministry of Environment and Natural Resources, Nairobi.
Prance, G.T., W. Balee, B.M. Boom & R.L. Carneiro. 1987. Quantitative ethnobotany and the case for conservation in Amazonia. Conservation Biology 1, 4: 296–310.
Slikkerveer, L.J. 1999. Ethnoscience, 'TEK' and its application to conservation. In: D.A. Posey (ed.), Cultural and spiritual values of biodiversity: 169–180. UNEP, Nairobi, Kenya.
Spjut, R.W. & R.E. Perdue. 1976. Plant folklore: A tool for predicting sources of antitumor activity? Cancer Treatment Reports 60: 979–985.
Swerdlow, J.L. 2000. Nature's medicine: Plants that heal. National Geographic Society. Washington, DC.
Thin, N.N. & T.N. Nhan. 2003. Flora of Pu Mat National Park. Publishing Agriculture House, Hanoi.
Tordoff, A., E. Fanning & M. Grindley (eds.). 2000. Ben En National Park. Society for Environmental Exploration, London.
Tran, T.A. & S. Ziegler. 2001. Utilization of medicinal plants in Bach Ma National Park, Vietnam. Medicinal Plant Conservation 7: 3–5.
Van Andel, T.R. 2000. Non-timber forest products in the north-west district of Guyana. Tropenbos-Guyana series 8. Wageningen.
Van Reede tot Drakenstein, H.A. 1688–1692. Hortus Malabaricus vol. I–XII. Amsterdam.
Van Valkenburg, J.L.C.H. & N. Bunyapraphatsara. 2001. PROSEA. Volume 12, Medicinal and poisonous plants. Backhuys Publishers, Leiden.

Appendix 1. Medicinal plant species used by local people. Key: * = species also treated in Hortus Malabaricus; + = species also treated in PROSEA. Life form: C = Liana; H = Herb; S = Shrub; W = Wood. W/C = Wild/Cultivated: W = Wild; C = Cultivated.

Scientific name	Common name	Life form	Use index	W/C	Part utilized	Medicinal application	Preparation and administration
POLYPODIOPHYTA - FERNS	Ngành Dương xỉ						
Adiantaceae	**Họ Tóc thần vệ nữ**						
Adiantum caudatum L.	Tóc thần vệ nữ	H	0.10	W	Leaves, stem	Fever, coughs	Decoction of leaves and stems is drunk
Aspleniaceae	**Họ Tổ chim**						
Asplenium nidus L.	Tổ điểu	C	0.04	W	Leaves, tuber	Strained muscles	Plant parts are crushed and applied externally
Blechnaceae	**Họ Ráng lá dừa**						
Blechnum orientale L.	Guột lá dừa	H	0.18	W	Leaves, stem	Wounds, snakebite	Plant parts are chewed raw or crushed, then paste applied on the affected part
Dicksoniaceae	**Họ Lông cu li**						
Cibotium barometz (L.) J.Sm.+	Lông cu li	S	0.25	W	Root	Haemostatic	Hairs from stipe bases are taken and applied on the affected part
Marsileaceae	**Họ Rau bợ**						
Marsilea quadrifolia L.	Rau bợ	H	0.23	W	Whole plant	Insomnia	Plant parts are cooked and eaten
Polypodiaceae	**Họ Dương xỉ**						
Drynaria fortunei (Mett.) J. Sm.	Cốt toái bổ	H	0.17	W	Stem, leaves, root	Strained muscles, weakness	Decoction of plant parts is drunk
Microsorum superficiale (Bedd.) Ching	Ráng	H	0.06	W	Leaves	Wounds	Leaves are chewed and paste applied on affected part
Schizaceae	**Họ Bòng bong**						
Lygodium conforme C.Chr.	Bòng bong lá to	C	0.08	W	Leaves, stem	Indigestion	Plant parts are decocted and the decoction is drunk
Lygodium scandens (L.) Sw.	Bòng bong lá nhỏ	C	0.05	W	Leaves	Rheumatism	Juice extracted from leaves are rubbed externally on affected part
PINOPHYTA - GYMMNOSPERMS	Ngành Thông						
Cycadaceae	**Họ Tuế**						
Cycas pectinata Buch.-Ham.	Tuế Lược	W	0.05	W, C	Root	Tuberculosis	Roots juice is taken with warm water
Gnetaceae	**Họ Gắm**						
Gnetum montanum Markgr.	Gắm núi	C	0.16	W	Seed	Malaria	Pounded seeds drunk with warm water
					Root, leaves	Snakebite	Leaves are chewed raw or leaves and roots are crushed and paste applied on affected part
					Seed	Detoxification	Seeds are chewed raw and swallowed
MAGNOLIOPHYTA - ANGIOSPERMS	Ngành Ngọc Lan						
MAGNOLIOPSIDA – DICOTS	Lớp 2 lá mầm						
Acanthaceae	**Họ Ô rô**						
Rhinacanthus nasutus (L.) Kurz*	Bạch hạc	S	0.12	W	Leaves, stem	Herpes, itches, wounds	Plant parts are crushed and paste applied on affected part

Appendix 1. Continued

Scientific name	Common name	Life form	Use index	W/C	Part utilized	Medicinal application	Preparation and administration
Strobilanthes cystolithiger Lind.	Chuỳ hoa	H	0.05	W	Leaves	Bone fractures	Leaves are crushed and paste applied on broken part
Alangiaceae	**Họ Thôi ba**						
Alangium chinense Lour.	Thôi ba	W	0.14	W	Leaves, root	Paralysis	Plant parts are crushed in water or roots are soaked in wine and applied, then rubbed by hand
Amaranthaceae	**Họ Dền**						
Achyranthes aspera L.* +	Cỏ xước	H	0.24	W	Flower	Nervous debility	Decoction of flowers is drunk
Amaranthus spinosus L.+	Dền cơm	H	0.26	C	Root	Fever	Roots juice is drunk
Amaranthus viridis L.	Đơn đỏ	H	0.26	W	Leaves, root	Snakebite, bee stings	Leaves and roots are crushed and paste applied on affected part
					Leaves	Fever	Leaves are decocted, then the decoction is drunk
Celosia cristata L.	Mào gà	H	0.26	C	Stem, leaves, root	Diarrhoea with blood	Plant parts are decocted, then the decoction is drunk
Anacardiaceae	**Họ Điều**						
Spondias lakonensis Pierre	Dâu da xoan	W	0.51	W, C	Root	Weakness after childbirth	Root decoction is given to mother after birth
Annonaceae	**Họ Na**						
Annona squamosa L.+	Na	W	0.15	C	Leaves	Sores	Leaves are crushed, then applied externally
Desmos cochinchinensis Lour.+	Hoa giẻ	C	0.04	W	Stem	Constipation	Small pieces of stem are decocted and the decoction is drunk
Fissistigma villosum (Ast) Merr.	Cánh hoa có lông	C	0.24	W	Leaves, stem	Stomach ache	Leaves and small pieces of stems are decocted, then the decoction is drunk
Xylopia vielana Pierre	Dền	W	0.01	W	Bark, root	Malaria	Small pieces of bark and roots are decocted, then the decoction is drunk
Apiaceae	**Họ Hoa tán**						
Centella asiatica (L.) Urb. +	Rau má	H	0.68	W	Whole plant	Detoxification, urinating problems	Plant parts are chewed raw and swallowed
Apocynaceae	**Họ Trúc đào**						
Alstonia scholaris L.*	Sữa	W	0.11	W, C	Bark	Irregular menses	Small pieces of bark are decocted, then the decoction is drunk
Catharanthus roseus (L) G.Don+	Dừa cạn	H	0.08	W	Root, stem	High blood pressure	Leaves and stems are decocted, then the decoction is drunk
					Leaves	Irregular menses	Leaves are decocted, then the decoction is drunk
					Root, leaves	Dysentery	Leaves and roots are decocted, then the decoction is drunk
Plumeria rubra L.	Đại	W	0.26	C	Leaves, flower	Diarrhoea	Flowers and leaves juice is drunk with warm water
					Bark	Dysentery	Small pieces of barks are decocted, then the decoction is drunk
Rauvolfia verticillata (Lour.) Baill.+	Ba gạc	S	0.23	W	Leaves	Sores, itches	Leaves are crushed and paste applied on affected part
Strophanthus caudatus (Burm.f.) Kurz +	Sừng Châu	C	0.04	W	Whole plant	High blood pressure	Plant parts are decocted, then the decoction is drunk

Wrightia annamensis Eberh. & Dub.	Mức xca trung bộ	S	0.06	W	Leaves	Dysentery	Leaves are decocted, then the decoction is drunk
Araliacea	**Họ Ngũ ra bì**						
Aralia armata (Wall. ex G. Don) Seem.	Đơn châu chấu	W	0.68	W	Root	Sore throat	Roots are chewed raw, then swallowed
Aralia touranensis Ha	Cuồng	C	0.32	W	Leaves	Rheumatism	Juice extracted from leaves are rubbed externally on affected part
					Root	Diabetes	Roots are decocted, then the decoction is drunk
Polyscias fruticosa Harms	Đinh lăng	H	0.82	C	Leaves, root	Weakness	Leaves are eaten as vegetable, roots are soaked in wine, then drunk
					Root	Indigestion	Roots are decocted, then the decoction is drunk
Schefflera octophylla (Lour.) Harms +	Chân chim 8 lá	W	0.84	W	Leaves, bark	Itches	Leaves and barks are crushed, then applied on the affected part
					Leaves	Urinating problems, weakness	Leaves are cooked, then eaten
Asclepiadaceae	**Họ Hà thủ ô**						
Gymnema inodorum Decne. +	Rau mơ	C	0.46	C	Root	Indigestion	Roots are chewed raw and swallowed
Streptocaulon griffithii Hook.f. +	Hà thủ ô	C	0.51	W	Root	Stomach ache	Roots are decocted, then the decoction is drunk
Telosma cordata (Burm.f.) Merr.	Hoa lý	C	0.19	C	Flower	Weakness	Flowers are cooked, then eaten
Asteraceae	**Họ Cúc**						
Artemisia vulgaris L.+	Ngải cứu	H	0.97	C	Leaves	Headache	Juice extracted from leaves, then drunk
					Stem, leaves	Risk of miscarriage	Juice extracted from leaves and stems, mixed with salt or sugar, then drunk
					Leaves	Weakness after childbirth	Leaves are cooked, then eaten
Blumea balsamifera (L.) DC.+	Đại bi	H	0.21	W	Leaves	Colds, flu, coughs	Leaves are decocted, then the decoction is drunk
					Stem	Stomach ache	Small pieces of stems are decocted, then the decoction is drunk
Eclipta erecta L.*+	Nhọ nồi	H	0.84	W	Root	Malaria	Roots are decocted, then the decoction is drunk
					Leaves	Haemostatic, wounds	Leaves are chewed raw or crushed, then paste applied on affected part
Elephantopus scaber L.*+	Cúc chỉ thiên	H	0.32	W	Root	Stomach ache	Roots are decocted, then the decoction is drunk
					Leaves	Dysentery	Leaves are decocted, then the decoction is drunk
Emilia sonchifolia (L.) DC.	Rau má lá rau muống	H	0.11	W	Leaves, root	Dysentery	Leaves and roots are decocted, then the decoction is drunk
					Leaves	Colds, flu	Leaves are decocted, then the decoction is drunk
					Leaves	Sores	Leaves are crushed, then applied on affected part
Eupatorium odoratum L.	Cỏ lào	H	0.40	W	Leaves	Stomach ache	Leaves are decocted, then the decoction is drunk
					Leaves	Diarrhoea	Leaves are decocted, then the decoction is drunk
Gynura crepidioides Benth. +	Rau tàu bay	H	0.57	W	Leaves, stem	Snakebite	Leaves and stems are crushed, then paste applied on affected part
					Leaves	Haemostatic	Leaves are chewed raw or crushed, then paste applied on affected part
Gynura japonica (Thunb.) Juel+	Cúc Tam Thất	H	0.26	W	Leaves, root	Infection	Leaves and roots are crushed, then paste applied on affected part

Appendix 1. Continued

Scientific name	Common name	Life form	Use index	W/C	Part utilized	Medicinal application	Preparation and administration
Gynura japonica (Thunb.) Juel+ (cont.)					Leaves	Haemostatic	Leaves are chewed raw or crushed, then paste applied on affected part
Xanthium strumarium L.+	Ké đầu ngựa	H	0.51	W	Stem, leaves, root	Dysentery	Plant parts are decocted, then the decoction is drunk
					Leaves	Itches	Leaves are chewed raw, then applied on affected part
Bignoniaceae	**Họ Đinh**						
Oroxylum indicum (L.) Vent.*+	Núc nác	W	0.09	W, C	Bark, fruit	Strained muscles	Barks and fruits are decocted, then the decoction is drunk
					Bark	Dysentery	Barks are decocted, then the decoction is drunk
Bombacaceae	**Họ Bông Gạo**						
Gossampinus malabarica (DC.) Merr.	Gạo	W	0.08	W, C	Leaves, bark	Bone fractures	Leaves and barks are crushed, then paste applied on broken part
					Leaves	Dysentery	Leaves are decocted, then the decoction is drunk
Caesalpiniaceae	**Họ Vang**						
Bauhinia viridescens Desv.	Móng bò	C	0.12	W	Root	Enteritis	Roots are decocted, then the decoction is drunk
Caesalpinia digyna Rottler +	Móc mèo núi	S	0.35	W	Stem, seed	Fever, coughs	Small pieces of stems and seeds are decocted, then the decoction is drunk
					Stem	Weakness	Small pieces of stems are decocted, then the decoction is drunk
Caesalpinia sappan L.*+	Vang	W	0.37	W	Leaves, root	Diarrhoea	Decoction of roots and leaves is mixed with honey and then drunk
					Leaves	Haemostatic	Leaves are chewed raw, then paste is applied on affected part
Gleditsia australis Hemsl. +	Bồ kết	W	0.28	W, C	Fruit	Toothache	Juice extracted from fresh fruit, then applied on affected teeth
Senna tora L.+	Thảo quyết minh	S	0.31	W	Flower	Anodyne	Flower is pounded, then given with warm water
					Seed	High blood pressure	Decoction of seeds is drunk
Tamarindus indica L.+	Me	W	0.21	W, C	Fruit	Indigestion	Fruit is decocted, then the decoction is drunk
					Fruit	Fever	Fruit is eaten
Caprifoliaceae	**Họ Kim ngân**						
Lonicera japonica Thunb.+	Kim ngân	H	0.01	W	Leaves	Allergies	Leaves are decocted, then the decoction is drunk
					Flower	Dysentery	Decoction of flower is drunk
Lonicera macrantha (Don D.) Spreng.	Kim ngân hoa to	C	0.04	W	Leaves	Dysentery	Leaves are chewed raw, then swallowed
Sambucus hookeri Rehder	Cơm cháy	W	0.02	W	Leaves, stem	Leprosy	Juice extracted from leaves and stem are applied on affected part
Caricaceae	**Họ Đu đủ**						
Carica papaya L.*+	Đu đủ	W	0.36	C	Root, leaves	Coughs	Roots and leaves are decocted, then the decoction is drunk

					Fruit	Urinating problems	Fruit is eaten
Clusiaceae	**Họ Bứa**						
Cratoxylum polyanthum Korth.	Thành ngạnh	W	0.25	W	Root	Toothache	Roots are soaked in strong wine and applied on the hurting teeth
Garcinia oblongifolia Champ. ex Benth.	Bứa	W	0.12	W	Bark	Stomach ache	Small pieces of bark are decocted, then the decoction is drunk
Combretaceae	**Họ Bàng**						
Quisqualis indica L.+	Dây giun	W	0.20	W	Leaves	Itches	Leaves are crushed, then applied on affected part
					Stem	Toothache	Small pieces of stems are soaked in strong wine and applied on the hurting teeth
Connaraceae	**Họ Khế**						
Cnestis palala Merr.+	Dây khế	C	0.29	W	Leaves, bark	Wounds	Leaves and bark are crushed, then paste applied on affected part
Rourea minor (Gaertn.) Leenh.* +	Khế rừng	W	0.07	W	Leaves, bark	Dysentery	Leaves and bark are decocted, then the decoction is drunk
Convolvulaceae	**Họ Rau muống**						
Argyreia acuta Lour.	Bạc thau	C	0.09	W	Stem, leaves, root	Menorrhagia	Plant parts are decocted, then the decoction is drunk
Merremia boisiana (Gagnep.) Ooststr.	Bìm bịp	C	0.16	W	Leaves	Indigestion	Leaves are chewed raw, then swallowed
Crassulaceae	**Họ Thuốc bỏng**						
Kalanchoe pinnata (Lam.) Pers. +	Thuốc bỏng	H	0.87	W, C	Stem, leaves, root	Detoxification	Juice extracted from plant part, then drunk
					Leaves	Burns	Leaves are crushed, then paste applied on affected part
Cucurbitaceae	**Họ Bầu bí**						
Cucurbita maxima Lam.	Bí đỏ	C	0.23	C	Leaves, fruit	Headache	Leaves and fruits are cooked, then eaten
Hodgsonia macrocarpa (Blume) Cogn.+	Đại hái	C	0.05	W	Leaves	Abscesses	Leaves are crushed, then paste applied on externally affected part
Momordica cochinchinensis (Lour.) Spreng.+	Gấc	C	0.34	C	Seed	Mumps	Seeds pounded and mixed with honey, then paste applied on externally affected part
					Seed	Food poisoning	Pounded seeds drunk with warm water
Trichosanthes cucumeroides (Ser.) Maxim.* +	Dưa núi	C	0.04	W	Leaves, stem	Fever	Plant parts are decocted, then the decoction is drunk
Cuscutaceae	**Họ Tơ hồng**						
Cuscuta chinensis Lam. +	Tơ hồng	C	0.04	W	Whole plant	Back pain	Plant parts are heated, then applied on the back
					Whole plant	Constipation	Plant parts are decocted, then the decoction is drunk
Dilleniaceae	**Họ Sổ**						
Tetracera scandens (L.) Merr.+	Chặc chìu	C	0.15	W	Root	Rheumatism	Juice extracted from roots is drunk
					Root, stem	Stomach ache	Small pieces of roots and stems are decocted, then the decoction is drunk
Ebenaceae	**Họ Thị**						
Diospyros decandra Lour.	Thị	W	0.07	C	Leaves, fruit	High blood pressure	Decoction of leaves and fruits is drunk
Elaeagnaceae	**Họ Nhót**						
Elaeagnus bonii Lecomte	Nhót	S	0.08	C	Stem	Dysentery	Decoction of small pieces of stems is drunk

Appendix 1. Continued

Scientific name	Common name	Life form	Use index	W/C	Part utilized	Medicinal application	Preparation and administration
Euphorbiaceae	**Họ Thầu dầu**						
Baccaurea ramiflora Lour.	Dâu da đất	W	0.25	W, C	Leaves	Itches	Leaves are crushed, then applied on affected part
					Leaves, fruit	Indigestion	Fresh leaves and ripe fruits are eaten
Bischofia javanica Blume	Nhội	W	0.11	W	Bark, leaves	Burns	Plant parts are crushed, then paste applied on affected part
Breynia fleuryi Beille	Bồ cu vẽ	S	0.05	W	Root	Malaria	Roots are decocted, then the decoction is drunk
Euphorbia antiquorum L.*+	Xương rồng	H	0.29	W, C	Stem	Toothache	Juice extracted from stems, then applied on affected teeth
Euphorbia hirta L.+	Cỏ sữa	H	0.12	W	Whole plant	Malaria	Plant parts are decocted, then the decoction is drunk
					Whole plant	Dysentery	Plant parts are decocted, then the decoction is drunk
Glochidion velutinum Wight+	Bọt ếch	S	0.48	W	Leaves, stem	Stomach ache	Plant parts are decocted, then the decoction is drunk
					Root	Toothache	Root is soaked in wine, then applied on hurting teeth
Jatropha curcas L.+	Dầu mè	W	0.04	W	Seed	Headache	Seed oil is applied on forehead
					Leaves	Kidney failure	Leaves are decocted, then the decoction is drunk
Mallotus barbatus (Wall.) Müll.Arg.+	Bùm bụp	S	0.12	W	Leaves, root	Dysentery	Leaves and roots are decocted, then the decoction is drunk
					Leaves	Haemostatic	Leaves are crushed, then paste applied on affected part
Phyllanthus reticulatus Poir.*+	Phèn đen	S	0.27	W	Leaves	Burns	Leaves are crushed, then paste applied on affected part
Phyllanthus urinaria L.	Chó đẻ	S	0.52	W	Whole plant	Sores, itches	Plant parts are crushed, then applied on affected part
					Leaves	Snakebite	Leaves are crushed, then paste applied on affected part
Ricinus communis L.*	Thầu dầu	S	0.14	C	Stem, bark	Weakness	Small pieces of stems and barks are decocted, then the decoction is drunk
Fabaceae	**Họ Đậu**						
Abrus precatorius L.*+	Cam thảo	S	0.86	W	Whole plant	Coughs	Plant parts are decocted, then the decoction is drunk
					Bark, stem	Sore throat	Barks and stems are chewed raw, then swallowed
Bowringia callicarpa Champ. ex Benth.	Dây bánh nem	S	0.09	W	Leaves	Rheumatism	Leaves are crushed in water, then rubbed externally
Derris elliptica Benth.+	Dây mật	C	0.03	W	Root	Nervous debility	Roots are decocted, then the decoction is drunk
Desmodium caudatum (Murray) DC.	Thóc lép	H	0.04	W	Root	Oedema	Roots are decocted, then the decoction is drunk
Erythrina fusca Lour.+	Vông đồng	W	0.27	W, C	Bark, stem	Haemorrhage	Small pieces of stems and barks are decocted, then the decoction is drunk
					Bark	Toothache	Barks are soaked in wine, then that wine applied on affected teeth
Mucuna pruriens (L.) DC.+	Mắc mèo	C	0.48	W	Stem	Weakness	Small pieces of stems are decocted, then the decoction is drunk
Pueraria phaseoloides (Roxb.) Benth.	Sắn dây	C	0.76	C	Tuber	Weakness	Powder made from tubers is drunk with water, or cooked, then eaten

Sophora japonica L. f.	Hoa hoè	W	0.27	W, C	Seed, flower	High blood pressure	Seeds and flowers are boiled, then drunk like tea
Spatholobus suberectus Dunn	Huyet rong lao	C	0.95	W	Stem	Weakness after childbirth	Small pieces of stems are boiled in water, then drunk
Hydrangeaceae	**Họ Thường Sơn**						
Dichroa febrifuga Lour.	Thường sơn	S	0.07	W	Leaves, root, stem	Weakness after childbirth	Plant parts are decocted, then the decoction is drunk
Lamiaceae	**Họ Hoa môi**						
Hyptis suaveolens (L.) Poit.	Tía tô dại	H	0.17	W	Root	High blood pressure	Roots are decocted, then the decoction is drunk
Leonurus sibiricus L.+	Ích mẫu	H	0.87	W, C	Leaves, stem	Weakness	Leaves and stems are decocted, then the decoction is drunk
					Leaves	Haemorrhage	Leaves are crushed in warm water and mixed with some salt, then drunk
Ocimum tenuiflorum L.	Hương nhu tía	H	0.78	W, C	Leaves	Headache	Leaves are crushed, then applied on forehead
					Leaves	Flu	Leaves are decocted, then the decoction is drunk
					Leaves	Cold	Leaves are decocted, then the decoction is drunk (special to treat children's cold)
Lauraceae	**Họ Long nảo**						
Cassytha filiformis L.*+	Tơ xanh	C	0.04	W	Stem	Malaria	Decoction of small pieces of stems is drunk
Cinnamomum cassia Blume+	Quế	W	0.82	C	Bark	Indigestion	Bark is chewed raw, then swallowed
					Bark	Stomach ache	Bark pounded and mixed with honey is given with cold water
Cinnamomum iners Reinw. ex Blume+	Re hương	W	0.21	W	Bark	Indigestion	Bark is chewed raw, then swallowed
					Bark	Stomach ache	Bark pounded and mixed with honey is given with cold water
Litsea cubeba (Lour.) Pers.+	Màng tang	W	0.12	W	Leaves, stem	Nervous debility	Plant parts are decocted, then the decoction is drunk
Litsea glutinosa (Lour.) C.B. Rob.	Bời lời nhớt	W	0.04	W	Bark, root	Dysentery	Small roots and barks are decocted, then the decoction is drunk
					Root	Enteritis	Roots are decocted, then the decoction is drunk
Leeaceae	**Họ Gối hạc**						
Leea rubra Blume +	Gối hạc	S	0.07	W	Root	Arthritis	Small pieces of roots are soaked in wine, then wine is applied to affected part
					Root	Stomach ache	Roots are decocted, then the decoction is drunk
Lythraceae	**Họ Bằng lăng**						
Punica granatum L.+	Lựu	W	0.15	C	Leaves	Dysentery	Young leaves are chewed raw and swallowed
Malvaceae	**Họ Bông**						
Abutilon indicum (L.) Sweet *+	Cối xay	S	0.51	W	Leaves, fruit	Fever, flu	Plant parts are decocted, then the decoction is drunk
Hibiscus rosa-sinensis L.*+	Dâm bụt	S	0.15	W, C	Leaves, stem	Sores	Plant parts are decocted, then the decoction is drunk
Sida rhombifolia L.+	Ké hoa vàng	S	0.07	W	Root, stem	Malaria	Small pieces of roots and stems are decocted, then the decoction is drunk
Urena lobata L.*	Ké hoa đào	S	0.09	W	Root, stem	Malaria	Small pieces of roots and stem are decocted, then the decoction is drunk
Melastomataceae	**Họ Mua**						
Melastoma normale D.Don	Mua	S	0.19	W	Leaves, stem	Infection	Plant parts are crushed, then paste applied on affected part

Appendix 1. Continued

Scientific name	Common name	Life form	Use index	W/C	Part utilized	Medicinal application	Preparation and administration
Melastoma sanguineum Sims.	Mua bà	S	0.15	W	Young leaves	Fever	Young leaves are decocted, then the decoction is drunk
					Young leaves	Sore throat	Young leaves are chewed raw, then swallowed
Meliaceae	**Họ Xoan**						
Melia azedarach L.+	Xoan	W	0.21	C	Leaves, root	Stomach ache	Plant parts are decocted, then the decoction is drunk
					Inner bark	Diarrhoea	Inner bark is decocted, then the decoction is drunk
Menispermaceae	**Họ Tiết dê**						
Cissampelos pareira L.+	Tiết dê	C	0.11	W	Leaves, stem, root	Rheumatism	Leaves, stems and roots are crushed, then paste applied externally
Coscinium fenestratum (Gaertn.) Colebr. +	Vằng đắng	C	0.04	W	Root, stem	Fever	Decoction of roots and stems is drunk
					Root	Dysentery	Roots are decocted, then the decoction is drunk
					Leaves	Wounds	Plant parts are crushed, then paste applied on affected part
Fibraurea recisa Pierre	Hoàng đằng	C	0.12	W	Stem	Wounds	Plant parts are crushed, then paste applied on affected part
					Stem, root	Weakness	Small pieces of roots and stems are decocted, then the decoction is drunk
Pericampylus glaucus (Lam.) Merr.	Lõi tiền	C	0.12	W	Leaves, stem	Snakebite	Plant parts are crushed, then paste applied on affected part
Pycnarrhena poilanei (Gagnep.) Forman	Phi đằng	C	0.08	W	Leaves, root	Eye sores	Plant parts are decocted, then the decoction is drunk
Stephania japonica (Thunb.) Miers+	Cam thảo	C	0.35	W	Stem, root	Diarrhoea	Plant parts are decocted, then the decoction is drunk
Stephania longa Lour.	Lõi tiền	C	0.16	W	Root	Stomach ache	Plant parts are decocted, then the decoction is drunk
Stephania rotunda Lour.	Củ bình vôi	C	0.51	W	Tuber	Stomach ache	Tuber decocted, then the decoction is drunk
					Tuber	Cold	Tuber decocted, then the decoction is drunk
Mimosaceae	**Họ Trinh nữ**						
Acacia farnesiana (L.) Willd. +	Keo ta	W	0.03	C	Bark, stem	Wounds	Plant parts are crushed, then paste applied on affected part
Entada phaseoloides (L.) Merr.+	Bằm Bằm	C	0.05	W	Bark, flower, leaves	Itches	Plant parts are crushed, then applied on affected part
					Bark	Malaria	Decoction of bark is drunk
Leucaena leucocephala (Lam.) De Wit	Keo dậu	W	0.02	W, C	Seed	Hookworm	Seeds pounded, then drunk with warm water
Moraceae	**Họ Dâu tằm**						
Artocarpus tonkinensis A.Chev. ex Gagnep.	Chay	W	0.12	W, C	Bark	Toothache	Juice extracted from barks is dipped on affected teeth, or bark is soaked in wine, then the wine is applied on affected teeth
Broussonetia papyrifera L.	Dướng	W	0.15	W	Leaves, root	Haemostatic	Plant parts are crushed, then paste applied on affected part
Ficus auriculata Lour.	Vả	W	0.18	W	Bark	Diarrhoea	Barks are decocted, then the decoction is drunk

Ficus benjamina L. +	Si	W	0.14	W, C	Latex	Itches	Latex paste is applied on affected part
Ficus heterophylla L.f.*	Vú bò	S	0.15	W	Root, stem	Weakness, jaundice	Small pieces of roots and stems are decocted, then the decoction is drunk
					Latex	Itches	Latex paste is applied on affected part
Ficus hispida L.f.*+	Ngái	S	0.15	W	Bark, leaves	Diarrhoea	Plant parts are decocted, then the decoction is drunk
Ficus racemosa L.*	Sung	W	0.22	W, C	Leaves, bark	Stomach ache, dysentery	Plant parts are decocted, then the decoction is drunk
Morus alba L.+	Dâu	W	0.26	W, C	Fruit	Weakness	Fruits are soaked in water with sugar, then eaten and drunk
Streblus asper Lour.*+	Duối	W	0.19	W, C	Root, leaves	Sunburn	Juice extracted from leaves and roots is applied on affected part
					Leaves	Flu	Leaves are boiled, then inhaled
Myrsinaceae	**Họ Đơn nem**						
Ardisia silvestris Pit.	Lá khôi	H	0.37	W	Fruit, leaves	Stomach ache	Plant parts are decocted, then the decoction is drunk
Embelia ribes Burm.f.*+	Chua ngút	C	0.19	W	Leaves, fruit	Hookworm	Leaves and fruits are chewed and swallowed
					Leaves, bark	Snakebite	Plant parts are crushed, then paste applied on affected part
Maesa balansae Mez	Đơn nem núi	S	0.10	W	Leaves	Hiccups	Leaves are chewed raw and swallowed
					Leaves	Hookworm	Juice from leaves mixed with sugar is drunk with warm water
Maesa sinensis A.DC.	Đơn nem	S	0.12	W	Leaves, stem	Oedema	Plant parts are decocted, then the decoction is drunk
Myrtaceae	**Họ Sim**						
Baeckea frutescens L.	Thanh hao	S	0.14	W, C	Leaves	Infection	Leaves crushed, then paste applied on affected part
					Leaves, stem	Irregular menses	Plant parts are decocted, then the decoction is drunk
Eucalyptus camaldulensis Dehnh.+	Bạnh đàn trắng	W	0.51	C	Leaves	Colds, flu	Leaves are boiled with leaves of bamboo, then steam is inhaled
Eucalyptus exserta F.Müll.	Bạnh đàn	W	0.52	C	Leaves	Colds, flu, headache	Leaves are boiled with leaves of bamboo, then steam is inhaled
					Root	Rheumatism	Roots are crushed in water, then applied on affected part
Psidium guajava L.*+	Ổi	W	0.27	C	Leaves	Diarrhoea, dysentery	Young leaves are chewed raw, then swallowed
Rhodomyrtus tomentosa (Aiton) Hassk.+	Sim	S	0.11	W	Stem, root	Diarrhoea	Decoction of stems and roots is drunk
					Root	Itches	Juice extracted from roots is applied on affected part
Oleaceae	**Họ Hoa nhài**						
Jasminum scandens Vahl	Lài leo	C	0.04	W	Root, stem, leaves	Back pain	Plant parts are steamed, then paste applied on the back
Jasminum subtriplinerve A.DC.+	Vằng	C	0.11	W	Leaves, root	Itches	Leaves and roots crushed, then applied on affected part
					Root, stem	Weakness after childbirth	Plant parts are decocted, then the decoction is drunk
Oxalidaceae	**Họ Chua me**						
Oxalis corniculata L.+	Chua me đất	H	0.10	W	Stem, leaves, root	Malaria	Plant parts are decocted, then the decoction is drunk
Passifloraceae	**Họ Lạc tiên**						
Passiflora foetida L.	Lạc tiên	C	0.07	W	Root, leaves, stem	Heart weakness, anodyne	Plant parts are decocted, then the decoction is drunk
Piperaceae	**Họ Tiêu**						
Piper betle L.*+	Trầu không	C	0.53	C	Leaves	Wounds, itches	Leaves are crushed, then paste applied on affected part
Piper lolot C.DC.+	Lá lốt	H	0.32	C	Leaves	Toothache	Juice from leaves, then applied on the teeth

Appendix 1. Continued

Scientific name	Common name	Life form	Use index	W/C	Part utilized	Medicinal application	Preparation and administration
Plantaginaceae	**Họ Mã đề**						
Plantago asiatica L+	Mã đề	H	0.79	W, C	Leaves, stem	Kidney failure	Plant parts are decocted, then the decoction is drunk
					Leaves	Urinating problems, cough	Leaves are decocted, then the decoction is drunk
Polygonaceae	**Họ Rau răm**						
Polygonum chinensis L.*+	Mía giò	H	0.16	W	Leaves, stem	Dysentery	Leaves and stems are chewed raw and swallowed
					Leaves	Snakebite	Leaves are crushed, then paste applied on affected part
Polygonum multiflorum Thunb. ex Murray+	Hà thủ ô do	H	0.21	W	Root	Weakness after childbirth	Small pieces of roots are decocted, then the decoction is drunk
Polygonum odoratum Lour.	Rau răm	H	0.08	C	Leaves	Malaria	Leaves are decocted, then the decoction is drunk
Portulacaceae	**Họ Rau sam**						
Portulaca oleracea L.*+	Rau sam	H	0.68	W	Stem, leaves	Weakness	Plant parts are cooked, then eaten
Rhamnaceae	**Họ Táo**						
Ziziphus mauritiana Lam.*+	Táo nhà	W	0.46	C	Leaves, root	Rheumatism	Juice extracted from leaves and roots is applied externally
					Leaves	Stomach ache	Leaves are decocted, then the decoction is drunk
					Leaves	Swellings	Leaves are crushed with salt, then paste applied on affected part
Ziziphus oenoplia (L.) Mill.+	Táo dại	W	0.04	W	Leaves, root, stem	Menorrhagia	Plant parts are decocted, then the decoction is drunk
Rosaceae	**Họ Hoa Hồng**						
Duchesnea indica (Andrews) Focke	Dâu núi	H	0.05	W	Leaves, root, stem	Stomach ache	Plant parts are decocted, then the decoction is drunk
Persica vulgaris Mill.	Đào	S	0.09	W, C	Flower, stem	Irregular menses	Plant parts are decocted, then the decoction is drunk
Rosa chinensis Jacq.	Hoa hồng	S	0.18	C	Flower, stem	Haemorrhage	Small pieces of stems and flowers are decocted, then the decoction is drunk
Rubus cochichinnensis Tratt.	Ngấy	S	0.15	W	Leaves, fruit	Oedema, jaundice	Fruits are eaten, or juice from leaves and fruit is drunk
					Leaves	Indigestion	Leaves are decocted, then the decoction is drunk
Rubiaceae	**Họ Cà Phê**						
Canthium horridum Blume+	Găng gai	S	0.25	W	Root	Dyspnoea	Decoction of roots is drunk
					Leaves	Wounds	Leaves are crushed, then paste applied on affected part
Hedyotis capitellata Wall. ex G.Don+	Dạ cẩm	S	0.13	W	Leaves, root, stem	Bone fractures	Plant parts are crushed, then paste applied on affected part
Morinda citrifolia L.*+	Mặt quỉ	S	0.08	W	Whole plant	Sores	Plant parts are decocted, then the decoction is drunk
					Root	Aphrodisiac	Roots are soaked in wine for a long time, then drunk
Morinda officinalis Haw.+	Ba Kích	C	0.24	W	Root, stem	High blood pressure	Plant parts are decocted, then the decoction is drunk
					Root	Aphrodisiac	Roots are soaked in wine for a long time, then drunk
Mussaenda cambodiana Pierre ex Pit.	Bướm bạc	C	0.04	W	Leaves, root	Arthritis	Decoction of roots and leaves is drunk
Neolamarckia cadamba (Roxb.) Bosser*	Gáo	W	0.12	W, C	Leaves	Itches	Leaves are crushed, then applied on affected part

Paederia foetida L.+	Mơ	C	0.81	C	Leaves	Dysentery, diarrhoea	Leaves are chewed raw and swallowed, or cooked with chicken egg, then eaten
Psychotria rubra (Lour.) Poit.	Lấu	S	0.56	W	Leaves, root	Kidney failure	Decoction of roots and leaves is drunk
Rutaceae	**Họ Cam**						
Clausena excavata Burm.f.+	Hồng bì dại	W	0.09	W	Leaves	Stomach ache	Leaves are decocted, then the decoction is drunk
Clausena lansium (Lour.) Skeels+	Quất hồng bì	W	0.10	W, C	Leaves, fruit	Cancer	Plant parts are decocted, then the decoction is drunk
Euodia lepta (Spreng.) Merr. +	Ba gạc	S	0.21	W	Leaves	Measles	Leaves are heated, then paste applied on affected part
					Leaves	Itches	Leaves are crushed, then applied on affected part
Glycosmis pentaphylla Spreng.	Cơm rượu	S	0.17	W	Leaves, root	Colds, flu, coughs	Juice extracted from leaves and roots is drunk with warm water
					Leaves	Stomach ache	Leaves are decocted, then the decoction is drunk
Micromelum hirsutum Oliv.	Mắt trâu	W	0.09	W	Leaves	Itches, skin diseases	Leaves are crushed, then applied on affected part
Zanthoxylum avicennae (Lam.) DC.+	Xẻn	W	0.06	W	Root, leaves	Aphasia	Decoction of roots and leaves is drunk
Zanthoxylum nitidum (Lam.) DC.	Xuyên tiêu	W	0.10	W	Leaves, bark	Itches	Leaves and bark are crushed, then applied on affected part
Simaroubaceae	**Họ Thanh Thất**						
Eurycoma longifolia W. Jack	Bách bệnh	S	0.19	W	Leaves, bark, root	Diarrhoea	Plant parts are decocted, then the decoction is drunk
					Leaves	Infection	Leaves are crushed, then paste applied on affected part
Solanaceae	**Họ Cà**						
Capsicum annuum L.*	Ớt	S	0.08	C	Root, fruit	Malaria	Plant parts are decocted, then the decoction is drunk
Daruta metel L.*+	Cà độc dược	S	0.12	W	Leaves	Swellings	Leaves are crushed, then paste applied on affected part
Solanum indicum L.	Cà dại hoa tím	S	0.22	W	Leaves, root	Toothache	Juice extracted from roots and leaves, then paste applied on affected teeth
					Root	Vomiting	Juice extracted from roots is drunk with warm water
Solanum torvum Sw.+	Cà dại	S	0.13	W	Root	Tooth ache	Juice extracted from roots, then paste applied on affected teeth
Sterculiaceae	**Họ Chôm**						
Helicteres angustifolia L.	Thầu kén đực	S	0.20	W	Leaves	Snakebite	Leaves are crushed, then paste applied on affected part
Sterculia lanceolata Cav.	Sảng nhung	W	0.12	W	Leaves, bark	Snakebite	Leaves and bark are crushed, then paste applied on affected part
Styracaceae	**Họ Bồ Đề**						
Styrax tonkinensis (Pierre) Craib+	Bồ đề	W	0.02	W	Leaves	Pneumonia	Decoction of leaves is drunk
Theaceae	**Họ Chè**						
Camellia sinensis (L.) Kuntze+	Chè	S	1	C	Leaves	Indigestion	Tea made from fresh leaves is drunk
Ulmaceae	**Họ Du**						
Trema orientalis (L.) Blume*	Hu Đay	W	0.12	W	Leaves	Vomiting	Leaves are chewed raw with salt and swallowed
					Leaves, bark	Diarrhoea	Decoction of leaves and bark is drunk
Urticaceae	**Họ Gai**						
Boehmeria nivea (L.) Gaudich.+	Gai	S	0.48	C	Root	Risk of miscarriage	Roots are boiled then eaten
Pouzolzia zeylanica (L.) Benn.*+	Bọ mắn	S	0.15	W	Leaves	Infection	Leaves are crushed, then paste applied on affected part
Verbenaceae	**Họ Tếch**						
Clerodendrum cyrtophyllum Turcz.	Đắng cảy	S	0.08	W	Leaves	Itches	Leaves are crushed, then applied on affected part

Appendix 1. Continued

Scientific name	Common name	Life form	Use index	W/C	Part utilized	Medicinal application	Preparation and administration
Clerodendrum fragrans Vent.+	Ngọc nữ	S	0.29	W	Root, leaves	Haemostatic	Roots and leaves are decocted, then the decoction is drunk
					Root	Rheumatism	Juice extracted from roots is rubbed externally
					Root	Irregular menses	Roots are decocted, then the decoction is drunk
Clerodendrum japonicum (Thunb.) Sweet+	Xích đồng nam	S	0.34	W	Root	Metritis, leucorrhoea, irregular menses	Roots are decocted, then the decoction is drunk
					Root	Irregular menses	Decoction of roots is drunk
Clerodendrum paniculatum L.+	Mò trắng	S	0.10	W	Leaves, root	Haemostatic	Roots and leaves are decocted, then the decoction is drunk
Stachytarpheta jamaicensis (L.) Vahl +	Cây đuôi chuột	H	0.06	W	Whole plant	Arthritis	Plants parts are decocted, then the decoction is drunk
					Leaves	Cold	Decoction of leaves is drunk
					Leaves	Skin diseases	Leaves are crushed, then applied on affected part
Verbena officinalis L.+	Cỏ roi ngựa	H	0.24	W	Leaves	Itches	Leaves are crushed, then applied on affected part
					Root, stem	Dysentery	Roots and stems are decocted, then the decoction is drunk
Vitex quinata (Lour.) F.N.Williams +	Đẻn	W	0.09	W	Fruit, leaves	Fever	Decoction of fruits and leaves is drunk
					Fruit	Indigestion	Fruits are eaten
Vitex trifolia L.*+	Đẻn 3 lá	W	0.07	W	Leaves	Arthritis	Decoction of leaves is drunk
Vitaceae	**Họ Nho**						
Cayratia japonica (Thunb.) Gagnep.	Nho rừng	C	0.12	C	Leaves	Bone fractures	Leaves are crushed, then paste applied on affected part
Cissus modeccoides Planch.	Chìa vôi	C	0.07	W	Root, stem	Arthritis	Decoction of leaves and stems is drunk
Tetrastigma strumarium Gagnep.	Dây quai bị	C	0.08	W	Leaves	Bone fractures	Leaves are crushed, then paste applied on affected part
					Leaves, root	Arthritis	Decoction of leaves and roots is drunk
LILIOPSIDA - MONOCOTS	Lớp 1 lá mầm						
Agavaceae	**Họ Huyết dụ**						
Cordyline terminalis Kunth	Huyết dụ	H	0.45	W, C	Root, leaves	Haemostatic	Roots and leaves are decocted, then the decoction is drunk
Alliaceae	**Họ Hành**						
Allium fistulosum L.+	Hành	H	1	C	Leaves, stem, Bulb	Flu, cold	Plant parts are cooked with rice then eaten (onion soup)
Allium odorum L.+	Hẹ	H	0.61	C	Leaves	Cold	Juice extracted from leaves, then mixed with sugar, is drunk (special to treat children's colds)
					Leaves, seed	Aphrodisiac	Juice extracted from leaves is drunk, or seed soaked in wine, is drunk (the longer soaked the better effect)
Allium sativum L.+	Tỏi	H	1	C	Bulb	Dysentery, coughs, flu	Fresh bulbs are eaten

Araceae	**Họ Ráy**						
Acorus gramineus Sol. ex Aiton	Thạnh xương bồ	H	0.24	W	Leaves, stem	Stomach ache	Leaves and stems are decocted, then the decoction is drunk
Aglaonema modestum Schott	Vạn niên thanh	H	0.17	W, C	Leaves, tuber	Bone fractures	Leaves and tubers are crushed, then paste applied on affected part
Alocasia macrorrhizos (L.) G.Don+	Ráy	H	0.14	W, C	Stem, leaves	Wounds, burns	Leaves and stems are crushed, then paste applied on affected part
Amorphophallus paeoniifolius (Dennst.) Nicol.*+	Khoai n_a	H	0.09	W, C	Leaves	Detoxification	Leaves are cooked, then eaten
Homalomena occulta (Lour.) Schott	Thiên niên kiện	H	0.22	W, C	Tuber	Weakness, coughs	Decoction from tubers is drunk
Pothos repens (Lour.) Druce	Chân rết	H	0.09	W	Whole plant	Food poisoning	Plant parts are decocted, then the decoction is drunk
Arecaceae	**Họ Cau dừa**						
Areca catechu L.+	Cau	W	0.09	C	Root, fruit	Dysentery, diarrhoea	Plant parts are decocted, then the decoction is drunk
Caryota mitis Lour.	Đùng đình	W	0.12	W	Root	Stomach ache	Small pieces of roots are decocted, then the decoction is drunk
Asparagaceae	**Họ Tóc Tiên**						
Asparagus cochinchinensis (Lour.) Merr.+	Tóc tiên	H	0.16	W, C	Root	Tuberculosis	Decoction of roots is drunk
					Leaves	Snakebite	Leaves are crushed, then paste applied on affected part
Commelinaceae	**Họ Thài Lài**						
Commelina communis L. +	Thài lài	H	0.21	W, C	Stem, leaves	Dysentery	Plant parts are decocted, then the decoction is drunk
Cyperaceae	**Họ Cói**						
Cyperus rotundus L.+	Cỏ gấu	H	0.09	W	Tuber	Diarrhoea	Tubers are decocted, then the decoction is drunk
Kyllinga monocephala Rottb.*+	Cỏ bạc đầu	H	0.21	W	Stem, leaves	Flu, fever	Plant parts are steamed, then paste applied on forehead
					Leaves, stem	Skin diseases	Plant parts are crushed, then applied externally on affected part
Dioscoreaceae	**Họ Củ mài**						
Dioscorea glabra Roxb.	Củ từ	C	0.06	W, C	Tuber	Dysentery	Decoction from tubers is drunk
Dioscorea pyrsimilis Prain & Burkill+	Củ mài	C	0.13	W	Tuber	Fever	Tubers are decocted, then the decoction is drunk
Hypoxidaceae	**Họ Sâm Cau**						
Curculigo orchioides Gaertn.*+	Sâm cau	H	0.15	W	Leaves, root, stem	Rheumatism	Decoction of plant parts is drunk
Iridaceae	**Họ Sâm Đại Hành**						
Eleutherine bulbosa (Mill.) Gagnep.	Sâm đại hành	H	0.16	W	Bulb	Weakness, indigestion	Bulbs are decocted, then the decoction is drunk
Orchidaceae	**Họ Phong Lan**						
Anoectochilus roxburghii (Wall.) Lindl.	Kim Tuyên	H	0.03	W	Whole plant	Weakness	Plant parts are decocted, then the decoction is drunk
Pandanaceae	**Họ Dứa**						
Pandanus tectorius Parkinson+	Dứa gỗ	S	0.06	W	Leaves, root, stem	Haemorrhage	Plant parts are decocted, then the decoction is drunk
Pandanus tonkinensis Mart. ex Stone	Dứa	S	0.05	W	Fruit	Sunburn	Juice extracted from fruits is rubbed externally
					Root	Oedema	Roots are decocted, then the decoction is drunk
Phormiaceae	**Họ Hương bài**						
Dianella ensifolia (L.) DC.+	Hương bài	H	0.30	W	Root	Wounds, infection	Roots are crushed, then paste applied on affected part
Poaceae	**Họ Cỏ**						
Chrysopogon aciculatus (Retz.) Trin.*	Cỏ may	H	0.09	W	Leaves, root, stem	Stomach ache	Plant parts are decocted, then the decoction is drunk

Appendix 1. Continued

Scientific name	Common name	Life form	Use index	W/C	Part utilized	Medicinal application	Preparation and administration
Cymbopogon citratus (DC.) Stapf+	Sả	H	0.08	C	Whole plant	Bone fractures	Plant parts are crushed, then paste applied on affected part
Eleusine indica (L.) Gaertn.	Cỏ Mần trầu	H	0.15	W	Leaves	Flu	Leaves are decocted, then the decoction is drunk
					Root	Urinating problems	Fresh roots are chewed and swallowed
Smilacaceae	**Họ Cầm Cang**						
Smilax corbularia Kunth+	Kim cang bạc	C	0.09	W	Leaves, root, stem	Indigestion	Plant parts are decocted, then the decoction is drunk
Smilax glabra Wall. +	Thổ phục linh	C	0.12	W	Root, stem	Arthritis	Plant parts are decocted, then the decoction is drunk
					Root, stem	Skin diseases	Juice is extracted from roots and stems and rubbed externally
					Root, stem	Bone fractures	Plant parts are crushed then paste applied on affected part
Zingiberaceae	**Họ Gừng**						
Alpinia zerumbet (Pers.) Burtt +	Riềng	H	0.57	W, C	Rhizome	Stomach ache	Rhizomes are pounded and drunk with cold water
Amomum villosum Lour.+	Sa nhân	H	0.36	W	Seed	Stomach ache	Seeds are pounded and mixed with honey, then drunk with cold water
					Seed	Malaria	Seeds aren pounded and given with warm water
Curcuma domestica Valeton = *C. longa* L.+	Nghệ	H	0.77	C	Rhizome	Sore throat	Fresh pieces of rhizomes are chewed and swallowed
					Rhizome	Stomach ache	Small pieces of rhizomes are cooked with honey, then eaten
Curcuma zedoaria (Berg.) Roscoe+	Nghệ đen	H	0.48	C	Rhizome	Stomach ache	Small pieces of rhizomes are cooked with honey, then eaten
Zingiber officinale Blume*+	Gừng	H	1	C	Rhizome	Weakness	Small pieces of rhizomes are soaked in wine, then drunk
					Rhizome	Indigestion, flu	Juice extracted from rhizomes is given with warm water

Appendix 2. Commercial medicinal plant species.

Scientific name	Common name	Abundance in the wild	Intensity of collection	Price in US$ (1$ = 16.000 Vietnamese dong)	Market demand
POLYPODIOPHYTA - FERNS	Ngành Dương xĩ				
Dicksoniaceae	**Họ Lông cu li**				
Cibotium barometz (L.) J.Sm.	Lông cu li	Low	Medium	0.32/kg dried root	Medium
MAGNOLIOPHYTA - ANGIOSPERMS	Ngành Ngọc Lan				
MAGNOLIOPSIDA - DICOTS	Lớp 2 lá mầm				
Araliaceae	**Họ Ngũ ra bì**				
Schefflera octophylla (Lour.) Harms	Chân chim 8 lá	High	Medium	0.07/kg fresh leaves	Medium
Asclepiadaceae	**Họ Hà thủ ô**				
Streptocaulon griffithii Hook.f.	Hà thủ ô	Medium	Medium	Not stable	Medium
Asteraceae	**Họ Cúc**				
Gynura japonica (Thunb.) Juel.	Cúc Tam Thất	Medium	Medium	Not stable	Medium
Fabaceae	**Họ Đậu**				
Abrus precatorius L.	Cam thảo	Medium	Medium	Not stable	Medium
Spatholobus suberectus Dum.	Huyet rong lao	High	High	0.06/kg dried stem	High
Lauraceae	**Họ Long nảo**				
Cinnamomum cassia Blume	Quế	Low	Low	0.7/kg dried bark	Medium
Myrsinaceae	**Họ Đơn nem**				
Ardisia silvestris Pit.	Lá khôi	Low	Low	0.1/kg fresh leaves	Medium
Polygonaceae	**Họ Rau răm**				
Polygonum multiflorum Thunb. ex Murray	Hà thủ ô do	Low	Medium	0.6/kg fresh tuber	Medium
Rubiaceae	**Họ Cà Phê**				
Morinda officinalis Haw.	Ba Kích	Low	High	2.5/kg fresh tuber	High
Mussaenda cambodiana Pierre ex Pit.	Bướm bạc	Medium	Medium	Not stable	Low
LILIOPSIDA - MONOCOTS	Lớp 1 lá mầm				
Alliaceae	**Họ Hành**				
Allium sativum L.	Tỏi	Cultivated		0.07/4 tubers	High
Araceae	**Họ Ráy**				
Acorus gramineus Aiton et Soland.	Thạnh xương bồ	Medium	Medium	1.9/kg dried stem	Low
Homalomena occulta (Lour.) Schott	Thiên niên kiện	Medium	Medium	0.32/kg dried stem	Medium
Smilacaceae	**Họ Cầm Cang**				
Smilax glabra Wall. ex Roxb.	Thổ phục linh	Medium	Medium	Not stable	Medium
Zingiberaceae	**Họ Gừng**				
Amomum villosum Lour.	Sa nhân	High	High	0.6/kg dried seed	High
Curcuma zedoaria (Berg.) Roscoe	Nghệ đen	Low in wild, but cultivated	Medium	0.95/kg fresh rhizome	High
Zingiber officinale Blume	Gừng	Cultivated		0.7/kg fresh rhizome	High