

Rapid Trade and Environment Assessment (RTEA)

Background Research Paper

**Environmental Impacts of Trade Liberalization in the
Medicinal Plants & Spices Sector of the Lao PDR**

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To inform the *Rapid Trade and Environment Assessment* for Lao PDR, seven background papers covering nine key economic sectors were commissioned by the RTEA Expert Advisory Panel, a body consisting of key government and private sector stakeholders established to provide overall guidance to the assessment process. These papers provided vital background information and illuminated key sector-specific policy recommendations for the main assessment and are seen as a valuable contribution to the growing body of in-country research focusing on the complex dynamics between trade and the environment in Lao PDR.

This research exercise was coordinated by the Science, Technology and Environment Agency and IUCN – The World Conservation Union in Lao PDR.

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Environmental Impacts of Trade Liberalization in the Medicinal Plants & Spices Sector, Lao PDR

by Kongmany Sydara*

Introduction

The potential biomedical validity of traditional medicines has attracted growing attention and discussion in recent years, particularly in response to the adoption of the 1992 Convention on Biological Diversity (CBD 2007). Consequently, this has led to an intensified focus on biodiversity-rich countries by many institutions that come bearing sophisticated technologies in search of new biologically active chemical compounds to be developed into drugs for clinical use.

Many groups of people use and rely on medicinal plants in Lao PDR, from individuals to commercial companies. Some processing companies focus on selected medicinal and aromatic plants, such as *Coscinium* spp and *Aquilaria* spp. *Coscinium* is a well-known plant in Lao PDR because of its broad medicinal properties, including use as an antioxidant and as an antiseptic. *Coscinium* is also the main source of berberine which is good for the treatment of diarrhoea and dysentery. *Aquilaria* or Agarwood is a raw material used for the distillation of Agarwood oil, an aromatic oil popular in the Middle East.

Farnsworth et al. (1985) found that approximately 60-80 percent of the world's population still depends on traditional knowledge and medicines for the treatment of common ailments and diseases. In recognition of the usefulness of traditional medicines, the Government of Lao PDR (GoL) has established the Traditional Medicine Research Centre (TMRC) under the Ministry of Public Health to study and incorporate the use of medicinal plants and traditional Lao medicines into the modern healthcare systems of Lao PDR (Libman et al. 2006). The TMRC has found that traditional medicines in Lao PDR include predominantly herbal medicines, and to some extent oils used for aromatherapy, massages and saunas (Sydara et al. 2005). A list of commonly-traded wild medicinal plants of Lao PDR can be viewed in Annex 1. Growth in the traditional medicines sector has been fuelled largely from international demand, particularly to countries such as China, Vietnam and Thailand (MoIC & ITC 2006).

The influence of the market economy on the trade and use of medicinal plants is growing year by year. The future accession to the World Trade Organization (WTO), Normal Trade Relations established with the United States, Generalized System of Preferences privileges from the EU, and free trade and economic integration in ASEAN are creating opportunities for Lao PDR to export medicinal plants and spices with larger market share (MoIC & ITC 2006). The influence of these changes on the medicinal plants sector is reflected in the increased production of traditional medicines in pharmaceutical factories (both in the public and private sectors). For instance, experts at the TMRC have observed that the number of traditional medicine products produced by the Pharmaceutical Factory No. 2 of the Ministry of Public Health has increased significantly in recent years (TMRC 2007). This growing demand, coupled with Lao PDR's rich medicinal plant resources, are among the key factors that have led to the identification of this sector in the *National Export Strategy 2006-2008* (MoIC & ITC 2006) as a key growth sector for trade.

The development of medicinal plants and spices for export can help to generate increased income among farmers, reduce poverty, stimulate entrepreneurship, and create a favourable business environment to integrate into the global marketplace. However, at the same time, this significant

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expansion requires significant resources and has raised some concerns about the inappropriate and unplanned use of medicinal plants, leading to the diminution of the richness of the country's biodiversity.

This paper will provide a history on Lao PDR's use and trade of traditional medicines, with support of a number of case studies, and suggest measures to be taken to ensure the sustainable use of Lao PDR's natural resources for the harvesting of traditional medicines and spices.

Section 1:

Overview of the medicinal plants and spices sector

1.1 Status of medicinal plants and spices

Lao PDR's floral resources are commonly viewed as plentiful and rich in diversity, with an estimated 8,000-11,000 flowering species (MAF & STEA 2003). There is however a lack of scientific information that describes in detail this resource (CBD 2007). Taxonomic works of the Lao's flora began at the start of the 19th century, with the work of the "Flore Générale de l'Indochine" (1907-1951) and the "Flore du Cambodge, du Laos et du Viêt Nam" volumes compiled by Petelot (1952; 1953; 1954). These volumes list around 1,350 plant species, of which about 600 species are found in Lao PDR. Since 1975, some institutions have carried out surveys on medicinal and aromatic plants; twenty-nine of the most commonly-used wild medicinal and aromatic plants are listed in Annex 2 (MAF & STEA 2004; TRMC 2007) with those plants used for the distillation of essential oils listed in Annex 3 (Vasist & Vishavjit 2003).

The majority of these resources are still collected from the wild, and this collection is supposed to be carried out in compliance with annual quotas set by the Ministry of Agriculture and Forestry (MAF) and outlined out in the working draft of the *National Export Strategy for Lao PDR 2006-2008: Sectoral strategy for medicinal plants and spices* (see Annex 4) (MoIC & ITC 2006). In addition to harvesting from the wild, a small but growing percentage of medicinal plants is also cultivated (see Annex 5). For example, agarwood plantations have been booming in recent years and can be found in many provinces, such as Savannakhet, Bolikhamxay and Vientiane.

1.2 Use of medicinal and aromatic plants

In Lao PDR, traditional remedies have a long-standing history in many communities, and continue to provide useful tools for treating diseases (Baird 1995; Southavong 1997; Condominas 1998). The use of traditional medicines and medicinal plants continues to be an important part of the culture of Lao communities, and will be for many years to come, in response to the steady growth in international export demand for medicinal products. The GoL recognizes the value of traditional medicine and has implemented a number of policies to support and encourage the application and use of traditional medicines and spices both in the public and private sectors.

1.3 Overview of environmental concerns in the sector

Lao PDR is consciously working to liberalize its economy, but suffers from a worsening trade imbalance, external debt and growing account imbalance. In response, the GoL supports all sectors with the potential to produce for export. Trade, however, can have complex and wide-ranging impacts (IISD & IUCN 2007). Prior to the new trade promotion policy of the GoL, the impacts of activities dealing with medicinal plants and spices on the environment were minor, because the scope of the activities at that time covered a very limited area. Since 1986, the impact of the market economy on the use of medicinal plants has increased year by year, with medicinal plants harvested not only for domestic consumption, but also for the international market (MoIC & ITC 2006). Insufficient planning and the inappropriate use of this valuable resource, could lead to a severe reduction in the country's biodiversity. TMRC staff have observed that some important medicinal plants such as *Coscinium* sp. and the rare orchid species *Anoectochilus* sp. are under threat. Already *Coscinium* sp. processing factories in the north have to move further south in response to the decreasing availability of this resource. *Anoectochilus* sp., which

is usually exported to markets such as China and Japan, is becoming harder to source from the forests. There is a need to strengthen current laws and regulations, and their implementation, to ensure the protection of this vital resource bank, and the natural environment which supports it.

1.4 Policy and regulatory framework for the medicinal plants and spices sector

All GoL policies now refer to the eradication of poverty as their primary objective, as outlined in the *National Growth and Poverty Eradication Strategy* (NGPES) (GoL 2004). The value of medicinal plants to the livelihoods of local people is clearly stated in this strategy. So too is the GoL's decision to promote cooperation between traditional medicine and modern medicine. Key policy decisions include the promotion of traditional medicine for local consumption and research into expanding its use; cooperation with trading partners to develop local production and export; and the development of the law for the protection and management of medicinal plants, as outlined in the GoL most recent strategy, the *National Export Strategy 2006-2008: Medicinal Plants and Spices* (MoIC & ITC 2006). This Strategy identifies the medicinal plants and spices sector as having key growth potential, and thus the potential to meet poverty reduction and development targets.

Due to the nature of medicinal plants and spices, other key policies and regulations are outlined in the health, forestry and agriculture sectors. These include:

The health sector (Ministry of Health)

- Law on Drugs and Medical Products, 01/NA, 8 April 2000 - This law defines principles, rules and measures relative to the management of cultivation, growth, protection, exploitation, production, importation, exportation, distribution, possession and use of drugs and medical products, in order to ensure the availability of high-quality, safe and appropriately-priced drugs and medical products for preventing and treating diseases and ensuring good health for the population. Article 2 stipulates that the State should promote the development of medical resources by cultivation, growth, protection, exploitation, purchase, research, preparation and production of modernized drugs and traditional medicines to be used locally, to substitute imports and to be exported. Article 3 notes that the State should widely promote the production and the use of modernized drugs in combination with traditional medicines in preventing and treating diseases.
- Decree No. 155 of the Prime Minister, 30 September 2003 - This Decree defines measures related to the promotion, management, exploitation, production, growth, and use of natural resources to protect the country's medicinal natural resources and rich biodiversity, and to ensure the sustainable use of medicinal natural resources. The Decree classifies medicinal plants in three categories: Category I encompasses rare and endangered species, Category II includes species that have a high commercial value and can be used for domestic consumption and for exportation, and Category III covers plant species that are available in abundance throughout the country. For harvesting and collection of medicinal plants in Category 1, approval of the Ministry of Health and other competent authorities is required. For Category 2, harvesting and exploitation are also to be certified by the Ministry of Health and concerned authorities, but can be obtained by providing a management plan for harvesting and replanting. The exploitation of Category 3 plants is not restricted since they are abundantly available in nature. However, the classification is not static. The plants in Categories 2 and 3 may be put in Category 1 in the future if management is inadequate.

The forestry sector (Ministry of Agriculture and Forestry)

- The forestry sector, which in turn is integral to the medicinal plants and spices sector, also provides important guidance to the sustainable growth of this sector. Important goals of the forestry sector include the alleviation of poverty, increasing the forest area from the current coverage of approximately 40 percent to 70 percent (MAF 2005), protecting the environment and making sustainable use of the country's natural forests.
- Forestry Law, 13/NA, 9 April 2005 - This law defines the basic principles, rules and measures related to the management, protection and use of natural resources and forestry land. It promotes

the rehabilitation, growth and extension of natural resources in the Lao PDR to ensure a balanced environment and sustainable forests and to protect water resources, prevent soil erosion, protect biodiversity and the environment, and contribute to the socio-economic development of the country.

Section 2:

Trade-related environmental impacts and national experiences in improving environmental sustainability in the sector

Current trade liberalization policies implemented by the GoL are opening up new possibilities for international trade of medicinal plants. Over the last decade, several products have been exported to neighbouring countries, Europe, Japan and the United States. The increasing demand in these foreign markets is spurring increased harvesting and production of medicinal plant and spice resources in Lao PDR.

Trade can provide many benefits to Lao PDR, particularly in the economic sector. Trade in forestry products in 2001 contributed 3.2 percent of the GDP and 25 percent of the total national export value, contributing substantially to the Lao PDR national budget (MAF 2005). Forestry also provides employment and fosters relationships for the transfer of knowledge and new technologies and management systems (STEPA & UNEP 2006). On the other hand, forestry, if not managed appropriately can have significant negative impacts on Lao PDR's natural environment, and ultimately the Lao economy that is largely dependent on natural resources. Unsustainable harvesting of forest products leads to a loss of biodiversity, as well as associated deforestation affects such as increased production-related pollution, including air, water and soil (STEPA & UNEP 2006). If not managed properly, these issues will ultimately have negative impacts on the environment, economy and livelihoods Lao PDR people.

2.1 Analysis of the impacts of increased trade in medicinal plants and spices on the natural environment

It is predicted that due to this foreign demand and national government policies for growth, this sector will continue to grow, and subsequent demand on the natural resource base will continue to increase. Determining and understanding the potential impact on natural resources is key to the sustainability of the sector and Lao PDR's environment as a whole.

An analysis of impacts of this situation requires the examination of numerous linkages between trade and environment. The *Trade and Environment Handbook* (IISD & UNEP 2005) outlines four categories of physical and economic impacts on environment and development resulting from trade flows and trade liberalization, including scale, structural, product (technology) and direct effects. Further information on these categories can be found in Annex 6. These categories, coupled with key environmental concerns sourced from the GoL's Environmental Performance Assessment (EPA) report (STEPA & UNEP 2006) are listed in Table 1. This Table provides a useful platform for the analysis of the potential impacts of increased trade and investment, and highlights some of the potential impacts, including land clearance, increased cultivation, over-harvesting, destruction of natural habitat and loss of biodiversity; potentially leading to increased water consumption, erosion, more intensive use of chemical fertilizers and pesticides and pollution.

Table 1: Matrix illustrating the linkages between trade and environment in the medicinal plants and spices sector

Category	Driving force	Pressure	Impacts on natural resource	Mediating factors	Example
Structural effects - Trade can lead to changes in the composition of an economy, causing it to produce more of the goods it makes well or has in abundance and less of those it does not.	Increased foreign market demand for medicinal plants and spices (see Annex 1).	Increased demand for cultivation and plantation land to supply medicinal plants and spices.	Demand for land leads to decreased natural forest areas; Cultivation of invasive species may threaten indigenous species and lead to a decline in biodiversity; Selection of key species may lead to the opening and harvesting of new forests.	Specific plans for cultivation and sustainable harvesting are developed and implemented widely.	See example below: Distillation of Essential Oil from Aquilegia wood (agarwood)
Product effects (also known as technology effect) - Traded products themselves can have an impact on the environment.	Greater openness to FDI	New investment brings new technologies for cultivation that increase yield or efficiency of processing.	Reduced consumption of raw materials from the wild and energy inputs; reduced polluting emissions (air, water, soil) per unit of output.	If the environmental regulatory regime is strong and promotes good technology, it increases the odds that any new technology imported will be the best available.	See note below on certified sustainable harvesting or ecologically-sound cultivation.
Scale effects - Trade leading to expanded levels of economic activity can have positive impacts in terms of the wealth it creates or negative impacts in terms of increased scale of production without appropriate control.	Increased foreign market access from lowering tariffs and non-tariff barriers.	Increased scale of production of medicinal plants and spices.	Increased wild harvesting and, in turn, pressure on natural resources; Increased cultivation and pressure on land, water resources.	If the environmental regulatory and policy regime is adequate there is little negative effect – including scientific information on the resource and sustainable harvesting or cultivation plans implemented, and/or private sector ensures sustainability of resource extraction.	See example below: unsustainable extraction of berberine.
Structural effects - Trade can lead to changes in the composition of an economy, causing it to produce more of the goods it makes well or has in abundance and less it does not.	Increased foreign market access from lowering tariffs and non-tariff barriers.	Increased demand for “green” goods such as organically cultivated or sustainably harvested medicinal plants leads to more environmentally sound cultivation and production techniques and sustainable harvesting.	Reduced consumption of raw materials and energy inputs; Reduced polluting emissions (air, water, soil).	If the private sector is aware of the value of catering to this market, certification can prove to be a powerful tool in sustainable development of this sector.	See note below on certified sustainable harvesting or ecologically-sound cultivation.

Source: Adapted by the author from IISD & UNEP 2005.

The analysis also highlights the potential for importing better technology and better processes which could reduce impacts on the environment. The analysis also indicates that if an appropriate and well-implemented policy and regulatory environment exists, the growth of the medicinal plants and spices sector in Lao PDR can be sustainable, and can bring many benefits to the country and its people.

With this in mind, it is important to note some of the threats that the sector is facing at present, including:

- No systematic and scientific approaches to harvesting;
- No specific plans for cultivation;
- No strict enforcement of laws and regulations;
- Weak collaboration amongst concerned authorities, between central and local authorities, and between public and private sectors; and
- Limited awareness among rural people on the preservation of biodiversity.

2.2 Case studies in the medicinal plants and spices sector

The following case studies focus on the trade in *Coscinium* sp. and *Aquilaria* sp. The example of trade in *Coscinium* sp. shows some of the impacts of unsustainable harvesting. In contrast, the trade in *Aquilaria* sp. is a good example of how an industry is using cultivation to ensure the sustainability of the natural resource upon which it relies. Finally, the example of certification of medicinal plants in Nepal is highlighted as an interesting tool being used to protect the resource.

Unsustainable extraction: berberine

According to surveys in the previous years (TMRC 2007), numerous factories in many provinces (such as Bolikhamxay, Luang Prabang, Huaphanh, Khammuane, Savannakhet and Xekong) are extracting berberine from the liana of *Coscinium* sp. (see photos in Annex 7). These factories are mostly run by Lao PDR companies, as well as foreign companies from China and Vietnam. These factories can buy materials from local villagers at a price of around 500 to 1,000 Kip per kilogram for raw *Coscinium* sp., or US\$10-20 per kilogram, depending on the quality, and export a large quantity into China (TMRC 2007). The demand for berberine is increasing year by year, with the demand for medicinal plants estimated at around US\$14 billion a year, with a projected rise to US\$5 trillion by the year 2050 (MoIC & ITC 2006). At present, China is one of the biggest trading partners of ASEAN countries. Plans and negotiations are underway between China and Lao PDR for the China-ASEAN FTA that will take effect in 2015 (CPI & UNDP 2006). It is expected that demand for medicinal plants and spices will further increase as a result of ASEAN.

With increased demand for produce also comes increased pressure on the environment as a result of over-harvesting. Species such as *linana* are collected from the forest by local villagers. Sometimes villagers collect not only the liana, but the roots as well (TMRC 2007). This method of collection can be very destructive, dramatically impacting on the biodiversity of the forest as well as threatening the survival of the species. With an increased demand in plant products, care needs to be taken in the way in which this material is harvested in order to meet the demand.

Cultivation: the distillation of essential oil from aquilaria wood (agarwood)

Activities dealing with the distillation of agarwood (*Aquilaria* sp.) have been implemented in many provinces throughout Lao PDR, including a factory in Pak Ka Ding District of Bolikhamxay province which has been used by the TMRC as a case study. A summary of the case study has been provided below (TMRC 2007):

- So far, the raw material for distillation has been collected from the wild. The factory pays 2,000 Kip per kilogram of agarwood.
- At present, the factory has 30 distillation units. In the future, the plan is to extend the capacity of the factory to up to 100 distillation units.
- For each batch of distillation, about 60-70 kilograms of the coarse and dried powder of agarwood are used. The distillation lasts for seven to nine days before collecting the essential oil from the

surface of the distillate by hand. Annex 8 shows the photos of the distillation unit and the essential oil from agarwood.

- If the quality of the wood is good, it is possible to extract 360 ml of essential oil from 30 units.
- The price of the oil depends on its quality. The solid oil is worth US\$1,200-1,350 per 360 ml, while liquid oil is worth US\$2,970-3,200 per 360 ml.

Besides the factory in Bolikhamxay, there are also other factories in other provinces. The need for raw material will increase as the demand for this kind of oil increases. According to the owner of the Bolikhamxay factory, the main buyers are from Arabic countries, who will come to the factory when the oil in stock is at about 1-1.5 litres, and there is currently increased demand for overseas, and factories are expanding in response to this demand (TMRC 2007). Agarwood is not only used for domestic processing, but also for export (Sundara 2006). From 2009, two Lao companies Lao Asian Ecology Public Co. Ltd. and Khamphay Sana Agriculture Co. Ltd., expect to export at least 2,000 tons of raw agarwood to Brunei per year under an agreement with the Brunei Kyarikat Khasana Permamta Hijua Company in February 2006 (IUCN & TRAFFIC 2006).

Fortunately, many companies and individuals have made efforts in recent years to maintain a sustainable supply of agarwood for domestic processing and for exportation, such as through:

- Propagation and *ex situ* conservation of *Aquilaria* sp. by plant tissue culture.
- Propagation and *ex situ* conservation of *Aquilaria* sp. by seeds.

The trade of this species is a good example for the sustainable production of natural forest products, however there are some concerns regarding the agarwood business that should also be noted:

- Plantations should be located on unused land to avoid negative environmental impacts on the landscape. Trees should not be cut down and the land cleared for the cultivation of agarwood.
- The GoL should be closely involved in this business in order to have regular and sustainable market supply.

A note on certification, environmentally-friendly cultivation and sustainable harvesting

In recognition of the negative impacts of the unsustainable supply of raw material from the wild, the GoL promotes the cultivation of medicinal plants for export. Cultivation of medicinal plants will not only help to conserve natural resources, but can also contribute to the socio-economic development of the country. Many foreign companies started to invest in cultivation, such as the plantation of *Styrax tonkinensis* P., *Orthosiphon stamineus* benth, *Dendrobium* sp., *Aquilaria* sp., *Amomum* sp., and *Eucalyptus* sp. These activities are still at the primary stage and more efforts should be put into this sector.

While the cultivation of medicinal plants can help provide a sustainable resource for the medicinal plants and spices sector, various issues such as deforestation, loss of biodiversity (monocropping) and land/water pollution (use of chemicals to cultivate) should be noted. Similarly, harvesting of medicinal plants from the wild should not be considered negatively if the resource is properly understood and management for sustainable harvesting is robust.

One option to ensure the sustainability of medicinal plant resources, in addition to government policy and regulation, is certification (Schippmann, Leaman & Cunningham 2002). As seen in Table 1, Foreign Direct Investment (FDI) has the potential to bring better technology (the technology effect) and methods of production from abroad. In terms of medicinal plants, this could mean the introduction of organic (and environmentally) certified cultivation techniques or certified sustainable harvesting.

One example of certification is coming out of Nepal where the Nepali Non-Timber Forest Product Promotion Alliance made up of corporations, government and non-profits have secured Forest Stewardship Council certification from the Rainforest Alliance/Smart Wood for a number of medicinal

plants. This is now being used as a means of protecting the wild resources and also enabling the group to tap into high-value niche markets abroad (Subedi 2006).

Section 3:

Conclusions and strategic policy recommendations for the medicinal plants and spices sector

3.1 Conclusions

The GoL has set the goal to graduate from the status of a least-developed country by 2020, which will require efforts by the public and private sectors. The non-timber forest products and medicinal plants and spices as a subsector contribute greatly to reaching this goal. For instance, in 2003 the export value of Gum (*Styrax tonkinensis*) alone was US\$1.2 million (MoIC & ITC 2006).

To address the threats listed in Section 2.1 is a significant challenge for the country as a whole and will require a better understanding of how to manage socio-economic development activities and to minimize the environmental impacts that might occur. Many factors might threaten the sector's ability to contribute to poverty alleviation while ensuring environmental sustainability:

- Bad management of the sector;
- Risk of over-reliance on medicinal plants and spices as a source of income for rural people;
- Slow development in remote areas;
- Weakness in laws and regulations enforcement; and
- Low participation of local communities.

In the coming years, trade in medicinal plants will continue to play an important role as part of the measures for poverty eradication in rural areas. Many local people, particularly in remote areas, earn money only from selling these products and also rely on them as their only affordable source of medicine. Wildlife trade involves a large domestic trade for food and medicine and a substantial international trade for different purposes, including traditional medicine, food and trophies. At the same time, the activities dealing with harvesting of these medicinal and herbal NTFPs represents another threat to our environment. As development proceeds, roads are constructed, forests are converted to other land uses and natural habitats are more extensively exploited. Therefore, those rural people will be facing a shortage of natural resources if there are no appropriate measures to fight against these environmental threats. With the national population estimated to reach 8.3 million in 2020 (MAF 2005), effective and efficient sustainable management of resources, and of the sector as a whole, must be the goal of the GoL in the process of development.

3.2 Strategic policy recommendations

The goal of the GoL is to ensure the sustainable growth of the medicinal plants and spices sector through cultivation, sustainable harvesting, and value adding in processing and marketing (MoIC & ITC 2006). Recommendations have been made below for the improved sustainable use of medicinal plant resources in Lao PDR:

- Collaborate with neighbouring countries on the conservation of bordering protected areas and control of illegal trade in wildlife and prohibited plant species. This not only helps to protect rare and endangered species, but contributes to the implementation of Convention on International Trade in Endangered Species (CITES) principles as well. Activities could include: pilot projects in collection sites on sustainable harvesting and fair market access in accordance with CITES regulations; and improved customs processes (through trainings on enforcement of legislation) at the border.

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- Work towards more scientific and community-orientated management of forest resources in order to generate timber and non-timber forest products at sustainable levels. This could be done by pilot work at the district level with local communities, and co-management agreements in and around protected areas that provide access for sustainable NTFP collection.
- Improve statistics on resource harvesting and exporting to guide future policy in the sector. The first step in the process should be to gather responsible agencies, increase collaboration and define roles and responsibilities.
- Develop and enforce laws and regulations related to the forestry sector as a whole, and especially to non-timber forest products. For example, the MAF has outlined harvesting quotas for specific medicinal plants, yet they are not properly adhered to. Ensuring the implementation and enforcement of such policy and laws would benefit the sustainable growth of the sector.
- Identify appropriate measures for improving awareness on environmental impacts for rural communities. This could be done by increased scientific research about collection methods and education for local communities on the importance of conservation and methods of conserving resources. The TMRC could be supported to continue work on medicinal plant reserves that provide better information on local resources, and opportunities for learning and raising awareness about these resources.
- Improve the quantity and quality of the exported medicinal plants and spices to meet the demands of foreign markets, through:
 - ▶ strengthening infrastructure, especially the construction of laboratories for quality control of exported raw and processed materials;
 - ▶ enhancing research and development, marketing and certification;
 - ▶ training personnel in taxonomy and photochemistry;
 - ▶ drafting new laws and regulations, especially for the protection of property rights and traditional knowledge of the country. Particular attention should be paid to legislation to enforce the Convention on Biological Diversity. This would include access and benefit sharing under the Bonn Guidelines, so that communities and the country can benefit from any potential commercialization of traditional medicinal plants (CBD 2007).
- Encourage the private sector to consider the environmental impacts of unsustainable harvesting and unplanned cultivation, and their responsibility for gaining permission from the country to bio-prospect, with assurance of access and benefit sharing of any commercialized products from traditional medicines and herbs, including the possibility of:
 - ▶ working with the GoL and civil society to explore the option of certification. An initial scoping study could be completed on the opportunities and current status of certification in the medicinal plants and spices sector in Lao PDR and abroad.
- Gain the full support of the private sector in addressing environmental concerns by establishing incentives including the possibility of:
 - ▶ lowering taxes for a period of time for the plantation of medicinal plants and spices dedicated to export in an effort to reduce the unsustainable harvesting of wild plants;
 - ▶ lowering the cost of the unused land that could be used for plantations;
 - ▶ ensuring market access for natural Lao products in export markets; and
 - ▶ reducing bureaucratic barriers to doing business in the sector.

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Annex 1: Commonly traded wild medicinal plants of Lao PDR

Source: Data from Traditional Medicine Research Centre

Number	Lao name	Scientific name
1	Chan Dai	<i>Dracaena cambodiana</i> P
2	Dok pheuang	<i>Dendrobium</i> spp
3	Duk Deua	<i>Amorphophalus</i> spp
4	Hao Pao Pet, Hao Tom Ngeun	<i>Stephania</i> sp
5	Het Pek	
6	Hoa Sam Sib	<i>Stemona tuberosa</i> Lour.
7	Ka Xao Phi Mod	
8	Kan Nam Man I Tou Ton	Distillation of <i>Cinnamomum camphora</i> oil
9	Kan Nam Man Pek	Distillation of <i>Pinus</i> oil
10	Ket Sa Na	<i>Aquilaria</i> spp
11	Kheua Hem	<i>Coscinium</i> spp
12	Kheua Tib Ti	
13	Khing Pha	<i>Polygonatum</i> sp
14	Kout Tin Houng	<i>Helmintostachus zeylanica</i> (L.) Hook.
15	Mak Chong Ban	<i>Sterculia lychnophora</i> Hance
16	Mak Kha	<i>Alpinia galangal</i> L.
17	Mak Kham Pom	<i>Phyllanthus emblica</i> Linn.
18	Mak Neng	<i>Amomum</i> spp
19	Mak Nhor Ban	<i>Morinda citrifolia</i> L.
20	Mak Nho Pa	<i>Morinda tinctoria</i> Roxb.
21	Mak Seng Beua	<i>Strychnos nux-vomica</i> L.
22	Man Kha Kai	<i>Codonopsis</i> sp.
23	Man On Ling	<i>Polygonum multiflorum</i> Thunb.
24	Nam Man I Tou Ton	<i>Cinnamomum camphora</i> oil
25	Nhan	<i>Styrax tonkinensis</i> P.
26	Pit Pi Khao	<i>Plumbago zeylanica</i> L.
27	Tin Pet	<i>Alstonia scholaris</i>
28	Teu Khang, Xeum Khang	
29	Toum Ka Deng	<i>Strychnos nux-vomica</i> L.
29	Van Bai Lay	<i>Anoectochilus</i> spp
30	Xeum pha	
31	Ya Hoa	<i>Smilax glabra</i> Roxb.

Annex 2: Commonly used medicinal and aromatic plants

Source: Data from Traditional Medicine Research Centre

Number	Lao names	Scientific name
1	Chan Dai	<i>Dracaena cambodiana</i> P.
2	Chong Ban	<i>Sterculia lychnophora</i> Hance
3	Chi Nay Kom	<i>Adenosma capitatum</i> Benth.
4	Dok Feung	<i>Dendrobium</i> spp
5	Fang Deng	<i>Caesalpinia sappan</i> Linn.
6	Fek Hom	<i>Vetiveria zizanoides</i> (L.)Nash.
7	Hat Mi	<i>Artocarpus lakoocha</i> Roxb.
8	Hoa Sam Sib	<i>Stemona tuberosa</i> Lour
9	Iane Done	<i>Osbeckia chinensis</i> L.
10	Khe	<i>Cinnamomum</i> spp
11	Kheua Hem	<i>Coscinium</i> spp
12	Khing Kheng Pa Kang	<i>Homalomena aromatica</i> Schott
13	Khing Pha	<i>Polygonatum</i> spp
14	Kong Sa Den	<i>Croton</i> sp.
15	Khom La Van Chor	<i>Evodia leptota</i> (Spreng) Merr.
16	Kout Tin Houng	<i>Helmintostachus zeylanica</i> (L.) Hook.
17	Mak Neng	<i>Amomum</i> spp
18	Mak Nhor Ban	<i>Terminalia citrifolia</i> L.
19	Mak Nhor Pa	<i>Morinda tinctoria</i> Roxb.
20	Man Kha Kai	<i>Codonopsis</i> sp.
21	Man On Ling	<i>Polygonum multiflorum</i> Thumb.
22	Seng Kham Ton	<i>Terminalia nigrovenulosa</i> P.
23	Si Khai Ton	<i>Litsea cubeba</i> (Lour.) Pers.
24	Som Mor	<i>Terminalia chebula</i> Retz.
25	Song Fa	<i>Clausena harmandiana</i> P.
26	Tin Pet	<i>Alstonia scholaris</i> L.
27	Tom	<i>Stephania</i> spp
28	Ya Hoa	<i>Smilax glabra</i> Roxb.
29	Yik Bo Thong	<i>Eurycoma longifolia</i> Jack.

Annex 3: Essential oil distilled at the Traditional Medicine Research Centre

Source: Data from Traditional Medicine Research Centre

Lao name	Scientific name	Essential oil yield (%)
Khar	<i>Alpinia galangal</i> (L.) Willd.	0.10
Khe hom	<i>Cinnamomum cassia</i> Bl.	0.05
Khi hoot (fruit)	<i>Citrus hystrix</i> DC.	0.40
Khi hoot (leaf)	<i>Citrus hystrix</i> DC.	0.78
Khi Min	<i>Curcuma longa</i> L.	0.32
Khing	<i>Zingiber officinale</i> Rosc.	0.10
Long leng (wood)	<i>Cunningghamia sinensis</i> R.Br.	0.60
Mak Khen	<i>Zanthoxylum nitidum</i> (Roxb.) DC.	1.90
Nad Hom Bay Noy	<i>Artemisia annua</i> L.	0.05
Nam Man Khieo	<i>Eucalyptus globules</i> Labill.	0.92
Phak See	<i>Foeniculum dulce</i> Mill.	0.60
Pek	<i>Pinus kesiya</i> Royle ex Gordon	2.50
Sab Heng	<i>Hyptis suaveolens</i> Pour.	1.00
Sa La Nat	<i>Mentha arvensis</i> L.	0.35

Sa Phao Lom Khao	<i>Ocimum bacilicum</i> L.	1.00
Si Khai Kheuang	<i>Cymbopogon citrates</i> (DC.) Stapf	0.75
Si Khai	<i>Cymbopogon nardus</i> (L.) Rendle	0.62

Annex 4: Quotas of wild medicinal plants for the year 2004-2005

Source: MoIC & ITC 2006

No.	Scientific name	Product	Quotas (tons)
1	<i>Amomum ovoideum</i> P.	Dried seeds	1,015
2	<i>Styrax tonkinense</i> P.	Dried resin	55
3	<i>Coscinium usitatum</i> Pierre	Dried liana	3,040
4	<i>Dracaena cambodiana</i> Pierre ex Gagnep.	Dried Red lignified core	15
5	<i>Sterculia lychnophora</i> Hance	Dried fruit	450

Annex 5: Some cultivated medicinal plants

Source: Data from Traditional Medicine Research Centre

No.	Lao name	Scientific name
1	Khing	<i>Zingiber officinale</i> Roscoe.
2	Khi Min Kheun	<i>Curcuma longa</i> L.
3	Ket Sa Na	<i>Aquilaria crassna</i> Pierre
4	Mak Deuy	<i>Coix lachrymal-jobi</i> L.
5	Mone	<i>Morus alba</i> L.
6	Nat Hom Bay Noy	<i>Artemisia annua</i> L.
7	Nha Nouat Meo	<i>Orthosiphon stamineus</i> Benth.
8	Nhane	<i>Styrax tonkinensis</i> P.
9	Phak Nok	<i>Centella asiatica</i> Urban
10	Phak Boua Leuat	<i>Eleutherine subaphylla</i> Gagnep.
11	Ra Sa Bi, Sam Phan Bi	<i>Andrographis paniculata</i> (Burm.f.) Wall. Ex Nees
12	Van Hang Khe	<i>Aloe vera</i> L.
13	Van Hoa Deo	<i>Curcuma xanthorrhiza</i> Roxb.
14	Van Phai	<i>Zingiber cassumunar</i> Roxb.
15	Kao Bok	<i>Catharanthus roseus</i> G.Don

Annex 6: Trade and environmental effect

The *Trade and Environment Handbook* outlines four categories of physical and economic impacts on environment and development resulting from trade flows and trade liberalization (IISD & UNEP 2005):

Scale effects - Trade leading to expanded levels of economic activity can have positive impacts in terms of the wealth it creates - the ability of people to acquire new and more environmentally-friendly technology or raised level of environmental concern of people with fewer basic livelihood concerns; or negative impacts in terms of increased scale of production without appropriate control, increasing use of natural resources, and in turn increasing impacts such as the unsustainable use of resources and pollution.

Structural effects - Trade can lead to changes in the composition of an economy, causing it to produce more of the goods it makes well or has in abundance and less of those it does not. An economy may change so that less polluting sectors dominate, labour-intensive industries may provide employment and wealth (see scale effect) and the demand for green goods may result in the composition of certain sectors being geared solely towards these markets. On the other hand, if the goods a country produces are more resource-intensive, polluting, and contribute less to development objectives, trade, if guided poorly can have significant adverse impacts on the environment.

Product effects (also known as technology effects) - Traded products themselves can have an impact on the environment. Positive effects may include investment in newer, more efficient and cleaner technology, or the rapid adoption of goods that have less environmental impact than those being used. Conversely, the product effect can be negative, such as foreign investment in cheaper but polluting technology and the transfer of poor management practices to the country.

Direct effects - Direct effects are those environmental impacts caused by the very fact that trade is occurring, for example pollution caused by the transportation of goods.

Annex 7: Extraction of berberine from *Cosciniium spp*



Raw material (*Cosciniium spp*)



Grinding of raw material



Maceration of raw material



Drying of crude berberine

Annex 8: Local method for the distillation of Agarwood oil in Pak Ka Ding district



Maceration of agarwood



Distillation apparatus



Solid form of oil



Liquid form of oil