TABI project

Survey on Botanical Orchids use in northern Laos

Xiengkhouang, Houaphan, Louang prabang, Oudomxay, Phongsaly and Vientiane provinces

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I. Background

TABI - The Agro-biodiversity Initiative- is a joint program of the Ministry of Agriculture and Forestry of the Government of Lao PDR and the Swiss Agency for Development and Cooperation (SDC). The two main goals of the program are to:

1. to conserve, enhance, manage and sustainably utilize the biological diversity of farming and forest landscapes to improve the livelihoods and incomes of upland farming families in northern Laos.
2. to integrate, to raise the status of Agro-Biodiversity as a key component in the development policies, practices and scenarios of the country.

TABI is currently implementing a wide range of subprojects to demonstrate options and systems that demonstrate Agro-Biodiversity based livelihoods in Houaphan, Louang prabang and Phongsaly. This project spans management of natural resources in natural areas such as forests and rivers, NTFPs domestication and improvement of current agricultural practices, and educational activities.

Forests are an integral part of rural households' livelihood in Laos (about 80% of the total population), as they provide daily subsistence needs and generate income. However, they are also the main habitat of epiphytic plants, which thrive in the moist microclimate within the forest canopy. With their very special requirements (e.g. nutrients, light, and water availability), orchids are highly vulnerable to collection, habitat degradation and deforestation.

Wild Orchids collection is a part of income since many years in the study area and actually a threat for orchids that are in the way of extinction.

The aim of this report is to show whether identification, selection and promotion of sustainably used of Wild orchids with promising commercial value who can contribute to improved livelihoods of poorer households.

II. Mission objective

The present mission aims to identify the different valuable orchid species and to collect data on the trade in orchid plants in North Laos to assess the volume of the trade and the purpose of the trade (ornamental, medicinal...), the species involved and the implications for forest conservation. Investigations will also gathered information on identifying the diversity of species of wild orchids found in the area with their uses, market chain study from collector to client and/or export when it is relevant. Consequently, the objectives focus on: 1) identifying economically valuable and sustainably used of wild orchids, 2) analyzing the potential of 3 short-listed orchid species, 3) conducting a market chain analysis of these selected orchids, 4) evaluating economic and natural conditions for locally added value and 5) making suggestions for the implementation and improvement of legal and economic regulations for sustainable resource management and commercialization.

III. Expected result of the mission

An assessment report about:

- An inventory of the main species of botanical orchids gathered and sold in northern Laos.
- The selected orchid's taxonomy description.
- Specific characteristics or ecology of each species which would actually need to be taken into account in the development of sustainable harvest and/or management;
- The analysis of collection impact, actual situation management and conservation. At least 3 case study analysis.

- The specific part of each species that is use.
- The specific chemical composition of each species when it's possible.
- An generalized "market/value chain" analysis (including who buys these orchids, and for what purposes)
- Market trend analysis for the different purposes identified (ornamental-medicinal).
- The legal status of orchid trade in Laos and abroad.
- The description of reproductive existing method.
- Opportunity and challenge of orchids production in northern Laos
- Any seasonality in the harvest of each species;
- Any seasonal difference in the prices
- At least 40 technical sheets of each identified species

IV. Location

The area studying is the north part of Laos characterized by highlands, mountain plain, imbedded in Karst's mountain. The area is 600 to 1800m above the sea level. The climate is subtropical from warm to cold in winter and marked by one wet season occurring from May to October. During this period, precipitation is 84% of the annual average rainfall of 1750 mm.

Survey was carried in 2 times, the first mission consisted of the visit of 3 villages Ban Longkham, Ban Piandi and Ban Sopkhao from Phou khoud district in Xiengkhouang province that was more focus on local practices and situation.

During the second survey, more extensive, the following localities have been visited in the course of the survey in the 5 provinces of Xiengkhouang, Houaphan, Louang prabang, Oudomxay and Phongsaly.

2 districts in Xiengkhouang (Pek and Phoukoud), 4 districts in Houaphan (Xamneua, Viengthong, Viengxay and Sop bao); 2 districts in Louang prabang (Luang Prabang and Nam Bak); 1 districts in Oudomxay (Xay district) and 3 districts in Phongsaly (Phongsaly, Khoua and Bounneua).

Study was extending to some parts of Vientiane Province in Kasi district and in Vientiane capital, visiting Chinese herbalist shop (Talat Xangtieng) and village collectors that are street seller (Ban Sappakhanon).

Itinerary of the mission in blue, red spot are surveyed places

V. Limitations of the survey

The main limitation factors were:

- Difficult to very difficult and dangerous roads, sometimes blocked, limit us in regards of the work plan to reach some remote villages and restrain us to select villages or site not more distant than 2 hours one way trip.
- Due to the strong banishment by the law of orchid's trade it was difficult to interview some people involved in orchid business, especially when a government officer was present during the interview. Some actors were reluctant to give information about the prices and the quantity they trade.
- The illegal nature of the activities poses methodological challenges. Sufficient data on illegal resource use do not exist and that collection of this information is difficult. No statistics about wild orchid trade these last 2 years are recording at the official level, district, provincial or border checkpoint. The principal method used to collect information were consultation of law-enforcement records, indirect observation, self-reporting, direct observation, direct questioning, and triangulation response technique.
- Interview were attempt with provincial and local forestry officers in four provinces and with representatives from CITES, but these provided few insights regarding the real situation practices (Wild orchid trade still exist), and officials either passed responsibility onto other offices. There was evidence to suggest that some government officials were displeased with the nature of the study. There are several possible explanations for this non-engagement, notably concern that this study would highlight institutional weakness in Orchid conservation Law enforcement.
- It was not the harvesting season that avoids us to collect acute information in quantity collected and in species identification. It is difficult for villagers to identify some species only with plant picture.
- The data used for this study reflects the present situation in the area. The respondents are mainly subsistence farmers/traders, using only their memory to tell figures of price, income, and harvested quantity and sold amounts of orchids. In general such figures are not recorded in written form and the people had to rely on their memory, drawing numbers from the sales and harvest some years ago sometimes. With this in mind, it is possible that the numbers presented do not precisely and exactly reflect the reality.
- We were caught by the time that avoid us to undertake long forest walk in remote part of the forest in consequence the number of identified orchid species is not exhausted and rely mainly on observations in private gardens or small shops on the road and villagers/traders information.

VI. First Finding

Almost all orchids are associated with horticulture and trade. Whole epiphytic orchids in Lao PDR are often collected by picking them from hosts (tree or rocks), but also sometimes by cutting trees or

branches. Many other orchids are collected whole plants from the ground from all types of forest. Yield depends on available materials, travel time, harvesting methods and the type of orchid.
The export and generally the trade of wild and/or semi-cultivated orchids, in any form, such as whole living plants (which occur all around the visited provinces) dried stems (which can be seen in Oudomxay, Phongsaly provinces and Vientiane herbalist Chinese shop) or otherwise semi-processed, is now illegal in Lao PDR unless CITES permits are obtained. All wild orchids species are protected under CITES rules. No wild orchid can be trade or transport in any form (living, dried, or otherwise processed) without CITES permits.
However, there still are many types of illegal activities in the orchid trade observed. Focusing on the north of the country, 2 markets exist firstly, orchids are mainly exported to China for medicinal uses and secondly for horticultural purposes, individual collectors are selling plants taken from the forest directly at the village gate to local or foreign people (Vietnamese mainly) without any reference to sustainable harvesting.
The mission show that trade in wild harvested orchids threatens local biodiversity due to over exploitation and habitat destruction. Collection of wild orchids was found to be widespread in the study area and this trade is threatening many species in the forest. All interviewee, collectors or NTFPs traders describe a strong depletion since 2 years in collected orchid species, less quantity is harvested every year(from near 600 Kg last year to less 200Kg this year in some village).
There is less knowledge about the use of orchids in Chinese medicine. This practice mainly utilizes *Dendrobium spp.* Species and *Anoechtochylus spp. Dendrobium spp.* are collected all over the 4 provinces. Hundreds of thousands of plants are in this way taken from the wild. Because of over collecting for this purpose, *Anoechtochylus lylei* (Jewel orchid), *Dendrobium nobile* or *Aerides odorata* for example, have already become very rare in Lao PDR.
However, the greatest threats to orchids in the country are over-harvesting due to a high market demand, as well as habitat loss.
At present, some species are so rare that it is difficult to come up with alternative or more sustainable methods to exploit these wild orchids perennially. Villagers have no knowledge about the use of the orchids they are harvesting and about added value technic as drying and rolling stem.
Concerning the villagers who have start orchids domestication, they faced business loss due to several issue as using poor structure material and shade-house management with a lack of technical skills and scarce market for this year (depend the species).
The most significant operation of orchid cultivation for export observed is the Jing Ling Chinese company in Oudomxay Province who export under CITES certification 50 tons raw of domesticated orchids (3 main species Dendrobium species are cultivated (*Dendrobium chrysotoxom, moschatum and fimbriatum*) with a positive market trend, especially for *Dendrobium chrysotoxom.*
In regards of the situation analyze, 8 species have a market potential linked to the domestication conditions*: Dendrobium chrysotoxom, Dendrobium moschatum, Aerides odorata, Dendrobium pulchellum, Dendrobium fimbriatum, Dendrobium gratiosissimum*, *Paphiopedilum concolor* and *Anoechtochylus spp* if adequate technic culture curriculum is developed with long term support from expert.

Actually, in regards of the situation that collecting wild orchids require more and more work and time for collection and market gap, very few visited families have issued the desire to start orchid culture and majority of the families plan to stop orchid collection for trade.
On the other hand, Provincial and local authorities in Samneua, Oudomxay and Phongsaly express the wish to develop orchid's domestication and trade with villagers supported by TABI.

Number of orchid species identified per provinces

Xiengkhouang	Houaphan	Oudomxay	Phongsaly	Louang P	VTE province
45	38	32	12	45	23

VII. Methodology

7.1. Plant Identification and uses

Botanical orchids observed were identified using standard literature and cross-referenced with herbarium specimens deposited at Vientiane Orchidees.
Trade, species diversity, and traditional use of botanical orchids were documented during forest walk, surveys of markets and retailers, interview of government representative from PAFO and DAFO, observation of individual gardens and through discussion with local villagers and traditional healer. Orchid material samples were identified to species level using their morphology.

7.2 Data gathering

Data were collected from interviews with local villagers involved in orchid collection, middlemen, local traders, traditional healer, Herbalist shop, CITES representatives and provincial and district forest officials. We used a semi-structured questionnaire for the interviews.
A detailed inventory of medicinal orchids and their uses was prepared by a literature study. Additional information was collected through key informant interviews with local plant healers at the study sites. Observations in individual gardens and forest walk provide us interesting information on the species diversity in the area visited. Trade volumes and approximate income were estimated based on surveys and current market prices.
A total of 36 interviews and many informal discussions were conduct. Interviews were, where possible, conducted privately in order to avoid the participation of others. Interviews included questionnaire-like questions, ranking exercises, and semi-directive, conversational questions used to establish motivations and personal experiences. Interviews addressed a broad range of issues, including demographic data, species selection, trade patterns, livelihood alternatives and economic dependence on trade, and regulations that govern resource trade.

Method	**Data collected**
Interview of key informant	Seasonal calendar, income generated, species, trading process, evolution of plant's diversity and quality, harvesting area, harvesting technics and sustainability, and economical context.

Local authorities interview	Legal status, harvesting area, sustainability, border trade, Quota allocation
Forest walk	Observation, identification, quantity and quality assessment
Company & Market visit	Observation, species, quantity, production method, prices, by product, constraints, market trend …

VIII. Introduction

Orchids are nature's most extravagant group of flowering plants distributed throughout the world from tropics to high alpine. They exhibit incredible range of diversity in shape, size and color of their flowers. They are important aesthetically, medicinally and also regarded as ecological indicators.

Several orchid species are cultivated for their various economic uses in traditional medicine and in floriculture.

Orchids are grow primarily as ornamentals and are valued as cut flowers because of their exotic beauty and their long lasting blooming period.

Secondly, orchids are grow and used as herbal medicines, food, and other cultural value by many different cultures (e.g China) and tribes (e.g Hmong-Akka- Kahmu).

Though large population of orchid is still observed in their natural habitat (Conservation area), in many parts of Laos their number is decreasing due to their high demand and population pressure for more than a decade.

Many orchid species are threatened due to their habitat destruction and indiscriminate over-collection. At present the orchids also figure prominently in the Red Data Book prepared by International Union for Conservation of Nature(IUCN) and the entire orchid family is now included in Appendix I and II of Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), where the international trade is strictly controlled and monitored.

Orchidaceae is regarded as the largest family of plant kingdom comprising 25,000-35,000 species in the world.

Very less study has been done regarding their medicinal properties. Limited information on medicinal values of orchids regarding their therapeutic is available.

The history of orchids might start with their uses in the medicinal purpose by Chinese, who were the first to cultivate and describe orchids, these plants first received recognition in the herbal writings of China 3,000 to 4,000 years ago, and they were the first to describe orchids for medicinal use.

During this mission, 71 species were identified, 51 with commercial value, 39 species of these orchids were listed with their medicinal uses and 10 with ornamental value, 31 for both purposes.

(Detailed list in Annex 3)

IX. General taxonomy of orchids

- Roots:

Anchorage is the primary function of roots in orchids, especially with the epiphytic species. The aerial roots are silver gray with at the extremity the last 2cm green. The chlorophyll of the roots enables the plant to manufacture nutrients. For some species, roots are the only photosynthetic organs.

- Stems:

The stems of orchids display a high degree of morphological diversity. It bears leaves and is terminated by a raceme or a spike. After completing the production of flowers, fruits and seeds it dies and disintegrates, living a corm or tuber to continue the life cycle. The stems length varies from 1cm long to 2meters depend the species. The type of stems determines the habit of the species. They are fundamental importance in the orchid classification, in the propagation and an economic importance for people.

- Inflorescence:

The flowers appear to be in clusters opening in acropetal succession. Position of the inflorescence has be taken as a criterion for classification

- Flowers:

Morphological diversity and structural complexity culminate in the flowers of orchids. An orchid flower is basically trimerous, pentacyclic and bilateral symmetrical. Modification of this basis structure occurs sometimes. The sepals of most orchids are subequal, free and spreading. The petals in general are subequal or slightly smaller than the sepals. The lip of orchids flower is the most specialized floral part. The shape, attachment, division and extraordinary colors are the most important criteria for species identification and classification.

- Column:

Morphologically, the column is the stalk witch bear s the pollination apparatus. The size, the shape and the structure of the column are directly link on the anther and the stigma. Column structure is a part of criteria for classification, especially in regards of sub-families.

- Anther and Pollinia:

The number and the position of the anther, the texture and the attachment are of fundamental importance in classification too.

- Ovary and stigma:

They represent the gynoccium of the orchid flower. Ovary position is a characteristic of a family and usually found below the sepals and the petals.

- Fruits:

The fruit is a capsule developed from the fecundation to produce seeds. The capsule presents the same characteristics for all genus but different morphologies. At the maturity time, the capsule (different time for different species) opens by drying to release the seeds.

- Seeds:

A capsule of orchids contain a high number of seeds (average of 300 000). All orchids produced numerous dust-like winged seeds adapted for wind dissemination. These seeds contain a differentiated embryo but no food reserved for the embryo development. In nature an orchids seed do not germinated unless it is first invaded by a beneficial symbiotic fungus that provide nutrients for the seed to germinate and growth.

X. The global Market

a. Legal

Legal concerning Orchids harvesting and trading rules are framing by the national Law:
- The National Forestry Law (24 December 2007 N°6/NA)
- Wildlife Law (24 Dec 2007- N°7/NA)

- NBCA Law (PM Decree No 164/1993 and environment law 2007, Articles 9-12)
- Environmental Protection Law, No 02-99/NA
- Province governor decree of the banishment of collection or transportation of wild orchids

And international convention rules:

- CITES (Convention on International trade of endangered species). Convention signed by Lao PDR the 01/March/2004.

The export of wild and/or semi-cultivated orchids, in any form or otherwise semi-processed, is now illegal in Lao PDR unless CITES permits.

In the 4 visited provinces, since 2 years, no quota is allowed for wild orchid's trade. Every collection or transportation is illegal.

b. Orchid collectors and collecting practices

In Xiengkhouang, at least 100 local people in the visited villages are involved in collecting wild orchids. These villagers are predominantly young adult, women and children. These collectors provided orchids to a total of 3-4 local middlemen. Some families have been involved in orchid collection and selling for more than 10 years. Medicinal orchids are usually harvested from December up to April with a peak period from January to March. For floriculture, the collection period was found to be throughout the annual calendar depending on the availability of flowering plants.

Collectors group traveled deep into the forest to search for orchids, often over 10 km walking distance in a mountainous landscape spending few days in the forest. It is an opportunity to villagers to collect other rare NTFPs. The forest status of orchids harvesting area is communal land and has free access for every villager.

Since 2 years, fewer families are collecting orchids because the sourcing scarcity and the market trend decreased. At least 30% of families have abandoned the orchids harvesting in the 3 villages visited.

Epiphytic orchids growing in trees are collected in clumps (all plant). Plants growing high up in the tree canopies and inaccessible to collectors are usually left if the tree could not be cut. Male are climbing on the tree or cut the orchid hosting tree to harvest orchids, women are using bamboo pole.

Collection of wild orchids usually started once a purchase order was received from middlemen. These persons usually are from nearby orchid collection sites throughout the collection period. Sometimes, the collectors received advance payments. The middlemen usually came from distant districts or even abroad (China, Vietnam). They show printed picture of desired species and/or small samples of life orchids and asked collectors to collect similar looking plants.

c. Market chain overview

However, there are many types of illegal activities in the orchid trade, for example, in Phongsaly, Koua district, wild orchids are mainly exported to China for medicinal uses and for horticultural purposes, villagers (Houaphan, Viengxay village) are selling plants directly harvested from the forest to foreign people (Vietnamese) without any reference to sustainable harvesting and, no CITES certification and generally without any control..

Due to the fast economic changes in Laos, some critical gaps have emerged now concerning the sustainable use of Botanical Orchids and their conservation.

From the different government representative interviewed, there isn't any trade of wild orchids anymore in the different provinces and no wild orchids were sized at the border point between China and Vietnam.

Reality shows that there seems to be little coordination and control between the different departments involved, leaving traders to deal with an unclear process and corrupt by the illegal trade with

Vietnamese traders or Chinese who are coming in the province just at harvesting time dealing directly with villagers.

The past 2 years shows that trade in orchids is becoming more specific and limited to few species as *Dendrobium parishii* , *Dendrobium chrysotoxom, Aerides spp* or *Anoechtochylus.*

During the mission we identified 2 distinct markets that look like to be related to the location. In the area visited, in Phongsaly and Oudomxay province, market is oriented to China demand, only selling orchids for medicine, whereas in Houaphan province huge quantity of ornamental orchids are trading to Vietnam. In Louang prabang and Vientiane province orchids are selling for both purpose in a smaller quantity compare to the others north visited provinces.

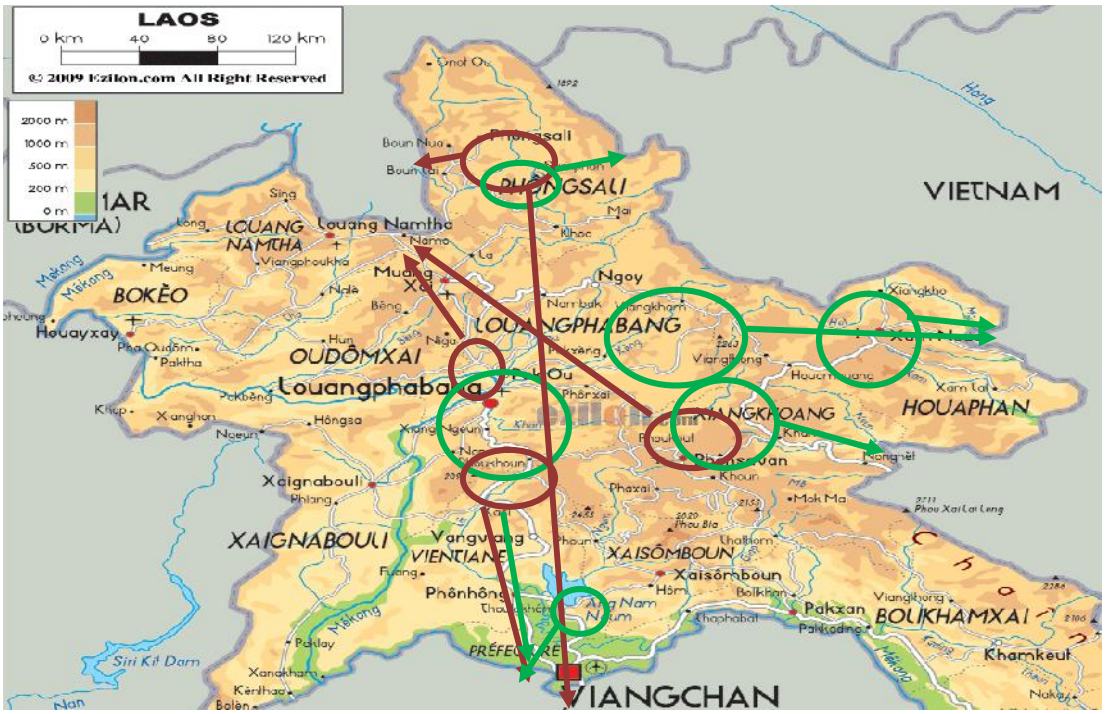
For collectors, at the village gate, the plant's prices are similar for both purposes medicinal or ornamental. However, the general lack of significant price difference across taxa is likely because of the high variability in prices, which reflects variables such as plant size, in bloom, rarity and demand.

Middlemen acted as leading agents, often responsible for a leading share of chain activity (transportation), dominant in terms of buying power and control of technology (contacts and trade networks), and operating at key positions in the value chain upon which other actors depended.

While we were generally not able directly to evaluate relationships between middlemen and other actors, we nevertheless found evidence that middlemen were involved in rule-setting. For example, harvesters that lacked market access were generally very dependent on middlemen to transport their goods, and identified some cases where middlemen imposed exclusivity arrangements with harvesters.

It was impossible to meet foreign Chinese or Vietnamese company who buy orchids to assess export value. These companies send their "collecting" team in the season directly in the village to buy or collect. There is any company representation in the province. One Chinese company is identified in Oudomxay province (Jin Ling Botanical Medicine Company) to export domesticated orchids legally.

Orchid market flow in north Laos. In red for medicinal purpose, In green for ornamental purpose



d. Market chain actor rapid description

Most market traders and harvesters had been involved in trade between 4-6 years, with several exceptions: traders at Phongsaly, Samneua and Oudomxay had been involved with trade for at least 10 years, and a small number of traders for more than 15 years.

Most traders and harvesters have only primary-level education.

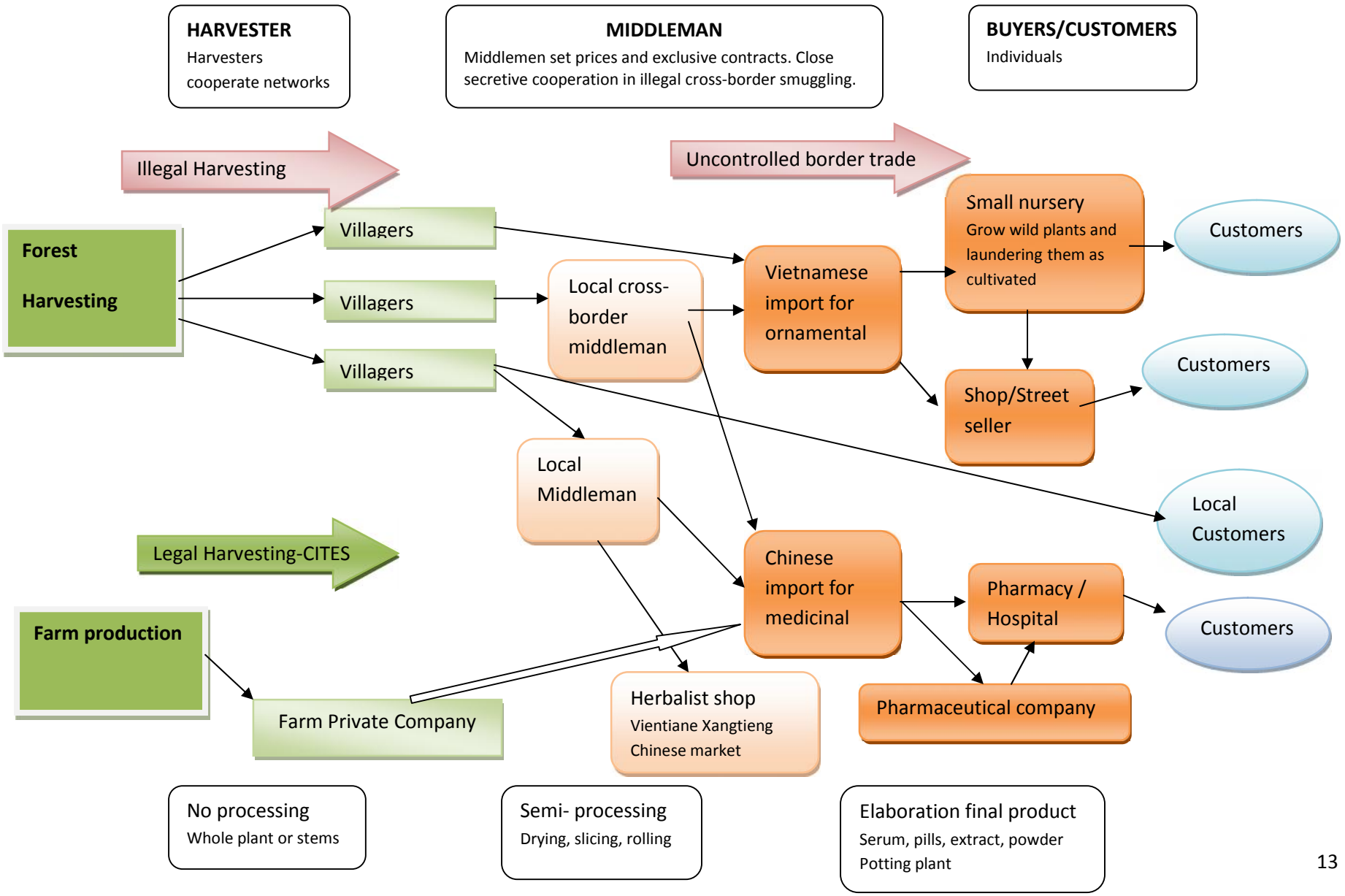
Reported motivations for participating in wild plant trade do not varied considerably across the different harvester or small trader. However, when provided with a list of potential reasons for choosing to trade wild plants, respondent motivations were principally economic, with most interviewee reporting botanical orchid's trade offered a better income than their alternative livelihood options and/or that trade provided supplementary income opportunities. Market traders also reported other, non-economic motivations for botanical trade, including personal interests in plants, need to assist family members with trade, and a desire to own and manage their own businesses.

SWOT analysis of the global wild orchid market

Strengs - No transport cost, Buyers come in the village to buy - Very good prices for some plants - Traditional activity - Incentive to forest protection - Enforce the role of women	**Weakness** - Difficult access to collecting area - Lack of control - Lack of added value skills - Lack in sustainable resource management. - Lack in market information
Opportunity - High prices for some species - Domestication is possible -No tax on collector - Support women involvement - Sustainable if good resources management - Tourism interest	**Threats** - Resources drastic depletion - Monopole of middle man - Low farmer interest if another activity is more lucrative - lack of labor forces - Interest from exporter decrease

Market chain flow: The place, position and market actors are represented in the illustrated market chain below, which starts at the study site and ends with end customers or possible destinations. Information of other market places taken into account for triangulation, however, is mostly excluded in the figure.

Global Identified market chain for ornamental and medicinal purpose



I. Case study of *Aerides odorata Lour.*

This Case study of ornamental orchids is the results of the field survey, market analysis and literature review of *Aerides odorata* presented in this case study.

Aerides odorata Lour is classified as endangered species at the Annex II and IUCN red list.

No statistics exist at the government level, at the provincial or district level; we can only collect informal information from them.

Strengs - Natives from the area - No transport cost, Buyers come in the village to buy - Lucky gift for some events	**Weakness** - Lack of control - Lack of added value skills - Lack in sustainable resource management. - Lack in market information
Opportunity - Added value can be done by domestication/storage - Good product value - Demand is increasing - in vitro-reproduction	**Threats** - Resources drastic depletion - Monopole of middle man - Low farmer interest if another activity is more lucrative

a. <u>Product characteristics and growth habitat</u>

The genus Aerides belongs to the family of Orchidaceae. Orchids are susceptible to stress factors such as temperature fluctuations, low humidity and mechanical damage. As epiphyte *Aerides odorata* occurs on trees, it grows monopodially. Another characteristic is its fragrance, which makes the genus Aerides odorata very attractive to orchid's lover. The flowers are white and blooming between June to September. This specie occurs especially in area above 600m elevation with high humidity in North Laos in low human impacted forest.

Aerides odorata is classified as endangered species at the CITES appendix II and actually quite rare in the wild.

b. <u>Local knowledge and practices</u>

Aerides odorata is collected opportunistically by villagers throughout the year. They know the local name "Koulab krapao pit".

The collector (man or woman) climb to the tree and the entire plant is harvested. Villagers attempt to collect orchids which are at least 15cm long, if several plants occur on the tree, they will collect only the biggest one with a better value.

Collection time depend on walking distance and reachability on the trees. In general, harvesting this specie becomes very scarce due to the strong depletion resulting of over-harvesting and habitat destruction.

Collected orchids are stored attached on trees around the houses waiting for middlemen (Lao or Vietnamese) who come to buy it one times a year usually in February or March.

As consequence of an extended storage with little care in unsuitable places with a not appropriate enlighten and watering result in losing at least 30% of the collected plants.

c. Availability, quantity and prices

Villagers declare: “now, we have to go very far in difficult places to find *Aerides odorata* for sale, orchids with great value are very rare now”.

Last year, around 80 kg were trade by a middleman in Viengxay. He buy this species around 20 000 per kg and sell it around 50 000 kip per kg to Vietnamese buyers. In Vietnam, *Aerides odorata* can be sold 50 to 100 000 kip per plant on floral market in Vietnam cities.

d. Economics for villagers

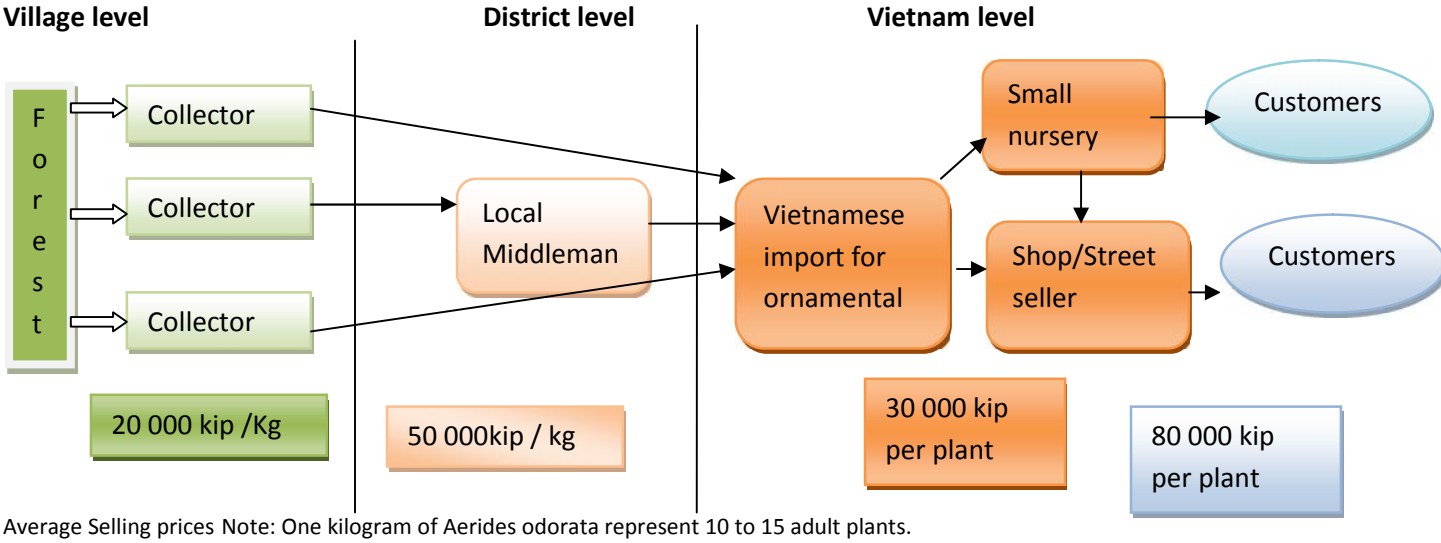
Cash income from Aerides odorata contribute last year of 20% of the global village orchid trade (estimation from interview of middleman and villagers in Viengxay).

In Viengxay district 5-8 families are involved in orchid collection, mainly the poorest one. They sell them collection to a middleman in Viengxay city. Sometimes they follow orders from independent traders from Vietnam. One family make around 500 000 kip per year selling this species.

e. Characteristic of market actors

Actor	**Location**	**Special feature**
Collector/Villagers	Ban Viengxay	Collect illegally Aerides odorata in the wild.
First middle man	Viengxay city	Close relationship with collectors Knowledge on valuable orchids Close relationship with border traders
Growers/stock	Vietnam	Owning shade-houses Species diversity on site Market destination is garden shop or street seller
Street sellers / garden shop	Vietnam cities	Shop keepers offer high quality plant Good margins on sell

f. Market chain on Aerides odorata Lour. in Samneua district



Average Selling prices Note: One kilogram of Aerides odorata represent 10 to 15 adult plants.

The market chain is quite simple and clear from the collectors to the end-customers.
Since 2 years, the provincial government enforces the Law on Orchids trade banishment in her stronger way, resulting in the vanishing of Lao middlemen who are easy to identified and controlled by the authorities.
Customer demand for ornamental orchids has increased over the last few years following the improvement of life standard in Vietnam. The main demand of end customers is mainly from June to September, when *Aerides odorata* are in bloom. However, the species is trade all round years with a pick for the TET (Vietnamese New Year).
Supply has reduced over the last few years in line the resources strong and rapid depletion resulting in selling prices increase and the quality of product is falling.
The price and the margins of *Aerides odorata* gradually increase from the forest gate to the end customers with more benefits for middleman and end seller.
The final plant price is determined by the number of leaves, timber décor, first appearance and flowering time.

g. Taxes, commissions and informal rules.

They are no taxes at the village level for selling *Aerides odorata*, in theory, taxes should be applied to the middlemen and at the border crossing.
However, there is no tax request at any places along the market chain in Laos.
As there isn't any quota allowed, this trade is illegal since 2 years, no official taxes can be collected.

h. Conclusion

As living standards have increased in Vietnam and Laos too, ornamental orchids are considered as prestigious and luxurious object, Orchids have always had a special status and there are many passionate collectors in urban area, it trend to make the price higher supporting by the market development.
Aerides odorata can be vegetative reproduced. The individual need at least two leads to initiate sprouting of a new leaf. The stimulation for producing new leaf is made by attaching a bronze wire around the stem. A new sprout will appear after 6 months and can be cut/separate after one year. This method is long and not very productive to support a business.
Generative in-vitro production of *Aerides odorata* is actually well known and control. The success rate is high around 90%. Production cost is high and the seedlings need around 5 years growing before to be available for trade. This production can be profitable but need a long term support in term of financing and technical.

II. Case study of *Anoechtochylus lylei Rolfe.*

This Case study of medicinal orchids is the results of the field survey, market analysis and literature review of *Anoechtochylus lylei* presented in this case study.
Anoechtochylus lylei Rolfe is classified as endangered species CITES annex II and IUCN red list.
No statistics exist at the government level, at the provincial or district level; we can only collect informal information from them.

Strengs	**Weakness**
- Natives from the area - High prices - No transport cost, Buyers come in the village to buy	- Short time storage - Lack of added value skills - Lack in sustainable resource management. - Lack in market information - Not yet domesticated - Weak law enforcement
Opportunity	**Threats**
- Added value can be done by drying process - Improving skills - Demand is increasing - in vitro-reproduction	- Resources strong drastic depletion - Monopole of middle man

a. Product characteristics and growth habitat

Anoechtochylus lylei is a terrestrial orchid species with velvety green leaves, which are metallic veined. The species is a representative of the families with vernacular name "Jewel orchids", another similar orchid can be found in Laos with the same purpose and value, *Anoechtochylus roxulbury* which has red leaves. This species is only found at elevations of 600 to 1800 meters in Karst, rocky mountain where primary forest still exists. It's often found in crevices under the shade of tall trees in humid conditions with black soils.

This species neither domesticated in large quantity, actually, in-vitro reproduction show goods prospects.

Anoechtochylus is used as health enhancer, aphrodisiac and tonic in the Chinese traditional medicine.

b. Local knowledge and practices

Anoechtochylus lylei is collected opportunistically by villagers throughout the year. They know the local name "Nha bai lai".This perennial species is harvested all year round. The whole plant including the rhizome is exploited. The yield is very low in relation of the harvesting spending time. Actually, 4 to 5 days are required to collect 2-3 kg of raw material.

The plant cannot be store more than few days and has to be sun-dry rapidly to prevent the rapid rottenness of the plant.

Collectors are not aware about the purpose/use of this orchid species.

c. Availability, quantity and prices

As the result of over-harvesting and high commercial value, availability of Anoechtochylus has drastically depleted over the last 5 years. The indicated collected quantity provided by a former trader and Forest officer in Boun neua village, Phongsaly province, was 5 to 10 Kg last year.

Prices are around 300 000 kip per Kg fresh and a minimum of 2 000 000 kip dry depend the quality of raw product.

Anoechtochylus genus is one of the top 3 of medicinal orchid plants price.

Demand from Chinese is still permanently high and apparently stable. The traded quantity of one contacted cross-border trader was around 200Kg of fresh plant in 2015. Selling prices to China range from 400 000 to 1 200 000 Kip per Kg fresh.

Some added value is added by middleman by drying the raw products. The plants can be sold 3 000'000 Kip/ kg dry.

Price fluctuations are related to quality which in turn results from trading with different subspecies. If supply is temporarily too high, product prices decline immediately. Therefore, it is vital to offer the commodity regularly in moderate quantities.

d. Economics for villagers

Interview done with the forest officer and 2 villagers in Phongsaly, Samneua and Louang prabang shows that, despite the trading high price few very poor families are going to collect this species regarding the high harvesting effort compare to return that could be very low.

The lack of knowledge in how to add value as drying deprives collectors to make an interesting benefits.

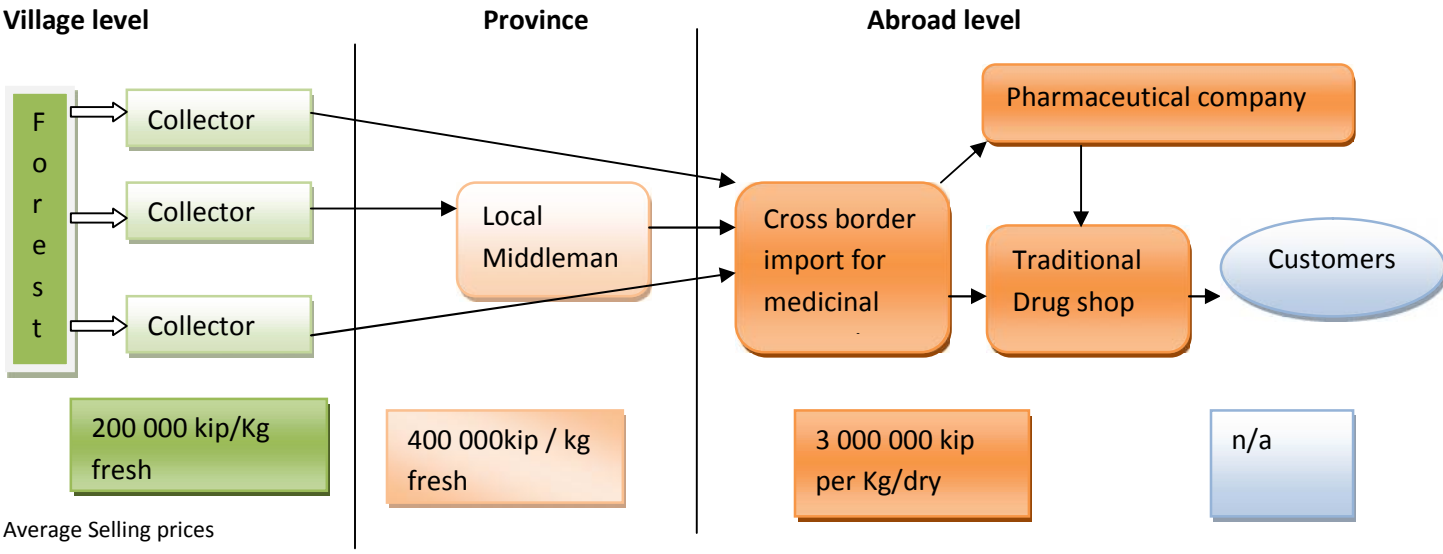
e. Characteristic of market actors

The market chain is quite simple and clear from the collectors to the end-customers.

As for the other plants and Provinces, since 2 years, the provincial government enforces the Law on Orchids trade banishment in a stronger way, resulting in the disappearance of Lao middlemen who are easy to identified and controlled by the authorities especially at the border point.

The Anoechtochylus raw product is traded to China through the main border gate of Boten and in non-official border point like Ban Chakhamdeng (35 km west Bounthai village) and probably without further semi-processing. Chinese customers probably use the product as aphrodisiac and antidote for snake bites as reported by one of the cross-border traders in Phongsaly province. As the availability in Phongsaly province is very low, the cross-border trader is buying plants from Louang prabang and Samneua.

f. Market chain on Anoechtochylus lyllei Lour.



.
Quality, appearance and size: Chinese customers require an entire raw, clean leaf. However, local collectors are unable to meet the Chinese quality requirements. If the leaves are dried, the weight reduces by 90 %. There are different subspecies with specific product values, and the subspecies with red plotted on the upper leaf side provides a high quality. A lower quality is extracted from subspecies which have two white nerves per leaf.
No information on product branding

g. Taxes, commissions and informal rules.

Information is analogous as previous species Aerides odorata.

h. Conclusion

There are currently no methods for cultivating this species in the international context. The species is mainly exported as raw material, although private traditional medicinal enterprises and pharmacies of which have industrialized and semi-industrialized processing chains, in China and Vietnam.
In respect to the fact that this species cannot be domesticated, conservation initiatives are urgent.
As *Anoechtochylus* genus is not domesticated and shows the highest product value at each market level, the pressure on this natural resource is very high. Collection and trade are legally prohibited. In order to conserve the species and to find ways to explore its economic value, the following recommendations are given:
At the village level, Small-scale experiments should be initiated in order to test domestication methods. This should include detailed observations of the species 'natural habitat and growth factors. Such experiments could also be supported by training on different cultivation techniques, and the knowledge of relevant cultivation aspects such as habitat, diseases and other features.
At the district level, Illegal harvesting and trade violations need to be rigorously punished. This requires an improved monitoring system and the relevant forestry and agriculture department should conduct an inventory at the district level to increase awareness of the micro habitat and the current occurrence of the species.
At national level: Research on habitat and biological characteristics should be initiated at different places in northern Laos. Collaboration with Chinese and other Southeast Asian researchers should be sought. This should include the sharing of knowledge resulting from cultivation trials.
In order to successfully conserve this species at national level, the government needs to seek alternative income sources at specific harvesting locations.
Ten phytochemicals compounds were isolated and elucidated as: beta-D-glucopyranosyl-(3R)-hydroxybutanolide (I), stearic acid (II), palmitic acid (III), beta-sitosterol (IV) and succinic acid (V), p-hydroxy benzaldehyde (VI), daucosterol (VII), and methyl 4-beta-D-glucopyranosyl-hutanoate (VIII); as well as p-hydroxy cinnamic acid (IX) and o-hydroxy phenol (X) were identified.

III. Case study of domesticated *Dendrobium chrysotoxom Lindl.*

This Case study of this botanical orchid is the results of the field survey, market analysis and literature review of *Dendrobium chrysotoxom Lind* presented in this case study.
*Dendrobium chrysotoxom Lindl i*s classified as endangered species CITES annex II and IUCN red list.

This species is used for medicinal and ornamental purpose.
We focus mainly on medicinal use and our main information are coming from the owner of the Jinling botanical medicinal farm in Oudomxay province, Xay district, 15 Km far from the provincial capital.
The Lao name is “Ueuang Kham”.

a. Product characteristics and growth habitat

Dendrobium chrysotoxom Lindl. is an epiphytic or lithophyte orchid growing mainly on tree trunks in sunny evergreen broad-leaved forests, but also as lithophyte on rocks in open forests. This orchid can be found at the elevation of 500 to 1600 m and be found in all 4 visited provinces.
It grows in cool to warm conditions with clustered, grooved, clavate or fusiform, to 30 cm long, many angled, apically thickened pseudobulbs enveloped by white, membranous sheaths carrying 2 to 3, towards the apex, lanceolate, coriaceous, leaves and blooms from winter through spring. The 30 cm inflorescence arises from nodes near the apex of the pseudobulbs and it is lax and pendulous and the flowers are highly fragrant of honey and are short lived.
Polyphenol, total flavonoid and antioxidant were isolated in *Dendrobium chrysotoxom*.

b. Knowledge and practices

Mr Lee starts growing orchids in Oudomxay province 10 years ago. Actually he is the owner of a 30 hectares shade houses growing mainly 3 species divided in 20 hectares of *Dendrobium chrysotoxom*, 5 hectares of *Dendrobium moschatum* and 5 hectares of *Dendrobium fimbriatum.*
The plants are breeding on rock beds under 70% shade nets with a basic watering system.
Fertizer is providing one time a year in November – December using animal manure (chicken or cattle).
The harvesting takes place from January to March consisting in cutting the old bulbs from the previous year. The bulbs are sun drying before the commercialization at the company place.
This culture is really sustainable and respects the environment.

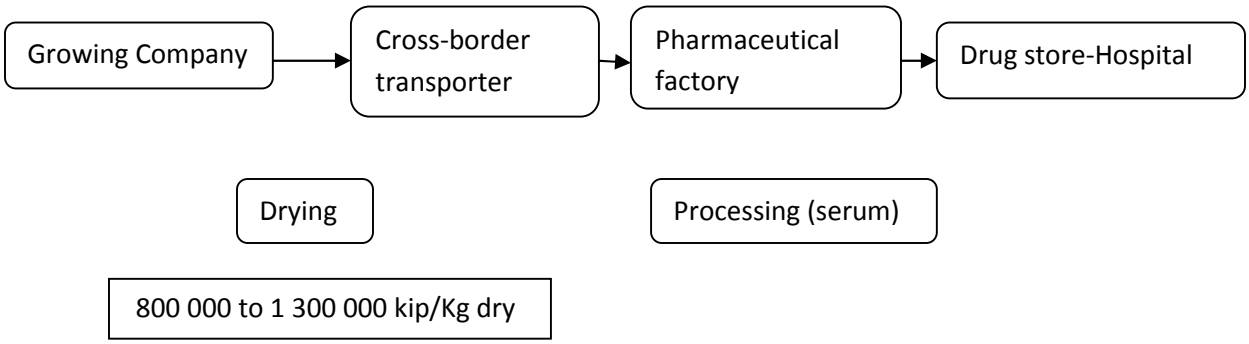
c. Availability, quantity and prices

As the others species, collecting *Dendrobium chrysotoxom* in the wild is challenging.
In Jinling farm, they produce an average of 50 tons of *Dendrobium chrysotoxom* and the owner declare that the quantity produced is not enough to meet the demand by Chinese pharmaceutical company and wants to expand the shade-house surface.
The price is determinate by the grade of the bulbs (size, color, spot, % of dryness …), around 80 000 kip fresh to 1 300 000 kip dry.

d. Market chain on cultivated Dendrobium chrysotoxom

A Chinese trader comes every year to buy the harvesting bulbs from Kunming for a Pharmaceutical factory. The bulbs are using by a complex process to produce a serum extract to fight diabetes and decrease mussels spams from paraplegia.
Quality, appearance and size: Chinese firm require an entire raw or dry, clean without disease mark bulbs. However, it is challenging to meet the Chinese quality requirements for the entire production. If the bulbs are dried, the weight reduces by 70 %.

Several actives chemicals compound were identified in *Dendrobium chrysotoxom*: Chrysotoxine, cytokines, polysaccharides, and chrysotobibenzyl who are potential neuro-protective with strong antioxidant activity.
Ten compounds were obtained and identified as (+)-syringare sinol (1), 5alpha, 8alpha-epidioxy-24(R)-methycholesta-6, 22-dien-3beta-ol (2), trans-3-(4-hydroxy-3-methoxyphenyl)-acrylic acid octacosyl ester (3), defusin (4), 3, 4-dihydroxy benzoic acid (5), 3, 4-dimethoxy-benzoic acid (6), vanillic acid (7), 3, 4-dimethoxy-benzoic acid methyl ester (8), 3, 5-dibromo-2-aminobenzaldehyde (9), heptadecanoic acid 2, 3-dihydroxy-propyl ester (10).
No information on product branding.



e. <u>Taxes, commissions and informal rules.</u>

Every year, the company applies to the province agriculture and forestry office for a quota to export the commodity in the regard of the cultivated area. Last year (2015), the company receives a quota of 50 tons fresh of Dendrobium chrysotoxom. The company is regularly inspected by Provincial forestry authorities and the CITES representatives from Vientiane to obtain the export certificate from CITES.
A tax is due by the company on the benefits has every foreign investment in Laos, the buyer is paying a 5% tax at the province level and another tax at the border gate around 3 to 5% too.
The company follows the international and Lao rules and regulations concerning botanical orchid trade.

IV. Case study of Paphiopedilum concolor Pftiz.

The Case study of this botanical orchid is the results of the field survey, market analysis and literature review of *Paphiopedilum concolor* presented in this case study.
Paphiopedilum concolor is classified as endangered species CITES annex I (prohibits commercial trade) and IUCN red list.
This species is used for ornamental purpose.
The Lao name is “Longthao nali lueang prachin”.

a. <u>Product characteristics and growth habitat</u>

Paphiopedilum concolor is terrestrial specie who can be found along streams on limestone rocks and leaf litter in dry evergreen, broad-leafed forests as well as on limestone cliff faces as a medium-sized, cool to warm growing terrestrial and lithophyte often in partial shade at elevations of 300 to 1200.

This specie can bloom 3 times per year in good conditions.
The population trend is decreasing and the population reduction is over 70% in the last three years and this is projected to continue in the next years.

b. Knowledge and practices

We only observed this specie at the Pha tad key botanical garden. During the interview of collectors in Viengxay (Houaphan province) and Nong kiaw (Louang prabang) they declare that some plants remain in the forest far away from the village and they collect it opportunistically.
The whole plant is collected without consideration for the sustainability of this practice.
Paphiopedilum concolor is an ornamental plant and has been extensively collected for commercial use for horticulture, domestic and international trade.

c. Availability, quantity and prices

Paphiopedilum concolor is under numerous threats especially from over collection for local and regional trade, exploitation for horticultural purposes and deforestation. Wild plants were traded throughout the year, peaking during the blooming time.
As many Paphiopedilum genus, there is a huge demand in this specie.
A big gaps in the price between the village gate and the final trader is huge, from 100 000kip per Kg to 100 000 kip per plant in the street shop.

d. Market chain on *Paphiopedilum concolor Pftiz.*

No clear market chain was identified because the resource is near extinction actually and the trade of this specie is sporadic.
Paphiopedilum concolor Pftiz met most of the conditions for successful commercialization of a farmed plant species, including conditions related to the economic viability of farming. Farmed specimens were available for the same price as wild-collected specimens. This contrasts with many wild-collected products, which are often less expensive than their farmed alternatives.

V. Economic projection in orchids production for a family

In regards of this study taking in account the different constraints as market trend, growing technical and availability of raw material we decide to present the possible economic perspective (estimated income) for a family who manage an orchid production for medicinal purpose.
A typical family orchid farm should consists at least of a 150m2 shade house and can host about 600 to 1200 mother plants to be profitable.

a. *Dendrobium chrysotoxom Lindl.*

Calculated income from 150m2 Shade House	
Plants per sqm	6.0
Surface in sqm	150.0
Nb of plants in shade house	900.0

prod per mother plant (Kg)	0.3
Total prod fresh	270.0
Prod. in kg (dry matter)	81.0
Price dry per Kg	300,000.0
Gross income / year kip	24,300,000.0
In dollar US	3037.5

b. Dendrobium Moschatum Lindl.

Calculated income from 150m2 Shade House	
Plants per sqm	4.0
Surface in sqm	150.0
Nb of plants in shade house	600.0
prod per mother plant (Kg)	0.8
Total prod fresh	480.0
Prod. in kg (dry matter)	144.0
Price dry per Kg	70,000.0
Gross income / year kip	10,080,000.0
In dollar US	1260

c. Dendrobium gratiosissimum Rchb. f.

Calculated income from 150m2 Shade House	
Plants per sqm	8
Surface in sqm	150
Nb of plants in shade house	1,200.00
prod per mother plant (Kg)	0.2
Total prod fresh	240
Prod. in kg (dry matter)	72
Price dry per Kg	200,000.00
Gross income / year kip	14,400,000.00
In dollar US	1800

VI. Conclusion

The very rare valuable orchid plants observed along the trip were young and small. All plants with a value were already collected. These observations corroborate the villager and officials or traders declarations on some species extinction in the area and the necessity to going further and further to collect these orchids species in very small quantity (e.g *Anoechtochylus*, *Dendrobium parishii* or *Dendrobium nobile*).

Wild orchids are deeply associated with the livelihoods of local communities and they are an important part of the traditional livelihood system and provide incomes so far, but an obvious observation shows a very fast and strong depletion in botanical orchids that have a market potential in the area because the over and non-sustainable harvesting technic. All along the last few years the increasing numbers of species and bulk volumes were illegally traded to China and Vietnam resulting in some species extinction. This trade creates severe threats to wild orchids urging development of alternative sources to exploit orchids more sustainably.

Villagers declare: "*now, we have to go very far in difficult places to find orchids for sale, orchids with great value are very rare now and furthermore this year, nobody come to order orchids from China, so we think that we will stop this activity soon*".

Major identified uses of medicinal orchids during Chinese orchid grower and local retailer interview include energizers, treatments of skin burns, fractured or dislocated bones, headaches, fever, and wounds, blood regulator, diabetic treatment and aphrodisiacs. Other uses include insect repellent, blood purifier, skin fungi, snake and scorpion bite antidote, inducement of abortions, and recovery from childbirth. Orchids are mainly used as paste, powder or juice, solely or mixed with other plant or honey.

The orchid species, either for medicinal or ornamental use, account for the lowest contribution to the cash incomes of households in villages. Although product value and customer demand are high, the strongly decreasing resource availability prevents a more positive influence on household cash incomes. However, the ornamental orchid species in particular have the potential to support the livelihoods of the poor if relevant points are carefully considered. Next to a strategy of cultivating the species in nurseries and applying vegetative/In vitro reproduction, special attention must be given to involve poorer households in this activity. Empirical evidence from other NTFP case studies shows a tendency that better-off households gain more from cultivation and vegetative reproduction, depriving poorer households of the resource and product.

XI. Recommendations

1. The actual harvesting technic is not sustainable and has to be stopped.

For monopodial and terrestrial species, all harvesting have to be stop, there isn't any way to collect them from the wild in a sustainable manner.

For the Dendrobium specie we describe in the paragraph below a sustainable technic that can be implemented with local collectors.

2. Actual families cultivating orchids needs some support.

Observation of some family shade house already implanted since 3 years show a lack of skills and management. An additional support and coaching is needed to improve the installation and the production. The choice of the specie should be relevant in regards of the market opportunity and trend. The shade house and growing tables have to be fixed and the growing medium be improve with a regular supply of organic fertilizer.

3. Gaps in the market.

New market path have to be find as trading specific species or producing ornamental orchids for Vietnam market.

The market is actually changing from a large trading orchid specie panel to a few specific marketing species. The chosen species for trade have to be rigorously choose in regards of the market trend at the province and local level. For example, in Phonsavahn (Xiengkhouand province) Chinese orchid farmer are experiencing difficulty to sell their production (mainly *Dendrobium gratiossissinum, Dendrobium devonianum, Dendrobium chrysanthum* and *Dendrobium anosmum*) in opposing situation in Oudomxay were the farm owner declare that his production is not enough for the market demand, growing *Dendrobium Chrisotoxom, Dendrobium moschatum* and *Dendrobium fimbriatum*.

VII. Suggestions

1. Orchid domestication; "Turning villagers from orchid's collector to perennial gardeners".

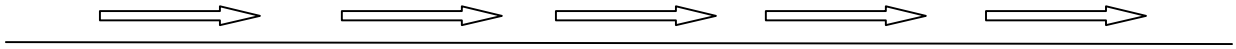
This activity is strongly wishes by local authorities, especially forest department representatives.
The idea is to collect whole orchid plant in the wild that remain far from the village to transfer them on suitable trees in the surrounding village forest. Each interested family will have a forest block suitable for the selected species and be responsible from the culture to trade.
Epiphytic orchids as Dendrobium genus are influenced by several variables including elevation, precipitation rhythm and humidity, bark rugosity and bark pH and sunlight intensity. Some orchids are generalists but others have very specific requirements.
The method described below is only relevant for Dendrobium genus.
The process of domestication will need 4 main steps.

i. An inventory of suitable trees in the future cultivation area has to be done. For successful establishment of Dendrobium orchids, trees with rugose bark should be the preferred hosts because moisture is retained for longer periods of time and foster a more large contact between roots and bark .
ii. End of March or early April, a collection mission has to be undertake with the group of interested villagers. The mission will take 4 to 5 days trip in the forest, as far as possible and an orchid specialist should lead the mission to identify the different species and to avoid collecting plant without interest.
iii. After "Pimay Lao" (new year) the Installation of the collected plant in the selected trees should be done following the first rain to support a better "mother plants" acclimatization.
iv. Regular coaching and support in added value process for villagers and development if possible of byproducts.

After the installation, a simple follow-up is necessary to assess the orchid health. Spraying bio-fertilizer is possible to enhance the plant well-being and increase the stem production. As in the forest, one year after the domestication harvesting the old stem can be done.
This method represents some advantages like protecting wild orchids in their habitat, sustainability by appropriate harvesting technics with light labor force, gender incentive, and valorization of the Lao biodiversity. Orchids garden created could be a tourist attraction in the future.

Theoretical time line:

November	December	April	May	December	Feb March
Family selection	Tree selection	Wild Harvesting	Installation	Inventory	harvesting



2. From artificial propagation (in-vitro)

This way is especially recommended for an ornamental orchid production as the live plant market needs the whole plant.

Artificial propagation of orchids has the potential to reduce illegal collecting in the wild through wider availability of stock material, and can also provide large numbers of plants within a short period of time. Artificially propagated plants often have the advantage of being more vigorous than wild collected stock, have a higher survival rate.

The establishment of a sustainable orchid production based on low cost *in vitro* propagation could be beneficial to the conservation of endangered orchids.

Turning villagers from orchid's collector to perennial gardeners take 3 main steps:

i. After specie selection, Start and develop an in vitro propagation in a laboratory. A partnership can be done with a national laboratory as the Ministry of Natural Resources and Environment (MoNRE) laboratory.
ii. The acclimatization step from lab to external condition is very sensitive and need special attention and care from experienced people in controlled surrounding.
iii. Implementation of the young orchid plant under shade-house on table or bed rocks or on the trees in the surrounding village forest if it's remaining enough suitable trees. Each interested family will have a forest block suitable for the selected specie and be responsible from the culture to trade. After, the global methodology is the same than the paragraph above in point one description "orchid domestication".

3. Recommendation to encourage having a cooperative, marketing groups, producer groups.

Group enterprises can impact upon the livelihoods of the farming communities in two important ways. The first is through the provision of technical services and the supply of inputs and production services. All can contribute to an expansion of production areas and an increase in farm productivity. The second channel for generation of impacts is through the provision of marketing services, which are very important for improving market access and raising farm-gate prices. In short, by providing essential production and marketing services, group enterprises can potentially contribute to increased farm profitability and farmer incomes, which are a critical determinant of local livelihoods.

REFERENCES

Bouakhaykhone, Svensuksa and Vichith Lamxay. 2005. Field Guide: The Wild Orchids of Lao PDR. National University of Laos, Manthatoulath Printing, Vientiane, Lao PDR.

Food and Agriculture Organization (FAO). 2004. "What is Agrobiodiversity?" From the Building on Gender, Agrobiodiversity and Local Knowledge Training Manual.

Grejmans, Martin, Sounthone Ketphanh, Vichith Lamxay and Khamphone Sengdara. 2007. Non Timber Forest Products in Lao PDR: A Manual of 100 Commercial and Traditional Products. Netherland Development Organization (SNV), Vientiane, Lao PDR.

ORCHIS Project. 2009. "Preliminary checklist of the Orchidaceae of Laos". http://www.orchisasia.org/orchids%20list.html

Phimmavong, S., B. Ozarska, S. Midgley & R. Keenan (2010). Forest and plantation development in Laos: history, development and impact for rural communities. International Forestry Review

Schuiteman, A and E.F. de Vogel. 2000. Orchid Genera of Thailand, Laos, Cambodia and Vietnam. National Herbarium Nederland, Leiden.

Seidenfaden, G. (1975–2003). Orchid genera in Thailand I-XIV. in Opera Botanica.

TANG Deying1,MA Jie1,ZHANG Lixia1,DUAN Lisheng1,SONG Meifang1,GAO Weiwei1,2 (1.Yunnan Branch,Institute of Medicinal Plant, Chinese Academy of Medical Sciences, Peking Union Medical College, Jinghong 666100,China;2.Institute of Medicinal Plant, Chinese Academy of Medical Sciences, Peking Union Medical College, Beijing 100193,China);Research and investigation in germplasm resource of Dendrobium chrysotoxom.

WANG Dong-mei et al(Medicinal Plant Research Institute, Chinese Academy of Medical Sciences, Beijing 100193);Study on Antioxidant and Nourishing Yin of Aqueous Extract from Dendrobium;Journal of Anhui Agricultural Sciences;2013-15

Huang, W.Y., Cai, Y.Z., Zhang, Y. (2009) —Natural phenolic compounds from medicinal herbs and dietary plants: potential use for cancer prevention.

Annexes

Annex 1: Mission calendar

Mission 1 Calendar

Date	Activity	Comments
Sunday 22 May, 2016	Afternoon: Fly to Phonsavahn town and road trip to Ban Longkham	Night in the village
Monday 23 May, 2016	Ban Longkham Focus group discussion Forest transect visit Direct observation of the situation	Night in the village Cluster is Ban DonTchay - 5 small villages
Tuesday 24-May-16	Ban Piandi Focus group discussion Forest transect visit Direct observation of the situation	Night in the village
Wednesday 25 May, 2016	Ban Sopkhao Focus group discussion Forest transect visit Direct observation of the situation	Night in Phonsavahn
Thursday 26-May-16	Morning: Visit of Phonsavahn orchids trader and interview Afternoon: writing first finding presentation	Phoukoud Phonsavahn
Friday 27-May-16	Morning: Presentation and discussion with DAFO in Phoukoud following by meeting with PAFO in Phonsavahn. Afternoon: Fly back to VTE	
Saturday 28 May, 2016	Writing report	VTE
Monday 30 May 2016	Debrief with TABI in Vientiane	VTE

Mission 2 Calendar

Date	Places	Itinerary // Activities	Over night
09-Nov	Vientiane	Desk review - questionnaire elaboration - admin -	
10-Nov	Vientiane	Visit of retailers/traders, MoNRE, Medicinal plant research center , CITES office	
11-Nov	Vientiane	Visit of Herbalist shop and Ban Sappakhannon (collector village)	
12-Nov		Sunday	
13-Nov		Trip VTE to Phonsavahn	Phonsavahn
14-Nov		Trip from Phonsavahn to Xamneua	Xamneua
15-Nov	Xamneua	Visit of local autorities from PAFO, MoNRE, collecting informations about trade, retailers, growers, collecting area. Visit of market, key informant, retailers and producer places for interview.	Xamneua
16-Nov		Visit of villages where villagers are involved in orchids harvesting.	Xamneua
17-Nov		Trip to Sohao border point to collect DATA with border autorities	Xamneua
18-Nov	Vieng thong	Trip to Viengthong // tentative meeting with Locals, DAFO and NBCA officer	Viengthong
19-Nov	Oudomxay	Trip to Oudomxay	Oudomxay
20-Nov		Sunday	Oudomxay
21-Nov	Oudomxay	Visit of local autorities from PAFO, MoNRE, collecting informations about trade, retailers, growers, collecting area. Visit of market, key informant,	Oudomxay
22-Nov		Visit of retailers and producer places for interview. villages where villagers are involved in orchids harvesting.	Oudomxay
23-Nov	Phongsaly	Trip to Boten border point to collect DATA with border autorities. Trip to Phongsaly	Phongsaly
24-Nov		Visit of local autorities from PAFO, MoNRE, collecting informations about trade, retailers, growers, collecting area. Visit of market, key informant, retailers and producer places for interview.	Phongsaly
25-Nov		Visit of market, key informant, retailers and producer places for interview.	Phongsaly
26-Nov		Trip to louang prabang	LP
27-Nov		Sunday	LP
28-Nov	Louang prabang	Visit of local autorities from PAFO, MoNRE, collecting informations about trade, retailers, growers, collecting area. Meeting with Pha thad Key botanical garden.	LP
29-Nov		Trip back to Kasi	Kasi
30-Nov	trip back to VTE	Meeting with DAFO and district environmental office in Kasi. Visit some families involved in orchid trade.	

Annex 2: List of botanical orchid identified during the mission

	Orchids Botanical name	Lao name (alphabet)	Purpose		Habitat	Places
1	Acampe papilliosa Lindl.	Chang saraphi noy		m	Epiphytic	Samneua, Oudomxay, Louang prabang, Vientiane province
2	Aerides falcata Lindl.	Koulap krapao poet	f		Epiphytic	Xiengkhouang
3	Aerides flabellata Rolfe	Koulap Nok philap	f		Epiphytic	Xiengkhouang
4	Aerides multiflora Roxb.	Koulab malai deng	f	m	Epiphytic	Samneua, Oudomxay, Louang prabang
5	Aerides houliettana Rchb.f.	Koulab leuang korat	f			
6	Aerides odorata Lour.	Koulab krapao pit	f	m	Epiphytic	Samneua, Oudomxay, Louang prabang
7	Anoechtochylus lylei Rolfe.	Nha bay lay		m	Terrestrial	Samneua, Oudomxay, Louang prabang, Phongsaly, Xiengkouang
8	Arundina graminifolia D.Don.	Ueuang pay		m	Terrestrial	Louang prabang, Vientiane province
9	Ascocentrum miniatum Lindl.	Khem set	f		Epiphytic	Louang prabang
10	Bulbophylum affine Lindl	na				Xiengkhouang
11	Bulbophylum careyanum Hook.	n/a		m	Epiphytic	Samneua, Oudomxay, Louang prabang, Vientiane province
12	Cleisostoma arietinum Garay	Khao Phae			Epiphytic	Xiengkhouang
13	Cleisostoma fuerstenberganium Krzl	Kang pla			Epiphytic	Xiengkhouang
14	Cleisostoma sp				Epiphytic	Xiengkhouang
15	Chilochista usneoides Lindl.	n/a		m	Epiphytic	Phongsaly. Oudomxay, Louang prabang
16	Coelogine trinervis Lindl.	Ueang mak			Epiphytic	every where
17	Cymbidium aloifolium (L.) Sw.	Ka re Ka ron	f	m	Epiphytic	Samneua, Oudomxay, Louang prabang, Vientiane province
18	Dendrobium aphyllum Fisher.	Ueang Sai long laeng	f	m	Epiphytic	Samneua, Oudomxay, Louang prabang, Vientiane province
19	Dendrobium anosmum Lindl.	Ueang say louang	f	m	Epiphytic	Phongsaly Samneua, Xiengkouang, Oudomxay, Louang prabang,
20	Dendrobium cariniferum Rchb.f.	Ueang Ngoen deng	f	m	Epiphytic	Samneua, Oudomxay, Louang prabang,
21	Dendrobium chrysotoxom Lindl.	Ueang Kham	f	m	Epiphytic	Samneua, Oudomxay, Louang prabang, Vientiane province
22	Dendrobium crepidatum Griff.	Ueang Sai nam Khieo	f	m	Epiphytic	Phongsaly Samneua, Oudomxay, Louang prabang,
23	Dendrobium cristallinum Lindl.	Ueang say sam sii	f	m	Epiphytic	Samneua, Oudomxay, Louang prabang,
24	Dendrobium crumenatum Sw.	Ueuang mali	f	m	Epiphytic	Samneua, Oudomxay, Louang prabang, Vientiane province
25	Dendrobium delacourii Guillaumin	Ueuang Dok Ma Kham	f	m	Epiphytic	Louang prabang
26	Dendrobium densiflorum Lindl.	Ueang Mon Khai Leuang	f	m	Epiphytic	Xiengkouang – Phongsali, Louangnamtha, Louang prabang, Samneua
27	Dendrobium devonianum Paxton.	Ueang sai pha kang	f	m	Epiphytic	Samneua, Oudomxay, Louang prabang, Xiengkouang

28	Dendrobium dixanthum Rchb.f.	Ueang Kham Pon	f	m	Epiphytic	Xiengkhouang, Phongsaly, Samneua, Oudomxay, Louang prabang
29	Dendrobium draconis Rchb.f	Ueang Ngoen	f	m	Epiphytic	Xiengkhouang, Samneua, Oudomxay, Louang prabang
30	Dendrobium farmeri Paxt.	Ueang matchanu	f	m	Epiphytic	Samneua, Oudomxay, Louang prabang
31	Dendrobium fimbriatum Hook.	Ueang kham noi - Ueang kham foi	f	m	Epiphytic	Xiengkhouang, Samneua, Oudomxay, Louang prabang, Vientiane province
32	Dendrobium findlayanum Rchb.f.	Ueang phuang yok	f		Epiphytic	Xiengkhouang, Samneua, Oudomxay, Louang prabang
33	Dendrobium friedericksianum Rchb.f	Ueuang Lueang chantabun	f	m	Epiphytic	Xiengkhouang, Samneua, Oudomxay, Louang prabang, Vientiane province
34	Dendrobium gibsonii Paxton.	Ueang Kham Ta	f	m	Epiphytic	Xiengkhouang, Samneua, Oudomxay, Louang prabang, Vientiane province
35	Dendrobium gratiosissimum Rchb. f.	Ueuang King dam	f	m	Epiphytic	Xiengkhouang, Samneua, Oudomxay, Louang prabang.
36	Dendrobium heterocarpum Wall.	Ueang si tan	f	m	Epiphytic	Xiengkhouang, Samneua, Oudomxay, Louang prabang, Vientiane province
37	Dendrobium moschatum Lindl.	Ueuang champa	f	m	Lithophite	Xiengkhouang, Samneua, Oudomxay, Louang prabang, Vientiane province
38	Dendrobium nobile Lindl.	Ueang Khao Kiu	f	m	Epiphytic	Xiengkouang, Samneua, Oudomxay, Louang prabang
39	Dendrobium parishii Rchb.f.	Ueuang sai nam khrang	f	m	Epiphytic	Phongsaly, Samneua, Oudomxay, Louang prabang
40	Dendrobium pendulum Roxb.	Ueang Mai thao lusi	f	m	Epiphytic	Phongsaly, Samneua, Oudomxay
41	Dendrobium pulchellum Roxb.	Ueang ta kway	f	m	Epiphytic	Samneua, Oudomxay, Louang prabang, Vientiane province
42	Dendrobium primulinum Lindl.	Ueang say nam pheung	f	m	Epiphytic	Samneua, Xiengkouang, Oudomxay, Louang prabang
43	Dendrobium signatum Rchb.f.	Ueang kham kiu	f	m	Epiphytic	Samneua, Xiengkouang, Oudomxay, Louang prabang
44	Dendrobium sulcatum Lindl.	Ueang champa nam	f		Epiphytic	Phongsaly, Samneua, Louang prabang
45	Dendrobium thyrsiflorum Rchb.f.	Ueuang mawn khai	f		Epiphytic	Xiengkouang, Phongsaly, Louangnamtha, Samneua
46	Dendrobium venustum Teijsm. & Binn	Ueuang Dok ma kham	f	m	Epiphytic	Samneua, Oudomxay, Louang prabang, Vientiane province
47	Eria sp				Epiphytic	Xiengkhouang
48	Eria tomentosa Hook.f.	n/a			Epiphytic	Xiengkhouang
49	Eulophia spectabilis Suresh.	Wan Hua Khru			Epiphytic	Xiengkhouang
50	Eulophia zollingueri J.J.Sm.	n/a			Epiphytic	Xiengkhouang
51	Geodorum recurvum Alston.	n/a			Terrestrial	Xiengkhouang
52	Grammatophyllum speciosum Blum.	Ueang phetchahueng - Wan phetchahung	f		Lithophite	Louang prabang
53	Habenaria sp				Terrestrial	Xiengkhouang

54	Hygrochilus parishii Pfitz.					Xiengkhouang
55	Malaxis Sp	Lin krabue			Terrestrial	Xiengkhouang
56	Mitrata seidenfania Garay.	Nuat phram	f		Epiphytic	Louang prabang, Samneua
57	Nervillea Sp				Terrestrial	Xiengkhouang
58	Oberonia Sp				Terrestrial	Xiengkhouang
59	Paphiopedilum concolor Pftzt.	Rongthao Nari doitung	f		Terrestrial	Karst, Louang Prabang
60	Papilionanthe teres Roxb.	Ueang mok	f	m	Epiphytic	Samneua, Oudomxay, Louang prabang, Vientiane province
61	Phaius tancarvilleae Blum.	Ueuang phao	f	m	Terrestrial	Louang prabang, Samneua, Phongsaly, Oudomxay.
62	Pholidota articulata Hook.	Ueuang To		m	Epiphytic-lithophite	Xiengkouang, Samneua, Oudomxay, Louang prabang, Vientiane province
63	Pelantantheria Sp				Terrestrial	Xiengkhouang
64	Rhynchostylis gigantea blum.	Ueuang sangkha	f		Epiphytic	Louang prabang, Vientiane province
65	Rhynchostylis retusa Blum.	Ueuang Hang ka hawk	f	m	Epiphytic	Samneua, Oudomxay, Louang prabang, Vientiane province
66	Spatoglotis plicata Blum.	Wan chuk ueang din	f		Lithophite	Louang prabang
67	Thelasis pigmaea Blum.	na			Lithophite	Xiengkhouang
68	Vanda brunea Rchb.f.	Sampoi nok	f		Epiphytic	Phongsaly
69	Vanda lilacina Teijsm. & Binn.	hang pla - Khem Khao	f		Epiphytic	Louang prabang, Vientiane province
70	Vandopsis gigantea Lindl.	Phaya chat than	f		Epiphytic	Louang prabang, Samneua
71	Vandopsis lissochiloides Pfitz.	Khao phra wihan	f		lithophite	Louang prabang, Samneua, Vientiane province

Annex 4: Interview instrument

Interview guiding questions for wild orchid traders

1	Trader category (small, medium, large, cross border)
2	Where are you from/born?
3	How old are you?
4	Ethnic group?
5	What is your highest level of education?
6	How long have you been trading orchids?
7	Do you trade orchids all year round or only seasonally?
8	*If seasonally:* What months of the year do you usually sell orchids?
9	Do you applied process to orchids for added value
10	Is orchid trading your primary source of income or a supplementary source of income?
11	How do you describe the market trend?
12	*If no:* Aside from selling orchids what other kinds of work opportunities or skills do you have?
13	What is the main reason that you chose to work with orchids trade?
14	What orchid species do you trade most often? (*Free list*)
15	Does your household depend on the income from plant trade:

16	How and where do you usually get your orchids?
17	How many different people do you usually buy orchids from?
18	How do you usually decide what orchids to buy, order or collect? Is it based on whatever is available?

Interview guiding questions for wild orchid collectors

1	Gender & age, household situation
2	What is your highest level of education?
3	How long have you been collecting orchids?
4	What is the main reason that you chose to work with orchids?
5	Please describe your usual methods for collecting orchids
6	Do you usually collect all of the orchids you find or only some plants?
7	Do you usually collect from all of the trees in a certain area or only from some of the trees?
8	What orchid species do you collect most often?
9	Who do you usually collect with or do you collect on your own?
10	How many other people do you know who are collecting orchids for sale?
11	In the last year where have you collected orchids?
12	What is the tenure/ownership of the land where you collect (*e.g. private, protected are, government*)
13	Once you collect in a certain area do you usually return to collect there again at a later date?
14	How do you usually transport the orchids?
15	Are there any orchid species that were once common but are now difficult to find or that were rare?
16	Do you know the used of the plant you are collected?
17	Do you know technical for adding value?
18	Do you wish to start orchid domestication?
19	If yes, what sort of support do you need?

Annex 5: CITES regulations

Appendix	**Species**	**CITES regulations**
CITES appendix I	*Aerangis ellisii* *Dendrobium cruentum* *Dendrobium nobile* *Laelia jongheana* *Laelia lobata* *Peristeria elata* *Renanthera imschootiana* *Paphiopedilum* spp. *Phragmipedium* spp.	• An import permit issued by the MA of the State of import is required. This may be issued only if the specimen will not be used for primarily commercial purposes and if the import is for purposes that are not detrimental to the survival of the species. • An export permits or re-export certificate issued by the MAF of the State of export or re-export is also required. • An export permit may be issued only if the specimen was legally obtained; the trade will not be detrimental to the survival of the

		species; and an import permit has already been issued. • A re-export certificate may be issued only if the specimen was imported in accordance with the provisions of the Convention and, in the case of a live animal or plant, if an import permit has been issued. • In the case of a live animal or plant, it must be prepared and shipped to minimize any risk of injury or damage.
CITES appendix II	All other species in the family Orchidaceae	• An export permits or re-export certificate issued by the MAF of the State of export or re-export is required. • Export permit may be issued only if the specimen was legally obtained and if the export is not detrimental to the survival of the species. • A re-export certificate may be issued only if the specimen was imported in accordance with the Convention. • In the case of a live animal or plant, it must be prepared and shipped to minimize any risk of injury or damage. • No import permit is needed unless required by national law.

Pictures

Dendrobium devonianum in Chinese farm (Phonsavahn)

Chinese orchid farm in Phonsavahn

Dry rolling stem of Dendrobium devonianum

Chinese farm in Oudomxay (Dendrobium chrisotoxom)

Dendrobium signatum plant (Ban Longkham)

A panel of different species(Houaphan)

Terrestrial orchid Geodorum recurvum

Thelasis pigmaea

Aerides flabellata

Dendrobium pulchellum in Chinese farm (Oudomxay)

Middleman orchid trader in Kasi

Orchids ready to sell (Phongsaly)

Packed Dendrobium in Vientiane, Chinese market Xiangtiang

Orchid street seller in Vientiane

Aerides multiflora for sale (VTE)