Value chain and market assessment of nine agricultural commodities in three provinces of Northern Laos

Bong bark, Tung oil, Paper Mulberry, Sichuan pepper, Rattan, Siam Benzoin, Bamboo, Sacha Inchi, and Sesame from Houaphan, Luang Prabang, and Sayabouri.

Commissioned by GIZ Laos

Produced by Village Focus International

Authors: Tassilo Tiemann, Davone Bounphasouk, Simone Vongkhamho, Soulygnuan Viengkhamsone, Sybone Lasahak

Laos, 2022

Table of Contents

List of abbreviations and acronyms

DAFO	District Agriculture and Forestry Office
DICO	District Industry and Commerce Office
MAF	Ministry of Agriculture and Forestry
MoIC	Ministry of Industry and Commerce
NAFRI	National Agriculture and Forestry Research Institute
PAFO	Provincial Agriculture and Forestry Office
PICO	Provincial Industry and Commerce Office
VC	Value Chain

Currency conversion

Currency	**LAK**
1 USD	11,500
1 EUR	12,800
1 THB	350
1 CNY	1,800

1.Summary and conclusions

1.1 Commodities

Tree crops have been promoted by the Government of Laos as a suitable way to move away from swidden agriculture. This study confirms what others have observed before, that not one model of tree crops suits all contexts in Laos and care must be taken in assessing the prevailing conditions and their potential for the sustainable management of a specific tree crop (van der Meer Simo et al., 2020).

The nine assessed value chains vary significantly. **Bong** bark is the only commodity which does not seem to be traded anymore in the target provinces and as such the information about it in this report is more of a general nature. Its pricing seemed comparable to paper mulberry and in other parts of the country some 700 tons were still produced in 2021. The main use for the commodity is as an adhesive, which burns smoothly and evenly and is used for incense sticks, mosquito coils etc. However, apparently new materials have recently come into use for this purpose, which has led to the decline of the value chain in the target provinces.

Bamboo is the most complex commodity, it being a number of related but independent products, each with its own set of production, market and legal conditions. So, no attempt was made to deliver complete information about bamboo as this would go far beyond the scope of this study. Rather a general overview is given with some example value chains. Bamboo is of great importance for individual households (e.g., housing, fencing) as well as for the international market (construction materials, household items, paper etc.). The products traded are mainly canes and slats and though some processing capacity seems to exist in-country, it cannot compete with neighboring countries. As food, bamboo shoots are domestically and regionally traded in fresh and processed form, but processing is generally not very sophisticated. The sampling for bamboo canes in this study was the smallest but canes seem to offer the most disadvantageous deal for farmers, getting only about 6% of the final product price, without any processing but drying taking place. However, bamboo canes are prone to fungi and beetle attacks and drying may not be as straightforward as it may appear. Whilst it seems that significant gains for farmers should be possible, WWF has tried for years to cash-in on these opportunities, but significant challenges remain, not least from the legal side. Shoots on the other hand seem to offer a clearer pathway. Here farmers also only get 33% of the gains, but both supply chains and processing seem less challenging and require little upfront investments. Bamboo worms, offer even more attractive returns, but to our knowledge active breeding is not undertaken, making the harvest purely opportunistic. For niche groups, handicrafts provide an attractive income opportunity.

Benzoin gum is a high-value, low yield commodity. It is an aromatic resin extracted from Styrax trees used in the perfume industry. The annual yield per tree is between 150 and 350 g of gum depending on tree age and location, placing the yield per hectare in the range of 13-20 kg. Given the low work intensity to get the gum, the price of 100,000-150,000 LAK/kg, depending on year and location, is a good income. Per area though, it cannot compete with other cash crops, especially bulk crops. The supply chain is well developed in the target provinces with three companies competing for produce and established business avenues into Europe and to a lesser degree Asian markets. Some of the exporting companies have strong social commitments as part of their business model, adding to the direct income benefits. Benzoin thus offers a good opportunity as shade tree or hedgerow tree in mixed cropping systems.

Paper mulberry is a fast-growing multi-purpose pioneer tree, harvested for its bark, which is used in the production of ornamental and high-quality paper products. The production of the trees is very simple, due to their high regeneration capacity, fast growth, and low maintenance requirements. However, the stripping of the bark is a slow and laborious process. This makes the price of 5000 LAK/kg unattractive unless no alternative income sources exist. Since the bark needs to be dried, its production is mainly restricted to the dry season, which also generally coincides with a lack of alternative income opportunities. Even though complex grading approaches exist, in general simple or no grading is used in-country. Few companies have processing facilities and produce paper pulp which is shipped wet to foreign buyers. Destination markets for both, bark and pulp are China, Thailand, and South Korea.

Rattan canes are mainly used for furniture and handicrafts, and are generally considered the high-quality version of bamboo., whilst the shoots are eaten. The palms grow as understory in forests, are slow growing and require good management to keep production sustainable. They are currently mostly harvested from wild stands, which makes them an opportunistic commodity, as they do not spoil, similar to timber. Canes are sorted by diameter, with 3 cm diameter canes selling for 3,000-5,000 LAK, whereas 1 cm canes sell for 1,000 LAK. Even though the international demand for rattan products is high, export from Laos is very limited as high fees and taxes on rattan as an NTFP make it uncompetitive compared with other producer countries such as Vietnam, the Philippines, Indonesia, or even Cambodia, which is a minor producer. In-country furniture production for the domestic market exists, but is largely manual, of low craftsmanship, and relying on traditional designs which have no export market. However, domestic demand seems strong. Shoots are eaten similar to bamboo shoots but sold at much higher price per weight (300,000 LAK/kg or more), since they are much smaller than bamboo shoots. Simple processing of boiling for local consumption or drying for export is practiced but quantities are small. Since about 200 fresh shoots are required to produce 1 kg of dried shoots, there might be a risk of over-exploitation given rattan's slow regeneration. Overall, the rattan value chain in Laos is small and not well developed, even compared to bamboo.

Sacha inchi is a vine cultivated for its seed, which is high in unsaturated oil used in the cosmetics industry. It also contains high protein levels for human and animal consumption. Other parts are used for tea and in recent years the commodity has seen a hype as "super food". This development provides a large international market, especially in China, Europe, and the US, but also in Malaysia and Taiwan, and the value chain demand is far outstripping supply. The crop is easy to grow but requires some care to provide high yields of up to 1 ton/ha. The farm gate prices vary between 8,000 to 20,000 LAK/kg, while traders export for sometimes double this price. Protein powder is sold for about 75,000 LAK/kg, while oil sells for 200,000 LAK/l, but only one producer exists in-country. The vine grows on trellises and stays productive for about 5 years.

Sesame is an annual crop grown for its seed which is rich in oil and protein. It is a hardy crop and can be produced in a wide range of environments. Compared to the international competition, Laos produces only small amounts of sesame and ranks in 37th place in terms of output globally. The global demand is high though, and selling the seeds is never a problem, mostly to Thailand and China. Most exporting traders work through brokers or district traders. The farm gate price varies by location between 6,000 and 9,000 LAK/kg, while export prices are around 14,000-16,000 LAK/kg. Black sesame is grown in some areas and comprises about 30% of the total production. Many stakeholders report the need to rotate sesame crops in order to stay productive, but we could not assess if this is due to inappropriate management or due to other factors.

Sichuan pepper or more correctly Indian Prickly Ash is the fruit of several Zanthoxylum trees, which are common fallow pioneers. It is used as spice, medicinal plants, and has more recently been explored in the scent and perfume industry. A number of different species with slightly different properties grow in Laos but no market differentiation has taken place yet. Seed availability is in theory high, but the supply chain is only absorbing small amounts of the potential production capacity. It could not be determined whether this is a structural problem or based on demand limitations. Traders report that selling the seed is never a problem but still they only buy a limited quantity. Whilst domestic use is common, export destinations are mainly Vietnam and Thailand, and to a lesser degree European countries. Overall, Sichuan pepper seems to have an immature market with great potential if development is successfully promoted.

The seeds of **Tung** trees contain a high proportion of a fast-drying oil which is used in the manufacturing of paints, varnishes, linoleum etc. In Laos it is often lumped together with Mu oil which come from a similar tree species and has similar properties. The farm gate price is 4,000-5,000 LAK/kg and export destinations are Vietnam and China, though it is rumored that ultimately almost all is processed in China, which has extensive processing capacities. The main consumer market seems to be Japan. The supply chain is, similar to Benzoin, characterized by few large buyers who export the majority of all produce. Although processing capacity exists in-country, the current high seed prices have led processors to sell seed directly, foregoing any processing beyond cleaning and drying. With large demand by Chinese processors, the crop seems to have large expansion potential and a stable market.

1.2 Opportunities and limitations

Many of the value chains described give the superficial impression that with a little extra effort, additional gains for producers could be achieved. Examples include drying of bamboo canes or rattan shoots, oil extraction from sacha inchi, sesame, or tung seed, and grading or pre-processing of paper mulberry bark. However, projects have tried to tap into some of these perceived opportunities and made little headway in establishing sustainable value chains. Even with so apparently low hanging fruits as bamboo poles, factors such as mold and damage by insects make improvements challenging. The fact that large Lao and foreign traders with substantial financial resources do rarely engage in processing, indicates that external factors, such as initial costs, available infrastructure, and other uncertainties seem to be prohibitive. When asked, few traders said they would consider investing in processing, often giving the required investment and low competitiveness as reasons. For some processes, such as paper processing, high initial investments of 1 million USD or more are necessary, which might be prohibitive or discouraging if other conditions such as transport and export are not conducive to business success. Thus, it seems that processing opportunities in Laos are limited under the current conditions.

However, it also needs to be acknowledged that many, especially higher processing steps would be unlikely to benefit farmers directly as they require industrial scale operation in order to be competitive with neighboring countries. In many value chains, farmers take a surprisingly high share of the overall revenues (Table 1 and Company Summaries in Annex 7). Lack of mechanization and small-scale production though limit overall income or return to labor, while large traders despite relatively small margins achieve high profits through their ability to scale their operation. Despite these limitations, different options may provide opportunities for different circumstances. Whilst this study did not focus on a comprehensive economic analysis of the assessed commodities, factors such as return on labor, yield per area, yield per year, as well as

less measurable factors, such as labor input per production, suitability for the village context etc. need to be considered to assess how attractive any of these crop options are. Mechanization of debarking for example could boost mulberry paper bark production without any other in-country processing and directly benefit farmers and the entire supply chain.

Table 1: Examples for price developments for a variety of commodities.

Commodity bought	Commodity sold	Farm gate price [LAK]	Export price [LAK]	Farm gate price %
Bamboo poles, fresh	Bamboo poles, dry	300	4800	6%
Bamboo shoots, fresh	Bamboo shoots, dry[1]	3,000	9,000 [2]	33%
Benzoin gum	Cleaned graded gum	120,000	155,000	77%
Paper mulberry Gr A	Paper mulberry Gr A	6,000	10,000	60%
Paper mulberry Gr B	Paper mulberry Gr B	5,000	7,500	67%
Rattan shoots	Dried shoots	200,000-400,000	350,000-525,000	57-76%
Sacha inchi nuts	Sacha inchi seeds	12,500	23,000	54%
Sacha inchi nuts	Sacha inchi oil	12,500	55,000 [3]	23%
Sesame seed Gr A	Sesame seed Gr A	9,000	11,000	82%
Sesame seed Gr B	Sesame seed Gr B	7,000	8,500	82%
Sichuan pepper, fresh	Sichuan pepper, dry	12,000	15,000 [4]	80%
Tung seed, dry	Tung seed, dry	7,000	8,500	82%

[1] - Mai Hok shoots; [2]- in-country sales price; [3] - equivalent of 1kg seeds, assuming an extraction rate of 83%; [4] - equivalent to 1kg fresh fruits

2. Introduction

The German Development Agency GIZ (Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH) has been tasked with implementing one of the main contributions to the Lao PDR Emission Reductions Programme through improved governance and sustainable forest landscape management (Project 1) together with other co-funding partners. This Project is referred to as CliPAD/I-GFLL. It is funded by the Green Climate Fund (GCF) with a contribution by the German Ministry of Economic Cooperation and Development (BMZ).

Project 1 started in June 2020 and will be concluded in June 2024. It is embedded in a broader programme and implemented in three provinces of Northern Lao PDR, namely Houaphan, Luang Prabang and Xayaburi, where it is active in 170 villages across 13 districts.

The project aims at reducing emissions from land use, deforestation and forest degradation through sustainable management of forests as well as conservation and enhancement of forest carbon stocks through the effective implementation of Provincial REDD+ Action Plans (PRAPs). It represents the first project of a programme that will ultimately mitigate 144.7 million tCO2eq over its 20-year lifetime (influence period, 2020-2039), at a cost to the GCF of Euro 0.4/tCO2eq.

The project takes a holistic approach to addressing key drivers of deforestation and forest degradation and has been developed to correspond to each of the four main drivers (agricultural expansion, expansion of shifting cultivation, infrastructure and other developments, unsustainable and illegal wood harvesting).

To achieve such a paradigm shift, the programme in which Project 1 is embedded:

- Strengthens the enabling environment for REDD+ through 3 principal means: enhancing the availability of financing for a deep transformation in the way Laos manages its forest landscapes – including through supporting a REDD+ Funding Window; revising and strengthening the legal and regulatory framework for forestry; and improving the enforcement of the new regulatory framework.
- Supports deforestation-free agriculture and agroforestry by enhancing productivity, increasing farmers' integration into agricultural value chains, and improving access to finance and private sector participation in economic activities that reduce pressure on forests.
- Supports the implementation of sustainable forest landscape management (SFM) and forest landscape restoration (FLR) on over 1.5 million ha of degraded lands.

Output 2 of this project ("Market solutions for agricultural drivers of deforestation") targets the agricultural sector as a key driver of deforestation and will lower targeted barriers, enhance productivity and post-harvest processing, increase farmers' integration into agricultural value chains (including agroforestry), and improve access to finance and private sector participation in deforestation-free agriculture. Deforestation-free value chains are those that can demonstrate that deforestation has not occurred throughout the value chain – from primary production through to sale to the consumer.

2.1 Objective of this study

The objective of this assignment is to establish quantitative and qualitative assessments of current and future markets for nine key agricultural commodities to be supported by project interventions. The market studies will provide essential information to selected agribusinesses cooperating with the project for future business plan development.

This assignment forms part of Output 2 “Market solutions for agricultural drivers of deforestation” and will help to foster private sector participation.

2.2 Summary of the Expected Outputs of the Assignment and Milestones

The main outputs of the assignment are:

9 market studies for agricultural commodities (Bong Bark, Tung Oil, Mulberry paper, Sichuan pepper, Rattan, Siam Benzoin (Styrax tonkinensis), Bamboo products, Sacha Inchi and Sesame) until 09/2022

2.3 Tasks

For each of the nine commodities, the consultants were asked to assess the following elements:

a existing literature on each of the products in terms of value chain and market information
b farm gate sales or sales at collection points
c any value-adding activities, such as drying, grading by quality standards (if grading standards exist), sorting, milling, processing etc. with price development for processed products
d transportation routes to local, national or foreign markets
e demand from downstream processors or markets, in-country and regional
f past fluctuations of commodity prices
g export procedures (shipping practices) e.g., in AFTA (Asean Free Trade Area) and current quota system
h existing storage facilities
i packaging of processed products

Overall, the market studies should assess the size of each market both in volume and in value, the various customer segments and buying patterns, the competition, and the economic environment in terms of barriers to entry and regulation. They should contain information on current marketing chains in terms of prices, volumes, values, weather impacts, supply and demand.

Furthermore, for each commodity, the studies should identify potential new customers and future markets and develop possible business ideas. This includes market opportunities within Lao PDR and for export to neighbouring countries.

The nine commodities comprise:

1 Bong bark – “Yang Bong” for the production of incense sticks, mosquito coils, glue and particleboard production.

2 Tung oil – Tung oil tree seeds for oil extraction; oil use for manufacture of lacquers, varnishes, paints, linoleum, oilcloth, resins, artificial leather, and in greases and cleaning and polishing compounds.
3 Mulberry paper – “Por Saa” dried bark for the production of artisanal paper e.g., used in boxes, envelopes, picture frames, paper strings, lamps, and umbrellas.
4 Sichuan pepper - Mak Khaen (Zanthoxylum Rhetsa), Dried pepper seeds and husks
5 Rattan products – fresh edible rattan shoots, preserved and dried shoots, rattan canes for furniture and handicraft production
6 Siam or Laos Benzoin (Styrax tonkinensis) – dried resin used in fragrances for perfumes and other such products
7 Bamboo products – fresh bamboo shoots, preserved and dried shoots for consumption, bamboo culms for building materials and handicraft, chopsticks or toothpicks and as wood substitutes such as flooring, panels and for non-traditional furniture
8 Sacha Inchi – dried seeds to produce roasted nuts, oil, butter, creams and beauty products for international markets, dry leaves and dried pods used as herbal teas as a secondary market
9 Sesame – cream-colored and black sesame seeds for oil and as a food in bakery products and other food preparations

3. Methodology and limitations

In a first step, the team leader with a small core team compiled and summarized all available information from published and gray literature, as well as information received from specialists in the respective commodities who were accessible through the immediate team network. The resulting skeletal documents served as basis for the development of a more targeted information gathering approach, in which specific missing information was collected, and interviews with key actors were pursued.

For an updated value chain mapping, it was attempted to get information about the value chains of all nine commodities from producers up to the last in-country stakeholders. However, due to budget and time constraints, a systematic and comprehensive approach was not feasible, especially because the value chains in this sector are not strictly organized, linear and well-defined, but rather dynamically adaptive to changing circumstances, with a large number of small and medium sized stakeholders occupying very short links of the chain. This makes mapping difficult and leads to the fast out-dating of specific information. However, the information provided here should be seen as snapshots of the current value chain organization, indicative of the general functioning of the sectors.

It was planned to map current production areas through provincial workshops, inviting representatives of DAFO and other institutions (e.g., DICO, customs, chamber of commerce etc.). However, after the first such workshop in Luang Prabang, this approach turned out to be too costly and similar workshops in Sayabouri and Houaphan had to be canceled. As a result, production maps are only complete for Luang Prabang.

It needs to be mentioned that this study did not aim at getting a complete picture of the market situation of each commodity. The chosen approach was aimed at covering as much ground as possible within the limited time and budget available. Going exclusively through government entities, all informal (unregistered) activities and trade were not assessed, which for some commodities may be substantial.

Key experts and other stakeholders interviewed in the process are listed in Annex 8.

4. Quotas, traders and permits

4.1 Quotas

In Lao PDR, commodities are allocated to traders in terms of “quotas” and three separate lists are maintained for all commodities submitted to the quota system, with species in the third list being quota free (see Annex 2). For List 1 commodities the quota is set by the central government directly for each province. The process does not allow for any intervention by the provincial administration. List 2 commodities are managed by the provinces, requiring companies to submit their quota requests for the coming year to the districts. Each district then proposes their requirements to the province who then assembles a provincial proposal to the central government (Dep. of Forestry (DoF) under MAF) for approval. Availability of NTFPs is determined based on a survey DAFO conducts in collaboration with PAFO to identify the available quantities in each district. The estimate is submitted by PAFO to DoF as basis for approval. Once the actually approved quotas are returned, the provincial administration allocates quotas to the requesting companies. If a product is on the CITES list, it will need to be approved by the CITES department at DoF. The export of medicinal plants has to be approved by the Ministry of Health (Interview with DoF, MAF). However, the quota system lacks transparency and consistency and even to leading PAFO officials it is sometimes not clear what the final decisions are ultimately based on.

There is also a second pathway after this main process: If the centrally approved quota is lower than the volume available in the provinces, PAFO can approve additional export of products. For this, market demand needs to be proven, it only applies to annual crops, and DAFO needs to certify the production volume. Thus, export of excess volume in one district beyond the approved quota, can be approved by PAFO. (PAFO interviews in Luang Prabang and Sayabouri, 2022)

It is essential to understand that harvesting and trade quotas are generally based on market demand and not on sustainable management practices. Quotas get approved based on what the market requests. They are not defined as a fixed value after the DAFO field survey.

The Ministry of Industry and Commerce (MoIC) and customs use international Harmonized System (HS) codes for their trade statistics. This system allocates codes to products or, more often, product categories. In some cases, quotas seem to also be based on these categories, namely with bamboo. This may add an additional layer of complexity.

In Table 2, the approved quotas for different commodities in the target provinces are listed. Quota approval and actual harvest/export data may vary considerably. Many traders have expressed their frustration with the quota system, as it is seen as cumbersome, expensive, and for some commodities a serious stumbling block. Quotas are provided once a year with delays not being uncommon, which may prevent the legal trade of commodities that have to be harvested during the approval process period. It was also reported that especially for truly high value commodities such as slipper orchids (*Paphiodelium callosum*, Lao: Bai Lai), which are a List 1 commodity, hundreds of kilos are moved over the green border into China by Lao farmers, as prices spur the trade, with or without quota. At the same time the experiences from bamboo and rattan projects indicate that the quota system does not support sustainable forest management, but prevents competitive trade and thus rather hampers efficient NTFP management.

The revised Forestry Law (2019) states that NTFP growers who have their plantation outside a forest area, can get a certificate of plantation (CP) if they register their operation (species, area size, business plan) with DAFO or PAFO, CP holders are exempted from the quota system and can sell their commodity like any other agricultural product. However, in reality traders don't worry about such details due to lack of law enforcement (NAFRI, 2022).

Table 2: NTFP quota approval in three provinces (by PAFOs)

	NTFP Quota Approval (2016 - 2020)				
NTFPs/provinces	**2016**	**2017**	**2018**	**2019**	**2020**
Bamboo poles (poles)	***0***	***1,450,000***	***2,210,000***	***3,500,000***	***3,700,000***
Sayabouri		500,000	700,000	500,000	700,000
Luang Prabang		0	0	0	0
Houaphan		950,000	1,510,000	3,000,000	3,000,000
Bamboo shoots (tons)	***900***	***1,100***	***500***	***500***	***350***
Sayabouri		200	200		
Luang Prabang	500	500	300	300	150
Houaphan	400	400		200	200
Bamboo worms (tons)	***100***	***120***	***18***	***75***	***79***
Sayabouri					
Luang Prabang		20	18	5	9
Houaphan	100	100		70	70
Benzoin resin (tons)	***25***	***21***	***57***	***60***	***60***
Sayabouri					
Luang Prabang	15	11	12	10	10
Houaphan	10	10	45	50	50
Paper mulberry (tons)	***300***	***250***	***270***	***400***	***469***
Sayabouri			40	100	100
Luang Prabang	300	250	230	300	369
Houaphan					
Bong bark (tons)	***0***	***0***	***0***	***0***	***0***
Sayabouri					
Luang Prabang					
Houaphan					
Rattan (canes)	***0***	***0***	***502,400***	***500,000***	***500,050***
Sayabouri			500,000	500,000	500,000
Luang Prabang					50
Houaphan			2,400		
Rattan fruit (tons)	***50***	***120***	***50***	***70***	***120***
Sayabouri		20			

Luang Prabang	50	50	50		50
Houaphan		50		70	70

4.2 Business registration

Whilst we have not looked specifically into this topic in this study, it may be necessary to provide a brief overview here to make the following sections better understandable. The information provided here is as it was conveyed by interviewed supply chain stakeholders and may not accurately reflect the legal framework.

A trader can register as a proper company at national/provincial level or as a district collector at district level. District collectors are registered with DAFO and are allowed to collect approved commodities within the district in which they are registered. They have to sell their products either locally at markets or to companies located within the province. The process is relatively simple and cheap, and constitutes what most small traders choose as the most suitable option for them. However, district traders have no export license and cannot legally act beyond district borders.

Companies can act within and across provinces as they are eligible to the respective licenses. They can also request an export license and so engage in international trade. However, getting an export license entails a lot of paperwork and expenses which is why many traders choose not to get one. Instead, they export through companies who have an export license and charge them a fixed price either per load (truck, container) or weight. Alternatively, traders without export license may also just sell their goods to exporting traders, which may reduce their potential profits but also makes business significantly easier for them. Companies registered as exporting companies related to agricultural products and NTFPs, need to request a quota from PAFO not the districts.

The information provided under Company Summaries (Annex 7) lists companies which are registered as such. Where individual names are listed the company name was either not obtained or the business is registered at district level.

4.3 Taxes

All registered traders are liable to pay tax, and district collectors are paying tax for collecting NTFPs and agricultural products in their home district. Taxes and their collection seem to be an ongoing issue in the country. While little has been written about the inefficiencies of the Lao tax system, careful recommendations to improve tax collection approaches have been spelled out (Suvannaphakdy and Toyoda, 2019). Nevertheless, complaints from business owners indicate unpredictability of taxes from year to year, non-uniform taxes throughout the country and high levels of corruption. Whilst the verification of these perceptions is beyond this study, the government is still in the process of reforming its tax system. How this will affect taxation of the commodities under scrutiny here is not foreseeable.

In the recent Act of the President of Laos No. 002 on 17 June 2021 on fees and charges (amended version is not completed yet), tax calculations for NTFPs have been clarified (see Annex 3). The tax fees will now additionally be based on CITES status of the species.

The rates of tax, customs, and other fees for some NTFPs coming from plantations, regeneration and conservation outside the three forest categories have been changed to be the same as those from within the three forest categories. The natural resource fee for all is 10%. However, it is not clear if this is already uniformly applied as traders report an apparently inconsistent range of taxes.

4.4 Export to China

Exports of agricultural commodities to China are based on the bilateral agreement between the two countries listing 13 agricultural commodities: rice, maize, cassava, banana, watermelon, passion fruit, sweet potato, soybean, green bean, long bean, pomelo, orange, and lemon. Each of these commodities has its specific MoU between the Department of Agriculture of MAF and the General Department of Taxation of China, agreements which do not exist for other commodities. Therefore, exporting items to China not included in the list above is difficult.

For NTFPs, DoF allocates quotas for provinces, solely based on a proposal from each province (see above). After provinces receive their quotas, PAFO can allow traders to export the NTFP products on their own, following the rules and regulations for exporting their products.

5. Specific information on Target provinces

5.1 Luang Prabang

The largest volume of NTFPs and similar commodities is collected in Nambak district because a Chinese investor operates a processing plant there. The investor does not provide much information to anyone though and no further information is available. (PAFO interview 2022)

Of the commodities relevant to this study, seven are commercialized in Luang Prabang province.

Bamboo: Bamboo shoots are being exported mainly to China. Other bamboo products are used only within the province. PAFO does not have valid requests for export quotas for bamboo in 2022.

Benzoin: is found in Nambak, Ngoi and Viengkham districts and exported by two companies called S.DFORES and AgroForex, sometimes leading to conflict (see in the respective chapter).

Paper mulberry: is found in all districts, and many traders collect it from villagers. However, it is not of primary interest to villagers because the price is low and the harvesting is difficult. The main markets are Thailand, China and Vietnam. Some companies operate processing factories for export to South Korea and China.

Rattan: is only used within the province.

Sacha Inchi: A big company (Mr. Oun Manolack's) was promoting sacha inchi in the province together with PAFO and DAFO. The company and farmers agreed on a selling price of 8000 LAK/kg for dried nuts to the company and signed contracts. Later, the company stopped collecting sacha inchi suddenly. Most farmers cut all their sacha inchi and planted other crops. Since 2018 a revival of the crop has started but it is slow going.

Sesame: Most producers are located along the Eu River and production is declining. Only white sesame is currently produced. A company tried to promote black sesame in the past, but the seed did not turn out black but red.

Tung oil: A factory used to produce biofuel but closed down. Most of tung plantations are in Xiengngeun district. There are around 7000 ha of tung trees, but it is decreasing since farmers are planting other crops. However, the PAFO has not finalized their survey on this crop.

5.2 Houaphan

In this province five of the commodities are marketed:

Sichuan pepper (Mak Kaen) has production areas in Xam Neua and Viengxay districts. They have two types, one with thorny stems and one with smooth stems, of which the thorny stem variety is more popular due to its aroma. Local farmers commonly let the trees grow naturally but at least three villages planted them in the form of orchards. Farmers harvest for home consumption and as cash crops from their home gardens and fallow areas. Helvetas has recently promoted the growing of Mak Kaen in Xam Neua and Viengxay districts, with France as export market.

Sesame (Mak Nga) is grown in all districts, but especially in Xam Tai, Sopbao, Viengsay, and Houameuang. However, it is normally grown on a very small scale.

Bamboo is the green gold for Houaphan, since natural bamboo forests cover large parts of the province; there are a number of bamboo species that play a crucial role for rural economic development for both food security and income generation. The bamboo species used for bamboo shoots are: bitter bamboo (Indosasa sinica), Hok bamboo (Dendrocalamus hamiltonii), Waan bamboo (Phyllostachys sp.), Dja bamboo (Sinrundinaria sp.) and others. The shoots are commonly sold to domestic urban markets. Bamboo poles, especially from Mai Kouane are mainly exported to Vietnam.

Tung (Mak Kao, *Vernicia montana*) has been planted in Houaphan province for several decades, and the current area is about 3042 ha in total. Xam Neua and Viengxay combined contribute the largest part of this area. The seeds are exported to Vietnam and China.

Benzoin (*Styrax tonkinensis*) is an integral part of the shifting cultivation systems. The production area of Styrax fallow areas is about 2450 ha, found in seven districts, Xam Neua, Houameuang, Viengxay, Xam Tai, Kouane, Sopbao, and Xieng kor. Agroforex company is the major trader for this commodity with export markets in the EU, while small traders export to neighboring countries.

5.3 Sayabouri

A number of companies actively collect NTFPs and agricultural products in the districts. In Sayabouri town the four major companies are: Somephet company, Nonsavanh village, Sayaphathana company, Natak village, Electsan company, Simueng village, and Houmphathana company.

Of the commodities relevant to this study, eight are cultivated in Sayabouri province.

Bong bank: used to be traded. There are still a lot of trees but no market.

Sichuan pepper: is harvested in Khorp and Xienghone districts and only one Vietnamese trader has been collecting it in Xienghone district.

Rattan: is found in Hongsa, Xienghone, and Khop districts and a rattan furniture manufacturer is based in Hongsa district. Some Hmong villages process and sell dried rattan to Thailand.

Bamboo: is found in Xienghone, Phiang and Kenethao districts. Dried bamboo shoots are made in Kenethao district (one larger producer from Oudomxay comes to Kenethao only for the bamboo season) and Xienghone districts, and then exports to China. Villagers In Phiang district make handicrafts from bamboo to sell along the way to Paklai district.

Sacha Inchi: was promoted by a company in the province in 2016/2017. They built a processing plant for sacha inchi but in the end did not come back to collect the produce from farmers. In another case in Xienghone district, the farmers paid for sacha inchi seedlings from a company and then the company never came back, making it look like a scam.

Sesame: is produced in almost all districts but planted areas are small, only around 20 ha in the entire province. In Hongsa, it is produced along the Mekong close to Pakou district, where traders from Luang Prabang are collecting it. While the market offers good opportunities, the harvesting season in September during the rainy season makes quality production difficult. Very little black sesame is being grown, mostly in Thana and Natak villages of Sayabouri district.

Paper Mulberry: almost no information is available at PAFO.

Tung: is grown in Saysathan district. It used to be promoted by the former district governor but once trees became productive, no markets existed to absorb the produce. As a result, villagers haven't been taking care of Tung trees since then.

Broom Grass is also found in this province, especially in Khop district. A lot is available, and many traders buy for a good and stable price.

In general companies export via four main border checkpoints to Thailand: Pangmone in Khorp district, Namhueng in Kenethao district, Phoudou in Paklai district, and Houytong in Xienghone district.

The agricultural section of PAFO is responsible for managing the import and export of all plant and animal products at the border. Before the COVID-19 pandemic, most traders were from Sayabouri town, Luang Prabang, Xiengkhuang and Vientiane provinces. Some shipping companies like Konmani and Onchanh operate directly at the border. Companies need to request phytosanitary certificates from the Namngeun border but can then export their products at any other border crossing in the province. It is thus not always clear where exactly goods cross.

Table 3 provides an indicative listing of a selection of commodities with their main destination countries, exported from Sayabouri in 2021.

Table 3: Export data for selected agricultural commodities from Sayabouri in 2021.

Product	Quantity (tons)	Border crossing	Main destination
Sugar palm	1,000	Namngeun	Thailand
Broom grass	1,510	Namngeun	Thailand
Paper mulberry	367	Namngeun	Thailand
Sesame	38	Namngeun	Thailand
Job's tear (with shell)	1,085	unclear	China, Thailand
Job's tear (without shell)	6,388	unclear	Mostly to China, Thailand
Maize	800	unclear	Thailand
Peanut	115	Pangmone	Thailand
Cassava (dried)	30	Pangmone	Thailand
Sacha Inchi	38	Pangmone	Thailand
Ginger	20	unclear	China

6. District specific information

6.1 Luang Prabang

Province	District	Bamboo	Benzoin	Paper Mulberry	Rattan	Sesame	Sichuan pepper	Tung
Luang Prabang	Nambak			Only wild re-growth in fallows. The annual production is only about 15 tons, all of which is normally exported to China.	Only shoots are traded and those mainly within Luang Prabang, small amounts are sold to Vientiane	Is not planted much but if, then mostly on rice fields	Is not traded outside the district and only sold locally	
Luang Prabang	Viengkham	Bamboo occupies almost 70% of the total area of the district. People use is as food and sell bamboo products all year round.	Is not commonly harvested, only some farmers close to Phonthong district do it	Common fallow trees, along roadsides, and riverbanks, but not much used.	Is common in all villages, and before COVID selling rattan fruits for 500,000 LAK/kg was common, but now there are no buyers anymore.	Is only planted for household consumption	Is rather uncommon.	There is a Tung plantation area of about 30 ha, established in 2018-2017.
Luang Prabang	Phonthong	Bamboo shoots (nor hok) are processed into nor hiaw (dried, deep fried bamboo flakes with an intense aroma) for export to China. In 2020, 25 tons of nor hiaw was sold, and in 2021, 50 t. Fingan company in Oudomxai province (Mr. Aling, 5628 8669) buys fresh bamboo shoots from farmers in the district for 1000 LAK/kg.				The sesame growing area is about 97 ha, of which currently 63 ha are cropped, yielding about 1 ton/ha		There used to be 322 ha of tung trees in Don, Poumbor, Longyarng, Vongxieng, Parn, Karng, Thasy, and Poumhone villages. Now there are only 25 ha left, from which 20 tons were harvested in 2021. A representative of Vongpheth company, Mr. Jieng Vongsonthai (Tel: 020 22742228), is the main buyer.

6.2 Sayabouri

Province	District	Bamboo	Bong bark	Paper Mulberry	Rattan	Sesame	Sichuan pepper
Sayabouri	Hongsa			Common fallow trees, along roadsides, and riverbanks.	Two main rattan planting areas: Pak Huay Yang village (>600 ha), and Nam Dok Mai village. They protect trees in village area and sell rattan for 1,000-1,500 LAK per meter. One rattan furniture company (Somvang) sells domestically.	The sesame is grown along the banks of the Mekong in Phou Dok Mai, Khok Aek, Huay Lai, Tha Non, and Nam Tok villages. It is mostly bought by traders from Luang Prabang.	
Sayabouri	Phiang	Bamboo is common and diverse. Many farmers produce handicrafts, including groups in Natan and Na Buam villages, and many shops in Viengkham village. No specific data.		The area is decreasing in favor of cassava cultivation.		In 2021, 920 ha of white sesame were planted, yielding about 821 tons, mainly in Nam Pui, Phoufar, Misay, Navaen, and Pak Song villages. Most is sold to Pa Boualei company in Nam Pui village. The buying price is 6,500 LAK/kg and most is exported to Thailand.	
Sayabouri	Khorp		Very little bong bark exists in the district, no traders to collect it. It can be found at Keung Lakkham village.		Rattan is grown in a few villages (e.g. Ban Nampao), mostly for shoots		Sichuan pepper is especially grown in Houamueang village, on the way to Pangmone. Once the border reopens, traders from Thailand will come to buy and/or villagers take Sichuan paper to sell in Thailand. Year to year, prices don't change much: ca.10,000 LAK/kg for raw and 35,000 LAK/kg for dried product. But no traders in the district collect it.

6.3 Houaphan

Province	District	Bamboo	Benzoin	Rattan	Sacha Inchi	Sesame	Sichuan pepper	Tung
Houaphan	Hiem	Bamboo shoots: Nor Here, Nor Xode, and Nor Hok, which are processed to dried shoots. The mature Mai Hok also produces bamboo worms.		Some cane productions for handicrafts and some rattan shoot collection for sale in local markets.		Two village zones, Phanthor and Daoheuang have grown it but do not have buyers. The district supports the idea of planting sesame and is looking for private sector support.	Little, mostly brought in from Xam Neua district.	Currently 61 ha produced about 490 tons. Lao Vernicia Montana Company was the first provider of seeds to farmers but now, almost all villages have Tung trees. The price is currently quite good.
Houaphan	Houa-meuang	There is a Bamboo Association.	Agroforex is the main buyer but there is not enough. In 2014, JICA supported farmers in 3 villages: Nalair, Nageng, Nasa	Just for handicraft production.		Some traders buy the commodity	A Vietnamese trader buys for 5000 LAK/kg but production is too low to cover demand.	Lao Vernicia Montana company has provided seeds to farmers. 23 businesses have invested in the district. About 100 tons/year are being exported. Buying prices are between 4000-6000 LAK/kg. Taxes: only profit tax 2%.
Houaphan	Xam Tai	There is a large growing area and four main buyers: Angzarng, Xabthavixai, Daothong, and Xaisounanh.	Agroforex comes frequently during the harvesting season.			Little	Little, just for household consumption	There are a few agents but not much is happening.
Houaphan	Viengxay					15 ha of growing area	22 ha of growing area	560 ha of growing area

For additional district data see Annex 4

7.Bamboo (ໝະວິດຕະພັນໄມ້ປ່ອງ)

7.1 Overview

The main difficulty in providing information on bamboo lies in “bamboo” being an umbrella term for a large number of species (see Annex 5) with similar properties and uses but different ecological adaptations. This creates difficulties and confusion when assessing the “bamboo value chain”, which in fact are many different chains.

The 13.7 million ha of natural forest in Lao PDR harbor 6.3 million ha of bamboo and regenerating vegetation (World Bank and International Finance Corporation, 2019). The richest areas for bamboos are the northern mountains in which at least 50 species were identified. In Xiengkuang and Houaphan provinces 30 of the species found differ from those in central and southern Laos. Dendrocalamus, Cephalostachyum and Oxytenanthera are the dominant bamboo genera (Khamhoung and Gansberghe, 2016). In Houaphan about 500,000 ha of mixed and 18,000 ha of pure bamboo forests were documented in 2006 (Boupha and Phimmavong, 2006; Melki and Kibler, 2018), a comprehensive and more recent survey is not available. Many bamboo species flower every 15 or 30 years, others, such as Dendrocalamus, bloom after 70 years, leading entire bamboo stands to die-off, before regenerating from seeds.

The global bamboo market size was valued at USD 53.28 billion in 2020 and is projected to increase to USD 82.90 billion by 2028 (GVR, 2021) compared to an estimated USD 7 billion in 2006 (Greijmans and Hitzges, 2012). The Asia Pacific region is the largest producer of bamboo with a share of over 77%, dominated by China, India, Vietnam and Indonesia. Globally, the market is expected to expand at a compound annual growth rate (CAGR) of 5.7% from 2021 to 2028 (GVR, 2021).

While in 2006 traditional markets such as handicrafts, traditional furniture and bamboo shoots accounted for almost 95% of the world market by value (Greijmans and Hitzges, 2012), by 2020, growing investments focus on infrastructure development, increasing use of sustainable building and construction resources, and rising consumer awareness regarding the uses and benefits of bamboo (GVR, 2021).

7.2 Uses and properties

Bamboos are fast growing species exploited through two production types: (1) natural forests and (2) cultivated bamboos (plantations and bamboo gardens). There are two categories of bamboo products: (1) bamboo canes and (2) bamboo shoots. Bamboo canes are processed for making a wide range of products: construction materials, household items, handicrafts, paper production, incense sticks, toothpicks etc. Bamboo shoots are processed for food (Khamhoung and Gansberghe, 2016), either fresh, fermented, dried or fried.

In Luang Prabang, shoots of the following bamboo species were at sale at markets: *Bambusa blumeana, Bambusa longispiculata, Bambusa tulda, Cephalostachyum virgatum, Gigantochloa albociliata, Indocalamus petelotii, Indosasa sinica, Dendrocalamus sinicus* (Łuczaj et al., 2021). These seem to match with the list of shoots in Nambak district, Luang Prabang, provided by DAFO, which distinguishes the following types of bamboo shoot: Nor khom, nor kood, nor whan, nor lan, nor hok, nor here, nor xarng, and nor jar, all of which are sold at local markets or at

roadside booths. However, it is possible that more species are being consumed throughout the northern provinces.

Additionally, bamboo worms, the larvae of the moth *Omphisa fuscidentalis* are harvested from one Bamboo species for sale. They are consumed deep fried as a snack.

7.3 Production types

Bamboo is generally harvested from the wild rather than planted as a crop. Unchecked this leaves the resource at risk of over-exploitation, especially where high volumes can be absorbed, as is, for example, the case for species used in paper production. Sustainable production systems need to be managed locally, which has in Laos been achieved through village committees. This management of village commons empowers villagers, encourages sustainable production practices and is based on a system of group control, as everyone in the village stands to lose from members who disregard the rules (Desbleds, 2021). Previous to the introduction of this approach, a quota was given to each village, with a first come first served approach, leading to destructive resource extraction (Boupha and Phimmavong, 2006).

Whilst canes can be harvested throughout the year for local use, commercial use normally requires more specific harvesting times. The harvest of shoots is limited to species specific periods, such as: Nor Kood from March-October; Nor Jar from February- May, Nor Whan from March-May, Nor Here/Nor Lan from April-June, and Nor Hok from June-August.

Bamboo worms live in the hollow spaces inside the canes and are harvested by splitting the canes. They seem to be harvested exclusively from wild populations and no managed production of the worms was found.

7.4 Production locations

Bamboo grows throughout the country with its highest diversity in the north. Each species grows in specific areas and has different sprouting times.

Figure 1 shows production locations in Luang Prabang province as identified by DAFO representatives. According to this information, the commodity is not evenly distributed over the province but has certain hotspot in which it is more common and traded in larger volumes.

7.5 Production volumes

On household level, the average production volume per hectare reported by TABI for 2013 was 5.3 tons of canes. The average income generated per household from bamboo was tagged at 1.4-2.1 million LAK, equivalent to about 430 kg of canes.

For shoots, a volume of 625 kg of fresh shoots per household was reported for Houaphan, generating 1.7 million LAK per household (calculation based on Khamhoung and van Gansberghe, 2016). The data are summarized in Table 4.

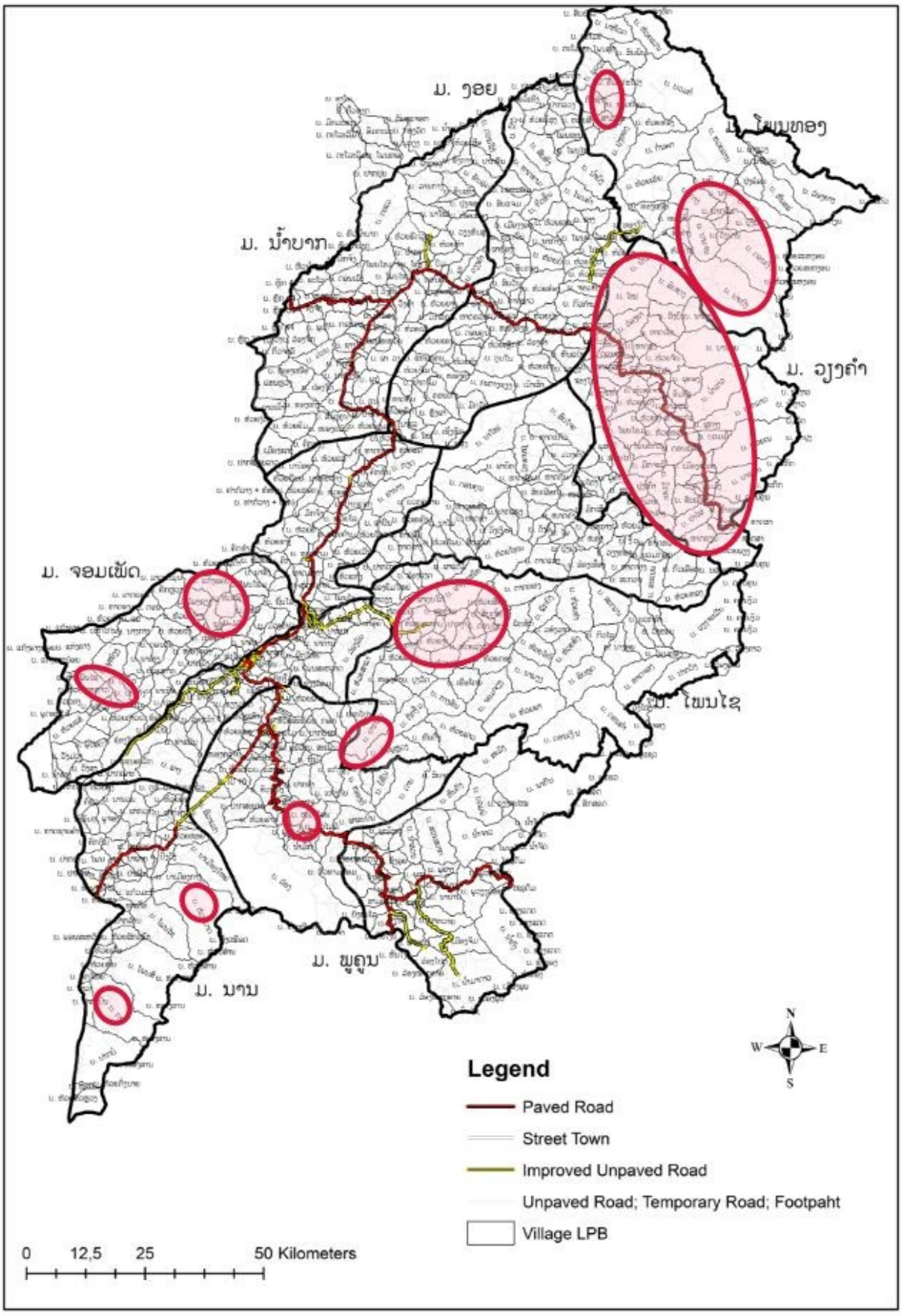


Figure 1: Bamboo production locations in Luang Prabang province. (Source: DAFO interviews)

Table 4: Bamboo production data for Luang Prabang and Houaphan (income in million LAK)

		HH	ha	Prod. (tons)	Income (in mil LAK)	Yield/ ha (t)	Prod./ HH (t)	Income/ ha	Income/ HH	LAK/kg
Luang Prabang	canes	397	32	170.8	559	5.3	0.43	17.5	1.4	3,300
Houaphan	canes	458			950				2.1	
Houaphan	shoots	336		210	587		625		1.7	2,800

Based on Khamhoung and van Gansberghe, 2016.

On larger scales, disaggregated production volumes for bamboo are hard to come by. Especially for canes, data seem much more limited than for shoots.

The registered production of bamboo shoots throughout Laos as recorded by MAF is given in Table 5. This data is likely to underestimate the true production though, as production for home consumption as well as informal trade would not be included. However, DAFO estimates that in Nambak district (Luang Prabang) alone, around 200 tons of Nor khom (bitter bamboo shoots), harvested in 16 villages, is sold per year.

Table 5: Bamboo shoot production in Laos by year.

Product	Production in tons (2016 - 2020)				
	2016	2017	2018	2019	2020
Bamboo shoots	982.8	583	940.4	1125.1	1004
Bamboo shoots (dry)	64	468	0	152	66

7.6 Production quotas

In addition to the inherent complications of the quota system, quotas for bamboo present the difficulty that bamboo species are treated individually. *Bambusa polymorpha, Dendrocalamus latifolius, Dendrocalamus longifimbriatus, Dendrocalamus sinicus, Gigantochloa haskarliane, and Schizostachyum branchycladum* are all List I items. *Dendrocalamus hamiltonii, Dendrocalamus pendulus, Bambusa tuldoides, Dinochloa scandense, Dendrocalamus giganteus, and Dendrocalamus asper* are List II items. All other species should be quota free (List III). *Dendrocalamus membranaceus* is found in both List II and List III. (For the complete list see Annex 2).

We were also told that the quota for bamboo canes given to an interviewed company was specific to canes 60 cm-180 cm in length. This might be related to their ultimate use and respective HS code.

In MAF statistics, bamboo shoots are presented aggregated as one commodity, and the approved production quotas at national level for different years are provided in Table 6.

Table 6: Production quotas for bamboo shoots

Product	NTFPs Quota in tons (2016 - 2020)				
	2016	2017	2018	2019	2020
Bamboo shoot requested	1,075	1,165	1,680	735	625

Bamboo shoot approved	-	7,085	1,650	-	-

7.7 Processing, Packaging, and Storage

Processing options at village level are generally quite limited for both shoots and canes. The drying of shoots (in Lao “Nor”) it the most common processing activity, in which 10 kg of fresh shoots are reduced to 1.1-0.4 kg of dried shoots. Canned shoots are occasionally produced and sold on village level in Xiengkhuang (an average of 5.6 cans per household in producing villages) (Khamhoung and van Gansberghe, 2016).

Chinese commercial processing units produce log fire dried, low quality shoots using sulfur as a preservative. GRET (“Professionals for Fair Development”, a French NGO) project villages produced dry shoots to meet the following standards:

- Grade B: sun dried regular quality thin slices of hok shoots (Nor Hok) produced by villagers at household level;
- Grade A1: sun dried good quality thin slices of hok shoots also produced at the household level (organic certification); or
- Grade A2: oven dried top-quality half hok shoots produced in processing units. Villagers harvest fresh shoots and sell them to the (village) processing unit, where they will be cut, washed, sliced and boiled. After boiling, the shoots are squeezed to remove excess water, then oven dried and finally packaged, sealed and labeled to be sold as a quality product (Participatory Guarantee System certification through Lao Organic (MAF/ DoA) (Melki, 2016).

However, there are no commonly used grading systems, and the quality of dried shoots is basically determined by the producer.

For canes, insects and fungi are a major concern to producers, especially the “powderpost beetle”, which bores into the canes and leaves a talcum like dust, reducing the appeal and thus price of the cane. Bamboo producers are using various methods to try to prevent insect attacks, ranging from soaking in water, smoking and lime washing to chemical treatments using petrol or other harmful substances. Despite that, beetle attacks are common after a few months. The use of Timbor (a commercial wood preservative that works as an insecticide and fungicide derived from borates), and/or a mix of borax and boric acid imported from Thailand, has been promoted as a non-toxic alternative. A Lao manual exists (Greijmans and Hitzges, 2012).

7.8 Value chain, prices, and income

A large number of bamboo value chains could be defined given the number of species and their different uses. GRET selected in their Bamboo and Rattan Project five particularly promising value chains (Porbounmixaithor, et al., 2016), for which the most detailed information is available. These are built around five species and one product line.

7.8.1 Mai Khouane (Dendrocalamus longifimbriatus) and Mai Hia (Shizostachyum virgatum)

Dried bamboo shoots for human consumption are mainly exported to Vietnam. The bamboo canes are used to make chop sticks and handicraft products. Harvesting period is from October to July.

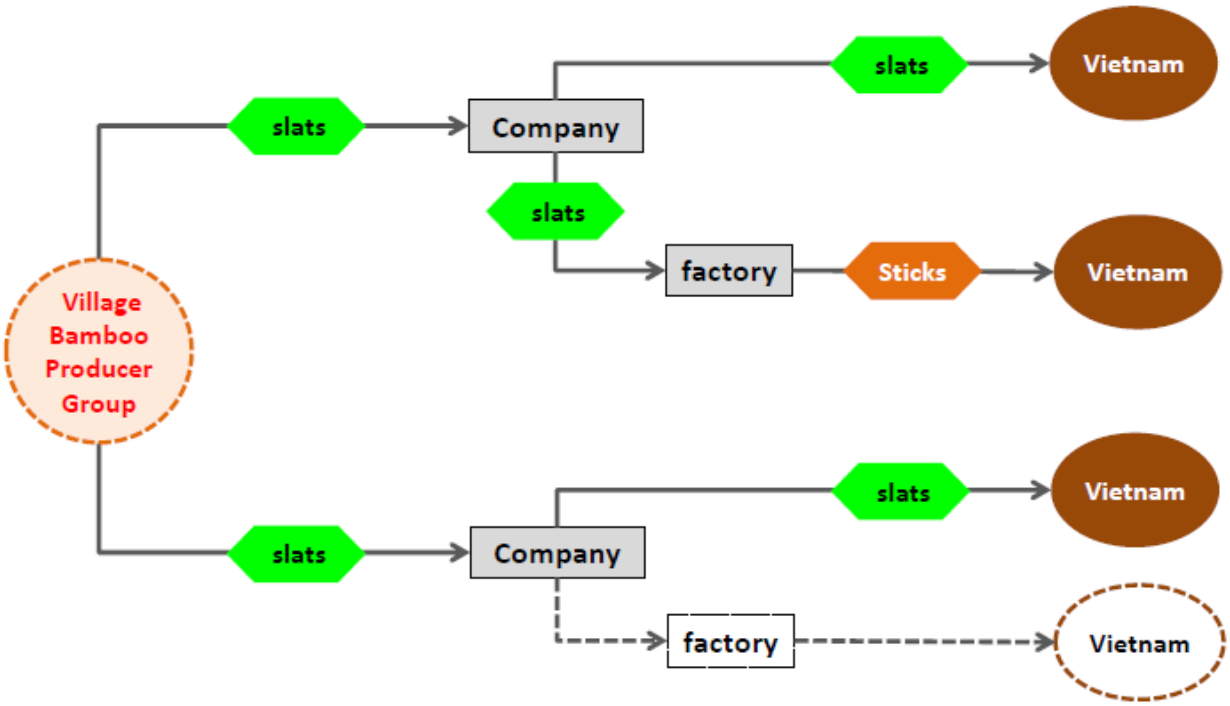


Figure 2: Basic supply chain for Mai khouane and Mai Hia. (Kibler, 2014a)

Average income over 4 years (2011-2014) was 1.6 million LAK per household, with the annual average varying between 1.1-1.9 million. Maximum incomes could reach 2.5 million LAK per year (Kibler, 2014a).

Significant volumes of canes are transported to Vietnam. The Houaphan Commercial State Enterprise Company alone exported more than 1,400 tons in 2021, collected from 14 villages in Viengxay district.

The farm gate price of canes is 300 LAK/kg (fresh), while the selling price to Vietnam is 8000 LAK/kg (dry). Drying results in 40% weight loss.

7.8.2 Mai Hok (*Dendrocalamus hamiltonii*)

Semi-processed slats and sticks are exported to Vietnam, where they are used for manufacturing toothpicks, chopsticks, incense sticks, and for making handicraft objects. The species is harvested from November to July.

In 2014, Kibler reported the price for fresh shoots sold for consumption at 1,000 LAK per shoot, harvested from July to September. Dried shoots were graded, Grade B selling for 20,000 LAK, Grade A1 for 25,000 LAK, and Grade A2 for 33,000 LAK (Kibler, 2014a). In Nambak district alone about 20 tons of sliced dried shoots were produced in 2021. While official statistics (Table 7) deviate significantly from DAFO price experience of (fresh shoots for 2,000-3,000 LAK/kg, and dry shoots for 70,000-80,000 LAK/kg), they do indicate a high price volatility from year to year.

Table 7: Average price for bamboo shoots as reported by PAFOs

Product	Average Price in LAK (2016 - 2020)				
	2016	2017	2018	2019	2020
Bamboo shoots	1,375	1,875	800	900	1,740

The production process for Grade A2-equivalent dried shoots includes:

- grading,
- weighing,
- smoking for 1 night,
- opening shoots for better drying (stabbing or slicing).
- drying
- packaging in 20 kg bags for export or wholesale.

For 1 kg of dried shoots about 9 kg of fresh shoots need to be processed.

Fresh shoots are exported mainly to China and Vietnam, as 1 kg of fresh shoots cost 6 THB (2000 LAK) in Thailand (2022), which is at the lower end of their price in Laos. A number of traders though, buy the shoots in Luang Prabang and export them to China in considerable quantities, according to DAFO interviews. However, export constraints also apply to this commodity, bamboo not being on the list of freely exchangeable goods. Nevertheless, some Chinese traders report having no problems exporting them into China.

Average income from Nor Hok over three years (2012-2014) was reported to be 0.87 million LAK per household, with the annual average varying from 0.6-1.3 million. Maximum incomes could reach 2 million LAK per year (Kibler, 2014a).

In Houaphan and Sayabouri provinces the value chains for Hok shoots (dried and fresh) found during this study still follow a simple linear pattern shown in Figure 4.

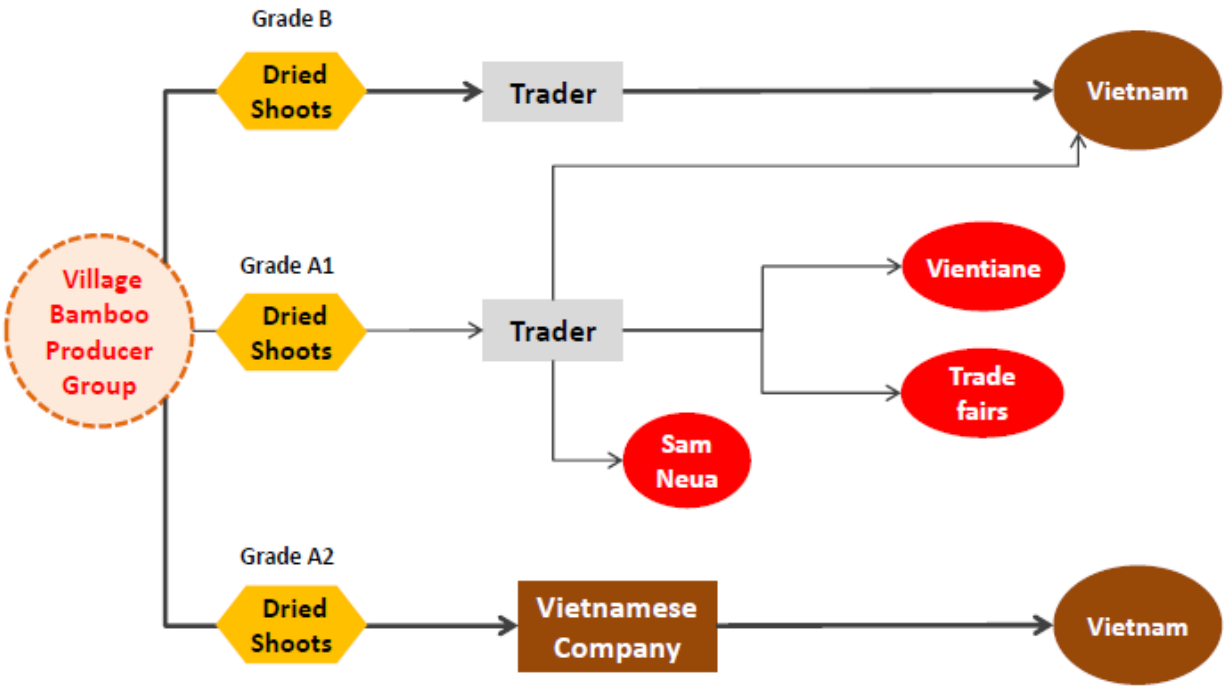


Figure 3: Basic supply chain for Mai Hok for three quality grades in Viengxay. (Kibler, 2014a)

Mai hok is also the host of tom air (bamboo worms), which are also produced and sold for consumption (see below).

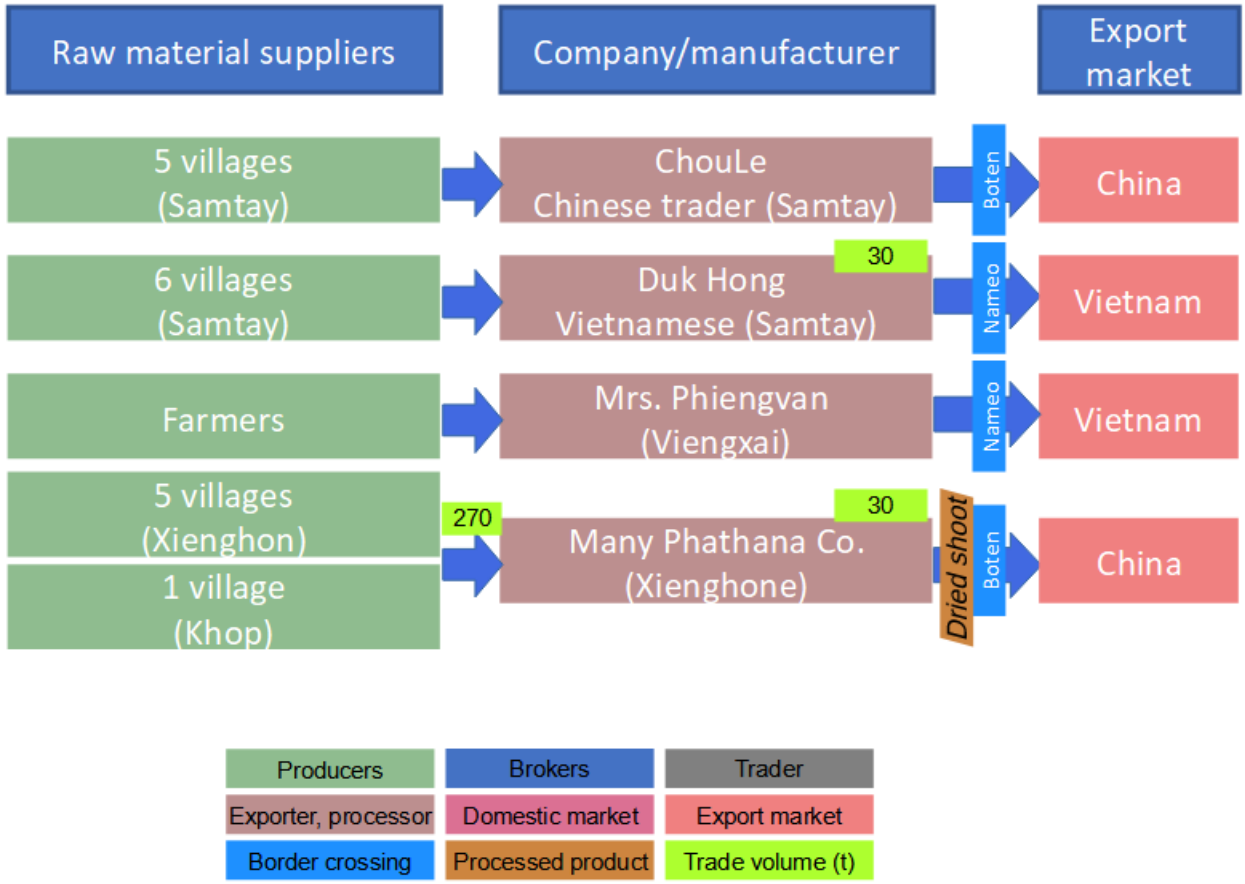


Figure 4: Value chains for Hok shoots in Houaphan and Sayabouri with trade volumes where known.

7.8.3 Mai khom, bitter bamboo (*Indosasa sinica*)

Bamboo shoots are consumed fresh, and whilst in many places mainly intended for the domestic market, export to China does take place. Prices change over the harvesting season, starting with 7000 LAK/kg for small sized shoots, and 5000 LAK/kg for big ones domestically in January, whereas Chinese buyers pay 6000LAK/kg for big shoots. By April all three are sold at 5000 LAK/kg, while later in the year the demand drops to zero (Guerrier, 2019), even though the actual harvesting period can extend to Mai (Nambak) or June (Oudomxay). However, the commercialization period is often shorter and in Oudomxay for example only lasts from January to April. The income per village fluctuates depending on the quantity of shoots each year, which depends on rain patterns: Late rains lead to less shooting. Average income over 4 years (2011-2014) was 1.4 million LAK per household, with the annual average varying from 0.6-2.5 million. Maximum incomes could reach 4.5 million LAK per year (Kibler, 2014a).

Shoots used to be mainly sold domestically but markets in China and Vietnam exist, though their size could not be gauged. Domestically oriented supply chains are geared towards larger urban areas as shown in Figure 5 and had a volume of 220 tons in 2014 from Xam Neua alone (Kibler, 2014a).

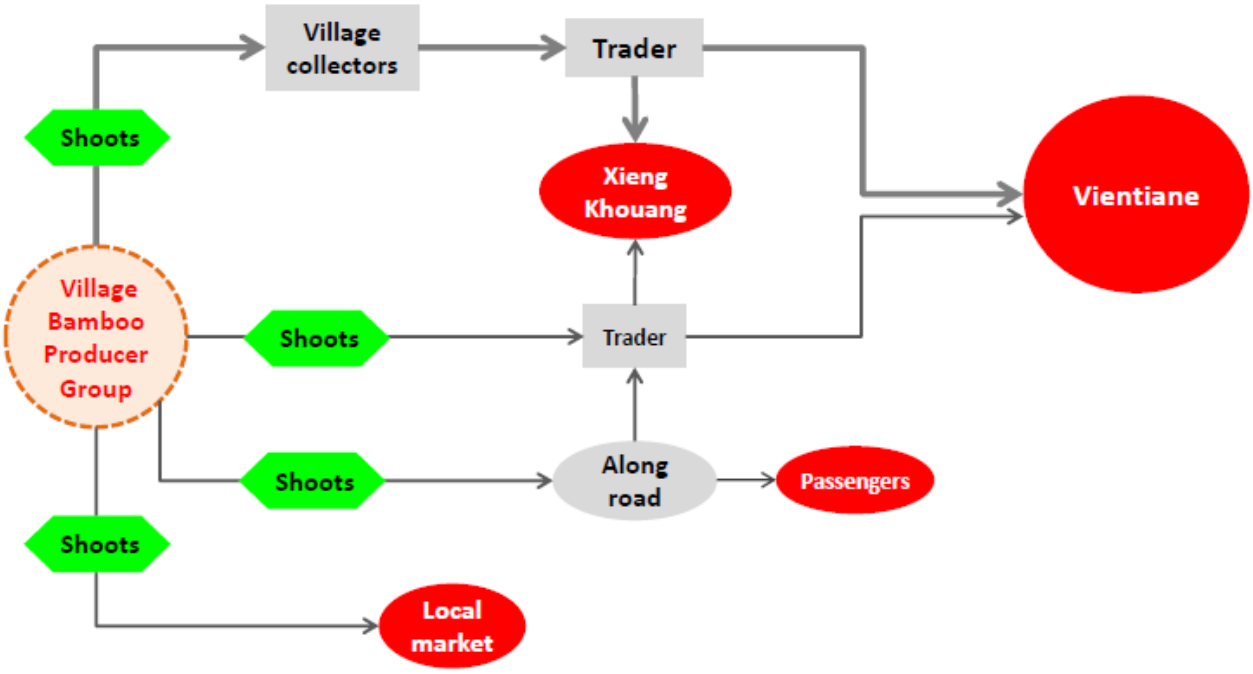


Figure 5: Basic supply chain for Mai Khom (Kibler, 2014a)

The canes of this species are used for furniture making.

7.8.4 Mai dja / Mai lan (*Sirundinaria microphylla*)

These are not processed and only sold as fresh bamboo shoots with harvesting (depending on early or delayed shooting) from March to end of May or May to August.

The canes are used for furniture, mainly for the domestic market, with up to 2-3 months harvest periods per year.

7.8.5 Mai Here

This bamboo species is also traded for its shoots. Similar to other species, the value chain is simple and linear, as shown in the following example from Nambak district in Luang Prabang (Figure 6). Mrs. Onkeo buys the shoots from villagers which deliver directly to her. She boils them and sells them on to buyers in Luang Prabang town. Buying prices vary from 2,000-5,000 LAK/kg, selling price is 15,000 LAK/kg.

7.8.6 Mai Xang (*Dendrocalamus brandisii*)

This species is used for paper pulp. While plans to build a bamboo paper plant existed, ultimately no such project was installed. We did not find any further indications that concrete plans for bamboo paper pulp were still ongoing. The harvesting period for bamboo culms is from November to July.

7.8.7 Handicrafts

Handicrafts were part of the GRET bamboo project and provided an average income over 4 years (2011-2014) of 1.7 million LAK per household, with the annual average varying from 1.4-2.1 million. Maximum incomes could reach 4 million LAK per year (Kibler, 2014a). This is significantly below the figure of what we got from our interviews with producers, indicating 100,000 LAK per day, when demand is there. Since the market absorption capacity is certainly limited, large-scale initiatives to

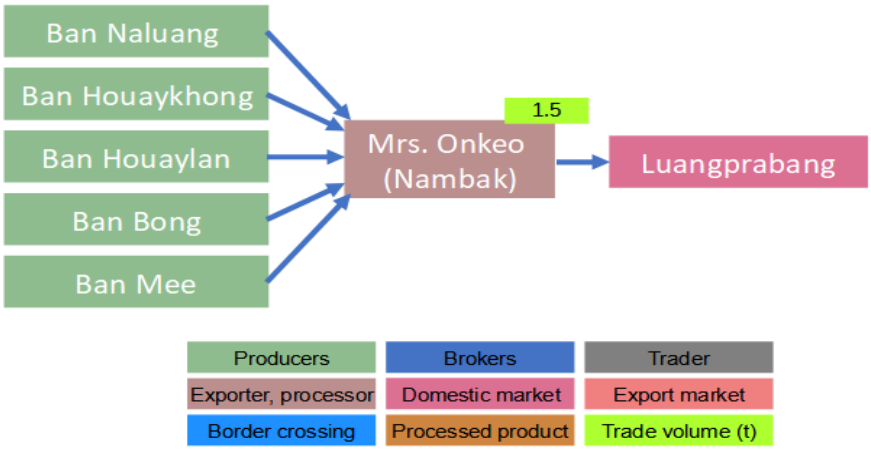


Figure 6: Example of a supply chain for Here shoots in Nambak district, Luang Prabang

promote this trade don't seem viable. But as a niche option it seems attractive, especially where high-quality products can be produced.

The value chains are simple, and items are produced exclusively for the domestic market, most of them being household items, such as sticky rice boxes, steamer baskets, trays etc.

While we did not assess this chain in depth, the information we got indicates that previous mappings still hold largely true (Figure 7).

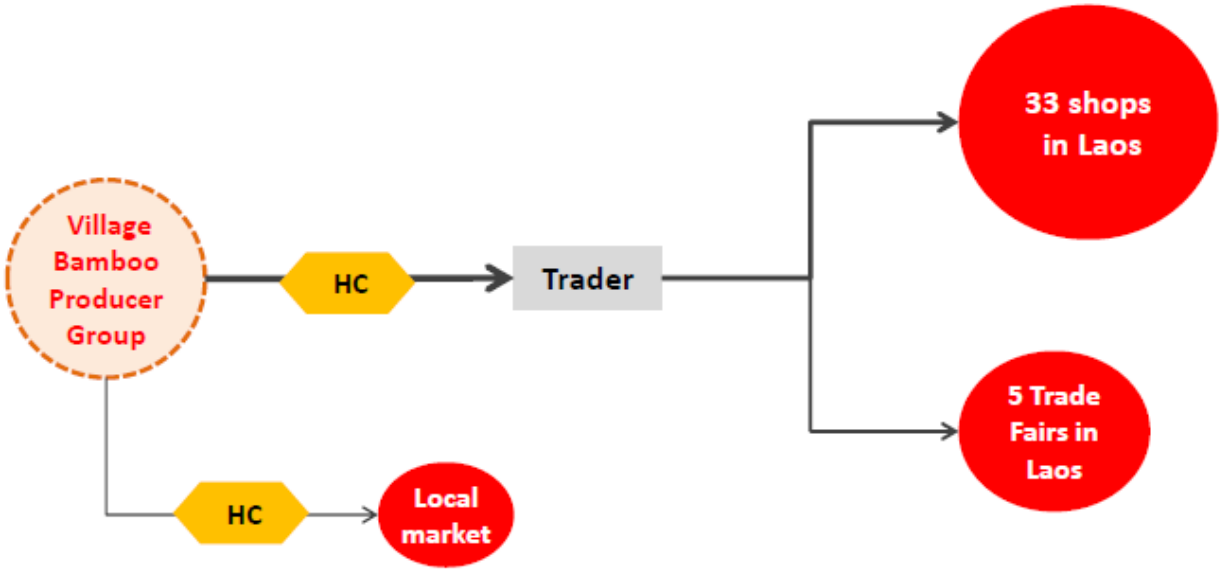


Figure 7: Handicraft product value chains from villages in Houaphan, (Kibler, 2014a)

For items like sticky rice baskets and rice steamers producers now often use Mai Bong, which is collected once a year and has to be of the right age to be suitable. Mai Kaolam is much preferred for handicraft because of its beautiful color and texture, but this species has disappeared from some village forests in Sayabouri, whether due to its natural cycle of renewal or for other reasons could not be established with certainty.

One important consideration for adopting handicrafts as income source is their social component. Baskets etc. can be produced at home by women and the elderly, allowing for a skeletal social

network to maintain itself where many young people leave to find work opportunities outside the village. This includes taking care of children, parents and even neighbors, for those who choose not to or cannot leave their villages.

7.8.8 Bamboo worms (tom air)

Bamboo worms are harvested from Mai hok in considerable quantities. The traders interviewed in this study who dealt in the commodity had sourced more than 80 tons of it from six districts (Figure 8). The worms are sold domestically but markets in China and Thailand exist and are supplied by some traders. The farm gate price changes from about 80,000 LAK/kg in the early season to 120,000 LAK/kg in the late harvesting season. The selling price lies 5,000-10,000 LAK above farm gate price.

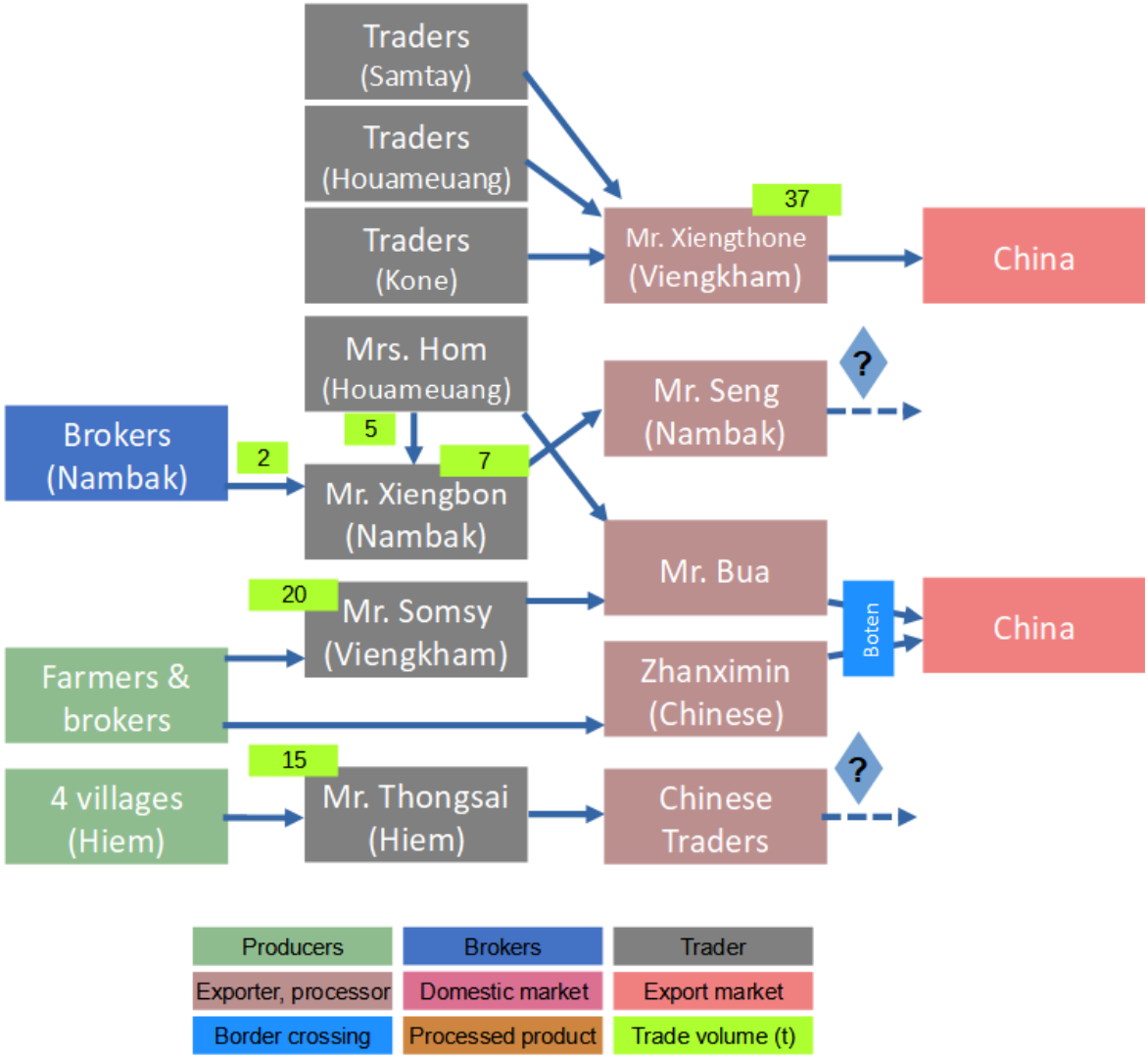


Figure 8: Bamboo worm supply chain example

7.8.9 Other considerations

The largest value chain gains came from slats and sticks followed by handicrafts, including rice baskets, baskets for other uses and decorative articles intended for domestic and export markets. Edible shoots have seen less increase in market value and paper products are currently negligible (Porbounmixaithor, et al, 2016). Slats and sticks have by far the highest total export volume (in LAK) though (see below, Destination Markets)

The GRET project tested two value chain models in parallel in 2013: (1) the export of slats after processing in a factory; and (2) direct export of slats without processing. The second model allowed to involve more villages and generated higher gains for producers thanks to competition among traders during the collection period. However, Houaphan province decided that 80% must be processed, while only 20% could be exported directly (Kibler, 2014b). Whilst these rules may still exist, it is questionable if they can be effectively enforced.

However, while the sale of fresh shoots, slats and sticks, and handicraft all bring similar total revenues, handicraft brings the highest average gross income to households. No systematic economic analysis has been conducted though, to assess the income per time invested and to assess opportunity costs.

7.9 Standards

Group certification has been established with the support of WWF and is intended to lower barriers to certification by individuals, such as (i) the limited financial income of small forest owners, (ii) periodicity of management activities and cashflow, and (iii) limited access to information and knowledge. However, efforts for group certification have had limited success due to farmers being unwilling to commit to membership while other cheaper and easier avenues for sales were available (World Bank and International Finance Corporation, 2019). Certification for smallholders has been costly, complex and discriminatory against smaller growers.

7.10 Legal elements

A National Action plan for sustainable rattan and bamboo (2021-2025) has been ratified as has been the provincial 3rd Five-Year Bamboo and NTFPs Development Strategy for Houaphanh Province (2021-2025). Both documents provide a road map for bamboo development and highlight opportunities and constraints.

Guideline 1758/MAF (30/07/2018) advises Provincial Agriculture and Forestry Offices and local authorities to continue to support industrial tree plantations projects namely eucalyptus, leucaena, teak, bamboo and other traditional types of trees.

The legal framework around bamboo is surprisingly dense. Legal documents related to the production and sale of bamboo products are listed in Table 8.

Table 8: A selection of legal documents related to bamboo production and sale.

Legal Source	Ministry Responsible	Scale/Scope of Application
Decision No. 0221/MOIC the Standard of Wood, Rattan and Bamboo Industrial Processing Factories (Processing Manufacture), 2007	MOIC	Large-scale Plantations Smallholder Plantations
Decision No. 1140/MOIC concerning the Standard of Wood, Rattan and Bamboo Processing Industry Factories 2007	MOI	All wood processors
Directive No. 0509/MF for the calculation of taxes on timber and non-timber forest products, 2009	MOF	Large-scale Plantations Smallholder Plantations
Notification No. 0094/SA Guidance on The Implementation of Ministerial Guidance on the Management of wood exportation for the purpose of revenue collection in timely manner; 2013	MOF	Large-scale Plantations Smallholder Plantations
Notification No. 1440/MOIC.DIMEX on Management of Wood Transport Vehicle, Wood Extraction Machinery, and Wood Processing Machinery in Consistency with the Laws and Regulations, 2008	MOIC	Large-scale Plantations Smallholder Plantations
Notification No. 1601 MOIC.DIMEX on the Management and movement of timber, timber products and non-timber products in domestic and for exportation 2008	MOIC	Large-scale Plantations Smallholder Plantations
Guideline No. 2156/MAF 2006 on Sustainable Production Forest Management Planning	MAF	Large-scale Plantations Smallholder Plantations
Guideline No. 2157/DOF Guideline on Timber Harvesting in Production Forest, 2006	MAF	Large-scale Plantations Smallholder Plantations
Proposal No. 0133/MAF 2012 for the approval of tree plantation & forest regeneration plan and the timber logging and NTFP harvesting plan for 2012 – 2013	MAF	Large-scale Plantations Smallholder Plantations
Order No. 17/PM on Strengthening the Forest Management, Protection and Coordination of Forest Management and Forestry Business, 2008	PM	Large-scale Plantations Smallholder Plantations

A complete list of all regulations related to timber and bamboo value chains can be found in Smith et al. (2017)

The 2021 Act of the President of Laos 002 specifies the following fees for bamboo in addition to general fees:

5	**Document approval for bamboo and NTFP collection**		
5.1	Certificate of permission to collect bamboo and NTFP which cost less than 10,000,000 LAK	time	200,000
5.2	Certificate of permission to collect bamboo and NTFP which cost between 10,000,000 LAK and 50,000,000 LAK	time	400,000
5.3	Certificate of permission to collect bamboo and NTFP which cost more than 50,000,000 LAK	time	600,000

The approximate accumulated tax rate for bamboo products stated by traders is 40%.

7.11 Main destination markets and demand

The demand for bamboo products is high and still rising, reflected in price increases of bamboo products at about 15% per year (IDC, 2016). The database of the International Bamboo and Rattan Organization (INBAR), lists bamboo flooring as the highest selling bamboo product out of Lao PDR, having increased total export value from 600,000 to almost 1.4 million USD between 2016 and 2019 (https://www.inbar.int/resources/). However, we did not come across any producers of bamboo flooring, so it is unclear if the target provinces produce this commodity or if they produce a commodity that is treated as flooring in the HS database.

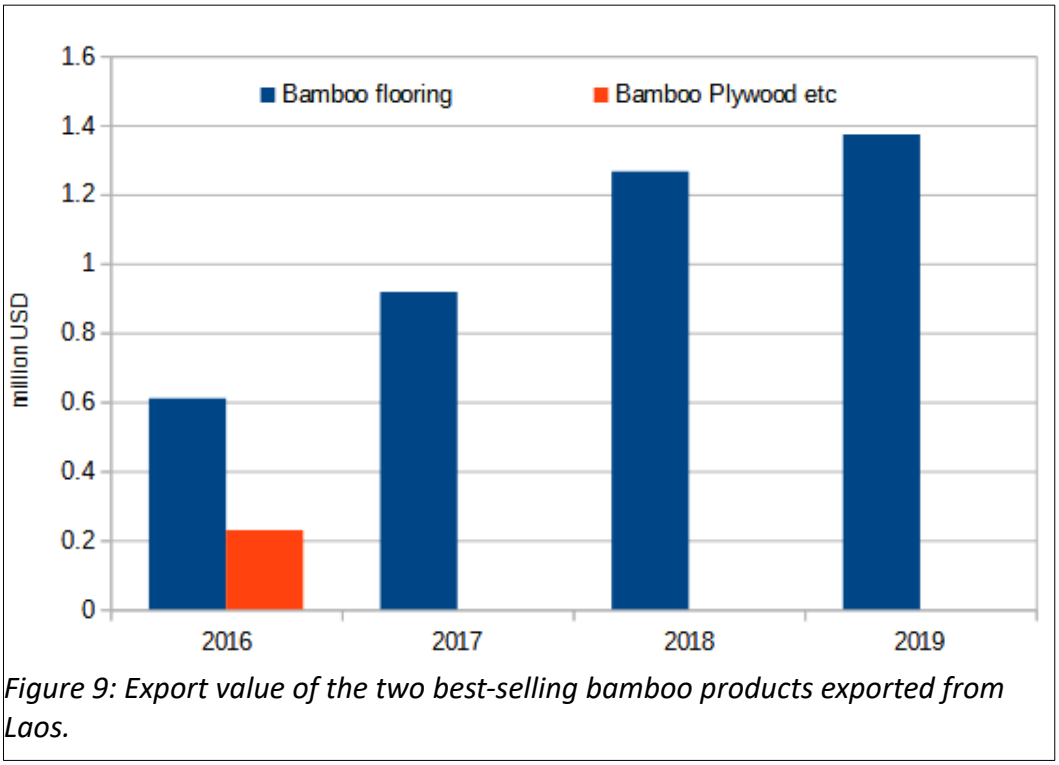


Figure 9: Export value of the two best-selling bamboo products exported from Laos.

Other products, such as bamboo plywood, raw bamboo, bamboo charcoal or handicrafts, make combined only a fraction of the export value of flooring and have erratic sales patterns, indicating unstable markets.

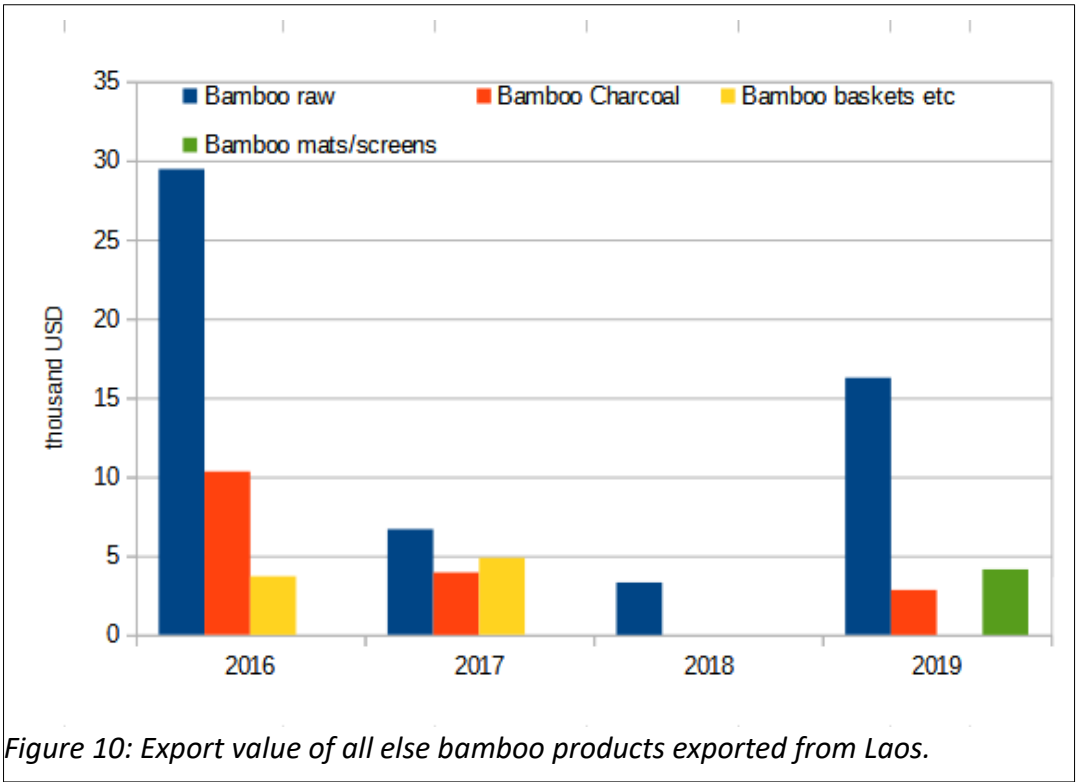


Figure 10: Export value of all else bamboo products exported from Laos.

The total global trade volume of bamboo was USD 3.05 bn. Of these, USD 2.05 bn (67%) were exported from China, followed by EU-27 (9%) Philippines (5%) Canada (4%), Mexico and Vietnam (3%), and India, USA, Thailand and Indonesia (each less than 3%). Main importers were EU-27 (32%), USA (29%), Japan (12) and India, South Korea, Canada, Australia, Saudi-Arabia, Russia, and Mexico (each 2% or less). However, given the difference between the traded value and the total market value of 53 billion USD, the registered trade proportion is small, indicating the major importance of bamboo as resource for in-country use rather than a traded commodity.

In terms of product categories, INBAR (2021) reports the global export volumes in Table 9.

Table 9: Global export volumes for Bamboo products

Products	Export value (2019)*	% of total exports (2019)
Bamboo articles of daily use	798	26.1
Bamboo shoots	295	9.7
Bamboo chopsticks	273	8.9
Small bamboo sticks	262	8.6
Bamboo basketwork/wickerwork products	234	7.7
Other bamboo panels used for construction	203	6.6
Bamboo furniture	146	4.8
Bamboo chopping boards	145	4.7
Bamboo plywood	122	4.0
Bamboo flooring	116	3.8
Bamboo charcoal	112	3.7
Bamboo mats/screens	107	3.5
Bamboo raw materials	87	2.8
Assembled bamboo flooring panels used for construction	51	1.7
Semi- finished bamboo plaits & plaiting articles	39	1.3
Bamboo paper based articles	34	1.1
Bamboo	26	0.9
Bamboo pulp	5	0.2
Total bamboo exports	**3054**	**100.0**

* value in millions

Regions and countries produce and absorb these products in different quantities which are provided in more detail in INBAR (2021).

7.12 Constraints

Constraints have been identified based on project experiences:

- Limited know-how in sustainable bamboo resource management and poor market information
- No clear policies to support the development of a bamboo industry

- Unfinished land use and land allocation with unclear forest and bamboo management policies not allowing protection and efficient harvesting of existing bamboo stands
- Present tax policies are perceived to have a negative effect on the development of the bamboo industry (Khamhoung and van Gansberghe, 2016)
- Sustainable access to international “niche” markets is still not stable (reasons include: cross border regulations and requirements, inter-cultural differences and expectations)
- Participatory Guarantee Systems (PGS) are a good tool to build producer capacity (organization and production) but it is not sustainable if there is no stable market
- PGS certification in Laos needs to go through MAF/ DoA “Lao Organic” certification because there is no legal structure for certifying a product as “PGS certified” (GRET, 2018)
- The Lao government gives bamboo forest concessions to foreign investors, which has a big negative impact on local producers (IDC, 2016)
- The price paid by state companies for Khouane canes at 300 LAK/kg is quite low compared to the selling price to Vietnam with no processing except drying, giving only 6.3% of the value to farmers
- The simplicity of the value chains allows for little value adding and their expansion potential may be limited

7.13 Recommendations and potential

It was recommended that in order to maximize the benefits of certification, both forests and wood industries should be certified. Partnerships between managers and owners of certified forests and certified business can result in shared value and sustainability of business. (World Bank and International Finance Corporation, 2019). To our knowledge, currently no such schemes exist.

Opportunities identified for project work include:

- Abundant bamboo resources are available
- Growing demands for bamboo products globally and in neighboring countries such as Vietnam and China
- Undeveloped domestic Lao market with opportunities for expansion
- First experiences in-country on which to build (Khamhoung and Gansberghe, 2016)
- Deep fried fermented bamboo shavings (Nor Hiaw), as known from Oudomxay and Luang Prabang, which can be applied as condiment, might present a high value opportunity
- The simplicity of bamboo shoot value chains may allow to build a local value chain from scratch quickly, even though limited value adding and expansion potential exist for such a chain (see constraints).

For projects with a strong forest protection focus, bamboo is naturally of interest. However, the experiences by GRET show, that establishing a functioning bamboo production system requires long-term commitment, as full integration into a forest management plan is necessary. Bamboo plantations are not common in Laos and their establishment might present an interesting option,

where conditions are suitable (e.g. considering potential damage in storm prone locations). List I and II species might be of special interest as they are likely to fetch higher prices due to lower competition from wild harvests. However, cultivation of such species might be more challenging. The relatively low value of common bamboo products makes them a bulk commodity, requiring substantial production volumes to attract the interest of traders and production economically viable. However, significant gains through simple processing (boiling of shoots, drying of canes) can be achieved. Whilst these gains seem attractive, it is an open question whether such changes would require a complete restructuring of the current value chains. Despite high transportation costs, the current systems are economically viable mainly because revenue margins are large due to the significant difference between unprocessed and pre-processed products. Scaling down processing to village or village-cluster level might result in an elimination of the factors that make the value chain currently viable, but detailed economic analyses, considering the location and circumstances of a given target area, would have to be conducted to assess this.

8. Benzoin (ຍາງ)

8.1 Overview

Benzoin resin (also called gum benzoin, gum benjamin, storax, sambrani or loban) is harvested from several Styrax tree species. Lao or Siam Benzoin is obtained from *Styrax tonkinensis*, a fast-growing tree found across Thailand, Laos, Cambodia, and Vietnam, mainly in mountainous upland areas, where it is native. It is the oldest internationally traded product from Lao PDR. (several online sources and Khamhoung and van Gansberghe, 2016). *S. tonkinensis* is found in north-west Vietnam and has been planted for more than 30 years on about 20,000 ha for paper pulp, as wind breakers, and as shade trees in tea plantations (Orwa et al., 2009). However, the trees there produce only small quantities of resin which is why they are planted for other reasons.

8.2 Uses and properties

The main active component in the resin is benzoic acid. It is used in perfumes and cosmetics as scent and fixative, in incense and scented candles, as food flavoring, and in some medical tinctures. Lao benzoin is considered by some high-end perfume manufacturers in Europe as the best benzoin for the perfume industry (Khamhoung and van Gansberghe, 2016).

Higher grades of Lao benzoin are used in the manufacture of fragrances that are later compounded and employed in a wide range of end-products such as personal health-care products (e.g. soaps, shampoos, body lotions and creams, bath oils, aerosols and talc); household and other products such as liquid soaps, air fresheners, fabric softeners, washing detergents, and other cleaning agents. Although there is occasional overlap in end-use between Lao benzoin and other benzoins, the pleasant, round fragrance of Lao benzoin is generally used for fragrances at the higher end of the market, such as fine fragrances (perfumes and colognes) and the more expensive soaps, imparting a sweet, “oriental” note to the fragrance. Although benzoin contributes its own fragrance to the final, formulated product, one of its important functions is to serve as a fixative for the other fragrance materials, increasing their tenacity and preventing loss of the middle and top notes of the more volatile components.

After years of lobbying and providing all required technical data and studies, Agroforex Co., a Lao enterprise, managed the inclusion of Lao benzoin in the Codex Alimentarius of WHO and FAO as a food additive. It is now used mainly in sweet food such as cakes, candies and softdrinks.

8.3 Production types

Two production types are distinguished: (1) naturally growing benzoin trees (mainly in upland fallows after rice) and (2) cultivated benzoin trees (in fallows or elsewhere). While Khamhoung and Gansberghe (2016) reported that cultivated benzoin trees were becoming more and more common, Vongkhamho (2022) reports that *S. tonkinensis* plantations comprise only about 1% of smallholder benzoin production systems and that 99% are based on rotational styrax fallows. Traditionally, *Styrax tonkinensis* has been well integrated into shifting cultivation systems with fallows of at least 10-12 years, and benzoin trees as the main fast-growing trees after upland rice rotation. The shortening of fallow periods has created more difficult conditions for growing and exploiting benzoin trees in fallows. (Khamhoung and Gansberghe, 2016)

Tapping through bark incisions takes place from June to November with its peak from August to September. Tapping starts with 5–7-year-old trees and lasts for 4-7 years until the fallow cycle ends (or up to 30 years in natural stands), adding more taps each year (up to 5) (Vongkhamho, 2022). Collection of resin (benzoin gum) takes place when the resin dries and becomes harder and brittle during the cooler winter season between November and April, with peaks in December or February-March (depending on location). Tapping and harvesting is men's work, while cleaning and sorting is mainly done by women. One man can tap 30 to 50 trees per day. Benzoin gum is mainly collected by the poorest ethnic minority highland farmers (Khmu, Laopong, etc.) and trees are individually owned (Khamhoung and Gansberghe, 2016). Khmu comprise 88% of benzoin tappers, having a long-standing tradition in this trade (Vongkhamho, 2022).

8.4 Production locations

S. tonkinensis prefers elevations above 700 to 1600 masl, with precipitation of 1500 to 2200 mm and temperatures of 15 – 26° C. The trees prefer clayey soils with pH <4.5 and no water logging (Orwa et al., 2009), and, being a fast growing pioneer, need full sunlight. According to Vongkhamho (2022), *S. tonkinensis* can be found throughout Houaphanh, Xiengkhouang, Luang Prabang, Phongsaly, and Oudomxay (Figure 11). However, production of Benzoin is mainly concentrated in Houaphan, Phongsaly and Luang Prabang provinces (Khamhoung and Gansberghe, 2016) and there largely in areas with strong presence of Khmu people.

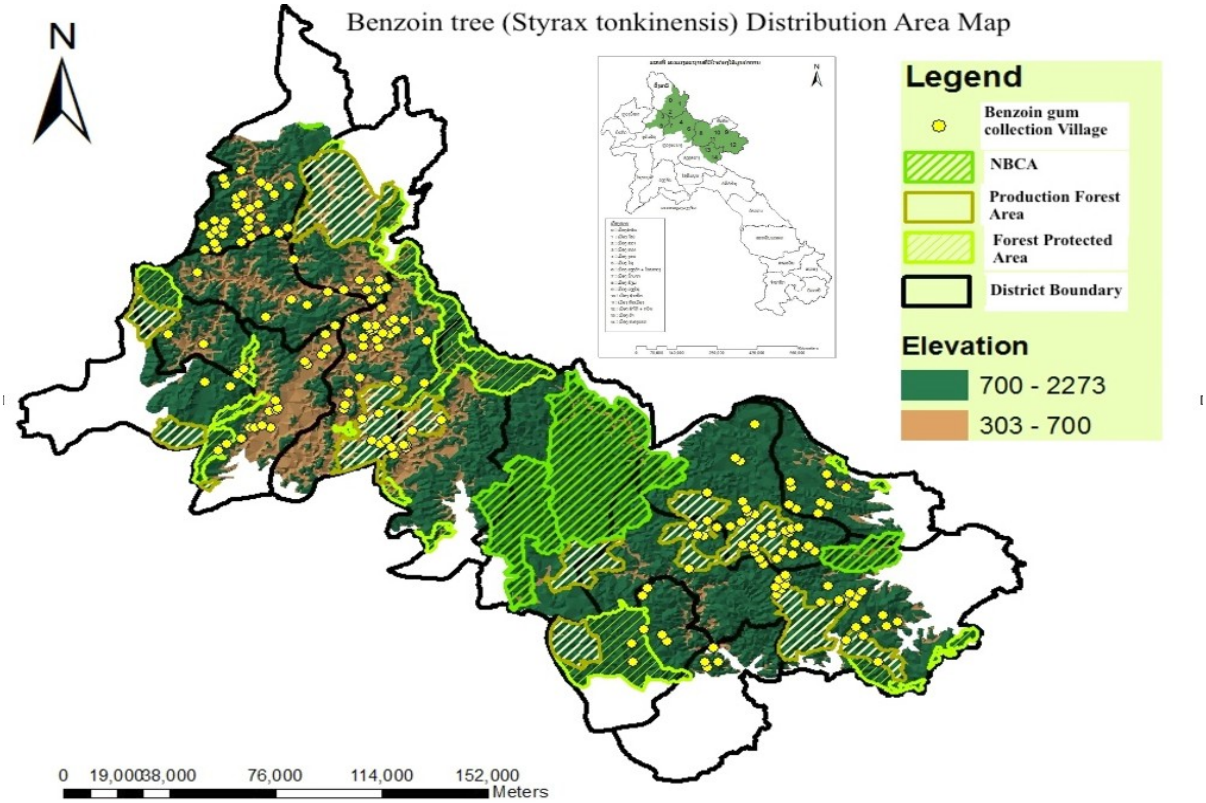


Figure 11: Areas suitable for benzoin trees in northern Laos (provided by Vongkhamho)

However, the actual production areas largely depend on the relationship villages have built with Benzoin buyers. In Nambak district, Luang Prabang, for example, 14 producer villages exist: Phathong, Houyseau, Houyhip, Phonhong, Nammong, Bankhong, kajet, Dokelaw, Mhakphouk, Yalo, Grang, Longjok, Namai, Dankarng, Phouker, and Khingkarng. Of these, Phathong village has

the largest area of about 135 ha belonging to 70 families. Roughly half of this area, about 70 ha, are young trees of less than 8 years.

Actual production locations in Luang Prabang are shown in Figure 12.

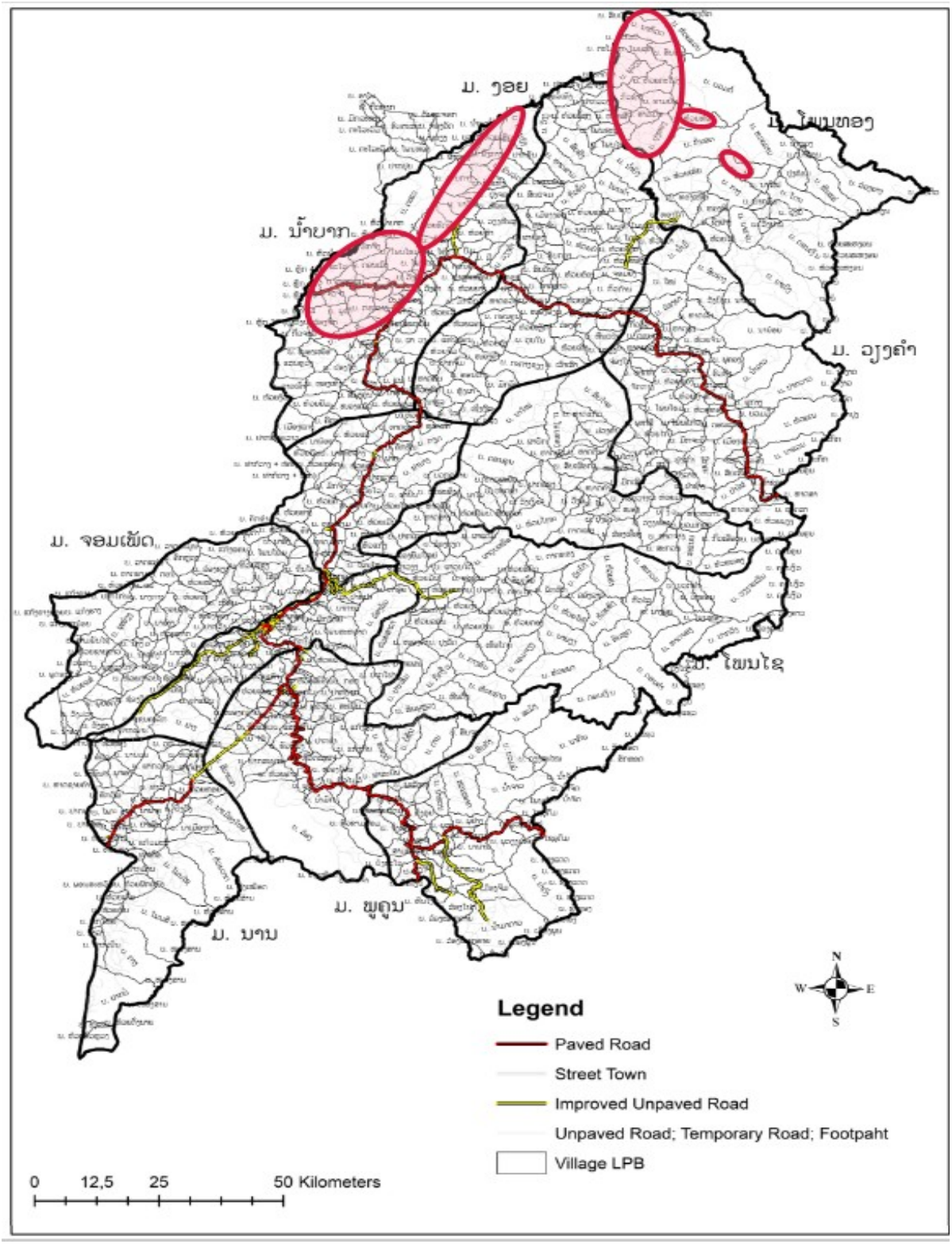


Figure 12: Benzoin production locations in Luang Prabang province. (Source: DAFO interviews)

Agriculturally used land comprises around two-thirds of the area suitable for benzoin trees, tying them closely to shifting cultivation systems. The remainder splits mainly between Forest Protected Areas and Production Forest Areas (Table 10).

Table 10: Areas potentially suitable for *S. tonkinensis* in Houaphan and Luang Prabang

Prov. & Dist	No. of Villages	Distribution area of Benzoin tree Area (ha)	BCA (%)	FPA (%)	PFA (%)	Agr (%)
Houaphanh	**82**	**784,641**	**7.8**	**2.8**	**18.4**	**71.0**
- Houameuang	8	211,972	9.4	-	18.7	73.2
- Samnue	39	249,964	7.7	-	18.7	73.6
- Viengxay	7	101,935	2.8	2.8	-	94.5
- Samtai & Kouane	28	220,770	8.7	8.6	27.6	55.1
Luang Prabang	**47**	**427,082**	**2.9**	**21.2**	**11.5**	**64.4**
- Nambak	14	80,274	-	22.3	1.3	76.5
- Ngoy	15	139,150	-	12.2	24.9	62.9
- Phonthong & Viengkham	20	207,658	5.9	26.8	6.5	60.8
Total	**129**	**1,211,723**	**3.8**	**11.7**	**16.5**	**68.1**

BCA=Biodiversity Conservation Area, FPA=Forest Protected Area, PFA = Production Forest Area, Agr = Agriculture Land

Source: Agroforex Co. 2015. DAFO, 2016. FAO, 2001. LGISU 2020.

8.5 Production volumes

The exact factors leading to high gum yields are unknown, but yields vary significantly between locations (Vongkhamho, 2022). The amount of benzoin gum produced per tree depends on location, tree age (Khamhoung and Gansberghe, 2016) and weather (high rainfall intensity leads to low production; small but regular rainfall and early cool weather, stimulates yields). Frequent harvesting without resting periods can lead to early die-off, which is problematic in natural stands.

The total area of growth in Luang Prabang and Houaphan provinces is estimated to be roughly 4000 ha in mixed stands with other plants (Vongkhamho, 2022). Small amounts of benzoin are possibly also produced in Oudomxay and Luangnamtha provinces. In total, about 250 villages are involved in benzoin production in the northern provinces (Khamhoung and Gansberghe, 2016).

The production records from DAFO's/PAFO'S and companies are partly contradictory, and none is likely to be complete. However, a combination of records shows the decrease of production in Luang Prabang and increase in Houaphan (Figure 13).

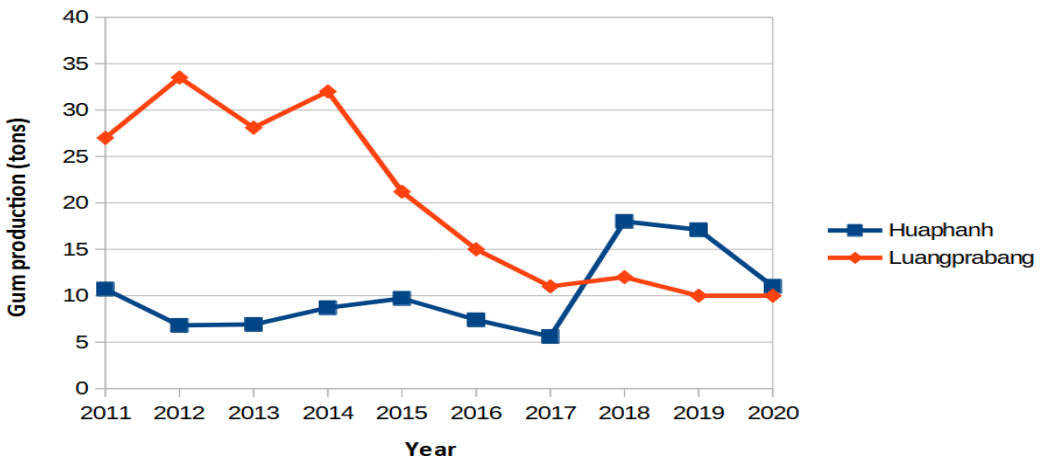


Figure 13: Benzoin gum production at provincial level, 2011-2020 (tons).
Source: Agroforex co., 2016. AT co., 2016. DICO, 2016, PAFO 2021.

A benzoin producer survey carried out in 2015 produced detailed data on producer numbers and production areas per district (Table 11). Vongkhamho et al. 2017, tried to estimate the production potential for benzoin growing areas assuming a dense production system (Table 12), coming to the conclusion that Houaphan would have higher yields per area than Luang Prabang.

Table 11: Benzoin production area (DAFOs benzoin producers survey 2015)

Prov. & Dist.	No. of villages	No. of HH	Benzoin area (ha)	Av. area (ha/HH)
Houaphanh	**69**	**1,397**	**2,432**	**1.7**
- Houameuang	3	13	9	0.7
- Samneu	39	794	1,541	1.9
- Viengxay	7	150	379	2.5
- Samtai	11	219	423	1.9
- Kouane	9	221	80	0.4
Louangprabang	**34**	**730**	**1,528**	**2.1**
- Nambak	12	285	536	1.9
- Ngoy	15	271	578	2.1
- Phonthong	7	174	414	2.4
Total	**103**	**2,127**	**3,960**	**1.9**

Table 12: Benzoin production potential

Location	Age (years)	Mean yield per year				Yield per total area (tons/year)
		Trees/ha	Tapped trees	Benzoin / tree (g)	Benzoin Kg/ha	
Houaphan	5 – 7	200	69	180	12.4	42
	8 – 10	200	79	280	22.1	
	11 – 15	200	51	340	17.3	
	Average		66	267	17.3	
Luang Prabang	5 – 7	290	93	150	14.0	22
	8 – 10	290	77	170	13.1	
	11 – 15	290	93	180	16.7	
	Average		88	167	14.6	

Vongkhamho et al. 2017, Agroforex co., 2015. FAO, 2001.

However, the total annual production in Lao PDR is not well documented. It was estimated to be between 70-90 tons in 2015 (Khamhoung and van Gansberghe, 2016)) and 40-70t (51t on average) per year between 2010 and 2020 (Vongkhamho, 2022). The production potential was estimated to be above 136 tons per year for the whole country in 2020 (Vongkhamho, 2022). It should be noted that production figures from government sources such as the Department of Forestry fall often severely short of company records, reporting between 30 and 95% of the

volumes recorded by the private sector (Vongkhamho, 2022). Both do not account for unregistered trade.

The latest official data put production in Luang Prabang and Houaphan at about 5 tons (Table 13) which is likely to be a gross underestimate.

Table 13: Production Area and volume by DAFOs (2021)

Sites	Styrax fallow area	Volume (t)
Luang Prabang	*	
Nambak	1,944	5
Ngoy	578	
Phonthong	414	13
Houaphan	**2,439**	
Houameuang	3	
Xam Neua	1,541	
Viengxay	379	
Sopbao	n.a	
Xiengkho	n.a	
Xam Tai	436	
Kone	80	

* no entry means no data was available

According to our own survey data three local traders in Nambak district alone collected 9 tons in 2021, and the export volume by 2 companies was 26 tons (though including collection from Phongsaly province). Ministry of Industry and Commerce records registered more than 46 tons of benzoin exports for 2021 (see under Destination markets, Table 19).

Table 14: Volumes of traders and exporters traded according to this survey

Sourcing area	Brokers/traders	Volume (tons)
Xam Neua, Houaphan	Mr Xaysavath	1.5
Xam Neua, Houaphan	Mr. Liengphone	none
Nambak, Luang Prabang	Mr. Houmphanh	4
Nambak, Luang Prabang	Mr. Bounmee	3
Nambak, Luang Prabang	Mr. Xiengtui	2
Exporters		
Houaphan, Luang Prabang, Phongsaly	Agroforex company	20
	S.DFORES company	6
Total		**26**

8.6 Production quotas

Quotas and permission letters are provided in conjunction by DAFO and DICO. However, quotas have rarely reflected actual production figures as production varies significantly from year to year and province to province. On average, production was only about 44% of the provided quota shown in Table 15. Changing yields, farmer ability, and productive area, make a quota-based system difficult to implement. Also, data collected by the government seems incomplete as they are lower than those collected by the main companies.

Table 15: Benzoin resin harvesting quotas, 2016 – 2020.

Provinces	Procedure	2014	2015	2016	2017	2018	2019	2020
Huaphan	Requirement	6	10	10	20	-	50	50
	Approval	80	110	-	10	-	-	-
Luang Prabang	Requirement	14	21	15	11	12	10	10
	Approval	10	20	-	3	45	-	-

Source: PAFO, 2021

In addition, not all provinces handle quotas the same way: Benzoin traders in Luang Prabang request quotas at district level, while in Houaphan they do so from PAFO.

8.7 Processing, Packaging, and Storage

Processing depends on the intended use and does generally not involve farmers other than for removing impurities from the resin tears. The first processing step (mainly cleaning and grading) is performed in Lao PDR by the exporting company without using solvents, following the international standard requirements for the pharmaceutical and flavoring industries. Benzoin grades are mainly based on size and color: The largest pieces are graded higher, lower grades correspond to smaller pieces. Usually, four grades are distinguished:

Figure 14: Benzoin Grades depiction (Source: Agroforex)

Grade 4 are fine particles or powder. As the resin is brittle and easily breaks into smaller pieces during transportation, post-harvest quality loss occurs (Khamhoung and Gansberghe, 2016). But yields and quality also depend on environmental factors such as soil moisture, topographic conditions (altitude, slope and orientation) and soil type (Vongkhamho, 2022). Through cleaning, a weight loss of 11.5% on average (8-18% depending on year) incurs additionally. (Vongkhamho, 2022)

The second processing step, which requires the use of solvents, is mainly performed in Europe, above all in France, where a number of enterprises are specialized in extraction producing benzoin resinoid, benzoin absolute, benzoin tincture, etc. (Khamhoung and Gansberghe, 2016), but also in Germany.

Some of it is used in Switzerland, mainly as a fixative of flavor, for making several high-end perfumes, but also as an active ingredient for making pharmaceutical products, especially skin care, in various European countries (Khamhoung and Gansberghe, 2016).

8.8 Value chain, prices, and income

The benzoin value chain is complex, and its sustainability partially relies on a combination of long-term business and social interventions from different stakeholders (Khamhoung and Gansberghe, 2016). Three major companies have been driving this market in Laos.

Whilst not the first company to trade Benzoin in Lao PDR, Agroforex, established in the early 1990, was for the first 15 years of its history unchallenged as buyer of benzoin. S.DFORES started around the same time but was not specialized in benzoin and left the market largely unchallenged to Agroforex. However, both companies had a strong social and extension approach, building long-term relationships with communities. Anouphap company (AT IMP - EXP sole Ltd) started their business in 2010 and seized within a few years about 50% market share from Agroforex, providing no support or other investments, but exclusively buying gum at higher prices (Vongkhamho, 2022). With this purely economic focus, it was able to pay on average 6% more than Agroforex (Figure 15), leading to it gaining fast traction. In 2018, both companies held similar market shares and together acquired about 87% of the national produce, cleaned and graded in Vientiane Capital.

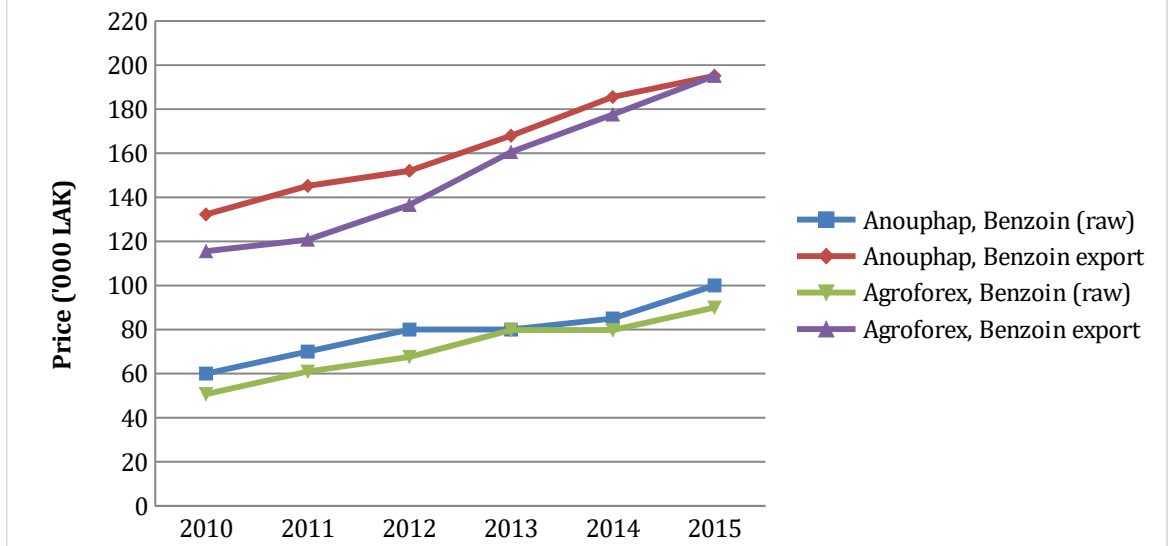


Figure 15: Purchase and export prices for Agroforex and Anouphap

S.DFORES was involved in the benzoin trade at a low level for about 30 years but only due to a collaboration with the Lao Helvetas Bio Trade project since 2017 the company started to gain a substantial foothold in this commodity. This increasing competition from S.DFORES started to reduce especially Anouphap's market share, which then due to export difficulties to Germany as a result of COVID-19, seized its Benzoin operations completely. It plans to re-engage in the trade by 2023.

All companies work through brokers and Agroforex and S.DFORES also employ company agents who have fixed contracts with them to not only collect produce in the village but also help with extension and other activities. Additionally, Lao, Chinese and Vietnamese traders buy a range of commodities including Benzoin and sell them either to the companies or export them to neighboring countries.

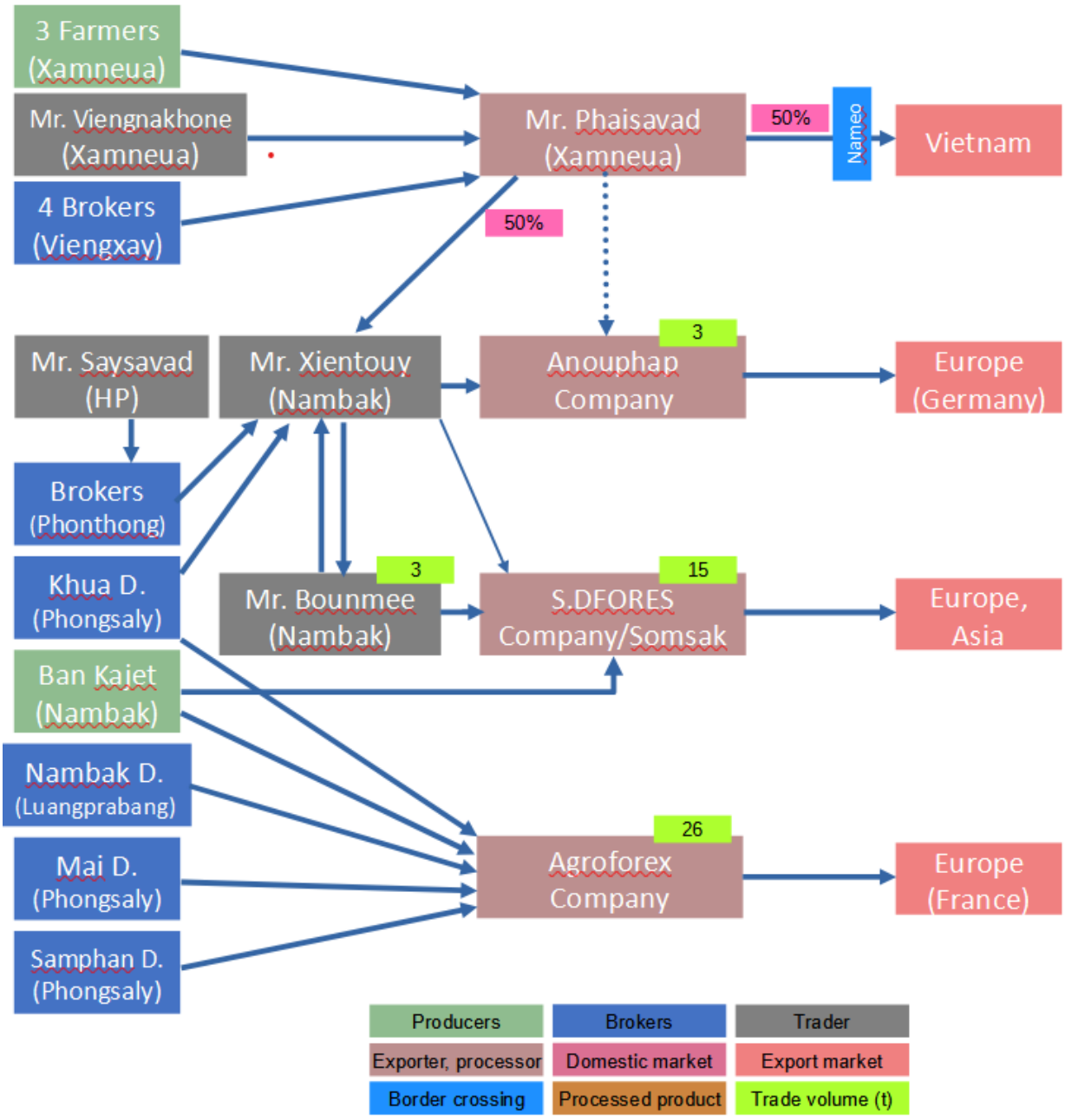


Figure 16: Benzoin supply chain (abridged).
Note: as of 2022 Anouphap Co. has stopped operation due to COVID-19.

Their activity tends to be more opportunistic and less targeted, though. They pay about 20-30% more than the companies but only buy A grade quality, while the companies pay a grade-independent fixed price. They can afford to pay these higher prices as they apparently often do not declare these goods to avoid taxes. The competing action of these players and the inclusion of opportunistic strategies creates a web of interaction that is not necessarily efficient and may ultimately disadvantage farmers (Figure 16).

Farmers store the resin tears in jute sacks for sale to traders. Farm gate prices for benzoin in Laos are currently around 100,000 LAK/kg. Many farmers stated that they would sell gum to the highest bidder even if they had made contractual agreements already. In some villages in Viengxay district, farmers would sell 30-50% of their harvest to other buyers, despite agreements.

Table 16: Raw benzoin resin farm gate price development, 2016 – 2020

Province	2016	2017	2018	2019	2020
Houaphan	150,000	150,000	150,000	110,000	110,000
Luang Prabang	120,000	140,000	150,000	100,000	110,000

Source: PAFOs, 2021.

In Luang Prabang (Phonthong district) a total of 182 HHs from 4 villages generated an income of 766 million LAK from benzoin sales in 2014 (4.2 million kips /HH) on 319 ha with 332 benzoin tree plots (Khamhoung and van Gansberghe, 2016). In Nambak district, the main companies who buy through their brokers are Agroforex (Mr. Houmphan) and Society Development of Forest Export-Import Sole Company Limited, in short S.DFORES CO; LTD.

8.8.1 Income generation

The trading prices in 2021 as reported during interviews for this study are given in Table 17.

Table 17: Trading price of benzoin gum at different supply chain stations

Province	District	Farm gate (LAK/kg)	Collector/Processor (LAK/kg)	International retailer (USD/kg)
Houaphan	Xam Neua	120.000 to 150.000	140,000 to 160,000	30
Luang Prabang	Nambak	120.000 to 150.000	155,000 to 160,000	

In order to assess how economically attractive growing Benzion is compared to alternative crops, Vongkhamho et al., (2016) conducted an economic analysis comparing it to upland rice and maize. Their findings indicate that while Benzoin gum can hardly compete with either crop on a per-area basis, it is quite attractive where labor (and capital) is limited, due to its low management requirements. Only 35 man-days/ha are required for benzoin harvesting, while upland rice requires 271 and maize 113 (Table 18). However, the analysis does not compare equal alternatives, as both annual crops may require fallow periods on the fragile soils found in the Lao uplands, while benzoin fills this specific gap and supports an ecologically more sustainable agricultural system.

Table 18: Cost benefit comparison between Benzoin gum and two bulk cash crops (2015)

Product Type	Yield (kg/ha)	Benefit per area unit (LAK/ha)	Benefit per labor (LAK/pers/day)	Land use
Benzoin gum	41.8	2,868,000	81,943	Fallow
Upland rice	2,090	6,104,000	22,491	Planted
Maize	4,200	4,572,000	40,640	Planted

Variables used for the calculations: 8,105 kip = 1 USD, labor cost 30.000 kip/day

Income from benzoin was found to be of special importance to poor households in remote areas. Increasing benzoin production by 10% reduces poverty by 3.1% on average. Contract farming of benzoin, though, was found to reduce these beneficial effects dramatically as farmers could not get the best price for their produce anymore (Vongkhamho, 2022).

8.9 Standards

While the processing of resin has to follow stringent procedures to produce the needed qualities, no standards exist for the production of benzoin gum. Since large tears are graded higher, good tapping, transportation and storage techniques could benefit higher prices.

8.10 Legal Elements and Taxes

The District Finance Office collects the following fees and taxes:

- Natural resource fee: 10% based on the farm gate price
- Profit tax, 24% based on the gross margin; though there may be differences between provinces, as conflicting information indicates
- 30,000 LAK/permission
- 100,000 LAK/ton of product for reforestation funds
- 20,000 LAK/ton of product for forest management

In Ngoy and Phonethong districts in Luang Prabang special rules apply:

- A fixed tax advance of 60 million LAK is requested from companies, which is non-refundable (effectively an operation fee)
- In case the actual purchases exceed this tax value, additional taxes based on the actual quantities would have to be paid

For export, MAF provides a proof of provenance together with a phytosanitary certificate for 25,000 LAK. Customs collects an export tax of 10% of the export value and the tax department collects 24% profit tax per year. The Department of Import and Export charges 100,000LAK for a certificate of origin.

Taxation for NTFPs is excessive, especially compared to agricultural and industry products for which the total tax is 13% (3% profit Tax and 10% export tax). Given that Benzoin is mainly harvested from fallows, it could be classified as agricultural product rather than NTFP. However, the fallows fall currently under the forest law (Article 3). A change would allow better prices to be paid to farmers or allow for more sustainable practices. The poor implementation of tax exemptions and other incentives for social SMEs in remote areas, as foreseen in the investment promotion law, has disadvantaged sustainable production approaches (Vongkhamho, 2022).

Transportation permits need to be obtained from PAFO in Houaphan and DAFOs in Luang Prabang in order to move merchandise within the country. DICO provides permits to buy products and claims taxes according to an assumed product price.

8.11 Main destination markets and demand

Only about 11-15% of Lao benzoin is used in-country, mainly for incense, while about 85% is exported, especially to niche markets in Europe (Khamhoung and Gansberghe, 2016). Here, direct

exports from Laos to the EU are the largest share of total exports, while indirect exports via Thailand, Vietnam and China make up only about 25% of exports to Europe. Other export markets are India and the USA, which combined receive less than 10% of exported benzoin (Table 19).

Table 19: Benzoin export volume by country (2016 - 2021)

Export market	Exported volume by year (tons)						Share (%)
	2016	2017	2018	2019	2020	2021	
France (FR)	16.63	41.25	24.73	15.16	15.6	19.74	39.9
Germany (DE)	20	40	24	16.42	10.9	8	35.77
India (IN)	2	8	2	8	3	3	7.79
Spain (ES)	3	4	2	0	3.95	13	7.78
Thailand (TH)	0	1.53	4.5	6	3	2.7	5.31
Sweden (SE)	0	0	0	0	3.3	0	0.99
Netherlands (NL)	0	0	0	1	1.68	0	0.8
USA	0.85	0.5	0.7	0	0	0.2	0.67
Turkey (TR)	0	0	0	0	2	0	0.6
Singapore (SG)	0	0.65	0	0.5	0	0	0.34
Israel (IL)	0.1	0	0	0	0	0	0.03
Total	**42.58**	**95.93**	**57.93**	**47.08**	**43.43**	**46.64**	**100**

Source: Department of Import and Export, MoIC, 2022

8.12 Constraints

The main constraints for the benzoin value chain in the target areas include:

- Shortening fallow periods for growing benzoin trees make this crop less and less feasible
- Damage to young trees by uncontrolled free-grazing animals
- No access to current market price information, with middlemen imposing the price
- Informal traders, who are operating without a license, distort the market, encourage corruption, impact on product quality and reduce tax revenues
- Other competing crop activities (especially cassava, but also rubber, coffee, tea)
- Knowledge transfer to the next generation: knowledge is handed down within families and young people rather look at growing more profitable cash crops
- The trees have a complex ecology and monocultures result in low yields, for unclear reasons
- Resettlement of villagers close to roads removes them far from styrax trees, leading many villagers to start new livelihood activities resulting in reduced benzoin production
- Not enough trees are available for tapping but capital is lacking to establish plantations (esp. in Houaphan) (Vongkhamho et al. 2020)
- Trees take 5-7 years to become productive, during which time farmers will get no income from the trees
- Lack of access to information on improved tree care and tapping

8.13 Recommendations and potential

Luang Prabang, Houaphan, and Phongsaly are the provinces with the highest potential for benzoin production. Given the uncertainty as to the exact factors driving gum yields, priority should be given to sustainability and rehabilitation of existing production areas. General advantages are:

- *Styrax tonkinensis* is a relatively fast-growing multipurpose tree (also cultivated for pulpwood in Vietnam and for firewood in China)
- Lao benzoin is renowned for its top quality by the perfume industry and the pharmaceutical industry
- Lao benzoin is sold as a certified organic product on some international markets, giving premium prices
- Where traditionally produced, tappers have considerable experience with benzoin, and its production has high acceptance
- The benzoin rehabilitation program led by the Agroforex Company can serve as a model for further expansion (Khamhoung and Gansberghe, 2016)
- The fact that long rotation cycles of more than 10 years are hardly found anymore, makes this crop especially suitable for plantations on privately owned land.

For the purpose of forest conservation and hill-side stabilization, benzoin production seems an interesting option. The extensive experience of Agroforex and, to a lesser degree, S.DFORES in community work and Styrax extension could be leveraged for further expansion. However, the commodity is mainly attractive to certain ethnic and economic groups which may limit its adoption potential. The ideal area for the production of these trees would be privately owned plots that, by village land use plans, have to be forested.

9.Bong bark, (ຢາງບົງ,Yang Bong)

9.1 Overview

Bong bark is harvested from a variety of trees from different taxonomic groups. These include

- Machilus kurzii (syn. Persea kurzii) for bong khao and bong daeng,
- Persea villosa (bong khao nhai);
- Persea umbelliflora (syn. Notaphoebe umbelliflora) (bong khao);
- Actinodaphne cochinchinensis (bong daeng noi);
- Machilus chinensis (bong khao noi);
- Litsea monopetala (bong khao, bong mee).
- Litsea glutinosa (syn. Litsea sebifera, Sebifera glutinosa)
- Machilus gamblei (syn. Persea gamblei)

Lao names include peuak bong, peuak khai, inthava, bong khao, bong daeng, Vietnamese boi loi, Thai yang bong, inthava, and Chinese 秃枝润楠 tu zhi run nan.

The powder of bong bark in pure form or different preparations is known as Joss Powder, Litsea Glutinosa Powder, Jig(g)at powder, Red Incense Powder, Tabu Powder, Gum Resin, Machilus Powder, and Kobuak Powder.

Over-harvesting and shifting cultivation have led to a decline in tree population and many species are now rare or threatened. Growing the trees in plantations has been promoted through Government projects as well as by traders from Thailand and Vietnam.

9.2 Uses and properties

The bark powder is water soluble and can be made into an adhesive, which burns smoothly and evenly. Red bong powder is more aromatic while white powder has better binding qualities and is odorless when mixed and burned with other ingredients. Its qualities make Bong powder especially suited as binding agent in incense and fragrance sticks and cones, as well as mosquito repellent coils. It is also used as glue in carton or particle board production. Mixed with soil, it is used for modeling and molding to make temple statues and household items.

Additionally, bong glue is extracted from the fresh leaves of the tree and the wood is appreciated as fuel wood for household use.

9.3 Production systems

The trees tolerate a wide range of soil conditions, terrains and altitudes. Production is traditionally extensive; trees being harvested in fallow areas. More recent approaches involve planting pure stands of Bong trees, or using them in mixed cropping with banana or rice. The latter two are systems that are meant to compensate for the lag periods of at least 4 years before the trees can be taken into production.

Bong trees mature in five years and stripping can start in year six. Some varieties become productive in 4 years. For harvesting the trees are traditionally felled and the stems stripped. Trees regrow from the cut stems (stools) and within 5 years the coppice cycle can start anew. For replanting, seedlings used to be provided by either DAFO or Vietnamese traders (MAF & ADB, 2014). Sustainable harvesting of bong bark has been promoted, and involves peeling the bark five times a year, dividing the trunk into five vertical sections (ADB & IFAD, 2014). However, this method is not universally adopted as it comes with its own set of limitations (MAF & ADB, 2014).

The bark is commonly sold in the dry season from November to February, as weather conditions facilitate drying during this season (MAF & ADB, 2014).

9.4 Production locations

While in the early 2000s the tree was mainly cultivated in the north of Laos, it found its way to other parts too and by 2013 was used throughout the country (MAF & ADB, 2014). In 2022, only minor trade with Yang Bong has been reported in northern provinces, mainly in Meung district, Bokeo, while the southern provinces, export more than 490 tons to Thailand and Vietnam. According to the 2021 annual reports of the respective PAFOs, no Yang Bong has been harvested in either Sayabouri, Luang Prabang, or Houaphan between 2017 and 2022. However, a large informal trade used to exist, with officially registered bong trade making up only about 1% of the actual trade volume in some districts (MAF & ADB, 2014).

9.5 Production volumes

A five-year-old tree with 10 cm DBH yields about 5 kg of bark. Producers with deeper knowledge of the commodity (e.g., how to judge the quality of the bark, how and when to harvest) derive a higher benefit from this activity and tend to belong to the better-off cohort in the village (MAF & ADB, 2014).

If managed as plantation, one hectare of bong trees can generate an income of about 15-20 million LAK/year. Trees can provide economic yield for up to 50 years. (ADB & IFAD, 2014).

Table 20 provides countrywide production figures for the past years, most of it being produced in the southern provinces.

Table 20: Bong bark production countrywide between 2016 – 2020, (tons)

2016	2017	2018	2019	2020
191.7	855	1345	1035	695

9.6 Production quotas

No quotas have been requested in the target provinces. Quotas requested on national level are provided in Table 21.

Table 21: Quotas requested nationally for bong bark by year.

Product	Quotas (2016 - 2020)				
	2016	2017	2018	2019	2020
Bong bark requested	342	1,100	1,405	935	945

Bong bark approved	-	505	100	120	370

9.7 Processing, Packaging, and Storage

The bark is sun dried after harvesting and bought from the producers by local traders. It is then finely milled into powder. In a further step, bong powder may be mixed with sawdust and perfumed talc-powder to get Kabuak or Joss powder, which serves as the basis for incense sticks. While there exists some processing capacity in Laos, most of the raw product is exported to Thailand and Vietnam and processed there. Further processing into incense requires the powder to be made into a paste adding water and charcoal. Some processors sell this raw incense while others produce a scented and fully packaged end product. Complete processing into incense sticks requires a set of eight machines to produce bamboo sticks; a mill; a raw incense paste mixer; and an incense stick maker, with a total cost of 13,000 to 35,000 USD depending on production capacity. (MAF & ADB, 2014).

The bark itself is normally transported loosely or in bales and storage should be dry and ideally dust free.

9.8 Value chain, prices, and income

Prices for dried bark used to vary from 3000-8000 LAK/kg when the trade was going strong up to about 2015. Contracts in which the payment is advanced based on available trees, with prices of 7000-10,000 LAK/tree were an option for farmers in urgent need for immediate cash.

The yield of dry bong bark is 3150 kg/ha selling for 0.67 USD/kg. The gains from fuel wood equal 145 USD/ha (van der Meer Simo et al., 2020a). The average price development recorded by PAFOs is given in Table 22. While these prices are much lower than those provided above, they indicate relatively high fluctuations.

Table 22: Average bong bark price in Laos.

Average bong bark price (2016 – 2020) [LAK]				
2016	**2017**	**2018**	**2019**	**2020**
1,850	1,200	2,300	2,300	1,800

Source: PAFOs, 2021

The supply chain for bong bark as presented in earlier studies is given in Figure 17. It is not clear to what degree even basic processing such as milling actually happened in Northern Laos. The only indication of bong bark trade in the North the study team came across was given by the Election Import-Export Co. Ltd in Sayabouri, which used to trade in bong bark, exporting to Thailand. From Thailand the bark would then be shipped to China. The company used to export about 70-100 tons per year. They have currently still 1 ton sitting in their warehouse in Laos and about 20 tons in Thailand because the demand in China has plummeted (see under Main Destination Markets).

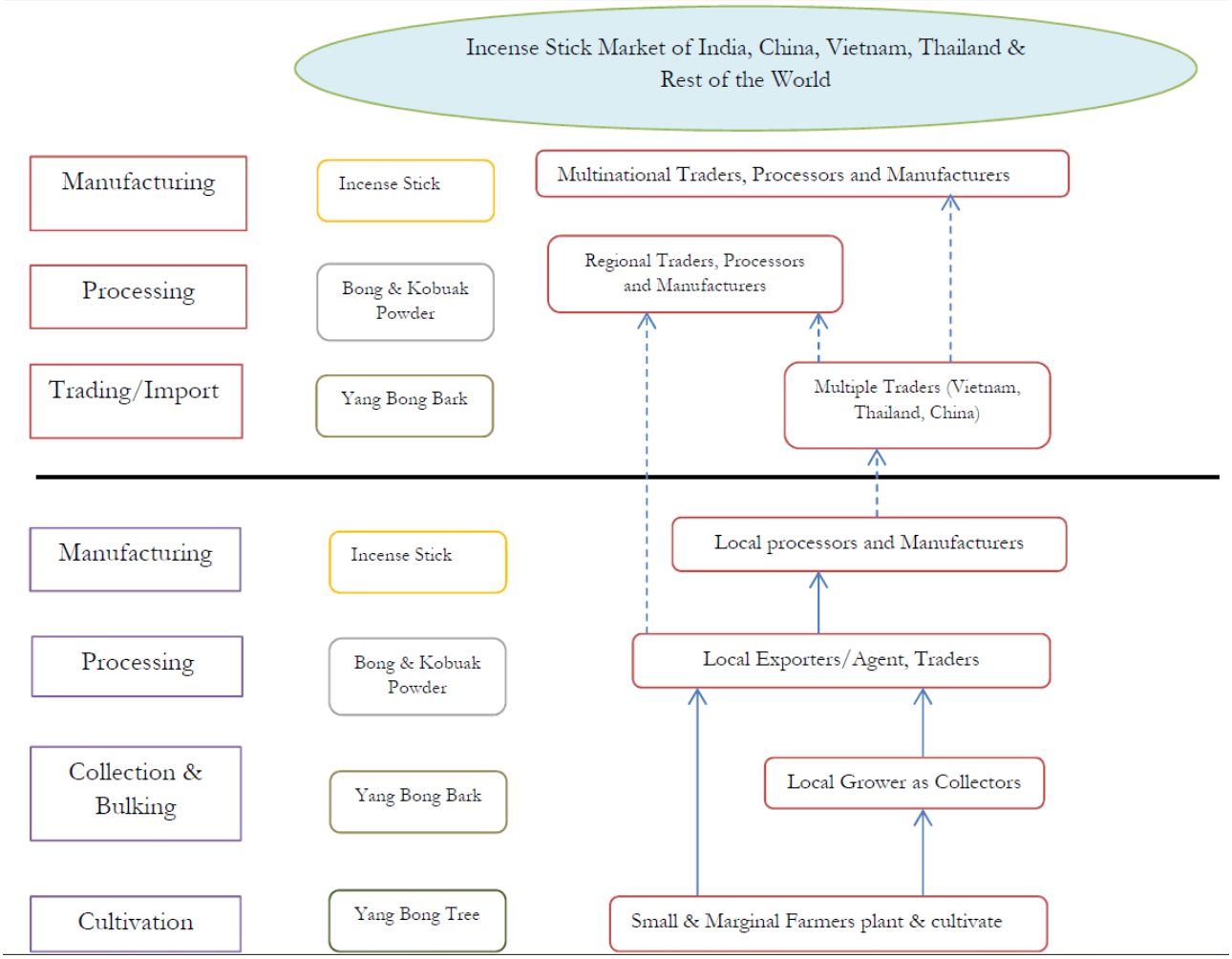


Figure 17: General value chain for bong bark (MAF & ADB, 2014).

9.9 Standards

None.

9.10 Legal Elements

Not explored.

9.11 Main destination markets and demand

Bong bark products find high demand in Thailand, Vietnam, China and India. However, the Election Import-Export Co. Ltd in Sayabouri used to export bong bark to China but had to re-orient towards Paper Mulberry, as their former buyers have replaced bong bark with another material. What this material is could not be determined.

9.12 Constraints

Constraints related to bong bark production are:

- Most trees harvested now are of older age, so a depletion of current stock seems to take place

- Farmers but also other parts of the supply chain are unorganized
- Supply quantities are small
- Infrastructure support is poor and less than adequate (MAF & ADB, 2014)
- The Bong market is relatively small and thus prone to price fluctuation and saturation (van der Meer Simo et al., 2020a)
- Compared to similar commodities such as paper mulberry, bong bark is low-priced

9.13 Recommendations and potential

Recommendations related to bong bark production are:

- Whilst land lease and cash crops are far more profitable and reliable than planting bong, most households prioritize food security and livelihood diversification over income maximization (van der Meer Simo et al., 2020b)
- Tree growing is used to secure land rights, following the GoL policy to move from swidden to permanent agriculture

Though this latter point is of definite relevance to projects focusing on forest protection and land use planning, it is questionable if bong is the best option for this purpose. If alternative materials to bong bark are indeed widely adopted, it is not unlikely that bong will largely disappear as traded good over the next couple of years.

10. Paper Mulberry (ເຈ້ຍບໍ່ສາ, Por sa)

10.1 Overview

The bark of paper mulberry trees (*Broussonetia papyrifera*) is the source of raw fibers for the production of paper. Usually, the trees are felled to harvest the bark, but as long as the roots are not cut, the trees re-grow fast and multiply quickly, ensuring sufficient supply. The bark of paper mulberry trees used to be mainly harvested in the provinces of Luangnamtha and Oudomxay, in the early 2000s, from where it was exported raw or as pulp to Thailand and Vietnam. A smaller part was processed in Laos, mainly in Luang Prabang Province, and sold on the domestic market in the form of paper products (lampions, cards, books, paintings, umbrellas, bags, boxes). The processing is done almost exclusively by women. Domestically, customers used to be mainly tourists and expatriates, but also Lao households. High potential is seen for its processing in Lao PDR and exports in the form of value-added paper products (Wiemann et al., 2009) but only isolated improvement in this direction has happened in the past 13 years.

10.2 Uses and properties

Being a tree crop, paper mulberry can be used for systemic purposes such as erosion prevention, soil improvement and weed suppression, while also having economic uses as animal feed (pigs, ruminants), cash income from bark, and fuel wood (Neef et al., 2010). Bark grades A+ and A are used to produce specialty papers (banknotes, liturgical objects) while grades B and C are sold to paper manufacturing plants for handmade paper and a variety of paper products, such as boxes, envelopes, picture frames, paper strings, lamps, and umbrellas (Neef et al., 2010; Ribeiro and Darnhofer, 2007).

10.3 Production systems

Paper mulberry is grown in three different ways: in natural stands, cultivated stands and inter-cropping systems. Paper mulberry bark harvested from natural stands is considered an NTFP and mainly found in secondary hillside forests. Whereas Neef et al. (2010) reported that natural stands have become increasingly depleted, today, the trees are so common that they are rarely planted. If traders order bark, farmers tend to harvest it from their fallow areas (DAFO Nambak).

Bark harvest does not follow a strict timeline and can be adjusted to market price and labor availability, allowing farmers to decide when to invest time in collecting and processing the bark. However, the need for drying limits it effectively to the dry season. Whilst the bark used to be collected during two periods, in the late dry season from March to April, the main harvest season, and at the end of the early dry/cold season in October-December (Ribeiro and Darnhofer, 2007), now collection seems to happen throughout the dry season.

Most farmers harvest bark only from the main stems, and only occasionally bark is collected also from branches (Neef et al., 2010). Following the harvest, the bark is cleaned, dried and graded, with harvesting and cleaning being labor intensive activities. Proper drying is crucial for obtaining good quality and higher prices. Product quality can be improved by boiling the fresh stems before stripping the bark, and by using machines to strip and clean the bark. These activities could be the basis for developing small-scale enterprises. Despite low prices, many farmers harvest paper

mulberry bark because it is easily accessible and can be done at any time without affecting other income opportunities (Ribeiro and Darnhofer, 2007).

Integrated teak–paper mulberry growing without thinning was found to be the most profitable fallow conversion when using income per area as metrics. It ranked in the midfield when looking at returns to labor (Anttila, 2016).

10.4 Production locations

Paper mulberry prefers moist alluvial soils, making river and stream valleys or moist lowland areas the best places for this tree to grow. A decline of forest resources and over-harvesting have led to some farmers growing paper mulberry in their home gardens, upland rice fields and fallows. Growth rates in upland areas are lower than in lowland areas where it is possible to reap the first harvest 6-8 months after planting the trees in comparison to 10-12 months in the uplands (Neef et al., 2010).

Figure 18 shows production locations in Luang Prabang province as identified by DAFO staff.

10.5 Production volumes

From cultivated stands, up to 500 kg of bark have reportedly been harvested per hectare but reported averages per family range between 50 and 100 kg per year. One farmer can harvest 10-30 kg of fresh bark per day. Even though bark of younger trees is preferred by traders as they get graded higher, farmers prefer older trees to get more weight per unit of labor (Neef et al., 2010).

From an average of 15 kg of fresh bark collected in one day, 9 kg of dried inner bark can be obtained after labor-intensive, manual cleaning and sun-drying.

The annual production volume of paper mulberry since 2009 recorded by PAFOs has been surprisingly stable between 300 and 400 tons per year (). However, the accuracy of these data is highly questionable, as we found significantly higher production figures in this study alone. The figures on production at district level seem to be more credible in Luang Prabang (Table 24), which confirm the same general trend of production and thus market stability. It was also indirectly confirmed by our interviewees, many of which have been trading in paper mulberry for many years.

Table 23: Paper mulberry bark harvested in Laos countrywide per year (tons)

Production in tons (2016 - 2020)										
2009	**2010**	**2011**	**2012**	**2013**	**|**	**2016**	**2017**	**2018**	**2019**	**2020**
350	250	330	331	440	**|**	335	350	238	392	800

Sources: PAFOs, 2021,

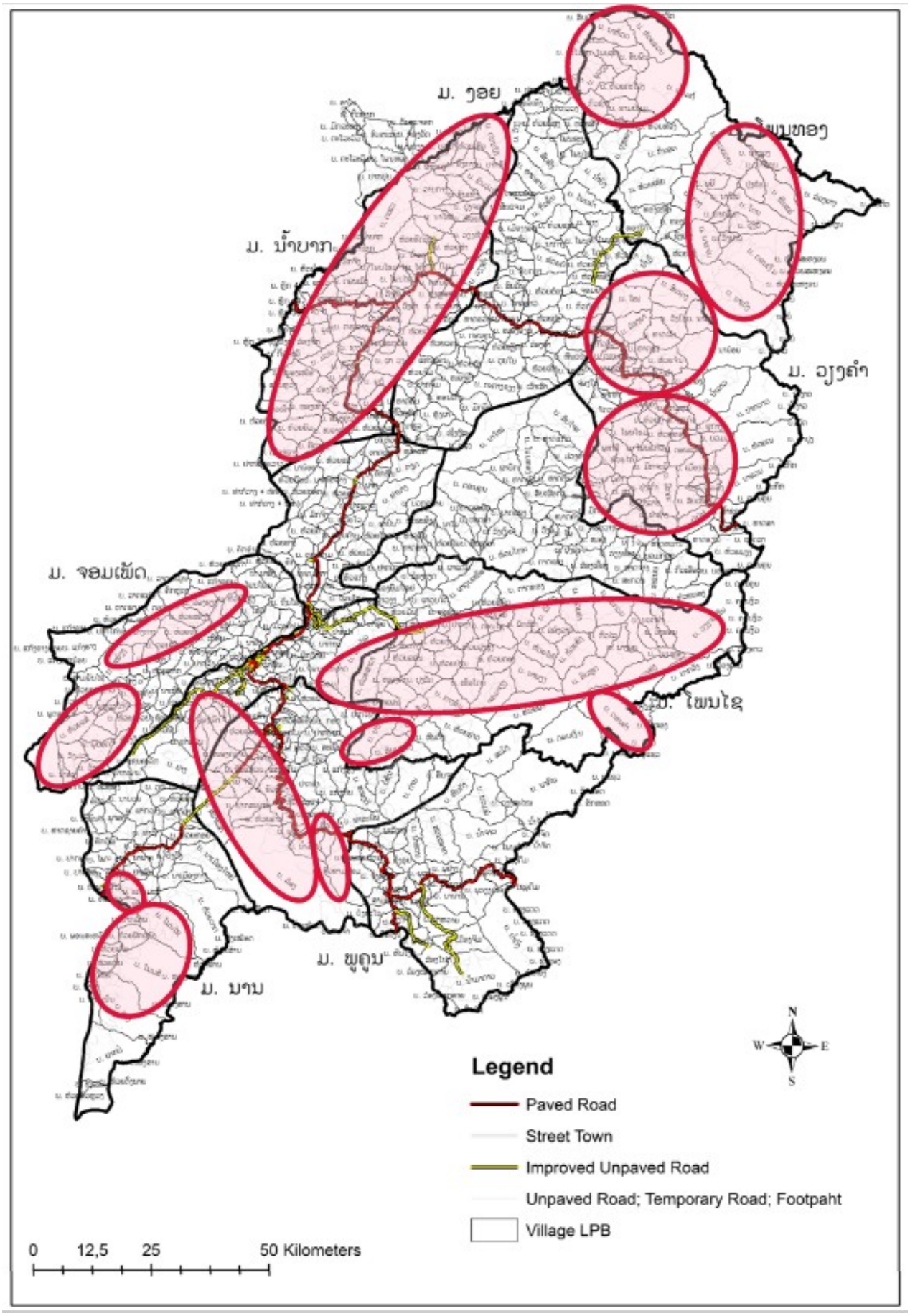


Figure 18: Paper Mulberry production locations in Luang Prabang province.
(Source: DAFO interviews)

Table 24: Production volumes in Luang Prabang province per district (tons)

Districts	Production volume, reported by DAFOs 2016 – 2020 (tons)				
	2016	**2017**	**2018**	**2019**	**2020**
Nan	100	-	-	-	-
Xieng Ngern	50	100	100	100	100
Phonxay	60	-	-	-	-
Pakxieng	-	100	100	100	100
Ngoy	-	-	-	-	70
Pak-Ou	50	30	-	70	49
Luang Prabang	50	20	30	30	50
Total	**310**	**250**	**230**	**300**	**369**

Source: PAFOs, 2021

10.6 Production quotas

Production quotas approved nationally are summarized in Table 25. Surprisingly quota approval has been relatively consistent below requests. However, neither requests nor approval seems to reflect actual production and export volumes even closely.

Table 25: National production quotas for paper mulberry bark.

Product	Quota (2016 - 2020)				
	2016	**2017**	**2018**	**2019**	**2020**
Request	338	373	298	532	663
Approval	-	250	308	170	253

10.7 Processing, Packaging, and Storage

Stems are normally cut about 40cm above the ground. The bark is pulled from the stems and occasionally from the branches. Then farmers carry the bark back to the village where they have to strip the outer bark off as soon as possible as peeling off the drying bark is very difficult. After peeling, the inner bark is dried for two to three hours and stored away until sold.

The number of quality grades traders distinguish depends on their business model. A maximum of four quality grades can be distinguished: A+, A, B and C. Only high-end markets grade that finely and even then, the exact definitions for each grade may vary (Table 26). Average traders use much simpler approaches, such as:

Grade A: soft bark (age ≤ 1 year), easy to peel off;	Grade A: bark from young trees,
Grade B: Hard bark (age 2 ≤ 1 years);	Grade B: bark from old trees,
Grade C: Very hard bark (age > 2 years).	Grade C: mixed bark

Similar to many other agricultural commodities, bark that has not been dried well leads to income losses for upstream stakeholders, given that it is traded per kg. This makes dryness a strong price setting criterion, independent of other quality criteria.

Table 26: Quality specifications of all grades of paper mulberry bark for high-end processors

Criteria	A+ Japan	A+ Thailand	A Japan	A Thailand	B and C Japan	B and C Thailand
Age	Mature, 1 year old and soft	5-6 months	Mature and less mature, 1 year old	Max. 1 year old	Over 1 year old and tough	> 7 months
Stripping method	Fresh stripping	Boil bark before stripping	Fresh stripping, steamed before stripped	Boil bark before stripping	Fresh stripping, steamed and burned before stripping	n.s.
Length	Fully grown stem min. 1m	Max. 1 meter	Mix of long and short stem	n.s.	n.s.	n.s.
Front color	White	White	White, light green	n.s.	Light brown	n.s.
Back color	White	White	Light brown	n.s.	Dark brown	n.s.
Dark skin	none	none	1-2 per bark	n.s.	More than grade A	n.s.
Joints	none	n.s.	1 per bark	n.s.	More than grade A	n.s.
Bruises	none	n.s.	none	n.s.	with and without	n.s.
dirt/mold	none	none	none	none	none	none
Dryness	Fully dry	Fully dry	Fully dry	Fully dry	Fully dry	Fully dry
Sorting	Less than 10 % mix of A	n.s.	Less than 10% mix of B	n.s.	No sorting All grades mixed Grade B only Grade C only	n.s.
Weight	Fully dried product and weighing 1% more than designated weight during the time of bundling	n.s.	Fully dried product and weighing 1% more than designated weight during the time of bundling	n.s.	Fully dried product and weighing 1% more than designated weight during the time of bundling	n.s.
Pressing	Bundled neatly parallel to the long lever of the pressing equipment and are not over pressed	n.s.	n.s.	n.s.	n.s.	n.s.

(Ribeiro and Darnhofer, 2007)

The processing of bark involves the following steps (based on Ribeiro and Darnhofer, 2007):

- soaking in water to soften and clean
- cook in caustic soda and rinse with water to spread the fibers
- bleach with hydrogen peroxide (less harmful for environment) or chlorine (cheaper)
- beating of the fibers to produce pulp, which is washed again. Color can be added

- Packing for export or spreading on cotton or plastic mesh screens for sun drying

One ton of dried bark results in about 900 kg of pulp as the high water content of 30% in the pulp compensates for losses during cleaning and processing. Losses are around 10 to 15% of total weight. The process is essentially the same in artisanal and industrial production. Commercially, the pulp is normally packaged in vacuumed sealed plastic bags of 15kg, and two bags might be combined into a 30kg wrap. One container can hold up to 600 30kg wraps (18 tons). Weight loss rate during packaging and pre-export is again about 10%.

When processed into paper, one kilogram of dry bark gives 7 paper sheets (price: 3000 LAK/sheet).

10.8 Value chain, prices and income

Village collectors (brokers) normally buy the bark from farmers in their own and from nearby villages and pay farmers directly. They either transport the bark to district traders or act as collection points. District traders buy from both brokers and farmers and sell to larger traders, exporters or processors. Some companies prefer to buy the bark in a compressed or baled form for reasons of efficiency, which might prevent some district traders from selling to them. It is common to have only one grade and respective price at this level, and only some stakeholders distinguish different qualities. Large traders and processors act as accumulators, buying bark from several districts and organize transport logistics at scale (Neef et al., 2010).

The supply chain goes mostly to Thailand, China, and South Korea, and to a lesser degree ends up in Luang Prabang (Figure 19).

In the entire commercialization process of paper mulberry, Thailand in 2010 transformed an imported raw material worth less than 1 million USD annually, into paper products worth around 50 million USD (Neef et al., 2010). In 2022, bark is still the most exported paper mulberry product from Lao PDR, and paper products are only beginning to be produced at a commercial scale (Table 27). However, traded volumes are substantial, and all traders mention that they could buy more or can’t find enough.

Table 27: Export volumes by different companies trading paper mulberry

NTFPs Exporters	District	Product types	Volume (tons/year)
Mulberry Pulp Dream International	Luangprab.	Paper pulp	215
Phethrama Mulberry Company	Luangprab.	Paper pulp, sheets	200
Agriculture trading and extension Co.	Pak Ou	Dry bark	1000
Mrs Sysamoud	Pak Seng	Dry bark	200
Agricultural Fruitage Development IMP-EXP Co	Luangprab.	Dry bark	80
Mr. Xiengthone	Viengkham	Dry bark	50
Mr. Pheuy	Ngoy	Dry bark	100
Total			**1,845**

See Annex 7 and the full Company Profiles for details on these exporters.

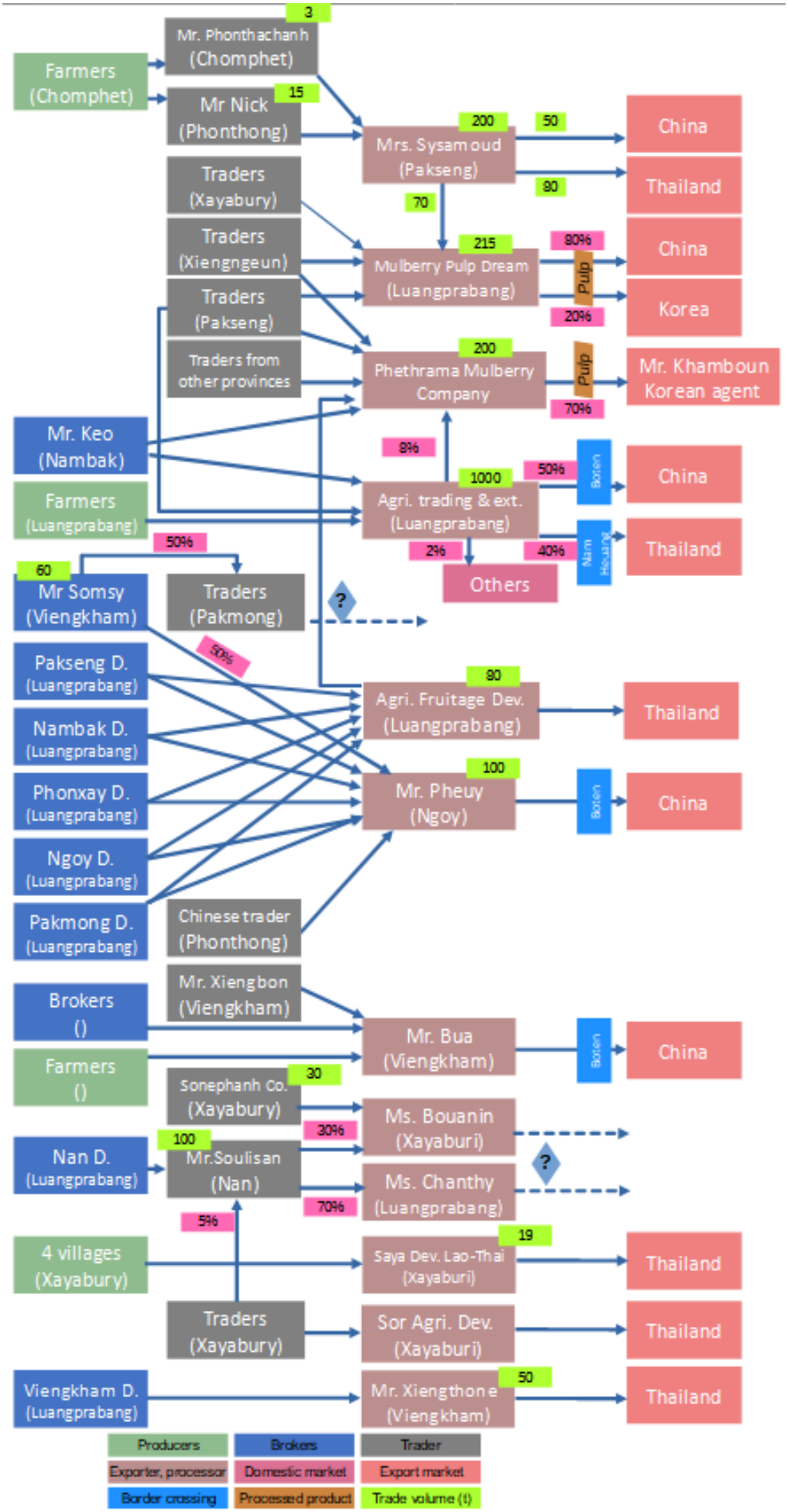


Figure 19: Paper mulberry supply chain in the target provinces (abridged)

On average, prices for paper mulberry bark seem relatively stable (Table 28). They vary not only slightly from year to year but also on a monthly basis, with prices slowly increasing from February on until they reach their peak in May, mainly because the warm and sunny conditions allow for good drying.

Table 28: Average prices for paper mulberry reported by PAFO

Average price of Paper Mulberry bark (2016 - 2020)				
2016	**2017**	**2018**	**2019**	**2020**
3,000	3,000	3,250	3,000	3,500

Source: PAFOs, 2021

They also vary slightly from location to location, either due to remoteness or other factors. In Chomphet district (Luang Prabang), for example, the bark is normally bought for 4,000-4,500 LAK/kg and sold for 5000 LAK/kg, but in 2022 the price rose to 5,000-6,000 LAK/kg for buying and 6,000-6,500 LAK/kg for sale. Where premiums are paid for higher grades, additional price gains of up to 200% can be paid.

Higher up in the value chain, one reason for price variations is the varying number of intermediaries in the chain.

As to export prices, Saya Development Lao-Thai cooperation company distinguishes 3 grades for export to Thailand:

- Grade A: bark from young trees: 28 – 29 THB/kg at the border gates.
- Grade B: bark from old trees: 22 – 23 THB/kg at the border gates.
- Grade C: mixed bark: 24 – 25 THB/kg at the border gates.

If export is done through a company with an export license, export costs will amount to about 1,600 LAK/kg.

Price development along the value chain was documented for 2010 (Table 29). We could not provide a complete analysis in this study but our data give indications of price variations along the value chain and by location (Table 30).

Table 29: Price development in LAK determined in 2010 (Neef et al., 2010).

Item	Farmer	Village collector	District trader
1 kg of dried bark	2700	3000	4455
Gross margin	2700	300	1465
Opportunity cost	1100	–	–
Transportation cost	–	72	500
Taxes and fees	–	–	400
Net profit	1600	228	565

Table 30: Selling prices in LAK/kg for dry paper mulberry bark in 2021 (from interviews)

Location	Farm gate	Broker	Trader	Exporters
Pakxieng district	5000 - 6000			
Luang Prabang		6500	7500	14,000 - 18,000*
Park Ou district	3000 - 5000		5,500 - 5,700	
Nambark district Ban Namtoum	5000	6,700 - 6,800		13,000 - 15,000
Nambark district Ban Mouang Nga	5000	6300 - 6400		
Viengkham district	3000	3500-4000	4,500 - 5,000	12,000
Phongthong district	3000		4500	
Chomphet	6000	6,500	7,500	
Ngoy district			5800	10000

*= pulp

Processed products sell at higher prices, with paper sheets selling for 3000 LAK/sheet. Seven sheets can be made out of 1 kg of bark, giving it the equivalent price of 21,000 LAK/kg of mulberry bark.

10.9 Standards

No specific standards apply for bark, apart from quality standards. For paper pulp, some importers would require environmental standards to be met, such as wastewater treatments etc. However, currently this does not seem to be an issue in the supply chain.

10.10 Legal elements

No specific legal regulation applies.

Paper mulberry is taxed under the general tax laws outlined under the chapter on taxes.

10.11 Main destination markets and demand

The demand for paper mulberry products was found to be high (e.g. Simppula, 2020), a finding supported by all exporters interviewed in this study, mentioning that they can sell any quantities they can purchase. Major markets are Thailand, Vietnam, China, South Korea, Japan, Central Asia, and Europe. Even though rarely tapped into, there seems to be a large potential demand in Europe and Central Asia, which is explored by some companies (e.g. Mulberry Pulp Dream International).

Markets for mulberry paper products from Thailand are in Japan, Europe and North America. Although the Japanese market is the largest, it is also the most demanding as to quality requirements.

10.12 Constraints

While exporters would like to buy much more, the value chain suffers from some inherent problems:

- The bark sells at low farm gate prices relative to the amount of work required for harvesting
- The volume of bark production could be higher
- The quality of the bark is too low or inconsistent
- Cleaning of the bark does not meet expectations
- No mechanization in harvesting and cleaning, and no mechanization available
- Contracts are sometimes not honored or do not exist, leading to uncertainties for upstream stakeholders
- Lack of understanding of the value chain among producers
- No production of quality end-products in-country

10.13 Recommendations and potential

In 2010 the following observations were made:

- High quality bark can promote the establishment of contracts, guarantee stable prices and higher demand, and thus lead to better income, benefiting all stakeholders
- A positive correlation between the number of female family members and family cash revenues from paper mulberry was found, which implies that paper mulberry is predominantly an income opportunity for women (Neef et al., 2010)

Paper mulberry could have very high potential indeed, if the harvesting process could be facilitated. Some companies even invest in their own research teams on mechanization solutions but until now the arduous manual labor of harvesting and cleaning is rewarded sufficiently to make paper mulberry a truly attractive alternative to other cash crops.

From a biological point of view, the small tree grows extremely fast, proliferates well, without additional labor input and can compete with most weeds. Its preference for rather moist soil conditions makes it only partially suitable for upland conditions.

11. Rattan (ໝວ໋ດຕະພັນຫວາຍ)

11.1 Overview

At least 32 rattan species are known in Lao PDR, with six high value species: *Calamus poilanei* (Wai Thoun), *C. nambariensis* (Wai Niew), *C. gracilis* (Wai Hom), *C. palustris* (Wai Am Hang), *C. viminalis* (Wai Khom) and *C. solitarius* (Wai Thok). Rattans are climbing palms of two types: solitary rattans (with only one stem) and clustering rattans (with several stems). Wild stocks of rattan have been declining throughout Lao PDR and Southeast Asia due to deforestation and excessive exploitation. Some species are now threatened, prompting initiatives to domesticate and cultivate rattan (Khamhoung and van Gansberghe, 2016). For production purposes, the choice of species will depend on the end-product a farmer wishes to produce. Rattan can be grown for the production of canes or poles and for its edible fruits and shoots. Edible shoot production has been progressively introduced in various villages of the country since 1994 and reached about 300 ha in 2012 (Khamhoung and van Gansberghe, 2016).

11.2 Uses and properties

Rattan cane is mainly used for furniture and handicrafts. The most important large-diameter rattan species for cane production in Lao PDR is *Calamus poilanei* (Wai Thoun), while the most cultivated species for edible shoots is the small-diameter species *Calamus tenuis* (Wai Nyeh) (Khamhoung and van Gansberghe, 2016). Rattan is much preferred as high-quality material over bamboo, as it has a finer texture, is better moldable, and is not attacked by insects or fungi. Its versatility allows a wide range of uses, from fine screens and wickerwork to paneling and large pieces of furniture such as beds and wardrobes. However, to fully take advantage of its quality traits, knowledge and skill are necessary.

Some species are exploited for both canes and shoots (Khamhoung and van Gansberghe, 2016). The shoots are eaten boiled, roasted, or dried, as an accompanying vegetable or snack with dip. The tardy fruits of some species are mainly sold for medicinal purposes.

11.3 Production types

Two main production types are distinguished: (1) wild rattan, mainly producing cane rattan that is collected from communal forest, and (2) cultivated rattan, with production of edible shoots mainly for the domestic market (only a few species are domesticated and cultivated). Edible rattan shoots can be harvested within two years after planting, whereas rattan for cane production takes at least six to seven years (Khamhoung and van Gansberghe, 2016), but can take significantly longer (11-15 years). The harvesting itself is season independent. Wild rattan is often just cut as a by-product of scavenging or hunting excursions into the forest. In such systems one person can carry up to 50 meters of canes per day.

Traditional harvesting practices are destructive, as both mature and immature stems are cut. Only mature stems 5-20 years of age bear fruits, so natural regeneration is restricted. Reproduction is especially poor for solitary rattans as the plant dies with the harvest of the shoots. Clustering species with multiple stems regenerate reasonably well, every three to five years. Over-harvesting of clustering species inhibits the formation of new clumps and taking too many young canes lowers economic productivity (Khamhoung and van Gansberghe, 2016).

Wild rattan requires a solid forest management plan that allows to estimate harvest volumes year by year. In order to remain sustainable, only about 20% of the available rattan canes can be harvested each year, but growth rates vary from area to area, which means that harvest volumes need to be adjusted to local conditions. This is especially important for single stem species but also affects how many stems in clumping species can be harvested. (pers. comm. B.P., WWF)

Cultivated rattan is less common as it requires shade trees. A combination with Eucalyptus might be possible but no data on feasibility in Laos exist. (pers. comm. B.P., WWF). However, other countries in the region, especially the Philippines, have developed some expertise in the sector, facing similar problems while at the same time having a substantial rattan industry. Climate type I in the Philippines compares to the Lao climate.

11.4 Production locations

Rattan grows best in deep, fertile alluvial soils with high moisture and organic content. The best sites are observed to be either sandy clay or clay loam. Rattan thrives best in soils with pH of five to almost neutral. However, in some areas where soil acidity is high, rattan exhibits fast growth once the forest canopy is opened to allow sunlight to reach seedlings. The plant has a wide distribution and altitudinal range from 200 to 2900 m asl. Though slopes too steep might be problematic for cultivation (ATIK, 1992).

As a climbing palm, rattan requires other trees to thrive. These can come in the form of forests or residual forests, private or communal tree plantations (e.g., rubber, teak, eucalyptus, coconut), reforestation or re-growth areas not scheduled for harvesting for the next 15 years.

In Laos, rattan grows widespread in many provinces and districts. While its use is not extensive, deforestation has reduced natural populations in many places. Both, in Luang Prabang (Figure 20) and Sayabouri (Figure 21), some areas are still rich production grounds, though. Longxeng village in Sayabouri district for example has been named as being rich of rattan, making rattan shoots one of the main village income sources. However, there is a general lack of suitable forest management for the conservation of rattan forests, which should be well zoned and not mixed with conservation zones.

11.5 Production volumes

Rattan harvesting is mostly done in remote forest zones making the collection of accurate production figures challenging. Official national production volumes for rattan are given in Table 31. However, such aggregated figures do not specify cane size or other uses of rattan.

Harvest quantities largely depend on the opportunity costs of farmers. When prices of other crops such as cassava are high, farmers might invest their time in more profitable crops than rattan. Since rattan does not spoil, this flexibility can be seen as an advantage. It does bring problems for the stability of the value chain, though.

Table 31: National production of rattan

Product	Production of rattan (2016 - 2020)				
	2016	2017	2018	2019	2020
Canes	2000	36680	8695	11802	0
Tons	0	0	10	5	22

Source: PAFOs, 2021.

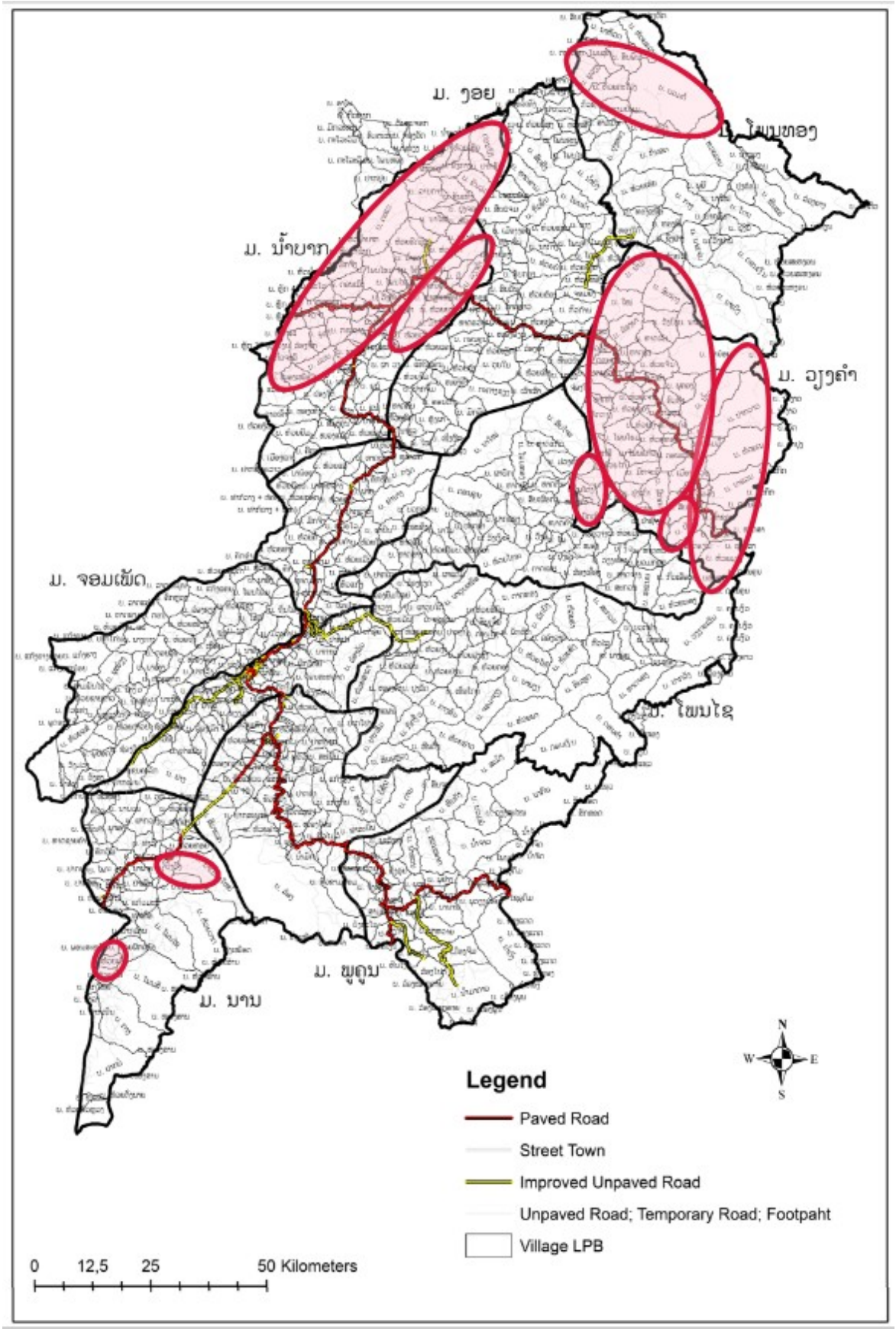


Figure 20: Rattan production locations in Luang Prabang province.
(Source: DAFO interviews)

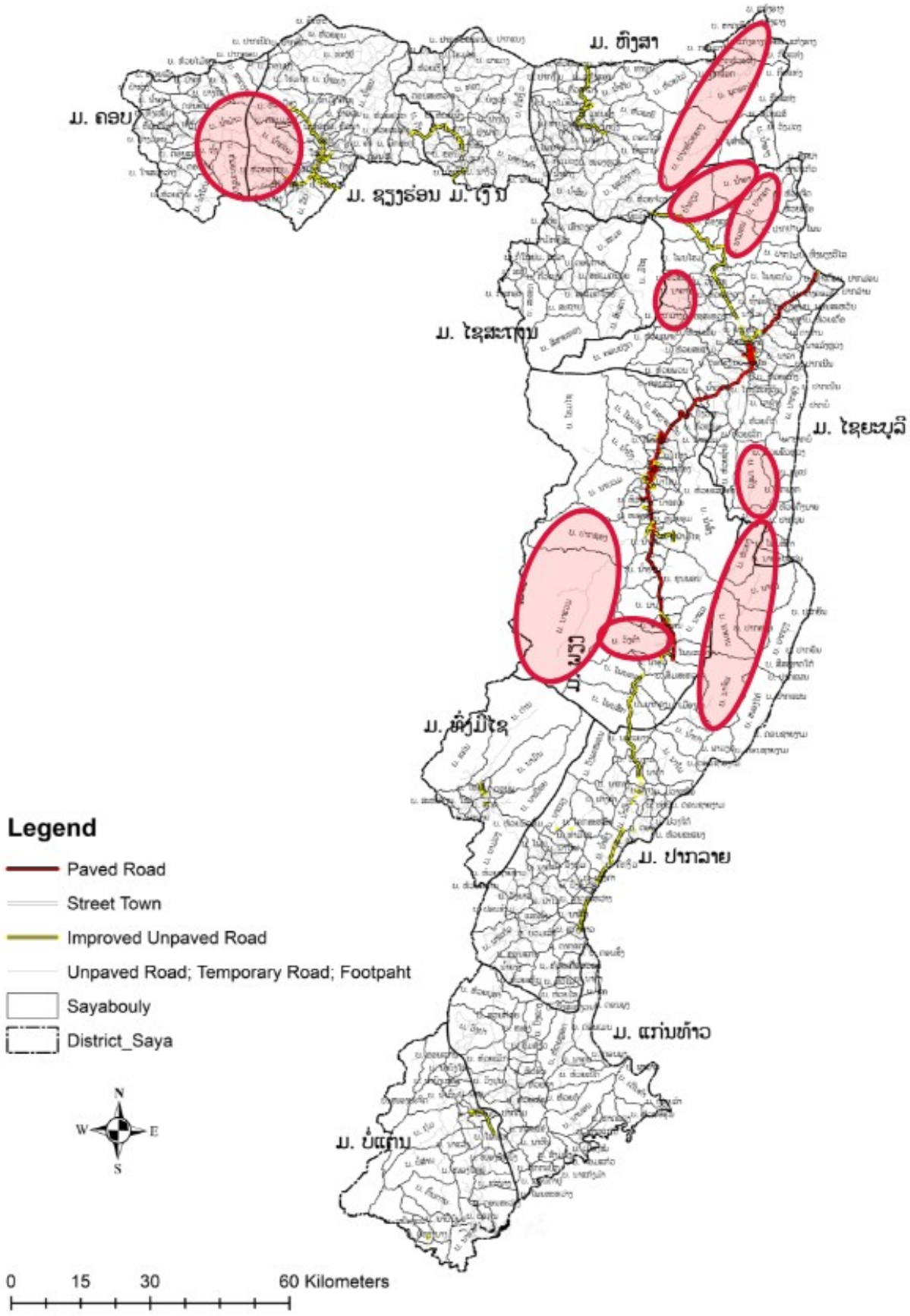


Figure 21: Rattan production locations in Sayabouri province. (Source: DAFO interviews)

On household level, the TABI Project provided some production figures for rattan shoots: 116 households in seven villages in Phoukoud district, Xiengkhuang, planted 19,652 rattan plants on 9.1 ha, producing 4,939 shoots of which 66% were sold, and 34% were consumed (Khamhoung and Gansberghe, 2016).

11.6 Production quotas

As rattan is classified as a forestry product, quotas apply for rattan harvesting. The national quotas for the past years are given in Table 32, and approval rates have lately matched requests relatively well.

Table 32: Quotas for rattan production

Product	Quota (2016 - 2020)				
	2016	2017	2018	2019	2020
Request (canes)	52,000	339,360	288,000	588,000	538,100
Request (tons)	19	5,062	1,694	5,194	7,150
Approved (canes)	-	387,015	356,700	579,268	668,150

11.7 Processing, Packaging, and Storage

11.7.1 Canes

Once the canes are harvested and debarked, they are sold directly or indirectly to a factory or manufacturer. Furniture makers boil rattan canes in a diesel solution for 45-60 minutes at 60-150°C to remove moisture, waxy materials, resins and gums and to improve color and prevent insect or fungi attack. After boiling, the canes are pressure washed or scrubbed with sawdust, and sun dried for 2-3 weeks to remove the remaining dirt and diesel. Subsequently, sulfur is used to provide a uniform color, while stains are removed with bleach. Then the canes are air dried for a period of 50-60 days, before being straightened and tied into sorted and graded bundles. Grading is based on diameter and condition: Rattans under 3 cm are small-diameter canes, otherwise they are graded large diameter. Defects due to fungal attack or dirt during storage (e.g storage on moist ground) lead to downgrading (Khamhoung and van Gansberghe, 2016).

For manufacturing furniture and handicraft products, the canes are bent under steam into desired shapes in molds.

In Hongsa, Sayabouri, furniture producers distinguish different quality grades, which are based on rattan species. Wai Khane is considered Grade A, and Wai Thoun Grade B. There is also Wai Hom, a small type of rattan which producers know of, but which is not found in Hongsa.

11.7.2 Shoots

Shoots are peeled out of their spiny bark and the cores of the stems are cooked. Fresh shoots can be kept for several days. Shoots may be boiled or steamed, and then sun dried. Seven to eight kilos of fresh shoots (200 shoots) give about 1 kg of dried rattan shoots (Khamhoung and van Gansberghe, 2016).

Producing dried shoots at a more commercial scale requires you to select the tender parts of the shoots and cut them into 40-50 cm long pieces, which are boiled for 25 minutes. The harder outer layers are then removed and the shoots oven dried for 1-3 days. This is followed by sun drying for

1-3 days until the shoots are completely dry, after which they are ready to be packed and sold. This process is quite energy intensive and for boiling and drying firewood is commonly used as fuel.

However, incorrect processing leads to a change of color or stripping, which makes the product unsellable.

11.8 Value chain, prices and income

Farmers manage their production forest on community level and sell raw rattan as end-products to companies and traders. Factories or middlemen buy canes from farmers for about 1000 LAK per meter for 1 cm diameter, and 3000 LAK per meter for 3 cm diameter canes in Hongsa district, Sayabouri. However, these figures seem rather on the low side compared to those given by PAFO (Table 33).

Table 33: Average prices for rattan canes

Product	Average Price (2016 - 2020)				
	2016	2017	2018	2019	2020
Large canes	5,500	5,500	5,625	6,500	5,400

Source: PAFOs, 2021

Canes are either exported to Thailand, Vietnam or China, or are used domestically for furniture production. Value chains are mostly simple and short, furniture makers often buy canes directly from producers and sell their products to urban shops or directly to consumers. Traders buy from brokers and export directly. The amount of income generated from rattan is difficult to quantify due to a general lack of official statistics (Khamhoung and van Gansberghe, 2016). One of the few examples of export for finished rattan products come from project work from WWF, focused on producing rattan baskets for the Swiss market. For the purpose of export, the project helped to set up rattan FSC certification leading to the two value chains shown in Figure 22.

Income per household can range from 100,000 LAK per month in simple systems, to 6 million LAK per months where high value items such as handbags are produced.

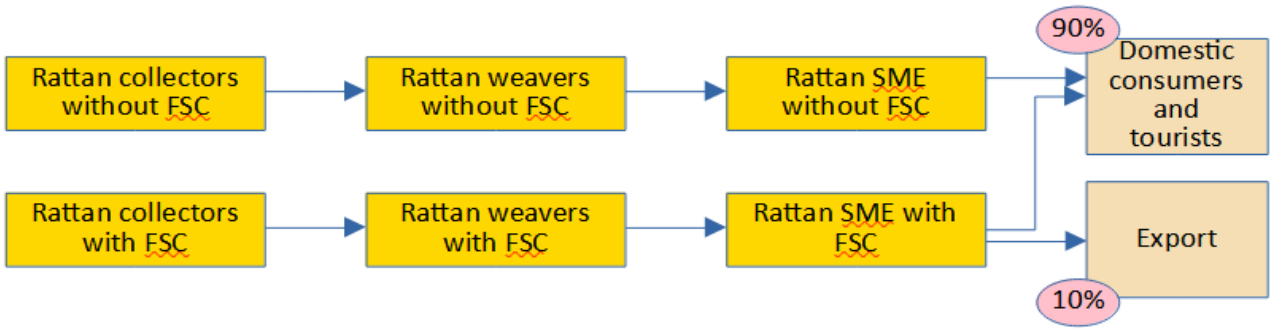


Figure 22: Rattan value chains, adapted from IDC (2016).

In the project, 125 villagers participated in the rattan basket production to produce 15 000 baskets over the period of one year. The total value of all rattan basket exports was USD 166,820 or 1,4 bn LAK. Per person income was 42.19% of the total value (USD 70,381 = 598,241,543 LAK), which equates to roughly 80 USD per villager per year.

Table 34: Revenue sharing among key actors in the WWF rattan production for export project

Key actor	Revenue [%]	Total Revenue [USD]	Annual Revenue [USD]
125 villagers + Village and community	42.2	70,381	10,054
Government taxes	14.2	23,705	3,386
Danlao Staff	6.7	11,177	1,597
Administration expenses	16.6	27,609	3,944
Third parties	16.5	27,509	3,930
Danlao Net profit	3.9	6,439	920

(Thammavong and Vongkhamsao, 2018)

While the approach seemed promising, the production process was complex, involving many steps (Figure 23) and a lot of project support. The sustainability of the systems is still in question because the FSC certification cannot be maintained by the project beneficiaries without external support.

Figure 23: Project production process for rattan baskets. (Based on Thammavong and Vongkhamsao, 2018)

For dried rattan shoots some export to Thailand exists, but quantities are small, and production can be characterized as artisanal. The farm gate price for shoots ranges from 1,000-2,000 LAK/shoot (depending on size, location, and demand), total investment for production of 1 kg of dried shoots is slightly below 1000 THB, while the kg sells for 1,000-1,500 THB.

There also seems to be a high risk of over-exploitation as rattan regenerates slowly and a large number of shoots are needed per kilogram of produce.

While rattan and bamboo are often lumped together in the same category, in Laos, many more people are involved in bamboo harvesting, processing and trading than in rattan. (IDC, 2016)

11.9 Legal elements

Similar to bamboo, taxes and fees on rattan are very high and can amount to more than 100% of the resource cost, which thus reduces the viability of rattan certification as well as its competitiveness on the international market. While the problem is understood in provinces where WWF worked, other provinces might be less aware of it. There are differences between different villages and production groups, which largely depend on negotiations by traders with the local governments, as they are the ones who have to pay the taxes.

Shoots are tax free, which is one of the reasons why they are the most common rattan product in the country.

A detailed expenses calculation is presented in Error: Reference source not foundError: Reference source not foundError: Reference source not foundError: Reference source not found.

11.10 Standards

No standards for rattan are required for export to neighboring countries. For Europe some sustainability certification is necessary, such as the FSC.

11.10.1 Forest Stewardship Council (FSC) Rattan certification scheme

An example of FSC certification in the rattan sector was a company with 80 rattan weavers in four villages supported by the WWF. The WWF worked with several wood and rattan companies on FSC certification (IDC, 2016).

The certification scheme is a Forest Management certification and can be provided for a group, such as a cooperation, farmer group, association, as well as to other legal entities such as companies. The scheme also allows the certification of NTFPs. While group certification is designed to reduce costs and increase opportunities for forestland owners/forest managers to participate in FSC certification by distributing the costs of certification among a large number of forest landowners, the certificate will be withdrawn if only one group member fails to meet the standard of FSC. However, being a member of a certified group does not automatically confer membership in the certified pool, thus, the group entity must have an internal monitoring scheme and plan to ensure that all the members in the group meet the requirements of FSC (Souksompong Prixar, 2014).

FSC-certification was achieved successfully with project support but certification has expired in 2021 and has not been renewed. Without project support certification is prohibitively expensive and beyond the management capacity of rural communities. Economic feasibility can only be achieved by combining rattan and timber production and thus raising the overall cash volume entering the production systems (interview with B.P., WWF).

11.11 Main destination markets and demand

The world’s rattan sector is estimated to generate global revenue of USD10 billion annually. Global demand for rattan products is strong, and new designs for rattan furniture and basketry products continue to appeal to modern consumers. Indonesia remains the major rattan product exporter, but China and Vietnam are increasing their share of global rattan trade despite being short of raw

rattan, whilst the Philippines, Myanmar, Malaysia, Thailand, Cambodia and Laos have plentiful resources but export in only relatively limited quantities (INBAR, 2015).

Over the past 30 years, a lot of rattan cane has been exported from Lao PDR mostly to Vietnam, China and Thailand. Now, most of the rattan raw material is exported, particularly to Thailand and Vietnam. What is not exported is used for local rattan furniture production, which is sold in the domestic market with production taking place year-round. A still smaller segment is used for rattan handicrafts: baskets, lamps, and home accessories. The quality of rattan weaving is mostly inferior to the international competition (IDC, 2016).

The rattan export market is volatile as Laos is not competitive with its neighboring producers, mainly due to high taxes and fees, and a cumbersome export process. Additionally, rattan products made in Laos do not meet export standards, all of which is reflected in INBAR rattan trade data (Figure 24).

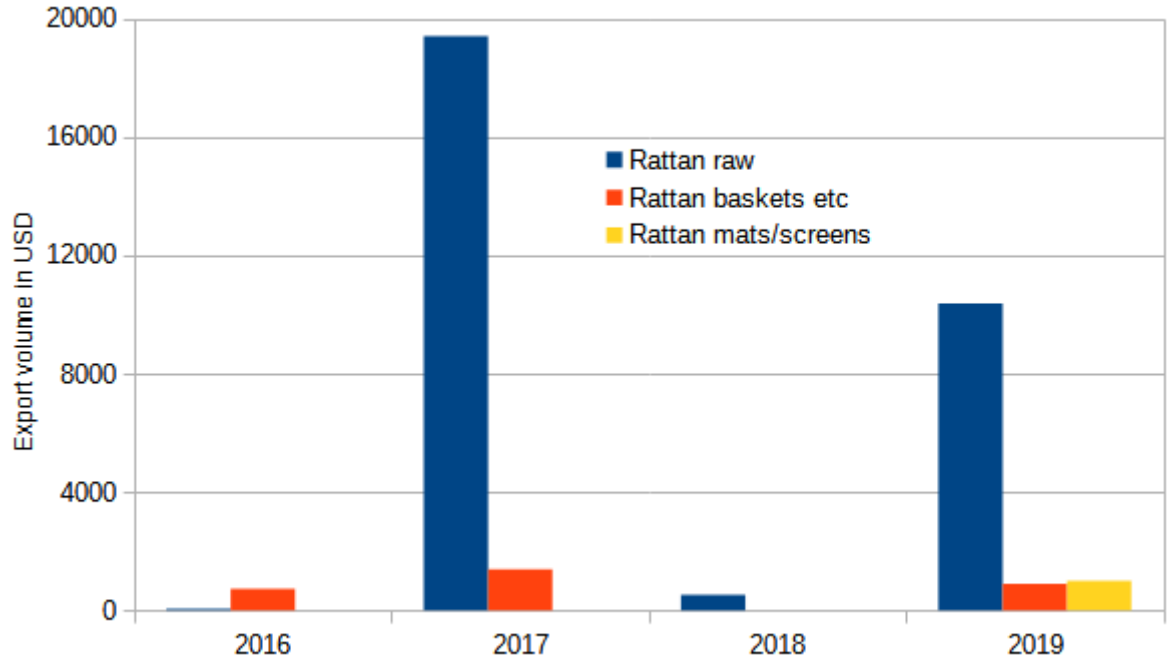


Figure 24: Rattan exports from Laos, based on INBAR data

Edible shoots are consumed locally or exported in small quantities to Thailand, Vietnam or China, and from there to Southeast Asian communities in France, the United States and elsewhere. Whereas, one kg of rattan shoot is sold locally for about 30-40 USD, dry shoots of *Calamus tenuis* (Wai nyeh) are sold for up to 100 USD per kg in the USA (Khamhoung and van Gansberghe, 2016).

11.12 Constraints

In spite of the progress in rattan research, many gaps remain, including on species growth and wild rattan resources. Continued deforestation and loss of habitat is a major concern, as is over-harvesting.

The following points have been identified as constraints to Lao rattan production:

- Insufficient knowledge of rattan resources and what opportunities they offer

- Insufficient management of existing rattan resources and no promotion of re-planting
- Inadequate product designs, simple products, and low-quality production
- No certification or verification of the production methods, and no product standards
- Current policy status is not supportive of sustainable production; high taxes and fees making competition with neighboring countries difficult.
- More difficult to grow and manage than bamboo, which grows and regenerates faster and is thus often preferred by producers (interview with B.P., WWF)
- Small production volume of rattan products
- Exports of rattan products only at a pilot project stage
- Lack of market contacts and export experience beyond raw rattan
- Low productivity due to use of traditional manual techniques by producers for stripping/cutting/splitting of rattan canes
- Lack of investment from the private sector
- Villagers do not have production and business plans reducing their ability to access local funding and implement their business ideas
- Lack of Micro-credits

11.13 Recommendations and potential

Similar to bamboo, rattan can be processed by hand at family level, but unlike bamboo it is not much affected by mold or insects and ultimately a much higher quality product. Both rattan and bamboo require forest protection and can lead to reduced deforestation, with rattan forest being sometimes the only forest not converted to agricultural land. This would also make it suitable for cultivation on privately owned land. Rattan is not an easy crop, and its slow growth may make it less attractive for private land owners, given the low returns during the first 6-10 years. But once a functioning production system is established, these same traits make rattan very suitable for fragile upland environments.

Rattan is promoted ASEAN-wide by INBAR, which is bringing together stakeholders to promote rattan production and help overcome hurdles at national levels. FSC certification brings premiums for raw rattan of 600 to 1,000 LAK per cane and allows Lao rattan products to reach European markets but is not relevant for the ASEAN market.

Saya Development Lao-Thai cooperation company sees potential for rattan shoots as export article to Thailand as there the price per shoot is 7 THB and they come unsliced.

12. Sacha Inchi (ຖົ່ວດາວອິນຄາ)

12.1 Overview

Sacha inchi (*Plukenetia volubilis*), is a perennial vine native to parts of South America and the Caribbean. Because it was traditionally consumed by indigenous groups in Peru, it is sometimes referred to as mountain peanut or Inca nut.

12.2 Uses and properties

The seed contains about 30% oil with a proportion of about 90% unsaturated fatty acids. It is used for dietary consumption or as cosmetic oil. Press cakes contain about 60% protein with a full spectrum of essential amino acids and high digestibility. It can be processed into powder, snacks, or protein supplements for both human and animal consumption. Roasted or fried seeds are sold too. Outer shells and leaves can be dried and sold as tea with anti-oxidant properties. In recent years sacha inchi has been marketed as “super food” for both oil and protein powder.

12.3 Production systems

Sacha inchi is planted in rows on trellises comparable to grapevines. It is sown directly or grown from seedlings which are germinated in sand for easy transplanting. Harvest is possible 8-12 months after establishment. While the seed is available all year round, the main production season is from November to April. This is partly due to lower yields in the wet season and partly because farmers focus on other activities during the rainy season. Mature pods are harvested manually from the vines. Plants normally reach a productive lifespan of five years before they require replanting or pruning to promote new growth.

While growing the crop is not difficult, it requires attention and labor to provide adequate care at all stages:

- watering of seedlings
- timely transplanting before young plants get entangled
- running the vines along trellis wires
- manual weeding
- protecting the base of plants from drought with mulch etc.

While fertilizing with manure, ashes, or other organic fertilizers can significantly increase yields, Lao farmers rarely apply such. Since young shoots can be eaten, this has been found in some cases to lead to over-pruning at the expense of seed yield.

12.4 Production locations

Most mountainous areas of Lao PDR, from Bokeo to Sekong, are suitable for the crop, but currently most of it is grown in the Northern provinces, where it was first introduced. Where irrigation and good drainage exists, it can also be grown in plains. The plants are sensitive to drought and waterlogging, like full sun and tolerate mildly acidic soils.

Production locations in Luang Prabang province are depicted in Figure 25.

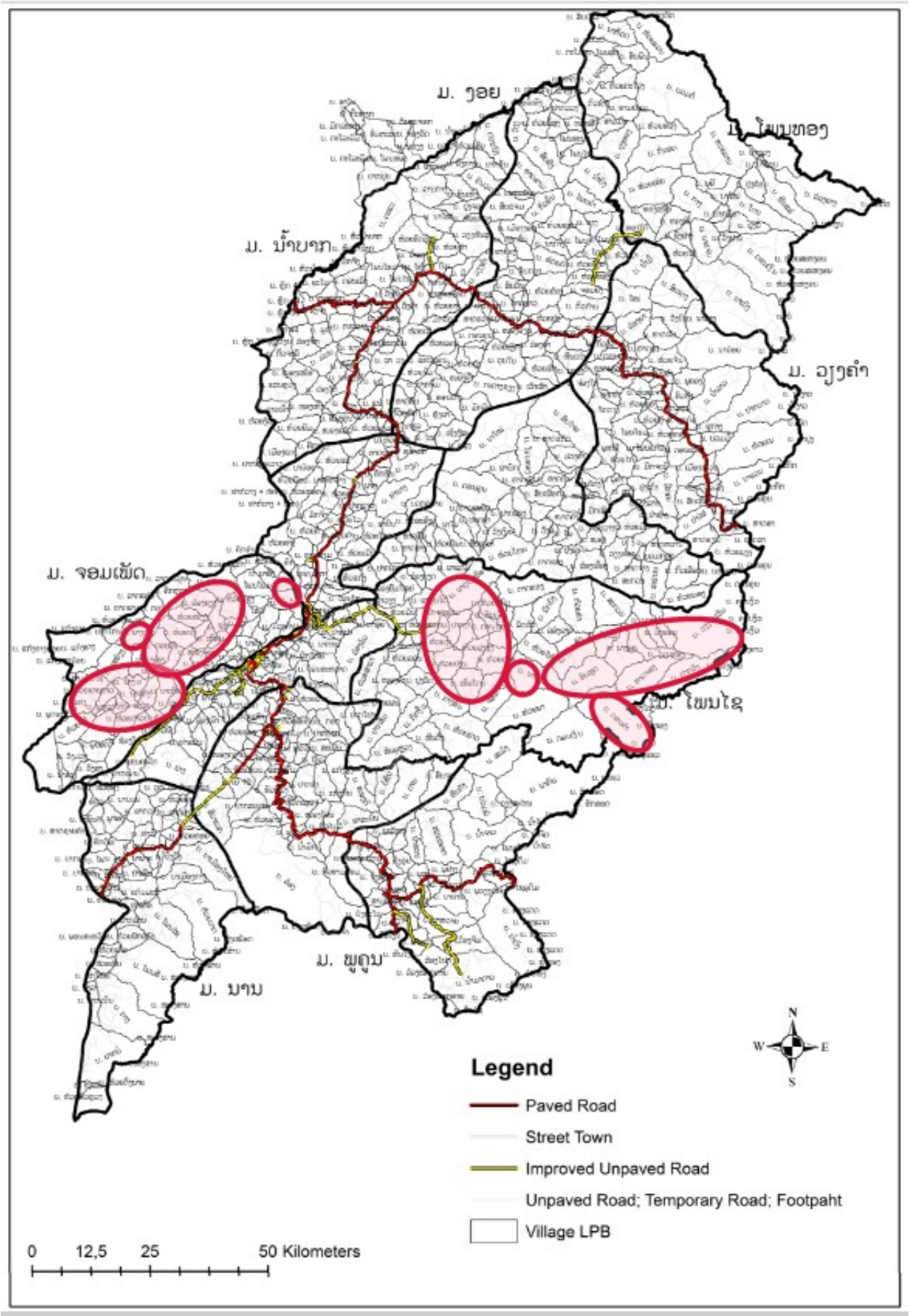


Figure 25: Sacha inchi production locations in Luang Prabang province.(Source: DAFO interviews)

Sacha inchi was initially introduced at a relatively large scale until this initiative broke down. Production was at this time far more extensive than it is now, but unsustainable as it depended all on one buyer who stopped his activities. Thus, current production areas represent a revived production, which is now built on a naturally evolving supply chain.

12.5 Production volumes

While ideal yields increase from 500 kg/ha in the first year, and 800 kg/ha in year two, to 1000 kg/ha and more in subsequent years, in the context of Lao smallholders, yields are generally only about half of that. Yields are mainly influenced by soil suitability and care given to plants.

The main production cycle is from September to May, while from July to August production decreases by ca 30%.

Total production of sacha inchi seeds in Laos is less than 1000 tons/year, one third of which is processed into powder. At current production levels, raw sacha inchi production can barely meet external and internal minimum demands to keep processors afloat.

12.6 Production quotas

As an agricultural product, no quotas apply.

12.7 Processing, Packaging, and Storage

The mature pods are sun dried for 1-2 days. The pods are then opened by tapping them with a stick or a specific shelling machine (which is rare in Laos). The black seeds are then dried for another 2-3 days, after which follows the removal of bad and empty seeds manually, often using a “kadong phat khao” (the traditional round rice sorting tray). Once seeds are dry to the touch, they are kept in rice bags, ideally elevated from the floor to avoid problems with moisture and pests.

True grading does not exist, but good seed may be divided into small and large seeds by processors, as larger seeds might be more suitable for certain roasted seed snacks. At farm level all seeds are bought at the same price. However, buying criteria exist. Seeds that have been harvested too early have low oil contents even though they look fully formed. During drying they will shrivel as they contain water rather than oil. Seeds not properly dried to the touch will be rejected by buyers, same as broken and cracked seeds due to the risk of causing the whole bag to mold in storage. They can however be grilled and consumed. Old seeds that were kept under farm conditions are also rejected due to quality loss from humidity, pests, etc.

Under factory conditions, seeds can be stored for 1-2 years. Shelling, pressing, roasting and retail packaging are the main processing steps.

Shells for teas have to be dry and free of fungi. The shells are only sold in one quality grade and should be split cleanly to extract the seed. As machines break the shells and make them undesirable for buyers for aesthetic reasons, it is necessary to crack the nuts manually with a small hammer. One worker can crack about 280 kg (7 bags of 40kg) per day this way.

Only Mai Savanh Lao Company does full processing of the seed, including oil extraction, protein powder and candy bar production. The details of this processing were not revealed.

12.8 Value chain, prices and income

Most sacha inchi in Laos is produced by an estimated 1000-3000 smallholder farmers mostly in the Northern provinces. Rare cases exist of a wealthy investor setting up a large-scale plantation, such as Mr. Oun Manolack in Luang Prabang, who stopped operation in 2013. Even major exporters and processors do not invest in large scale plantations, though some are considering this idea. As an example, one of the main players in the value chain, Mai Savanh Lao, a processor in Vientiane, has a small organic farm in Sekong of about 5 ha, where sacha inchi is grown, while the bulk of the raw material they process comes from the Northern provinces.

For most farmers the crop is a side income, with production areas of 0.25 to 1 ha. They sell to district traders who sell to larger traders which sometimes export raw seeds or otherwise sell to a processor who then exports intermediate or end-products (Figure 26).

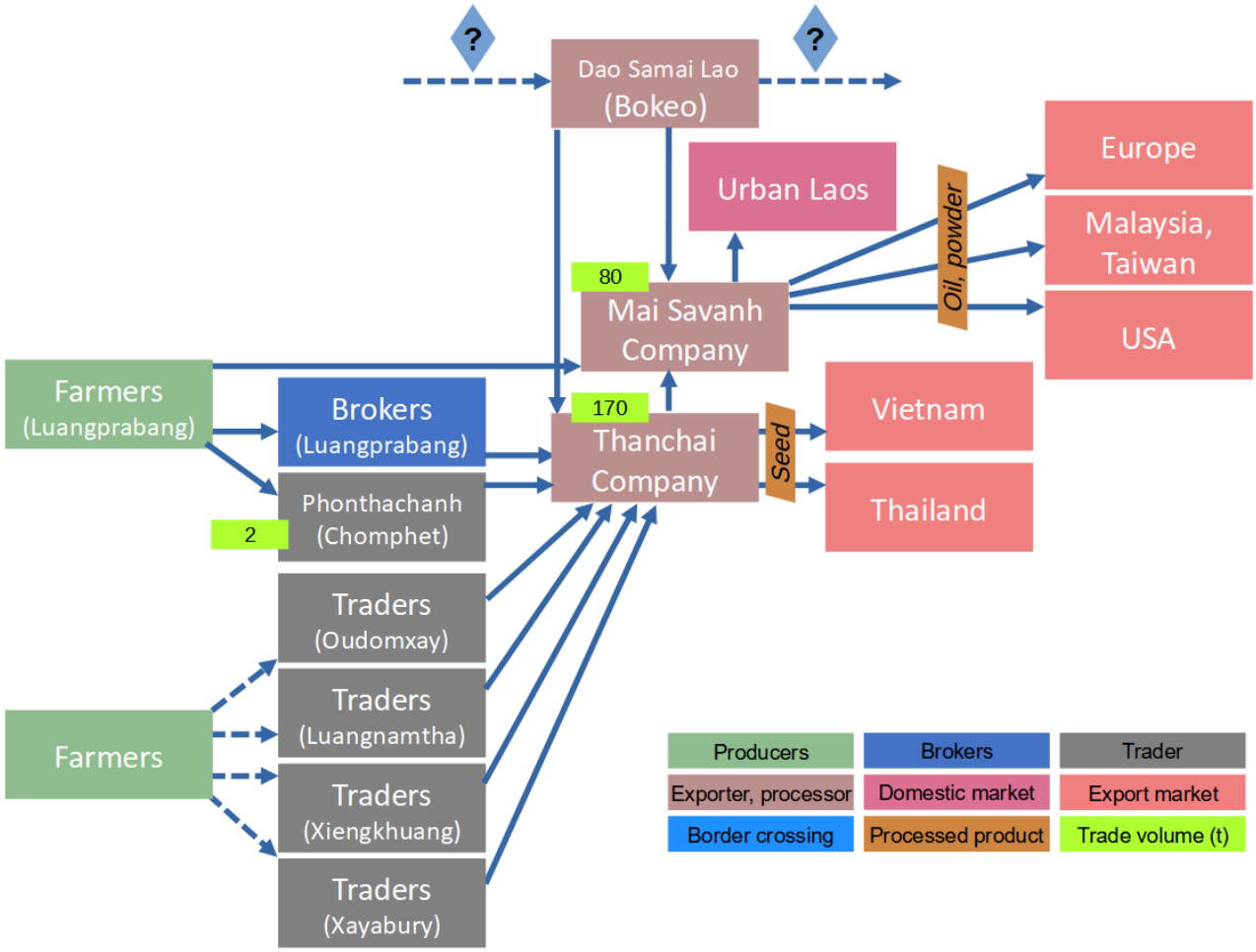


Figure 26: Sacha inchi value chain for the target provinces (abridged).

As of February 2022, the farm gate price for seeds is around 16000 LAK/kg, but price fluctuations are common and ranged from 8000 to more than 20,000 LAK/kg between 2016 and 2022. Some value chain actors such as Mai Savanh Lao guarantee a lower end price of 10,000 LAK/kg and follow market prices as they rise. The company also certifies organic production and contracts the producers for a premium of 1000-2000 LAK/kg, to ensure their quality for export markets. Sacha inchi shells sell for 4,000 LAK/kg.

Traders normally add 2000-5000 LAK/kg and roasted seeds are sold in bulk for around 8 USD/kg (88,000 LAK), powder in bulk for about 6.5-7 USD/kg, oil in bulk for around 20 USD/l, and the retail

price for powder in Vientiane is around 12 USD/kg. An example of the price evolution along the supply chain is given in Table 35.

Major players in the value chain are larger traders such as Thanchai company in Luang Prabang (see company profile), or Dao Samai Lao in Bokeo and Luangnamtha, who provide extension support, sell to Mai Savanh Lao and also export to Thailand. Many smaller non-specialized agri-traders feed into these companies or sell to other sources. Mai Savanh Lao acts as local extension provider and end-product processor which aims at keeping added value in the country.

Table 35: Sacha Inchi value chain example from Luang Prabang.

	Farmers	Traders	Other provinces	Exporter	Vietnam	Thailand	Vientiane
Tons traded	147	147	23	170	163	7	80
Selling price (LAK/kg)	12,500	14,000	16,000	selling at:	23,000	23,000	19,000
Price increase/kg (LAK)		1,500	3,500		8,800	7,000	4,250
Total gain (‘000 LAK)	1,837,500	220,500	80,500		1,434,400	49,000	340,000
Total gain USD	183,750	22,050	8,050		143,440	4,900	34,000
Total value	183,750	205,800	36,800		374,900	16,100	152,000

12.9 Legal elements

Lao certificates of origin, phytosanitary inspection for export, and standard microbiological analysis at the customs entry are required for export, as for other crops too. Food quality or organic certification depend on client requirements.

12.10 Standards

No standards are required for seed export. For the export of processed food products such as oil or protein powder, production standards will have to comply with the rules of the importing country. Mai Savanh Lao for example produces powder using HACCP/GHP standards.

12.11 Main destination markets and demand

For raw seeds, 500-1000 tons are exported yearly to Thailand, Vietnam and South Korea.

Europe, Malaysia, Taiwan, and the USA are main destination markets for oil, which is only produced and exported by Mai Savanh Lao (ca. 20,000 liters per year).

Currently markets in China and the USA are growing rapidly and promise increasing demand. Traders and processors estimate that 2000-3000 tons/year could still easily be absorbed. When demand in neighboring countries increases, which is likely to happen in the foreseeable future, supply will not be able to cover foreign and domestic demand unless production is increased. All major traders and exporters are involved in extension activities to keep local production growing.

12.12 Constraints

Whilst sacha inchi is a very promising high value crop, it comes with some drawbacks that hamper extension efforts:

- Sacha inchi is not native to Lao PDR and most farmers have no experience growing it
- Establishment and care taking is labor intensive
- In Europe only the oil has been approved to be used for food or cosmetics, the powder is not allowed to be sold
- For processors, a guaranteed quantity of raw material is vital but contract farming is hard to enforce in Lao PDR as traders tend to subvert contractual agreements for their own benefit
- A very large Chinese project introduced sacha inchi in the Northern provinces as an alternative to opium. When the project failed, farmers were left stranded with produce they could not sell. This left deep resentment and distrust in planting the crop in the affected areas.

12.13 Recommendations and opportunities

The main opportunities lie in the nature of the plant and the current international market trends:

- Sacha Inchi does not require much space, can be expanded without opening up new land, and can be grown in marginal areas
- There is an expanding global market and high potential in the USA and China for refined oil and protein powder products

Sacha inchi seems an attractive option as income opportunity for smallholders. It does not have specific soil protecting or slope stabilizing characteristics, which would be desirable in mountainous conditions, but it is also highly unlikely to promote deforestation and can be grown in a mixed system with trees.

13. Sesame (ໝາກງາ)

13.1 Overview

Sesame (*Sesamum indicum*) originated in India and is widely naturalized in tropical regions around the world and cultivated for its edible seeds. It is one of the oldest oil crops known, with archaeological evidence of its use dating back as far as 3500 BC. It has one of the highest oil contents of any seed (Oplinger et al., 1990).

13.2 Uses and properties

Sesame seeds contain about 50-57% oil and 25% protein, with oil content being inversely proportional to its protein content (Oplinger et al., 1990). The oil contains approximately 47% oleic acid and 39% linoleic acid. It keeps well and resists rancidity, due to the presence of the antioxidants sesamol and sesamolin. Sesame paste (Tahini) is made from hulled sesame seed and is rich in protein and energy (Iowa State University, 2022). The seeds are very rich in iron, magnesium, manganese, copper, and calcium, and contain vitamin B1 and vitamin E (Kafiriti and Mponda, 2022).

Commercially, sesame oil comes in two types: i) raw pressed, which is a pale-yellow liquid, high in polyunsaturated fats, used as frying oil, in cosmetics and in food preparations; and ii) toasted seed oil, which is amber-colored with an intense flavor, and is, as it burns quite easily, not used for cooking but as a flavoring agent in the final stages of food preparation. It has caught increasing attention due to several health benefits (Iowa State University, 2022).

Sesame meal from press cake contains 34 to 50% protein and is used as food ingredient or animal feed, depending on grade (Iowa State University, 2022).

Non-food uses for sesame oil are its inclusion in soaps, paints, cosmetics, perfumes, bath oils, pharmaceuticals, and insecticides.

Other sesame types, foremost among them black sesame, are used as spice in bakery, meals and shakes.

13.3 Production types

Sesame, traditionally called a survivor crop, is robust and needs little farming support. It grows in drought conditions, tolerates high temperatures, growing on residual soil moisture after the rainy season or even when rains fail or are excessive. It has since antiquity been grown by subsistence farmers at the edge of deserts, where no other crops grow. However, modern high-yielding varieties thrive best on well-drained, fertile soils of medium texture and neutral pH. Initiation of flowering is sensitive to photoperiod, as the oil content in the seeds increases with day length. Moisture levels before planting and flowering impact yield most. Most commercial cultivars of sesame are intolerant of waterlogging and rainfall late in the season prolongs growth (Oplinger et al., 1990).

Normally grown as an upland crop, it can also be grown under irrigation during the dry season. It has a cropping cycle of three months (ADB, 2019) and is normally planted between June and July in Laos by broadcasting seeds in upland areas. Harvesting takes place between September and November. Caterpillar infestations are the only major problem during the growing period. Some

farmers use pesticides, but this has no impact on their sales as the use of agro-chemicals is not a criterion.

Two types of white sesame are distinguished in Laos, long and short season sesame, though the exact nature of these could not be determined, as translation of these terms is vague. Depending on the cultivar, sesame matures generally in 75 to 150 days after sowing. But sesame is also photosensitive and whereas most cultivars are short-day plants, neutral day varieties are in use (Kafiriti and Mponda, 2022). Whichever it is, neutral day or slow maturing sesame, long season sesame, has small seeds whereas short season sesame has bigger seeds and both are planted during the rainy season and harvested at different times of the dry season or late rainy season.

High rainfall can affect the seed quality leading to reduced prices. Rain around harvest time will also reduce yields by leading to early spilling of seeds.

Producers and traders also explained that sesame could not be grown in the same area in consecutive years, requiring villagers to sow sesame in different areas every year, adding additional labor and logistics. The reasons are not clear, but it is suspected that sesame as deep rooting scavenger may exhaust nutrients in soils quickly, and since farmers do not fertilize, consecutive crops would lead to low yields.

13.4 Production locations

Sesame requires a warm, moist, weed-free seedbed, in a well-draining soil, as the plant is susceptible to waterlogging at any stage of growth. Some authors found sesame to be an important crop for a number of villages in Viengkham district in Luang Prabang (Yap et al., 2019). In this study Ngoy and Nambak districts were identified as major producers (Figure 27).

Black sesame is cultivated mainly in Phiang and Sayabouri districts (ADB, 2019), but also in Sayabouri province white sesame is by far more common.

13.5 Production volumes

World production of sesame has continuously increased over the past years and was at 6.8 million tonnes in 2020, with Sudan (1,525,104 t), Myanmar (740,000 t), Tanzania (710,000 t) and India (658,000 t) the world's leading producers (FAOSTAT). Laos ranked 37 with an approximate output of 11,489 tons in 2020, a sharp decline from more than 16,000 tons in 2018 and before. The production of black sesame has increased strongly in Lao PDR since 2013, production reaching 3,557 metric tons in 2017 (ADB, 2019), about 22% of the total sesame production in Lao PDR.

In Luang Prabang DAFO-registered production in 2021 was 557 tons on 436 ha, while in Houaphan it was 155 tons on 232 ha ().

Depending on variety, sesame produces 0.7 to 2 tons per hectare (Oplinger et al., 1990), in Laos, yields of 1-1.5 tons/ha are common. Black sesame in Laos is commonly a wet season upland crop with yields of 1.7 to 2.1 tons/ha (ADB, 2019).

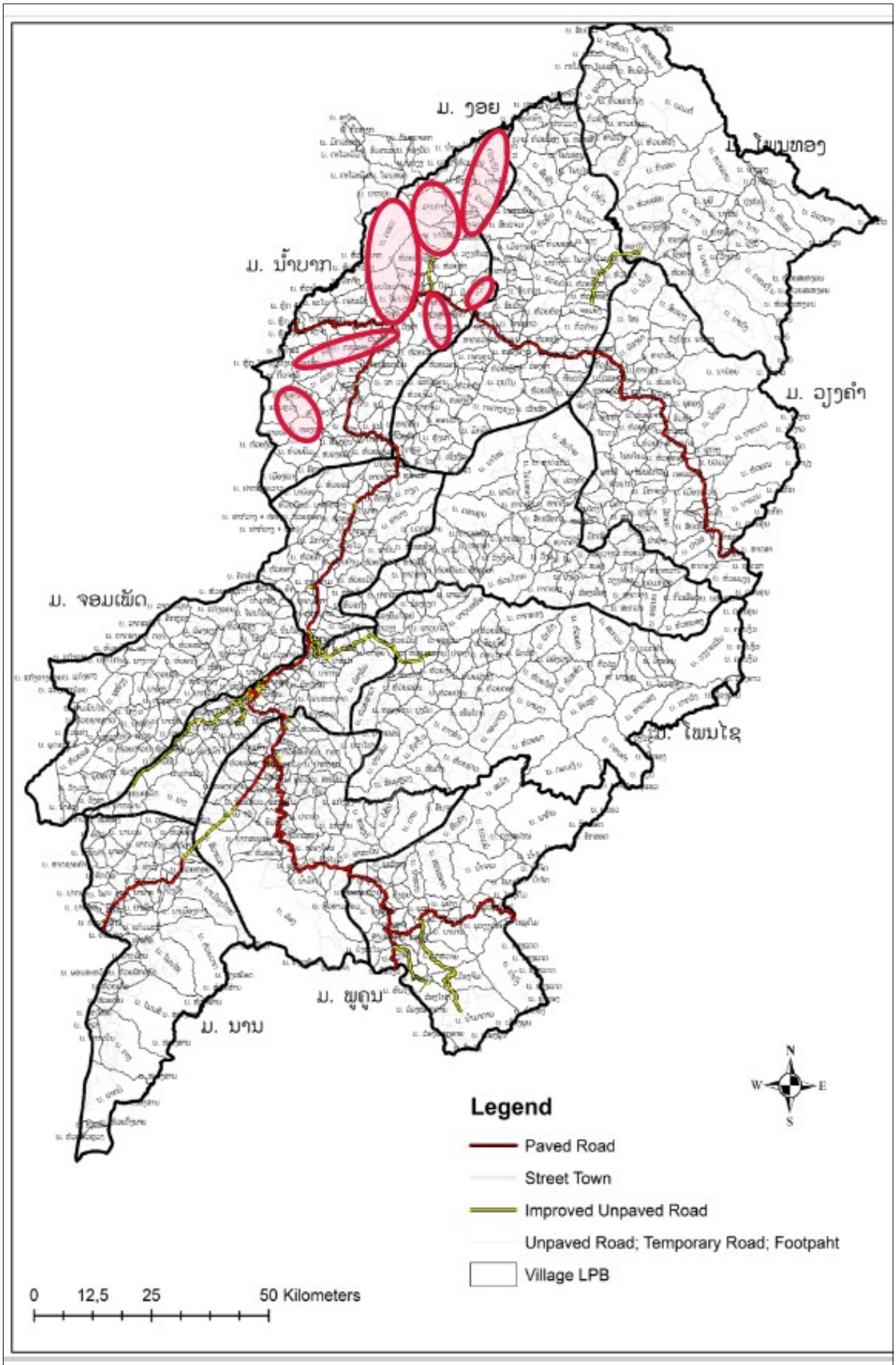


Figure 27: Sesame production locations in Luang Prabang province. (Source: DAFO interviews)

Provinces (2021)

Table 36: Sesame production area and volume for Houaphan and Luang Prabang

Districts	Area (ha)	Volume (tons)
Houaphan		
Xam Tai	45.3	-
Hiem	2.6	3.83
Houameuang	167.5	150
Viengxai	15	1
Xam Neua	1.21	-
Luang Prabang		
Nambak	318.5	477.7
Viengkham	19.7	15
Phonthong	97.4	64.5
Total	**667.2**	**712.0**

Source: DAFO reports 2021.

13.6 Production quotas

No production quotas apply.

13.7 Processing, Packaging, and Storage

After harvest, the seeds have to be further cleaned using standard seed cleaning equipment. Because sesame has a small flat seed, it is difficult to aerate. Therefore, the seeds need to be harvested as dry as possible, then dried and stored at 6 percent moisture or less. Too moist seeds can quickly heat up and become rancid. The seeds must be cleaned and dehulled. For seed sale, grades are based on color and size.

Grade A seeds are whole, undamaged seeds of white color while Grade B seeds are slightly discolored and imperfect seeds. For black sesame no grading was reported.

Sesame oil is extracted by pressure in a mechanical expeller and tolerates only minimal heating during the extraction process. We did not come across any major sesame oil extraction operation in the country.

13.8 Value chain, prices, and income

The sesame supply chain landscape is not much more complex than other supply chains in Laos, but the number of traders involved in it is relatively large, probably because sesame is already less of a specialty commodity than others in this study. The marketing chain generally starts with a first level of collectors, either village brokers or district traders, who then sell on to exporters (Figure 28).

Direct interaction of exporters with farmers is less common but exists where extension activities are part of the exporters business model and can be found especially related to black sesame. Demand apparently always outstrips supply. Especially traders in Houaphan have difficulties to find

enough produce both in Hiem and Xam Tai districts to supply acceptable amounts to their Vietnamese trade partners.

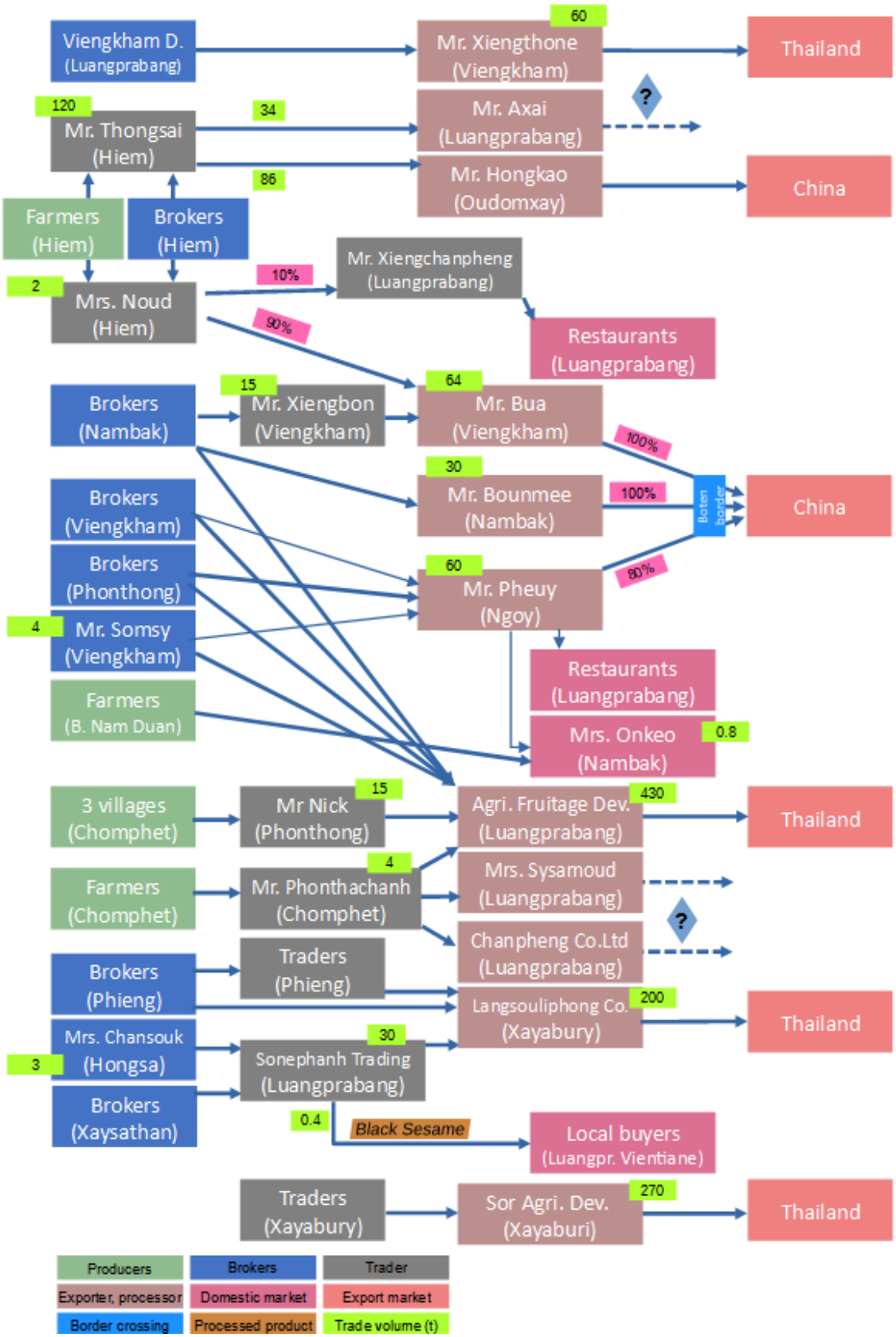


Figure 28: Sesame supply chain in the target provinces (abridged).

In Thailand, the market mostly demands long-season sesame, as it is valued higher for its quality than the short-season variety. No such preferences have been reported for Vietnam and China.

Prices vary significantly even within districts () but are ultimately dictated by the foreign buyers to which the product is exported. Because of this, sellers and buyers are normally in close contact during the buying season to make sure that price changes can be passed on down the supply chain swiftly to brokers and producers. In one case where a local trader reported that he could not find a buyer for his sesame, it was because he had bought at too high a price and could not sell for a profit. Where grading happens, Grade A seeds sell at about 20% higher prices than Grade B seeds.

Table 37: Sesame price variation by grade at collecctor level

Buyer	Buying Grade A	Buying Grade B	Selling Grade A	Selling Grade B
Broker, Hiem, HPN	6,000-8,000		8,000-10,000	
Trader 1 Chomphet, LPB	15,000	12,000	16,000	13,000
Trader 2 Chomphet, LPB	9,000	7,000	11,000	8,500
Trader Phonexay, LPB	14,000	13,000	15,000	14,000
Hongsa, SBL	14,000		14,500-15,000	

Along the supply chain, collectors add about 4000 LAK/kg to the farm gate price, with exporters adding another 3,000-5,000 LAK/kg generally at least doubling the farm gate price (Table 38). However, for traders who are not exporters themselves and export via a company with an export license, export costs will amount to about 1,300 LAK/kg.

Table 38: Sesame price development along the supply chain

Location		Buying prices		
Province	District	Farm gate (LAK/kg)	Collectors (LAK/Kg)	Exporters (LAK/Kg)
Houaphan	Hiem	6,000 – 8,000	9,500 – 10,000	14,000 – 15,000
	Nambak		12,000 – 14,000	15,000 – 16,000
Luang Prabang	Viengkham	8,000 – 9,000	12,000 – 13,000	16,000
	Ngoy		14,000 – 15,000	16,000

While the Black sesame value chain is comparatively small, it is important in the local context. Provincial statistics of Sayabouri report an export volume of 596 tons of black sesame. Black sesame is sometimes collected together with maize and Job's tears for Thai importers and stored at the exporters' warehouses in Paklai and Ngeun districts. In Luang Prabang black sesame is still rarer. Some exporters provide credit to local collectors to buy the merchandise for them. The farm gate price is determined by the Thai exporters, plus 500 LAK/kg for the local traders (ADB, 2019).

13.9 Standards

No standards exist. Even controls for agro-chemical residues seem to be lacking or lax.

13.10 Legal elements

No specific legal rules apply to the trading of sesame. Taxation is the same as for other agricultural products.

13.11 Main destination markets and demand

Currently sesame is exported exclusively to the larger neighboring countries, Thailand, China and Vietnam. Demand in these countries is strong and rising. China ranks as the number one buyer of sesame worldwide with a total value of 1.3 bn USD. Japan is second with 333 million USD, South Korea ranks 5th with 130 million USD and Vietnam ranks 10th with 65 million USD worth of imports. This shows that Laos has no need to look for buyers in non-Asian markets, the demand of its direct neighbors and the wider Asian community is far beyond the country's capacity of supply, so market demand is unlikely to be a limiting factor.

Traders in Phiang district (Sayabouri) see strong market demand for Lao sesame, primarily in Thailand and China. China was a leading sesame-exporting country in the past but has now become the largest importer in the world (ADB, 2019). Exporters in Houaphan sell to Vietnam and report that it is never a problem to sell the seed and that demand is always high.

Black sesame is one of the main export products from Sayabouri to Thailand after maize, Job's tears and cassava.

13.12 Constraints

Many of the problems for sesame are those reported also for other seed crops in Lao PDR:

- Poor post-harvest handling, especially improper drying by farmers and contamination with foreign materials
- Insufficient or unreliable production
- Low seed quality
- Without fertilization, sesame may require plot rotation in consecutive years
- The crop only occupies a plot for 120 days, which does not make it ideal for projects focusing on soil stabilization on sloping lands, unless it is part of a mixed cropping system.

13.13 Recommendation and potential

Sesame is a relatively high value crop with an apparently inexhaustible market absorption capacity. Seeding and growing are easy and the crop does not require a lot of maintenance. As traders and authors have noted, developing the market requires an increased volume of better quality sesame (ADB, 2019), which requires better harvest and post-harvest management. Whilst white sesame is easy to sell, black sesame also has good market potential in Thailand and is a crop option for the dry season. Sesame is traditionally a post season crop for rice, or other crops, thriving on residual soil moisture. Given the apparent need for plot shifting, its suitability in a sustainable upland production context needs to be carefully assessed.

14. Sichuan pepper, Indian Prickly Ash (ໝາກ ແຄ່ບ)

14.1 Overview

Sichuan Pepper (or Szechuan Pepper) in a wider sense is the fruit of several Zanthoxylum species. In Laos, *Z. rhetsa*, Indian Prickly Ash (also Indian ivy rue, or Mak Khaen in Lao), is commonly cultivated in the northern mountainous regions, mainly in Phongsaly and Oudomxay (Sisaphaithong, 2019). True Sichuan Peppers (red or green, see under Uses and properties), can be found in pockets but are much less common in the country. However, even for Indian Prickly Ash, some confusion seems to prevail as to the species in use for production. The differences in aroma and phenotype indicate that *Z. simulans* and *Z. limonella* might both be harvested and sold as *Z. rhetsa*. Farmers in some areas (e.g. Xienghorn district, Xayaburi) distinguish three types of Sichuan pepper: big, medium, and small seed bearing, with the small seeds being strongly scented.

14.2 Uses and properties

Sichuan Pepper is used as a spice for cooking and as a medicinal plant. In Chinese cuisine two species are favored, Red Sichuan Pepper (*Z. bungeanum*), and Green Sichuan Pepper (*Z. armatum*), which can be used fresh or dried. In Japan *Z. piperitum* is used and in South Korea *Z. schinifolium*, while *Z. rhetsa* is typically used in Western India (Wikipedia). Further species are used throughout S- and SE-Asia. *Z. bungeanum* has been found to have analgesic, anti-inflammatory, antibacterial, and antioxidant effects (Zhang et al., 2017). Several of these and other Zanthoxylum species are used across the tropical world as medicinal plants (sciencedirect.com index search). *Z. rhetsa* is also used by the international perfume industry.

14.3 Production systems

Traditional systems are often unsustainable, harvesting the seeds from trees in forests, often by cutting down the trees to get to the fruits. Produce collected this way also contains a high percentage of immature seeds. However, with the reduction of swidden agriculture or increasingly shortening rotation cycles, the long fallow periods that allowed trees to grow to maturity in traditional systems disappear. While the tree is currently common it is not clear how its population will be affected by agricultural systems transformation.

Fallow forests (ideally with a high occurrence of *Z. rhetsa*) can be converted into Indian Prickly Ash orchards. In such gardens Indian Prickly Ash is more productive than under natural conditions, grows taller and lives up to 25 years. Farmers usually practice a seven-year fallow after the trees die or become unproductive, then burn the land and establish a new orchard from the seed store in the soil. This system constitutes a 27–32-year rotational farming system and is practiced in the villages of Ban Eun and Ban Pheum in Viengxay district, Huaphan Province (Foppes and Nampanya, 2019; ex. Wilson et al., 2019). The same authors also describe the production structure in Ban Eun, where 340 ha out of the total village area of 815 ha (40%) is set aside as production forest, and about 100 ha out of these 340 ha have been converted to permanent gardens with Indian Prickly Ash. Farmers in Nan district in Luang Prabang report that the Sichuan

tree is difficult to plant and maintain if transplanted from the wild, and that is will often die after three years, whereas naturally grown trees don’t show any such problems. Because of such experiences, the establishment of true Mak Khaen orchards is currently not practiced, but the establishment from seed has been shown to be possible (interview with Dak Dae company).

The seeds take about three months to mature and get ripe between September and December, depending on location and tree variety/species. Since maturation happens over a longer period on each tree, at least two harvests in two-week intervals are required to harvest the mature fruits (DakDae). Farmers report that it is advisable to prune the tree branches while collecting the fruits, as it will increase yields in the following year.

14.4 Production locations

Zanthoxylum rhetsa, is a pioneer species common in young forests such as swidden fallows throughout large areas of northern Laos. It grows at altitudes between 500 and 1500 m asl and can be found naturally in evergreen forests. Little is known about the conditions that lead to good quality fruits. Producer surveys indicate that, while the trees grow in a wide range of environments, the quantity and quality of the fruits they produce varies between localities, with rainfall being one known determining factor (Foppes and Nampanya, 2019).

Three villages in Viengxay district, but especially Ban Eun and Ban Pheum have earned the reputation of being the producers of the highest quality Sichuan pepper in the country, with traders paying premium prices for their produce. However, quality perception seems to be influenced by reputation, too, as laboratory analyses did not find significant differences in seed composition between different locations in Houaphan province (Dak Dae).

The trees are generally common enough to be found in most villages throughout the target area, though most villages do not market the seed. Some villages though may have significant numbers of trees that are kept for production purposes, such as Thongchai village in Xienghone district (Sayabouri), which has a total of 7-8 hectares of Sichuan pepper mixed crop gardens.

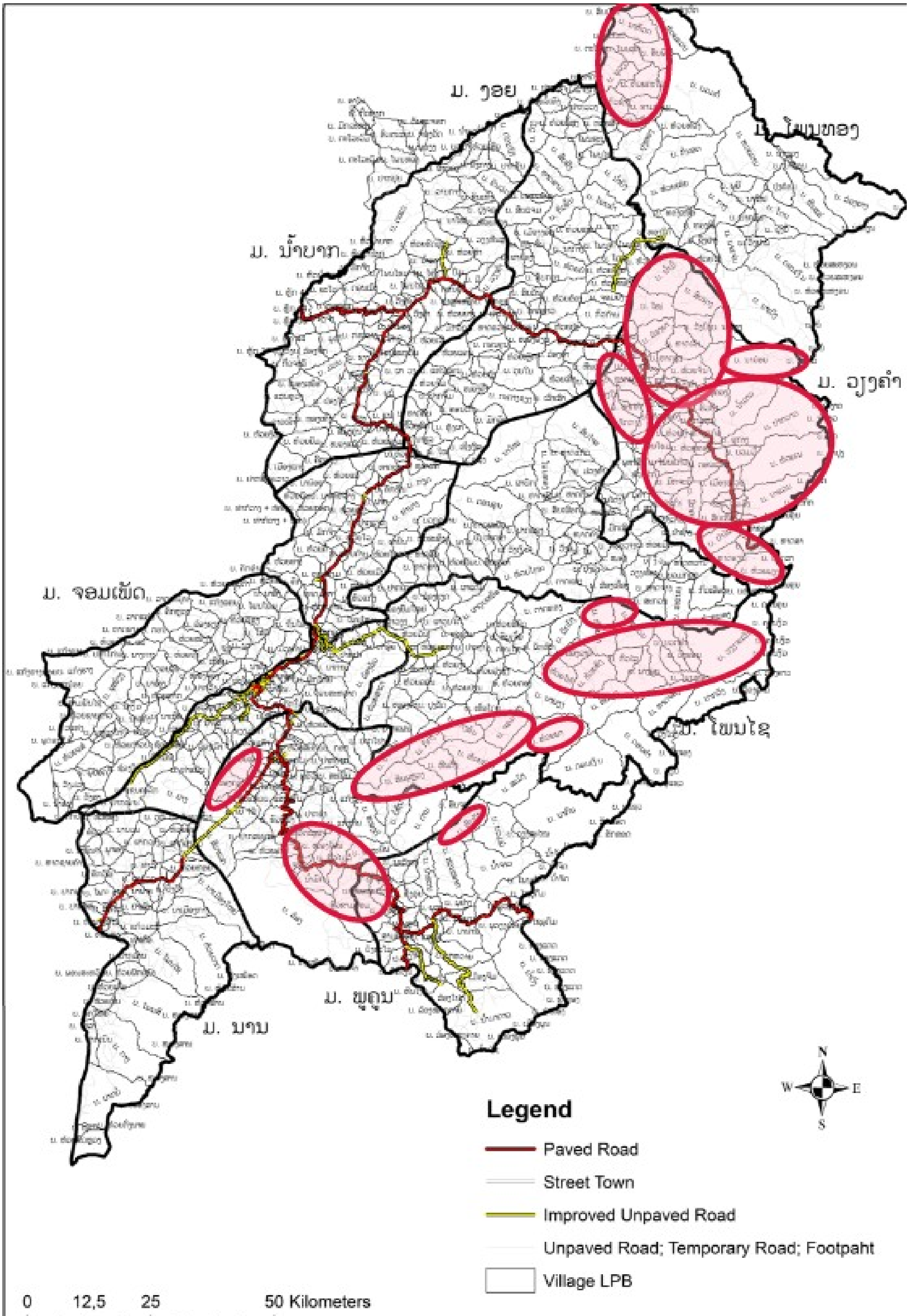
The distribution of Sichuan pepper production areas in Luang Prabang province is shown in Figure 29.

14.5 Production volumes

The amount of product per tree varies widely. Depending on tree size, location and other factors, it ranges from a few kilograms to up 60 kg per tree (the average being between 25 and 30 kg). The production volume per village depends very much on the production system and may vary between a couple of hundred kilogram to 20 or more tons. However, maximizing production is not a relevant metric for Mak Khaen producers since it is rare that demand exceeds what villages can supply. Based on their own calculations, Foppes and Nampanya (2019) estimated that farmers in dedicated Sichuan pepper villages in Houaphan only sell 5-20% of their potential production.

14.6 Production quotas

No production quotas apply.


ມ. ງອຍ
ມ. ໂພນທອງ
ມ. ນ້ຳບາກ
ມ. ວຽງຄຳ
ມ. ຈອມເພັດ
ມ. ໂພນໄຊ
ມ. ພູຄູນ
ມ. ນານ
N
W
E
S
Legend
Paved Road
Street Town
Improved Unpaved Road
Unpaved Road; Temporary Road; Footpaht
Village LPB
0
12,5
25
50 Kilometers

14.7 Processing, Packaging, and Storage

Simple air drying for about one week is practiced by both traders and farmers, reducing the product weight to about 25-30%. If twigs are removed, another ca. 20% of weight are lost. The weight of dried capsules without seeds is about half that of capsules with seeds. Other than this, no processing is done along the value chain (Foppes and Nampanya, 2019).

Although no grades are currently distinguished, quality matters for different buyers. The criteria on which quality depends is not clear but location, fruit maturity and obviously tree species or subspecies are important factors. The main local quality criteria are aroma, size and color of the fruit. It has been reported that the best quality fruits have a rich scent, small seeds and the fresh seed capsules are red in color when ripe (Foppes and Nampanya, 2019). However, given the just developing product diversification such classification may only be of temporary validity. For scent producers, for example, trees in Mueang Fueang produce larger and more fruits, with a less intense aroma, that is more appreciated by certain producers of soaps, while those from Houaphan appeal more to perfume producers (interview with Dak dae Co.). It is anticipated that with a developing market differentiation (e.g. perfumes, scented products (soaps etc), condiments etc), grading and especially a stronger distinction of different Zanthoxylum species for different product lines will develop. Farmers do differentiate between different “types” already, e.g. Mak Kouang, Mak Khaen mi nam lai, Mak Khaen mi nam noi (Foppes and Nampanya, 2019), or simply by the size and scent of fruits, but these seem only local conventions and vary from location to location.

The true Sichuan Pepper, “Mak Mart”, (*Z. bungeanum* and *Z. armatum*) has much smaller leaves and much bigger seeds with a harsher taste and smell than Indian Prickly Ash. These species do not occur naturally, but some households have 1 or 2 plants in their gardens, imported from elsewhere (Foppes and Nampanya, 2019).

14.8 Value chain, prices, and income

In principle, the main actors along the value chain are: (1) village producers, (2) district traders, and (3) retail traders in markets at district and provincial level, or (4) exporters (Figure 30).

Most traders prefer to buy the fresh fruits from farmers (in September/October) as ripe seeds are red when fresh, whilst when dry, all seeds turn black, and it gets hard to distinguish ripe from unripe seeds. Therefore, harvest and marketing need to be coordinated, a task one producer in the village normally takes on, calling traders so that pickup can be organized for the same day. Traders often come four or more times during the harvesting season to fill their trucks.

Farmers sell the bulk of their produce fresh, the remaining part they sell during the rest of the year on local markets for 10,000 LAK/kg fresh and 30,000 LAK/kg dry fruits. In the most renowned villages for Mak Khaen in Houaphan (Ban Eun, Ban Pheum) farmers usually sell fresh fruits with twigs (complete inflorescences) to traders for around 13,000-15,000 LAK/kg (52,000-60,000LAK/kg dried). In other villages or areas, prices are significantly lower. Traders in Xam Tai district report 12,000 LAK/kg fresh and 40,000-45,000 LAK/kg dry. In Meuang Feuang, Vientiane Province, the price is 7,000 LAK/kg, but demand is generally low. In Nan district, Luang Prabang, villagers sell the fresh fruits for 10,000LAK/kg, and the dry inflorescences for 35,000 LAK/kg.

Dried inflorescences are sold in bundles of about 80g (“mat”) for 5,000 LAK each (which is equivalent to ca. 60,000 LAK/kg). Dried fruit capsules with the seeds are sold for 100,000 LAK/kg. The brown seed capsules alone, which contain most of the flavor, are sold by some traders for

200,000-250,000 LAK/kg (Foppes and Nampanya, 2019). This peeling process is labor intensive and currently not mechanized. One person can process about 4kg of seed per day (Dak Dae Co.).

Annual household income from Indian Prickly Ash ranges widely depending on locality but starts as low as 0.75 to 3 million LAK (10-25% of annual household income) and has a medium range of 4-8 million LAK (about 150-300 kg of dry seed per season). In Xienghorn district, Sayabouri, farmers

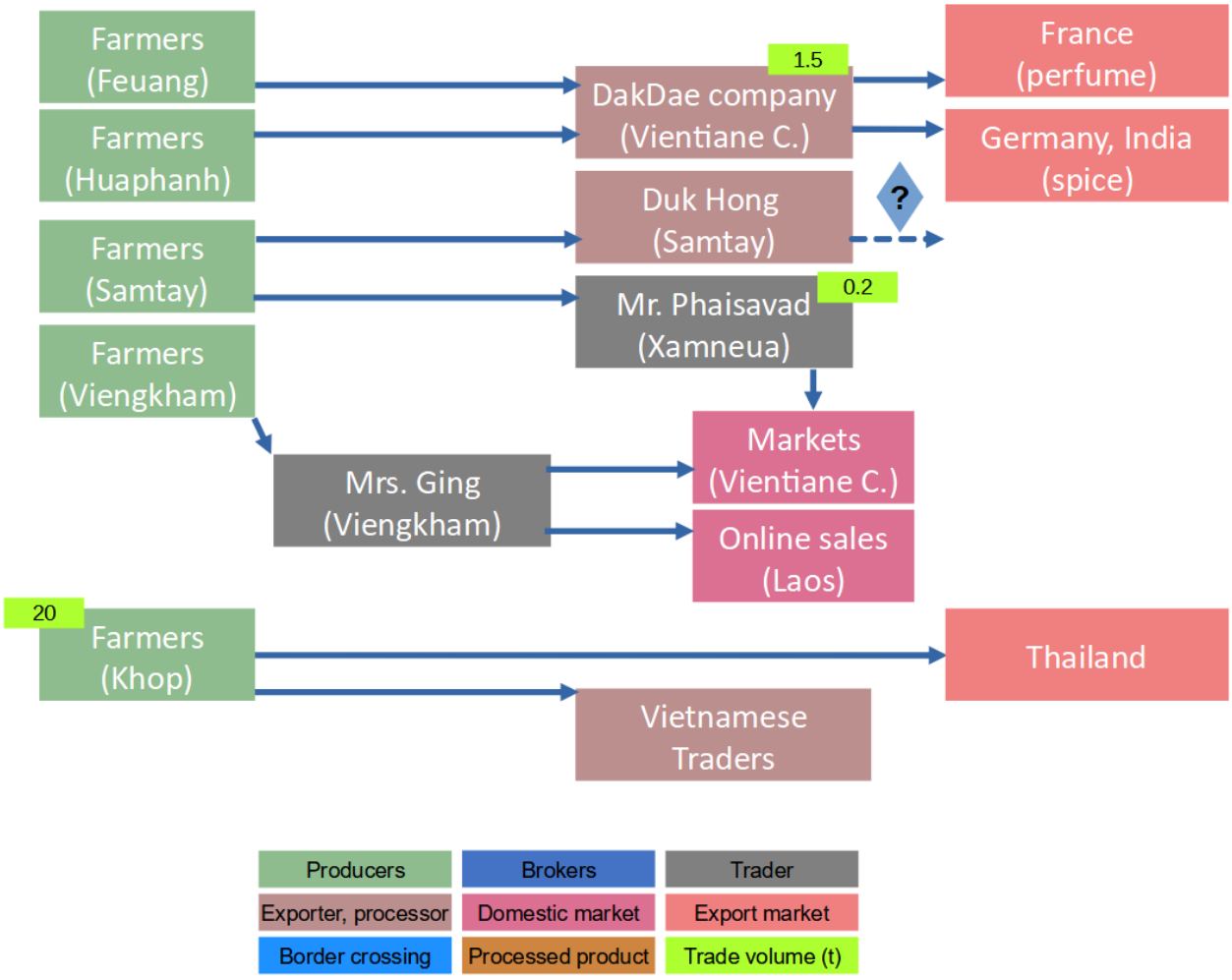


Figure 30: Example of Sichuan pepper supply chains in the target provinces.

report that the domestic market is the most relevant for them, and that before COVID-19 they could not cover the local demand.

This indicates that the supply chain is not well organized and that the large capacities that seem to be available in the country are largely under-explored, while in other parts supply cannot meet demand. In the same villages in Xienghorn district, that could not meet local demand, for example, a trader from Houn district in Oudomxay came to buy for sale to Thailand, while a Vietnamese trader came there to buy for export to Vietnam.

Hence, it seems that the value chain for Mak Khaen has significant development potential, for both the domestic and export market. Currently, three villages in Houaphan have established a reputation for outstanding product quality and whilst this reputation might be exaggerated, it allows them to demand higher prices due to large competition among traders. Such special Geographic Indications could be formalized (e.g. Kampot pepper in Cambodia), and build the reputation of a producer area. On the other hand, the lack of distinction even between different species in the market carries large potential for product diversification. Dak Dae company is an exporter looking

into engaging new villages and working with villagers on establishing new production sites for specific markets.

14.9 Standards

A potential for quality marks or controlled designation of origin label exists, since one village Ban Eun in Houaphan, is recognized for its high-quality produce. There is interest but lack of know-how on how to implement such a scheme (Foppes and Nampanya, 2019).

Organic certification is requested by some international importers (e.g. in Germany) but the cost for certification is prohibitive. In other countries (e.g. India, Myanmar) importers visit the production sites and check the quality by visual examination, which could be a suitable practice for Laos (DakDae).

DakDae company has their own record-based tracing systems, to provide transparency about the origin and handling of each batch. Being the only company, which engages in alternative uses related to scent production though, this is an exception. As this process is more sophisticated and aims at a more high-end product, a more stringent process is required. Normal traders and exporters to neighboring countries have no such systems in place, as their products are only sold as spice without sophisticated processing.

14.10 Legal elements

Within village boundaries, *Z. rhetsa* orchards can only be established in production forest areas, not in protected forest areas.

Tax regulations again are not clear. Some companies reported that only profit tax applied, as Indian Prickly Ash was not considered a NTFP, while others stated to be charged a tax rate of 40% on mak khaen. It is possible that distinctions between produce from production forests and other areas are made.

14.11 Main destination markets and demand

Domestic use is common in the Northern provinces, as is export to Vietnam and Thailand. Export to China was not reported, but true Sichuan Pepper (Mak Maat) is apparently produced in Phongsaly and exported to China. It is thus not unlikely that value chains into China exist which the study team did no come across.

Dak dae company explores supplying the perfume industry in France, and spice traders in Germany and India but the COVID-19 pandemic has slowed progress for this niche market. Other companies (Mai Savanh Lao) are sourcing in the South of Laos and are exporting dried fruits to France for spice.

The market size for Mak Khaen is hard to estimate as no official statistics exist. Quantities reported by some of the traders and exporters interviewed in this study indicate a rather small export market, but the patchiness of the production and supply chain make estimates difficult. Likewise, the potential absorption capacity of export markets is hard to predict, due to the strong niche character of the product. It also has apparently no HS code assigned to it, which means that it does not appear in official trade portals.

14.12 Constraints

The expansion of mak khaen would face some minor constraints such as theft of fruits or even felling of trees to get fruits in settings where trees are grown in fallow areas. Otherwise, the increase of production is almost effortlessly possible as the resource seems to be readily available.

The true constraint though seemed to be the lack of supply chain organization and the lack of information on its size or absorption and growth potential. This makes investing in this commodity as a stable upland crop within a forest-supporting system risky.

14.13 Recommendations and potential

The production potential for mak khaen is large as the trees grow wild throughout the Northern provinces and establish themselves readily. Given the market uncertainties, it does not seem wise to establish large orchards in new areas with a pure focus on seed production. However, the tree may be integrated as a shade tree with an additional income option for other main crops such as tea or coffee, or in mixed livestock systems, as reported by Foppes and Nampanya (2019).

15. Tung (ໝາກກົ້ງ)

15.1 Overview

The tung tree or China wood oil tree (*Vernicia fordii;* previously *Aleurites fordii*) is the source of tung oil, and together with a similar species, the mu oil tree (*Vernicia montana,* previously *Aleurites montana*) occupies an important niche in the industrial plant oils market. The trees likely originated in China and have been grown and cultivated for oil production there for thousands of years but are now cultivated in many parts of the world. China, though, still accounts for at least 70% of global tung oil production annually. Tung oil, (also known as China wood oil, Lumbang oil, tung oil paraformaldehyde, and tung meal) is extracted from the seeds which contain up to 60% of oil by weight, which has as main ingredient α-eleostearic acid. In recent years research efforts have been made to understand the tung oil bio-synthetic pathway and find ways to transfer it to other organisms. (Shockey et al., 2016).

While tung tree and mu tree are not fully interchangeable, they will be treated as such in this report, as farmers and processors do not seem to distinguish between the two. For non-specialized products such as biodiesel, a distinction is apparently not necessary.

15.2 Uses and properties

Tung oil is a high-quality fast-drying oil used in the manufacturing of paints, varnishes, inks, linoleum, and numerous other products. In recent years, tung oil has been used in synthesis schemes for the production of modern high value/high-performance materials such as specialized resins and biodiesel. Its component, α-eleostearic acid, is still of interest in the chemical industry due to its high reactivity and ease of crosslinking via its conjugated double bond system, which allows its use as building block for polymers and other organic compounds (Shockey et al., 2016).

All in all, tung oil can be used in the production of 58 products, the most common ones being biofuel, cosmetics, and floor waxes.

Mu oil (also labeled as Chine wood oil) is used as varnish similar to Tung oil and is prized as a wood finish. The wood is also harvested.

15.3 Production systems

Tung trees grow easily at altitudes from 400 to 1,600 m asl and become productive four to five years after establishment. In the first year of harvesting the yield of well nursed trees is about 20 kg of seeds/tree, which increases in subsequent years to double or more. Under less optimal conditions, yields start at 5-10 kg/tree. Tung trees stay productive for many decades and are not affected by any major pests and diseases.

The oldest known Tung tree in Laos found in Houaphan province, is about 70 years old, and yields around 200 kg/year. The tree blossoms from February to March and Tung fruits ripen between September and November, which is when they fall off the trees. Farmers collect the fruits from the ground and dry them at home. After two days the seeds can be separated from the fruits. Once the seeds are fully dried, they are ready for oil extraction.

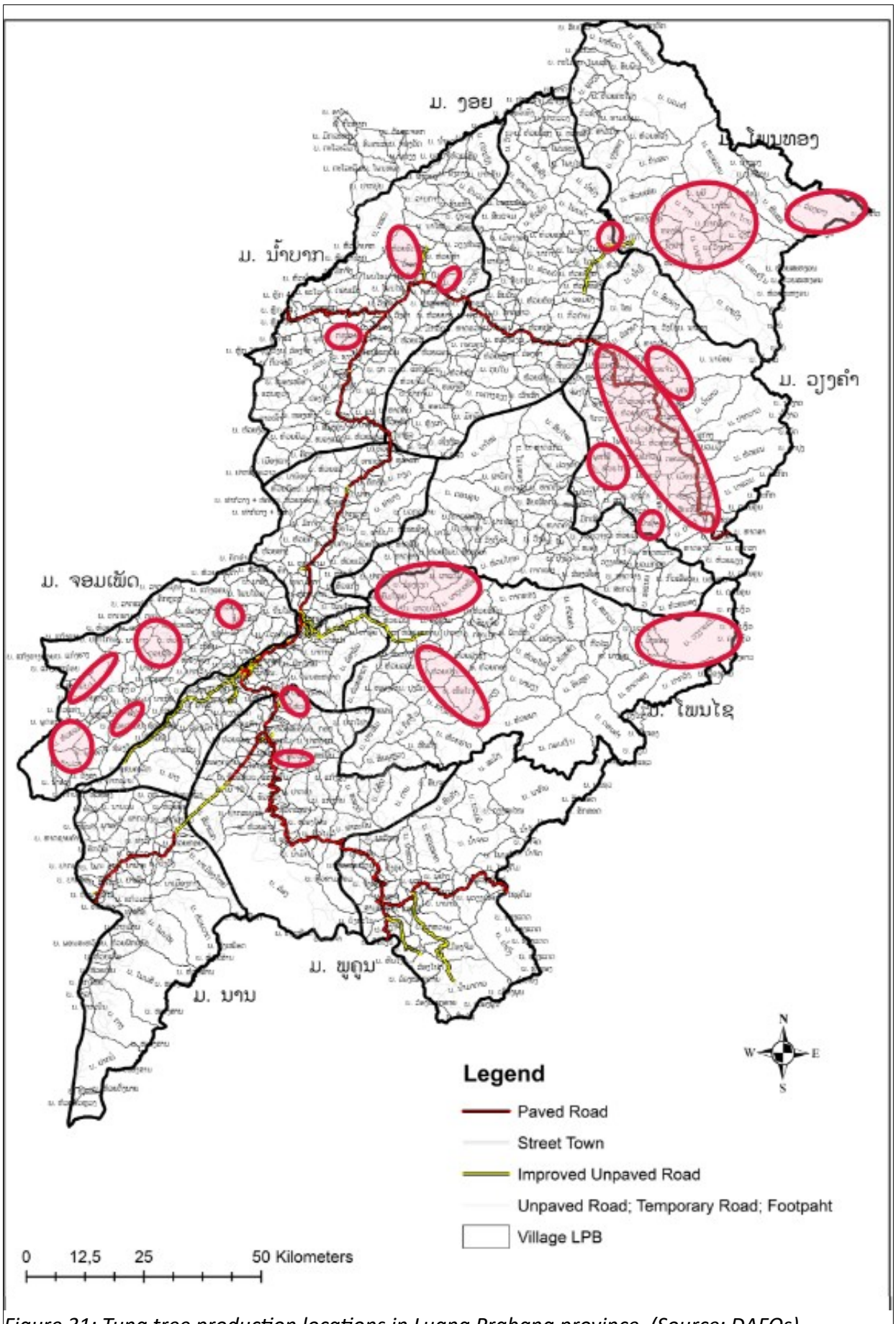


Figure 31: Tung tree production locations in Luang Prabang province. (Source: DAFOs)

Plantations have been set up in the past, mostly with the idea of cashing in on the bio-fuel hype of the early 2010s, but most have disappeared now. For the establishment of a plantation, it takes about 4 kg of seed per hectare.

15.4 Production locations

V. montana prefers well drained, sandy soils, and is grown in hillside plantations in northern Vietnam. Under natural conditions, it can be found at the margins of primary forests.

Production locations in Luang Prabang province are shown in Figure 31.

15.5 Production volumes

In the first harvesting year one tree can yield 20kg of seed, successively increasing over the years. One full grown tung tree can yield 220-270 kg of shelled seeds or 120-140 kg of dried seeds. At a spacing of 5 x 5 meters, Tung yields about 3.3 tons/ha.

Reported production areas, especially in Houaphan are substantial but average yields are 2.8 tons/ha, small compared to the trees' potential (Table 39). However, since demand is high, this presents an opportunity for increased production efficiency.

Table 39: Tung tree growing area and production volume in Houaphan and Luang Prabang Provinces (2021)

Districts	Area (ha)	Volume (tons)
Houaphan		
Xamtai	40	60
Hiem	61.46	490.95
Houameuang	167.5	150
Viengxai	560	1680
Xamneua	-	-
Luang Prabang		
Phonthong	24.9	20
Total	**854**	**2401**

Source: DAFO reports

15.6 Production quotas

Tung seeds need quota approval but relevant data could not be obtained.

15.7 Processing, Packaging, and Storage

Tung seeds do not require any special treatment before export. They are inspected before buying to make sure that they are reasonably clean and free of foreign bodies. No further grading or treatment is undertaken within the country.

For oil extraction seeds get pressed, requiring 4 kg of good quality seeds or 5.5kg of low-quality seed for the production of 1 kg of oil. However, while oil production capacities exist, no oil extraction takes currently place in-country (see next section).

15.8 Value chain, prices, and income

Like most agricultural supply chains in Laos, also the Tung chain is simple (Figure 32). Companies commonly work with brokers or traders who pick up the seeds from villages. Collection happens mostly in January and February.

Often, the head of the village is acting as company representative and collects Tung seeds from the villagers. The current farm gate price is 4,000 LAK/kg for fresh seed and 5,000 LAK/kg for dry seed, though some small traders in Houaphan paid as little as 3,000 LAK/kg (2021). These brokers and small traders then deliver the seed to larger traders who buy them for 300-500 LAK/kg above farm-gate price and sell them for 5,500-6,000 LAK/kg to exporters. In Houaphan buying prices of 6,000-7,000 LAK/kg were mentioned. Exporters sell for 6,500-8,500 LAK/kg, depending on quality, to Vietnam and China. It was indicated that ultimately almost all of the production ends up in China.

Conflicts sometimes arise from these arrangements and loss of trust in the commodity can be the consequence. In one case, for example, the company did not pay the village head even though he had already collected the seed from villagers, meaning he could not pay villagers for their produce. Even though the company is still actively collecting Tung seed in the area, villagers are worried that it might soon stop doing so due to obvious problems of liquidity.

However, Tung as an industrial product seems to be traded in larger quantities. One trader in Houaphan noted that large quantities were always easy to sell but that it can be hard to find buyers for small ones, emphasizing the need for critical mass production or collection.

In some villages in Xiengngeun district, such as Houyhere, Kiewchaluang, Phoukhao, Kiewhae, Kiewkajap and Kiewyha tung plantations exist. One of the larger tung plantations (3 ha) belongs to the governor of Xiengngeun district, located in Kiewchaluang village, who allows villagers to collect tung fruits from his plantation as long as they in return take care of the plantation.

Villagers don’t know why companies buy tung seeds from them, but they heard that tung oil is used to produce fuel but are not sure about that.

The price for tung seed is currently high, having led Lao Vernicia Montana company to entirely abandon processing of seed into tung oil and ship seeds directly to China. This approach is apparently more profitable than processing in-country. The company will take up oil production again when the seed price falls.

Extension activities by upstream stakeholders are not uncommon. Lao Vernicia Montana Company, for example, provided 6 tons of seeds to 20 villages so far and offers a minimum buying price of 3000 LAK/kg seeds, adjusted by market price developments. Their target is to supply seed to a total of 78 villages.

15.9 Standards

No production standards apply.

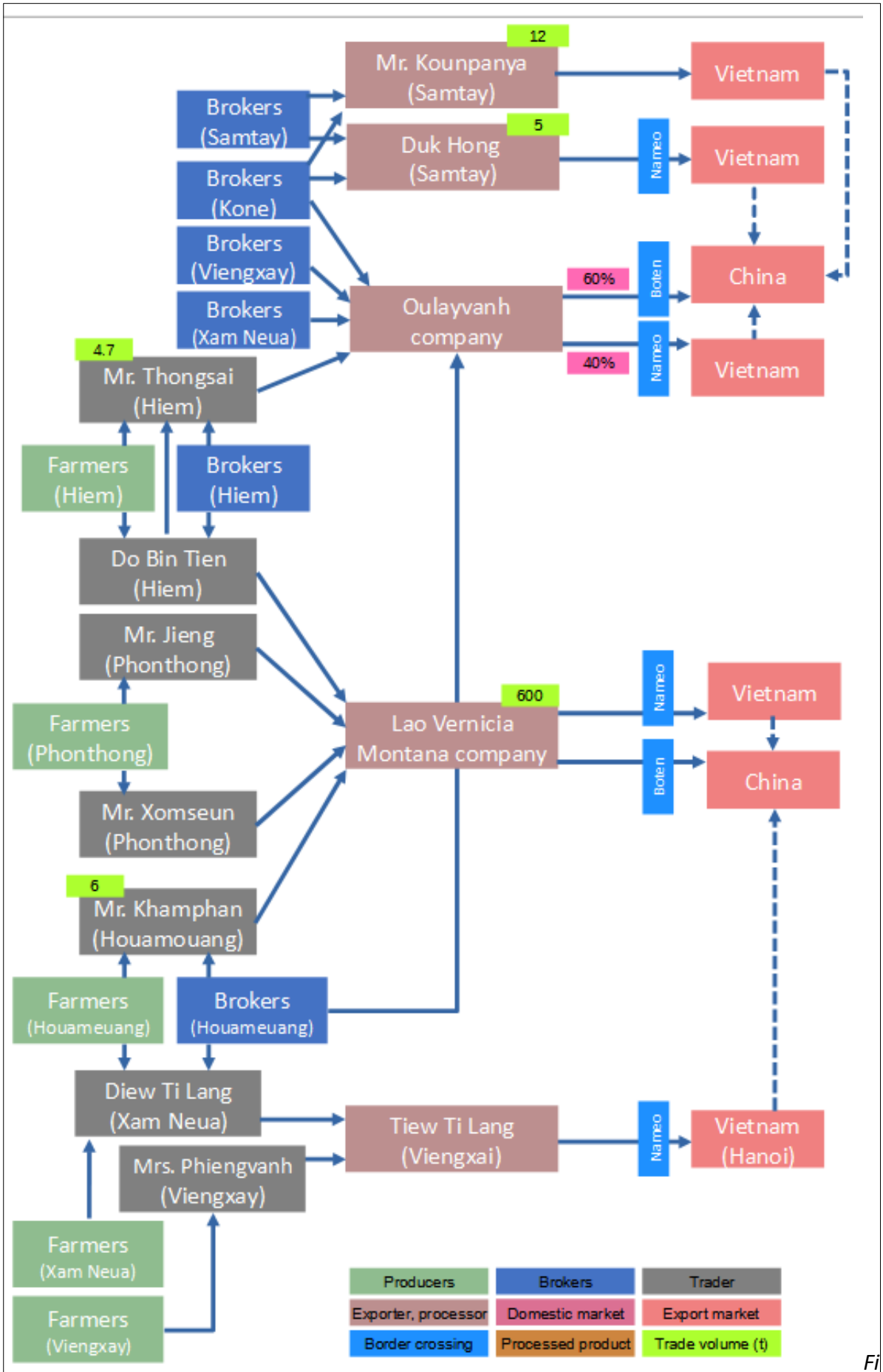


Figure 32: Tung supply chain in the target provinces (abridged)

15.10 Legal elements

Despite Tung oil requiring a quota, one of the main buyers reports it being taxed at only 3%, like normal agricultural commodities. It is possible that this applies to produce coming from plantation trees.

15.11 Main destination markets and demand

Globally, the tung oil market is expected to grow from 287 million USD In 2020, to reach 344.2 million USD by 2026. The main producers of tung oil are all based in China and in 2017, wood finishing application held 91% of the consumption market share. Within China the market is highly competitive, mainly because processors cannot find enough tung seeds domestically, and less and less of it is grown on Chinese soil (Market Watch, 2022).

For Lao PDR, the main markets for Tung seed are Vietnam and China. Apparently, most of the tung oil produced from these seeds is generally exported to Japan where the oil is used in many applications. It is not clear in how far the seed is processed in Vietnam or only passed through to processing facilities in China, which need around 20 million tons of tung seed per year to work at full oil extraction capacity.

However, exporters in Laos see good potential for Tung seed and all of them have export targets that are 3-10 times above their current operations.

15.12 Constraints

The main constraints for Tung seed seem to be the lag period before trees become productive and the lack of information circulating about the value chain. The finding that most farmers did not know what Tung seed was being used for points towards a strong information imbalance along the value chain, which ultimately harms all stakeholders.

15.13 Recommendations and opportunities

The tung market seems stable and prices reflect this stability. While the seeds do not sell at highly attractive prices, the price is in the good mid-range for agricultural commodities. If local buyers keep being reliable trading partners to farmers, stable business relationships such as in coffee or sacha inchi could lead to long-term stability and prosperity. If direct exports to China could be arranged through a bilateral agreement, it would likely benefit Lao producers.

From a deforestation prevention and slope stabilization point of view, tung seems a good choice and might add an interesting option to the choice of available tree crops.

16. References

16.1 Taxes

Suvannaphakdy, S., & Toyoda, T. (2019). Assessing the Fiscal Impact of Trade Liberalization in Laos: A General Equilibrium Approach (No. 34; GSICS Working Paper Series, p. 23). Kobe University. http://www.lib.kobe-u.ac.jp/repository/81011876.pdf

16.2 Bamboo

Boupha, L., Phimmavong, S., 2006. Laos Resource Mapping and Farmer Input Market- Studies of the Vietnam-Laos Bamboo Feasibility Study (Final Report). Oxfam Hongkhong, Vientiane, Lao PDR.

Desbleds, L., 2021. From shared governance of bamboo forests to structuring of sustainable value chains - The Bamboo programme through the prism of the commons, Cahier projet. GRET, Vientiane, Lao PDR.

Greijmans, P.M., Hitzges, C., 2012. SNV Bamboo Programme - Approaches, Lessons and Innovations in Lao PDR (Project summary). Vientiane, Lao PDR.

GRET, 2018. Project: Development of Multi- stakeholders and Sustainable Bamboo & Rattan value chains in Lao PDR.

GVR, 2021. Bamboos Market Size, Share & Trends Analysis Report By Application (Industrial Products, Shoots, Furniture, Raw Materials), By Region (North America, Europe, APAC, CSA, MEA), And Segment Forecasts, 2021 - 2028 (No. GVR-2-68038-819-0). Grand View Research, San Francisco, USA.

IDC, 2016. European market study, Laos Home Decoration & Personal Accessories (Market study). The Centre for the Promotion of Imports from developing countries (CBI), Ministry of Foreign Affairs, EU.

INBAR, 2021. Trade Overview 2019, Bamboo and Rattn Commodities in the International Market (Analysis). International Bamboo and Rattan Organisation, Beijing, China.

Khamhoung, A., Gansberghe, D.V., 2016. Sixteen Lao agrobiodiversity products with high potential for food security and income generation. Swiss Agency for Development and Cooperation (SDC), Vientiane, Lao PDR.

Kibler, J.-F., 2014a. Taxes and fees for promoting sustainable bamboo based value chains, Huaphan Province.

Kibler, J.-F., 2014b. Innovative learning process for building sustainable NTFP value chains: the case of the Bamboo Project in Huaphan Province.

Łuczaj, Ł., Lamxay, V., Tongchan, K., Xayphakatsa, K., Phimmakong, K., Radavanh, S., Kanyasone, V., Pietras, M., Karbarz, M., 2021. Wild food plants and fungi sold in the markets of Luang Prabang, Lao PDR. J Ethnobiol Ethnomed 17, 6–6. https://doi.org/10.1186/s13002-020-00423-y

Melki, S., 2016. Development of NTFP Value chain Natural Resource & Agroecology The case of the Hok Bamboo shoots development - The Bamboo Project / GRET in Huaphan Province, Laos.

Melki, S., Kibler, J.-F., 2018. Des filières durables de bambou dans la province de Houaphan, au Laos. La Garance voyageuse 122, 44–47.

Porbounmixaithor, H., Huynh, P., Herchuechang, A., Saengmany, B., Melki, S., 2016. Community-based management of natural bamboo forests (Guide). GRET, Lao PDR.

Smith, H., Barney, K., Byron, N., Keenan, R., Vongkhamsao, V., 2017. Tree Plantations in Lao PDR: Policy Framework and Review (Project Working Paper). ACIAR, Vientiane, Lao PDR.

World Bank, International Finance Corporation, 2019. Partnerships and Opportunities for a New Green Forest Economy in Lao PDR: Sustaining Forest Landscapes and Livelihoods. World Bank, Washington, DC, USA. https://doi.org/10.1596/32019

16.3 Benzoin

Khamhoung, A., Gansberghe, D.V., 2016. Sixteen Lao agrobiodiversity products with high potential for food security and income generation. Swiss Agency for Development and Cooperation (SDC), Vientiane, Lao PDR.

LGISU 2020. Lao Geographic Information System Unit. Mekong Geographic Information System Data; Department of Agricultural Land Management (DALaM), Ministry of Agriculture and Forestry. Lao PDR.

Orwa, C., Mutua, A., Kindt, R., Jamnadass, R., Simons, A., 2009. Agroforestree Database: a tree reference and selection guide version 4.0. [WWW Document]. The Agroforestree Database. World Agroforestry Centre, Kenya. URL http://apps.worldagroforestry.org/treedb2/

Vongkhamho, S., 2022. Desk review - Development of Benzoin (Styrax tonkinensis) Upstream Value Chains for Uplands of the Lao PDR (Desk review). Forestry Research Center, NAFRI, Vientiane, Lao PDR

Vongkhamho, S., 2016. Main Research Finding on Development of Benzoin (Styrax tonkinensis) Value chain in five Upland provinces (Houaphanh, Luang Prabang, Phongsaly, Oudomxay and Xiengkhouang) of Laos. Forestry Research Center, NAFRI, Vientiane, Lao PDR

16.4 Bong

ADB & IFAD, 2014. Community Empowerment and NRM for Sustainable Development - Best practices of NRMPEP. IFAD, Vientiane, Lao PDR.

MAF & ADB, 2014. Lao PDR: Sustainable Natural Resources Management and Productivity Enhancement Project - Value Chain Development Study of Yang Bong (Persea Kurzii) (Documents Produced under Grant No. 37579– 032). ADB, Vientiane, Lao PDR.

van der Meer Simo, A., Kanowski, P., Barney, K., 2020a. Economic returns to households participating in different models of commercial tree plantations in Lao PDR. int. forest. rev. 22, 132–152. https://doi.org/10.1505/146554820828671535

van der Meer Simo, A., Kanowski, P., Barney, K., 2020b. The role of agroforestry in swidden transitions: a case study in the context of customary land tenure in Central Lao PDR. Agroforest Syst 94, 1929–1944. https://doi.org/10.1007/s10457-020-00515-4

16.5 Paper mulberry

Anttila, J.P., 2016. Implications of middlemen in smallholder teak production systems in Northern Lao People's Democratic Republic (Lao PDR) (Master thesis). Department of Forest Sciences, University of Hersinki, Helsinki, Finnland.

Neef, A., Suebpongsang, P., Manythong, C., Tacheena, W., Kazuo, O., 2010. Can Paper Mulberry Contribute to Building Sustainable Rural Livelihoods in Northern Laos? Southeast Asian Studies 47, 403–426.

Ribeiro, M.M., Darnhofer, I., 2007. Understanding the supply chain of paper mulberry bark in Lao PDR using causal mapping (Project report). CIAT, Universität für Bodenkultur Wien, Vienna, Austria.

Simppula, A., 2020. Village-level changes in landscapes, land use and rural livelihoods: A case study of three villages in Nambak District, Lao PDR (Master thesis). Department of Forest Sciences, University of Hersinki, Helsinki, Finnland.

Wiemann, J., Ashoff, V., Grad, M., Meyer, A.K., Ruff, S., Staiger, T., 2009. Laos on its Way to WTO Membership, Challenges and opportunities for developing high-value agricultural exports (Study). German Development Institute / Deutsches Institut für Entwicklungspolitik (DIE), Bonn, Germany.

16.6 Rattan

ATIK, 1992. Trees and their management – Growing rattan. Workshop to revise the agroforestry technology information kit (ATIK), November 16-21, 1992, Silang, Cavite. International Institute of Rural Reconstruction (IIRR), Department of Environment and Natural Resources (DENR), Philippines. http://www.nzdl.org/cgi-bin/library?e=d-00000-00---off-0cdl--00-0----0-10-0---0---0direct-10---4-------0-1l--11-en-50---20-about---00-0-1-00-0--4----0-0-11-10-0utfZz-8-00&cl=CL1.230&d=HASH018d03b99cc52b06c1e2fb2b.13&gt=1

IDC, 2016. European market study, Laos Home Decoration & Personal Accessories (Market study). The Centre for the Promotion of Imports from developing countries (CBI), Ministry of Foreign Affairs, EU.

INBAR, 2015. Toward a framework for rattan sector development in asean countries, in: Results of a Nine-Country Consultation on Sustainable Rattan Management and Development in South-East Asia. International Network for Bamboo and Rattan, Beijing, China, p. 24.

Khamhoung, A., Gansberghe, D.V., 2016. Sixteen Lao agrobiodiversity products with high potential for food security and income generation. Swiss Agency for Development and Cooperation (SDC), Vientiane, Lao PDR.

Phommasane, S., Viengkham, O.V., Phongkhaphanh, T., 2020. Marketing Chain Analysis on Rattan in Ba Beng, Ban Tha, Lakhonpheng District, Salavan Province (Project report). Agro-Forestry Consultant (AFC), Vientiane, Lao PDR.
Souksompong Prixar, 2014. FSC Rattan Certification Implementation in Laos, WWF Report. WWF Laos, Lao PDR.
Thammavong, B., Vongkhamsao, V., 2018. Rattan: from Research toward Sustainable Development and Use.
B.P. - Key expert interview with the World Wildlife Fund Laos (WWF) project leader on rattan Ms. Bouavanh Phachomphonh

16.7 Sacha inchi

The information is based on key interviews with representatives from Mai Savanh Lao and Thanchai companies, as well as with staff from PAFOs and DAFOs.

16.8 Sesame

ADB, 2019. Market Chain Assessments - Sustainable Rural Infrastructure and Watershed Management Sector Project (Market Chain Assessments). Asian Development Bank (ADB), Vientiane, Lao PDR.
Iowa State University, 2022. Sesamy Profile [WWW Document]. Agricultural Marketing Resource Center, Iowa State University. URL https://www.agmrc.org/commodities-products/grains-oilseeds/sesame-profile (accessed 7.4.22).
Kafiriti, E., & Mponda, O. (2022). Soils, Plant Growth And Crop Production—Growth And Production of Sesame. In Food and agricultural sciences, engineering and technology resources (1st ed., p. 10). UNESCO. http://www.eolss.net/sample-chapters/c10/e1-05a-46.pdf
Oplinger, E.S., Putnam, D.H., Kaminski, A.R., Hanson, C.V., Oelke, E.A., Schulte, E.E., Doll, J.D., 1990. Sesame [WWW Document]. Alternative Field Crop Manual. URL https://hort.purdue.edu/newcrop/afcm/sesame.html (accessed 5.4.22).
Yap, V.Y., Xaphokhame, P., de Neergaard, A., Bech Bruun, T., 2019. Barriers to Agro-Ecological Intensification of Smallholder Upland Farming Systems in Lao PDR. Agronomy 9, 375. https://doi.org/10.3390/agronomy9070375

16.9 Sichuan pepper

DakDae: Key expert interview with Ms. Anousone Phimmachanh (anousone@dakdae.com), co-founder of DakDae company.
Foppes, J., Nampanya, N., 2019. Case Study on Impacts on Biodiversity and Compliance with Ethical Biotrade Principles in the Indian Prickly Ash (Mak Kaen) Sector in Laos (Projecct study). Helvetas, The Regional Biotrade Project in Laos supported by SECO, Vientiane, Lao PDR.
Sisaphaithong, T., 2019. Conservation and utilization of genetic diversity of vegetable accessions in Lao PDR
Wilson, A., Woda, C., Foppes, J., Giuliani, A., 2019. Case Studies: Biodiversity Impact Learning from the cases of Siam benzoin, organic chili, Indian prickly ash and jujube in Vietnam, Laos and Myanmar (Prepared for the Regional Biotrade Project In Southeast Asia). Helvetas, Vientiane, Lao PDR.
Zhang, M., Wang, J., Zhu, L., Li, T., Jiang, W., Zhou, J., Peng, W., Wu, C., 2017. Zanthoxylum bungeanum Maxim. (Rutaceae): A Systematic Review of Its Traditional Uses, Botany, Phytochemistry, Pharmacology, Pharmacokinetics, and Toxicology. Int J Mol Sci 18, 2172. https://doi.org/10.3390/ijms18102172

16.10 Tung

Shockey, J., Rinehart, T., Chen, Y., Yangdong, W., Zhiyong, Z., Lisong, H., 2016. Chapter 10 - Tung (Vernicia fordii and Vernicia montana), in: McKeon, T.A., Hayes, D.G., Hildebrand, D.F., Weselake, R.J. (Eds.), Industrial Oil Crops. AOCS Press, pp. 243–273. https://doi.org/10.1016/B978-1-893997-98-1.00010-5
Market Watch, 2022.Tung Oil Market Size In 2022. Industry analysis report, abstract. https://www.marketwatch.com/press-release/tung-oil-market-size-in-2022-26-cagr-with-top-countries-data-what-trends-are-influencing-the-growth-of-the-tung-oil-industry-in-depth-94-pages-report-2022-04-25

Annexes

1. Annex 1. Project related considerations

The nine assessed commodities vary substantially in their biological, market, and ecological characteristics. Only bong bark can be excluded as an option for cultivation in the uplands of the three target provinces, since no active value chain for this commodity could be identified anymore.

While when simple scoring is applied (Table 40) tung comes up as a clear favorite in terms of balancing sustainability, income generation and market stability, this picture has to be modified: Depending on location, and village circumstances, benzoin or sacha inchi may be far better choices than tung. Sesame by itself is unlikely to be suitable for upland stabilization and deforestation prevention, but if embedded in a mixed cropping system for example with a tree crop, it could serve as cash component within a sustainable system.

Table 40: Scoring the nine commodities regarding their suitability as sustainable upland crop

	Ease of cultivation	Landscape protection	Ease of system management	Market size	VC organized	Price stability	Income generation
Bamboo	++	+	(- -)	+	+	-	-
Benzoin	+	++	-	+	++	+	+
Bong	++	++	+	- -	- -	- -	- -
Paper mulberry	++	+	++	++	+	+	-
Rattan	-	++	- -	+	-	++	+
Sacha inchi	-	(+)	+	++	+	++	++
Sesame	++	-	-	++	+	+	+
Sichuan pepper	+	++	+	?	- -	++	(+)
Tung	+	++	++	+	+	+	+

Bamboo and rattan require strong communal forest management skills unless they are grown on private plots. While this is very feasible for some bamboo species, it is far more challenging for rattan. Whereas currently men rather produce bamboo and rattan poles, whilst women collect shoots, it is possible that, given strong economic opportunities, this pattern would change. The production of village handicrafts is an option in pockets for the domestic market, but without substantial support, no export opportunities exist here.

Benzoin on the other hand offers an opportunity where labor is limited, since harvesting and management are not labor intensive but slow. Paper mulberry in contrast is highly labor intensive and the price per unit of produce is comparatively low, making it an “opportunistic commodity”, that is one that will only be exploited if nothing better is available. If mechanization can be developed, it might jump the queue and become a quite attractive option.

The promotion of Sichuan pepper is a gamble since market absorption capacity at this stage is unclear. Once a well-organized supply chain is established, the trees could become an interesting income source for upland communities. However, currently only a small proportion of the

potentially available produce seems to be harvested and sold, leaving open questions as to the expansion capacity of this market.

Sacha Inchi is very promising as a new rising star for upland farmers. However, with respect to sustainable upland farming systems it can only be classified as being unlikely to do damage and contributing to system stabilization only by having a five-year renewal cycle. Similar to sesame, this could be improved if the crop gets integrated with tree crops. However, sacha inchi is generally grown on a relatively small scale (0.25-1 ha).

Tung trees finally seem to combine all the desired characteristics for a stable upland crop. However, the value chain does currently not expand into Sayabouri and in the other provinces the commodity is grown in certain clusters only. It is therefore unlikely to be a preferred choice under all circumstances.

2. Annex 2. Quota Lists I-III

ສາທາລະນະລັດ ປະຊາທິປະໄຕ ປະຊາຊົນລາວ
ສັນຕິພາບ ເອກະລາດ ປະຊາທິປະໄຕ ເອກະພາບ ວັດທະນະຖາວອນ

ກະຊວງກະສິກຳ ແລະ ປ່າໄມ້ ເລກທີ 0279 /ກປ
ນະຄອນຫຼວງວຽງຈັນ, ວັນທີ 19 ກຸມພາ 2020

ຂໍ້ຕົກລົງ
ວ່າດ້ວຍການກຳນົດບັນຊີ ເຄື່ອງປ່າຂອງດົງ I, II ແລະ III

- ອີງຕາມ ກົດໝາຍວ່າດ້ວຍ ປ່າໄມ້ ສະບັບເລກທີ 64/ສພຊ, ລົງວັນທີ 13 ມິຖຸນາ 2019;
- ອີງຕາມ ດຳລັດຂອງນາຍົກລັດຖະມົນຕີ ສະບັບເລກທີ 99/ນຍ, ລົງວັນທີ 9 ມີນາ 2017 ວ່າດ້ວຍ ການຈັດຕັ້ງ ແລະ ເຄື່ອນໄຫວ ຂອງກະຊວງກະສິກຳ ແລະ ປ່າໄມ້;
- ອີງຕາມ ໜັງສືສະເໜີຂອງກົມປ່າໄມ້ ເລກທີ 0537/ກປມ, ລົງວັນທີ 31 ມັງກອນ 2020;
- ອີງຕາມ ການຄົ້ນຄ້ວາ ແລະ ສະເໜີຂອງກົມນະໂຍບາຍ ແລະ ນິຕິກຳ ເລກທີ 080/ກບນ, ລົງວັນທີ 03 ກຸມພາ 2020

ລັດຖະມົນຕີກະຊວງກະສິກຳ ແລະ ປ່າໄມ້ ອອກຂໍ້ຕົກລົງ

ມາດຕາ 1. ກຳນົດ ບັນຊີເຄື່ອງປ່າຂອງດົງ I, II ແລະ III ດັ່ງນີ້:

1. ບັນຊີເຄື່ອງປ່າຂອງດົງ I ລວມມີ 70 ຊະນິດ:

ລຳດັບ	ຊື່ລາວ Lao Name	ຊື່ວິທະຍາສາດ Scientific Name	ສ່ວນນຳໃຊ້
1	ເກດສະໜາ	*Aquilaria crassna*	ໝົດຕົ້ນ
2	ກົກອ່ຽນດ່ອນ	*Eurycoma harmandiana*	ຮາກ
3	ກຸດຕີນຮຸ້ງ	*Helminthostachys zeylanica*	ຮາກ, ຫົວ
4	ກຸດນາງນີ	*Cibotium barometz*	ຫົວ, ຂົນ
5	ກົກຄັນກົດ	*Polygonatum sibiricum*	ຫົວ
6	ເກົ້າຖານ	*Ariseama calcareum*	ຫົວ
7	ຂົມລະຫວານຈ້ໍ	*Evodia lepta(spreng)*	ໝົດຕົ້ນ
8	ຂີງແຄງປາກົ້ງ	*Homalomena aromatic*	ຮາກ, ຫົວ
9	ແຄ່ຫອມ ຫຼື ຈອງຫອມ	*Cinnamomum cassia*	ເປືອກ, ໃບ

ລ/ດ	ຊື່ລາວ Lao Name	ຊື່ວິທະຍາສາດ Scientific Name	ສ່ວນນຳໃຊ້
10	ເຄືອແຫມ (ແຫມຄວາຍ)	*Coscinium fenestratum*	ເຄືອ, ຮາກ
11	ເຄືອຈານ	*Butea superba*	ເຄືອ
12	ເຄືອປະສິງ	*Streptocaulon juventas*	ເຄືອ
13	ເຄືອຕາກວາງ ຫຼື ກຳແພງເຈັດຊັ້ນ	*Salacia verrucosa*	ເຄືອ
14	ເຄືອແດງດ່ານ	*Sargentodoxa cuneata*	ເຄືອ
15	ເຄືອໃສ້ຊ້າງ ຫຼື ໝ້ອຍເລືອດ	*Bauhinia sp.*	ເຄືອ
16	ເຄືອບ້າລາຍ ຫຼື ບ້າບິນ	*Entada reticylata*	ເຄືອ, ໝາກ
17	ເຄືອບ້າໃຫຍ່ ຫຼື ໝາກແຄ້	*Entada scandens*	ເຄືອ, ໝາກ
18	ເຄືອສາມຫາງ	*Byttneria andamanensis*	ເຄືອ
19	ເຄືອສົ້ມສ້ຽວ	*Bauhinia glauca*	ເຄືອ
20	ຈັນຍານ	*Illicium verum*	ລຳຕົ້ນ, ດອກ, ໝາກ
21	ຈັນແດງ	*Pterocarpus santalinus*	ແກ່ນ, ລຳຕົ້ນ
22	ຈັນໄດ	*Dracaena cambodiana*	ແກ່ນ, ລຳຕົ້ນ
23	ໂສມແດງ	*Decaschistia harmandii*	ຫົວ ຫຼື ຮາກ
24	ໂສມດິນ, ໂສມຟູ, ໂສມຜາ	*Elatostema platyphylloide*	ໝົດຕົ້ນ
25	ດອກເຜິ້ງປ່າ ຫຼື ດອກເອື້ອງປ່າ	*Orchidaceaesp*	ທຸກສ່ວນ
26	ຕົ້ນໄຮເລືອດ ຫຼື ໄຮແດງ	*Ficus altissima*	ໝົດຕົ້ນ
27	ຕົ້ນໝາກເກືອນ້ຳ	*Diospyros embryopteris*	ລຳ, ໝາກ
28	ຕົ້ນໝາກເກືອ	*Diospyros mollis*	ໝາກ
29	ຕຸມຕາແດງ	*Strychnos sp.*	ໝາກ, ແກ່ນຕົ້ນ
30	ຕົ້ນຢາງ	*Dipterocarpus sp.*	ຢາງ, ນ້ຳມັນ
31	ເບເບລິນ	*Mahonia nepalensis*	ຮາກ
32	ເບ້ຍລາຍ	*paphiopedilum callosum*	ຮາກ
33	ປອມບີກະທີ່ງ (ໂສມງອກລີ່ງ)	*Panax vietnamensis*	ຫົວ
34	ຜັກຕົບຮຸ້ງ	*Helminthostachys zeylanica*	ໝົດຕົ້ນ
35	ໄມ້ກ້ອນ	*Bambusa polymorpha*	ລຳ, ໜໍ່, ຮາກ
36	ໄມ້ຫວີ່ງ	*Dendrocalamus latifolius*	ລຳ, ໜໍ່, ຮາກ
37	ໄມ້ຜາງ	*Dendrocalamus longifimbriatus*	ລຳ, ໜໍ່
38	ໄມ້ເບາະ ຫຼື ໄມ້ປອກ	*Dendrocalamus sinicus*	ລຳ, ໜໍ່
39	ໄມ້ລວງມອກ	*Gigantochloa haskarliane*	ລຳ, ໜໍ່, ຮາກ

ລ/ດ	ຊື່ລາວ Lao Name	ຊື່ວິທະຍາສາດ Scientific Name	ສ່ວນນຳໃຊ້
40	ໄມ້ຮີກໝາມ	*Schizostachyum branchy-cladum*	ລຳ, ຫໍ່, ຮາກ
41	ຢາຫົວ	*Smilax glabra*	ຫົວ
42	ຕົ້ນແປກ	*Pinus sp.*	ຢາງ
43	ຕົ້ນຢານ	*Styrax sp.*	ຢາງ
44	ເລັບມືນາງ	*Schefflera CllipticHarms*	ເປືອກ, ລຳ
45	ເລັບຮຸ້ງ	*Celtis sp.*	ເຄືອ
46	ຫົວສາມສິບ	*Stemona tuberosa*	ຫົວ
47	ຫົວຊີ້ດິນ ຫຼື ເຫຼັກຊີ້ດິນ	*Cucurligo orchioides*	ຫົວ
48	ຫົວກະບຸກ ຫຼື ຫົວດຸກເດືອ	*Amorphophallus campanulatus*	ຫົວ
49	ຫົວຜຸກປ່າ	*Alocasia macrorrhizos*	ຫົວ, ໃບ
50	ຫົວກະຊາຍ	*Boesenbergia rotunda*	ຫົວ
51	ໝາກແໜ່ງຂຽວ	*Amomum uliginosum*	ໝາກ, ຮາກ
52	ໝາກຕາວ	*Arenga westerhoutii*	ໝາກ, ຍອດ, ຫໍ່
53	ໝາກແໜ່ງແດງ	*A. Villosum*	ໝາກ, ຮາກ
54	ໝາກສາມສິບ	*Stemona cochinchinensis*	ໝາກ, ຮາກ
55	ໝາກແສງເບືອ	*Strychnos nuxvomica*	ໝາກ
56	ໝາກກະເບົ້າ, ກະເບົ້າ	*Hydnocarpus anthelminticus*	ໝາກ
57	ຫຍ້າໃບລາຍ	*Ludisia discolor*	ໝົດຕົ້ນ
58	ຫວາຍທຸນ	*Calamus poilanei*	ເສັ້ນ, ຍອດ, ໝາກ, ໃບ
59	ຫວາຍທອກ	*Calamus solitarius*	ເສັ້ນ, ຍອດ, ໝາກ
60	ຫວາຍເສີຍ	*Calamus harmandii*	ເສັ້ນ, ໃບ
61	ຫວາຍຫຼຶ່ມ	*Calamus evansii*	ເສັ້ນ, ຍອດ, ໝາກ
62	ຫວາຍແຂ້ວໝີ, ບະລອງເອີຣ	*Calamus acanthospethus*	ເສັ້ນ, ຍອດ, ໝາກ
63	ຫວາຍຕະບອງ	*Calamus rudentum*	ເສັ້ນ, ຍອດ, ໝາກ, ໃບ
64	ຫວາຍໜີ່ນ, ຫວາຍເລົ່າ	*Calamus flagellum*	ເສັ້ນ, ຍອດ, ໝາກ, ໃບ
65	ຫວາຍກະໂຕກ	*Calamus laoensis*	ເສັ້ນ, ຍອດ, ໝາກ, ໃບ
66	ຫວາຍນິກຂໍ່	*Calamus wailing*	ເສັ້ນ, ຍອດ, ໝາກ
67	ຫວາຍໜາມເຫຼືອງ	*Calamusplathycanthus*	ເສັ້ນ, ຍອດ, ໝາກ
68	ຫວາຍນ້ອ, ຫວາຍໜາມເຫຼືອງ	*Calamus nambariensis*	ເສັ້ນ, ຍອດ, ໝາກ

ລ/ດ	ຊື່ລາວ Lao Name	ຊື່ວິທະຍາສາດ Scientific Name	ສ່ວນນຳໃຊ້
69	ຜັກກູດ	*Angiopteris evecta*	ເຫງົ້າ, ລຳຕົ້ນ
70	ຮິ່ມສາມເມືອງ	*Paris sp.*	ຫົວ ຫຼື ຮາກ

2. ບັນຊີເຄື່ອງປ່າຂອງດົງ II ລວມມີ 54 ຊະນິດ:

ລ/ດ	ຊື່ລາວ Lao Name	ຊື່ວິທະຍາສາດ Scientific Name	ສ່ວນນຳໃຊ້
1	ກົງສະເດັນ	*Croton nanus*	ໝົດຕົ້ນ
2	ຂີ້ໝັ້ນຕົ້ນ ຫຼື ຍໍປ່າ	*Morinda angustifolia*	ຮາກ
3	ຈອງບານ	*Scaphium macropodium*	ໝາກ
4	ສອ່ງຝ້າ	*Clausena harmandiana*	ໃບ
5	ສີໃຄປ່າ	*Litseea cubeba*	ໝົດຕົ້ນ
6	ສີສຽດ	*Pentace burmanica*	ເປືອກ
7	ໂສມດາກຈີ່ງ ຫຼື ມັນຂາໄກ່	*Codonopsis javanica*	ຫົວ
8	ຊ້າປ່ານ	*Boehmeria densiflora*	ໃບ, ຍອດ
9	ຍໍປ່າ	*Morinda tinctorial*	ລຳ, ໃບ, ໝາກ
10	ຕົ້ນແສງຄຳ	*Terminalia nigrovenulosa*	ເປືອກ
11	ຕົ້ນບີຄົ່ນ	*Brucea javanica*	ລຳຕົ້ນ
12	ຕົ້ນກະໂດນນ້ຳ	*Barringtonia acutangular*	ລຳ
13	ຕົ້ນຕູມ	*Aegle marmelos*	ໝາກ
14	ຕົ້ນໝາກມອນກາ	*Caesalpinia bonduc*	ໝົດຕົ້ນ
15	ຕົ້ນຈຳ	*Ardisia silvestris*	ຮາກ, ລຳ
16	ຕົ້ນຕາກວາງ	*Diospyros eugenii*	ລຳ
17	ຕົ້ນໝາກສ້ອຍ	*Leonurus heterophyllus*	ໃບ, ລຳ
18	ຕົ້ນໝາກຜັບດົງ	*Diospyros bejaudii*	ລຳ
19	ຕົ້ນເໝືອດຄົ່ນ	*Scleropyrum wallichianum*	ລຳຕົ້ນ
20	ຕົ້ນເກືອມ	*Canarium kerrii*	ໝາກ, ຢາງ
21	ເຕີຍປ່າ	*Pandanus fibrosus*	ຮາກ, ໃບ, ໝາກ
22	ຕົ້ນບົງ	*Nothaphoebe*	ເປືອກບົງ
23	ທົ່ມພາຍ	*Paradina hirsute*	ລຳ
24	ເບັ່ງຊ່ອນ ຫຼື ລິ້ງຊ່ອນ	*Plumbago zeylanica*	ໝົດຕົ້ນ
25	ປົດປີ່ຂາວ	*Plumbago zeylanica*	ດອກ

ລ/ດ	ຊື່ລາວ Lao Name	ຊື່ວິທະຍາສາດ Scientific Name	ສ່ວນນຳໃຊ້
26	ເປົ້າເລືອດ	*Croton robustus*	ລຳ
27	ປະດິ່ງເລືອດ	*Dalbergia bariensis*	ເຄືອ
28	ຝາງແດງ	*Caesalpinia sappan*	ແກ່ນ
29	ຝົນແສນຫ່າ	*Stixis scandens*	ລຳຕົ້ນ
30	ມອນກາ	*Caesalpinia rhombifolia*	ລຳຕົ້ນ
31	ໄມ້ຮີກໜຽວ ຫຼື ຮີກຂຽວ	*Dendrocalamus hamiltonii*	ລຳ, ໜໍ່
32	ໄມ້ໂລ້	*Dendrocalamus pendulus*	ລຳ
33	ໄມ້ວຽດ	*Dendrocalamus membranaceus*	ລຳ, ໜໍ່
34	ໄມ້ເປາະ	*Bambusa tuldoides*	ລຳ, ໜໍ່
35	ໄມ້ແຮ້	*Dinochloa scandense*	ລຳ
36	ໄມ້ດ້ຳມຂ້ວນ	*Dendrocalamus giganteus*	ລຳ
37	ໄມ້ໄຜ່ຕົ້ງ ຫຼື ໄມ້ຮີກຫວານ	*Dendrocalamus asper*	ລຳ, ໜໍ່, ເຫງົ້າ
38	ເລັບມືນາງໜາມ	*Acanthopanax gracilistrylus*	ເປືອກ
39	ຫິວສາມພັນຮູ	*Hydnophytum fomicarum*	ຫົວ
40	ຫາດມື້	*Artocarpus lakoocha*	ແກ່ນ
41	ຫຍ້າມຸ້ງກະຕ່າຍ	*Oldenla ndia capitellata*	ໝົດຕົ້ນ
42	ຫວາຍບຸ່ນດຳ	*Calamus rhabdocladus*	ເສັ້ນ, ຍອດ
43	ຫວາຍຫອມ	*Calamus gracilis*	ເສັ້ນ, ຍອດ, ໜາມ
44	ຫວາຍໜາມລີ	*Calamus henryanus*	ເສັ້ນ, ຍອດ, ໜາມ
45	ຫວາຍສະວັ້ງ	*Calamus palustris*	ເສັ້ນ, ຍອດ, ໜາມ
46	ຫວາຍນ້ຳເຜິ້ງ, ຫວາຍນ້ຳ	*Calamus siamensis*	ເສັ້ນ, ຍອດ, ໜາມ
47	ຫວາຍໂຕ່ນ	*Calamusviminalis*	ເສັ້ນ, ຍອດ, ໜາມ
48	ຫວາຍຫາງໜູ	*Calamustetradactylus*	ເສັ້ນ, ໜາມ
49	ຫວາຍກະທິງ	*Calamus oligostachys*	ເສັ້ນ, ໜາມ
50	ຫວາຍບຸ່ນຝາດ	*Daemonorops jenkinsiana*	ເສັ້ນ,ຍອດ,ໜາມ,ໃບ
51	ຫວາຍຕາເລີກ, ຫວາຍງ່ຳ	*Korthalsia laciniosa*	ເສັ້ນ
52	ຫຍ້າໜອນໜ່າຍ	*Desmodium triquetrum*	ໝົດຕົ້ນ
53	ອ້ອຍສາມສອນ	*Streptocaulon extensum*	ເຄືອ
54	ເຮືອນກວາງ	*Diospyros ehretioides*	ລຳ

3. ບັນຊີເຄື່ອງປ່າຂອງດົງ III ລວມມີ 165 ຊະນິດ:

ລ/ດ	ຊື່ລາວ Lao Name	ຊື່ວິທະຍາສາດ Scientific Name	ສ່ວນນຳໃຊ້
1	ກຳລັງເສືອໂຄ່ງ	*Ziziphus attopensis*	ຮາກ, ເຄືອ, ໃບ
2	ກົກໄຄ້	*Elaeocarpus grandiflorus*	ລຳ
3	ກະຈຽວຂາວ	*Curcuma parviflora*	ຮາກ, ດອກ
4	ກະດອມຂົມ ຫຼື ຂີ້ກາໜ່ຽມ	*Gymnopetalum chinense*	ໝົດທຸກສ່ວນ
5	ກ້ານຕົ່ງ	*Columbrina pubescens*	ລຳຕົ້ນ
6	ແກ້ວຮາກຫອມ	*Alyxia divaricate*	ຮາກ
7	ແຂມ	*Thysanolaena maxima*	ດອກ, ຫໍ່
8	ຂີ້ງປ່າ	*Globba schomburgkii*	ຮາກ, ໃບ, ລຳຕົ້ນ
9	ຂ່າໂຄມ	*Alpinia bracteate*	ໝົດຕົ້ນ
10	ຂັດເຄົ້າແກ້ວ	*Randia siamensis*	ຮາກ, ລຳ
11	ເຂົ້າສາມສ່ຽມສີ່ມຝານ	*Fagopyrum cymosum*	ໝົດຕົ້ນ
12	ໄຂ່ປຸ ຫຼື ດອກຈອງ	*Viburnum odoratissimum*	ລຳ
13	ໄຂ່ປຸ ຫຼື ໄຂ່ມຸກ	*Sambucus eberhardtii*	ລຳ, ໃບ
14	ຂະຍອມຜູ	*Rauwolfia serpentine*	ຮາກ
15	ຂີ້ງຜາ	*Zingiber sp.*	ຫົວ
16	ເຂົ້າຫຼ້າມດົງ	*Goniothalalamus saigonensisp*	ລຳຕົ້ນ
17	ຂົມຕີນຮຸ້ງ	*Helminthostachys*	ໃບ
18	ເຄືອເຄື່ອເຕົ່າ	*Poikilospermum suaveolens*	ເຄືອ
19	ເຄືອກອຍ	*Dioscorea hispida*	ຫົວ
20	ແຄ່ເຜັດ	*Cinnamomum sp.*	ເປືອກ, ໃບ
21	ເຄືອເຂົ້າຣໍ	*Tinospora crispa*	ເຄືອ
22	ເຄືອໄສ້ຕັນ	*Aganosma marginata*	ເຄືອ
23	ເຄືອໝາກຊິ່ມໂສມ	*Amalocalyx microlobus*	ເຄືອ
24	ເຄືອສີ່ມໂກ່ຍ	*Ampelocissus latifolia*	ເຄືອ
25	ເຄືອຫາງກວາງ	*Ancistrocladus cochinchinensis*	ເຄືອ
26	ເຄືອສ້ຽວແດງ	*Bauhinia penicilliloba*	ໝົດຕົ້ນ
27	ເຄືອໝາມກະຈາຍ	*Caesalpinia digyna*	ເຄືອ
28	ເຄືອກະແຕ້ງ ຫຼື ງວງຊຸ່ມ	*Calycopteris floribunda*	ເຄືອ

ລ/ດ	ຊື່ລາວ Lao Name	ຊື່ວິທະຍາສາດ Scientific Name	ສ່ວນນຳໃຊ້
29	ເຄືອຊາຍຊູ້	*Capparis zeylaniaca*	ເຄືອ, ຮາກ
30	ເຄືອເຂົ້າປຸ້ນ	*Cissus repens*	ເຄືອ
31	ເຄືອສອບແສບ	*Connarus semidecandrus*	ເຄືອ
32	ເຄືອຕະໂລ່ນໂຕນ ຫຼື ກ່ຳມຫາມ	*Artabotrys harmandii*	ເຄືອ, ຮາກ
33	ເຄືອຈອງກອຍ	*Artabotrys hexapetalus*	ເຄືອ
34	ເຄືອທຸບ	*Mucuna brevipes*	ເຄືອ
35	ເຄືອໝາກຊິມ	*Myriopteron extensum*	ເຄືອ
36	ເຄືອອີຫົກ	*Olax obtusa*	ເຄືອ
37	ເຄືອໝາກເຫັບ	*Pachygone dasycarpa*	ເຄືອ
38	ເຄືອໝາກຢາງຂາວ	*Parabarium quintaretii*	ເຄືອ
39	ເຄືອນ້ຳແມ້	*Thunbergia grandiflora*	ຮາກ
40	ເຄືອເລັບແມວ	*Ziziphus oenoplia*	ເຄືອ, ໝາກ
41	ເຄືອຂີ້ກາ	*Trichosanthes rubriflos*	ຮາກ, ໝາກ, ໃບ
42	ເຄືອໄສ້ໄກ່	*Morinda officinalis*	ເຄືອ
43	ເຄືອຕຳແຍ	*Mucuna pruriens*	ໝາກ
44	ເຄືອໝາກແຕກ	*Celastrus paniculata*	ຮາກ, ເຄືອ
45	ຍໍເຄືອ ຫຼື ເຄືອຕັ້ງ	*Morinda umbellate*	ເຄືອ
46	ງ້ວນດອກເຫຼືອງ	*Gelsemium elegans*	ທຸກສ່ວນ
47	ງ້ວນໝຸ	*Dregea volubilis*	ເຄືອ
48	ຈີ່ນາຍກ້ອມ	*Adenosma capitatum*	ໃບ, ລຳ
49	ຈັນຈຸມ (ກຸ່ມໝາກແໜ່ງ)	*Amomum aromaticum*	ໝາກ
50	ສ້ານເຕ່ຍ ຫຼື ສ້ານນ້ອຍ	*Dillenia hookeri*	ຮາກ, ລຳ
51	ສ້ານໃຫຍ່ ຫຼື ສ້ານແວ້	*Dillenia ovata*	ເປືອກ, ລຳ, ໝາກ
52	ສະຫງ່ອນ	*Millettia leptobotrya*	ລຳ
53	ສົ້ມຂົ້ມອນ	*Embelia ribes*	ໝາກ
54	ຊ້ຳປ່ານນ້ຳ	*Debregeasia velutina*	ເປືອກ, ລຳ
55	ດຸກອີ່ງ ຫຼື ອ້ຽງຄະແຍ	*Dendrolobium lanceolatum*	ຮາກ, ລຳ
56	ຕົ້ນງ່ຽງດຸກໃຫຍ່	*Canthium berberidifolium*	ຮາກ, ລຳ
57	ຕົ້ນໜໍ່ສານ	*Rhapis laosensis*	ໜໍ່
58	ຕົ້ນບົກ	*Irvingia malayana*	ໝາກ

ລ/ດ	ຊື່ລາວ Lao Name	ຊື່ວິທະຍາສາດ Scientific Name	ສ່ວນນຳໃຊ້
59	ຕົ້ນໝາກແຂ່ນ	*Zanthoxylum limonella*	ໝາກ, ຮາກ, ເປືອກ
60	ຕົ້ນໝາກຕໍ່ຂຽວ	*Livistona saribus*	ໝາກ
61	ຕົ້ນໝາກສົ້ມຜີດ	*Rhus chinensis*	ໝາກ
62	ຕົ້ນໝາກຫຸ່ມ	*Rubus multibracteatus*	ໝາກ
63	ຕົ້ນໝາກໄຟ	*Baccaurea ramiflora*	ໝາກ, ເປືອກ
64	ຕົ້ນໝາກແຊ່ວ	*Elaeocarpus hygrophilus*	ລຳ
65	ຕົ້ນໝາກຂາມປ້ອມ	*Phyllanthus emblica*	ໝາກ, ເປືອກ
66	ຕົ້ນໝາກແຕກ	*Ruellia tuberosa*	ໝົດຕົ້ນ
67	ຕົ້ນສົ້ມມໍ	*Terminalia chebula*	ເປືອກ, ໝາກ
68	ຕົ້ນສີດາໂຄກ	*Gardenia obtusifolia*	ລຳ
69	ຕົ້ນແຄ່ໝູ	*Cinnamomum obtusifolium*	ເປືອກ, ໃບ
70	ຕົ້ນຊາຍນອນດ່ຽວ	*Pyrrhosia lingua*	ເຫງົ້າ, ຮາກ
71	ຕົ້ນຊ້າງນ້າວ	*Ochna sp.*	ລຳ
72	ຕົ້ນຊ້າຈອງ	*Cinnamomum cassia*	ເປືອກ, ໃບ
73	ຕົ້ນຢາງບິງ	*Machilus kurzii*	ເປືອກ
74	ຕົ້ນໝາກກໍ່	*Castanopsis sp.*	ໝາກ
75	ຕົ້ນມຸ່ຍແດງ ຫຼື ໝາມແທ່ງເຫຼືອງ	*Dioecrescis erythroclada*	ລຳ
76	ຕົ້ນເດື່ອຫວ້າ ຫຼື ໝາກຮິ	*Ficus auriculate*	ລຳ
77	ຕົ້ນຜ່າສາມ	*Flacourtia montanna*	ລຳຕົ້ນ
78	ຕົ້ນດອກປ້າງ ຫຼື ດອກຕ້າງນ້ອຍ	*Hoya macrophylla*	ໝົດຕົ້ນ
79	ຕົ້ນໝາກກອກ	*Spondias pinnata*	ເປືອກ, ໝາກ
80	ຕົ້ນດອກລຳໂພງ	*Datura arborea*	ລຳ
81	ຕົ້ນບານ	*Bauhinia variegata*	ລຳ, ໃບ
82	ຕົ້ນດອກຈານ	*Butea frondosa*	ດອກ
83	ເຕີຍນ້ອຍ	*Pandanus urophyllus*	ຮາກ, ໝາກ
84	ເຕົ່າແລ້ງ	*Polyalthia luensis*	ຮາກ, ລຳ
85	ຕັບເຕົ່ານ້ອຍ	*Polyalthia debitis*	ຮາກ, ລຳ
86	ຕ້າງໝາມ	*Trevesia burckii*	ລຳ
87	ຕີບບອດ ຫຼື ແອບເຂົ້າ	*Abutilon indicum*	ໝົດຕົ້ນ
88	ຕາວຮ້າງນ້ອຍ	*Arenga caudate*	ລຳ, ໃບ

ລ/ດ	ຊື່ລາວ Lao Name	ຊື່ວິທະຍາສາດ Scientific Name	ສ່ວນນຳໃຊ້
89	ຕຸມຕັ່ງ	*Naringi crenulata*	ລຳ
90	ຕ່ອມເງິນ	*Stephania rotuda*	ຫົວ
91	ຕົ້ນຊາຍຊຸ້	*Capparis micracantha*	ໃບ
92	ຕົ້ນກ້ວຍເຫງົ້ນ ຫຼື ໜັງຫ່ຽວ	*Polyalthia cerasoides*	ລຳ
93	ຕົ້ນດຳດວນ	*Popowia aberrans*	ລຳ
94	ຕົ້ນໝາກໝໍ້	*Rothmannia vidalii*	ລຳ
95	ຕົ້ນຄາງແຮ້ງ	*Stereospermum suaveolens*	ລຳ
96	ຕົ້ນສະເມັກແດງ	*Syzygium zeylanicum*	ລຳ, ໃບ, ໝາກ
97	ຕົ້ນລານ	*Palm sp.*	ໃບ
98	ຕົ້ນໝາກລີນໄມ້	*Oroxylum indicum*	ໝາກ, ເປືອກ
99	ຕົ້ນໝາກເຝືองป่า	*Averrtioa carambola*	ໝາກ, ເປືອກ
100	ຕົ້ນຊາ ຫຼື ຕົ້ນແຈ	*Camellia nematodae*	ລຳຕົ້ນ
101	ຕົ້ນງິ້ວດອກຂາວ	*Bombax anceps*	ເປືອກ
102	ຕົ້ນບີເຍືอง	*Dalbergia dyeriana*	ເປືອກ
103	ຕົ້ນນ້ຳເຕົ້ານ້ອຍ ຫຼື ນ້ຳນ້ອຍ	*Polyalthia suberosa*	ຮາກ, ລຳ
104	ຕົ້ນບີບາ ຫຼື ຫູຊ້າง, ເຂົ້າກວາง	*Platycerium willinkii*	ຫົວ, ຮາກ
105	ຕົ້ນປ໋ສາ	*Broussonetla papyritera*	ເປືອກ
106	ຕົ້ນປໍພານ	*Colona auriculata*	ຮາກ
107	ຕົ້ນເໝືອດກ້ຽง	*Aporosa villosa*	ລຳ
108	ຕົ້ນເໝືອດເຫຼືองๆ ຫຼື ເໝືອດດົง	*Aporosa Planchoniana*	ລຳ
109	ຕົ້ນເໝົ່ຳຊ້າง	*Antidesma bunius*	ລຳ
110	ຕົ້ນໝາມແຫ่ง	*Randia tomentosa*	ລຳ
111	ບອນໝາມ	*Lasia spinosa*	ລຳ, ຮາກ
112	ປໍບິດ	*Hlicteres isora*	ຮາກ, ໝາກ
113	ປໍແສນພັນ ຫຼື ເຄືອສ້ຽວ	*Bauhinia ornata*	ລຳ
114	ປໍແສດ ຫຼື ຂີ້ມອນ	*Mallotus philippensis*	ເປືອກ, ລຳ
115	ເປືອກເມືອກ	*Machilus kurzii*	ເປືອກ
116	ເປົ້າທอง	*Croton thorelii*	ຮາກ, ລຳ
117	ແຜ่ນດິນເຢັน	*Aglaonema modestum*	ຮາກ
118	ເผ็ยฝาน ຫຼື ດຳມຜ້າ	*Cipadessa baccifera*	ລຳ, ໃบ

ລ/ດ	ຊື່ລາວ Lao Name	ຊື່ວິທະຍາສາດ Scientific Name	ສ່ວນນຳໃຊ້
119	ພາຍສະລຽງທົ່ງ	*Murdannia gigantea*	ໝົດຕົ້ນ
120	ພວງພີ	*Clerodendrum paniculatum*	ໃບ, ຮາກ, ດອກ
121	ຜັ່ງຄີ	*Croton tomentosus*	ຮາກ
122	ຝອດຝາວ	*Gouania leptostachya*	ໝົດເຄືອ
123	ມັນອ້ອນລີ	*Polygonum multiforum*	ຫົວ
124	ມັນຂາໄກ່ ຫຼື ໝາກກ້ວຍຖ້ອຍ	*Codonopsis tubulosa*	ຫົວ
125	ໄມ້ຫຼອດ	*Arundinaria petelotii*	ລຳ
126	ໄມ້ຮາງ	*Bambusa sp.*	ລຳ, ໜໍ່
127	ໄມ້ຂວາງ ຫຼື ໄມ້ກອກ	*Bambusa thorelii*	ລຳ
128	ໄມ້ຊ່າງຄຳ	*Bambusa striata*	ລຳ, ໜໍ່
129	ໄມ້ປະອໍ	*Bambusa balcooa*	ລຳ, ໜໍ່
130	ໄມ້ໄດ	*Cephalostachyum sp.*	ລຳ
131	ໄມ້ເຂົ້າຫຼາມ	*Cephalostachuym pergracile*	ລຳ
132	ໄມ້ຊາງໜິ່ນ	*Dendrocalamus membranaceus*	ລຳ
133	ໄມ້ຫໍ່ຮາກ	*Dendrocalamus barbatus*	ລຳ
134	ໄມ້ສະໂນດ	*Gigantochloa apus*	ລຳ
135	ໄມ້ງິ້ນຫວານ	*Gigantochloa atter*	ລຳ, ໜໍ່
136	ໄມ້ບໍ່	*Gigantochloa latifolia*	ລຳ
137	ໄມ້ກະແສນ	*Oxytenanthera albociliata*	ໜໍ່
138	ໄມ້ໄຈດ	*Vietnamosasa ciliata*	ລຳ
139	ໄມ້ເຜ້ກ	*Vietnamosasa pusilla*	ລຳ
140	ໄມ້ໜໍ່ຂົມ	*Indosasa sinica*	ໜໍ່
141	ໄມ້ເຮ້ຍ	*Schizostachyum blumei*	ລຳ, ໜໍ່
142	ຢີກບໍ່ຖອງ	*Eurycoma longifolia*	ລຳ, ຮາກ, ໃບ
143	ລະວຽງ	*Canthium horridum*	ໝົດຕົ້ນ
144	ລຸມພຸກ ຫຼື ມຸ້ຍຂາວ	*Randia uligonosa*	ລຳ
145	ຫົວໄກ່ເຖື່ອນ	*Commelina diffusa*	ໝົດຕົ້ນ
146	ຫີ້ງຫາຍນ້ອຍ	*Crotalaria alata*	ໝົດຕົ້ນ
147	ຫານງົວ	*Dendrocnide basirotunda*	ລຳ
148	ຫານຊ້າງ	*Dendrocnide meyeniana*	ລຳ

ລ/ດ	ຊື່ລາວ Lao Name	ຊື່ວິທະຍາສາດ Scientific Name	ສ່ວນນຳໃຊ້
149	ຫັດສະຄືນ ຫຼື ເຄືອຮັ້ງຮ້ອນ	*Croton caudatus*	ເຄືອ
150	ຫອມໄກ່ນ້ອຍ	*Celosia argentea*	ຮາກ
151	ເຫັດ	*mushroom sp.*	ທຸກສ່ວນ
152	ເຫຼືອງແກ້ວ	*Rinorea logiracemosa*	ລຳ
153	ຫວາຍເຕັ້ຍ	*Calamus acanthophyllus*	ເຫງົ້າ, ຮາກ
154	ຫວາຍແຍ້	*Calamus tenuis*	ເສັ້ນ, ຍອດ, ໝາກ
155	ຫວາຍໜອງ	*Calamus godefroyi*	ເສັ້ນ, ຍອດ, ໝາກ
156	ຫວາຍໜາມໃສ	*Calamus erectus*	ເສັ້ນ
157	ຫວາຍຫາງໜູນ້ອຍ	*Calamus bimaniferus*	ເສັ້ນ
158	ຫວາຍແດງ, ເດົາອາມີ່ນ	*Calamus guruba*	ເສັ້ນ
159	ຫວາຍກຳເຫຼົ້າ	*Calamus minor*	ເສັ້ນ
160	ຫວາຍໜາມໄຊ	*Myrialepis paradoxa*	ເສັ້ນ, ຍອດ
161	ຫວາຍກະເທີຍ, ຫວາຍຕ້ຳ	*Plectocomia pierreana*	ເສັ້ນ, ຍອດ
162	ຫວາຍກະເທີຍ	*Plectocomia himalayana*	ຍອດ
163	ຫວາຍແດງນ້ອຍ	*Plectocomiopsis geminiflora*	ຍອດ
164	ໝາດໜອງ ຫຼື ໝາດໜ່ຽມ	*Blumea balsamifera*	ໃບ, ລຳ
165	ຮັ້ງຮ້ອນ	*Diospyros malabarica*	ລຳ

ມາດຕາ 2 ມອບໃຫ້ ກົມປ່າໄມ້ ເປັນໃຈກາງປະສານສົມທົບກັບພາກສ່ວນກ່ຽວຂ້ອງ ທັງຂັ້ນສູນກາງ ແລະ ທ້ອງຖິ່ນ ໂຄສະນາເຜີຍແຜ່ ແລະ ຈັດຕັ້ງປະຕິບັດ ຂໍ້ຕົກລົງສະບັບນີ້ ຢ່າງເຂັ້ມງວດ.

ມາດຕາ 3 ຂໍ້ຕົກລົງສະບັບນີ້ ມີຜົນສັກສິດ ນັບແຕ່ວັນລົງລາຍເຊັນເປັນຕົ້ນໄປ.

ລັດຖະມົນຕີກະຊວງກະສິກຳ ແລະ ປ່າໄມ້

ກະຊວງກະສິກຳ ແລະ ປ່າໄມ້ ສປປ ລາວ

ປອ.ສົງ ທິແກ້ວ

3. Annex 3. Act of the President of Lao No. 002 on fees and charges

From the Act of the President of Lao No. 002 from 17 June 2021 on fees and charges the following articles intend to clarify incurring charges for different commodities.

Article 20: Fees for industry and commerce sectors are as follows:

No.	Content	Unit	Rate (LAK)
I	Documents on importing and exporting goods		
1	Document approval for import and export	set	10,000
2	Special card for border trade	time	10,000
3	Certificate of Transit	set	10,000

Article 21: Fees for agriculture and forestry sectors are as follows:

No.	Content	Unit	Rate (LAK)
3	**Approval of documents for importing, exporting and transit of plants as seen in the Law on Plant Protection and Plant Quarantine**		
3.2	Plant hygiene certificate for export	set	50,000
3.5	Certificate of Safety for exporting plant products	paper	50,000
3.6	Certificate of Safety of Analysis of Plant Products	paper	50,000
5	**Document approval for bamboo and NTFP collection**		
5.1	Certificate of permission to collect bamboo and NTFP which cost less than 10,000,000 LAK	time	200,000
5.2	Certificate of permission to collect bamboo and NTFP which cost between 10,000,000 LAK and 50,000,000 LAK	time	400,000
5.3	Certificate of permission to collect bamboo and NTFP which cost more than 50,000,000 LAK	time	600,000
6	**Approval of documents for running the activity of Forestry and Plants in the forest as seen on CITES convention**		
6.1	Certificate of running activities related to forestry and plants in the forest as seen in the CITES convention which costs less than 10,0000,000 LAK	time	200,000
6.2	Certificate of running activities related to forestry and plants in the forest as seen in the CITES convention which costs between 10,0000,000 LAK and 50,000,000 LAK	time	400,000
6.3	Certificate of running activities related to forestry and plants in the forest as seen in the CITES convention which costs between 50,0000,000 LAK and 100,000,000 LAK	time	1,000,000
6.4	Certificate of running activities related to forestry and plants in the forest as seen in the CITES convention which costs more than 100,0000,000 LAK	time	2,000,000
7	**Certificate of transferring wood and NTFP within the country, certificate of exporting the wood and NTFP including the certificate for running business on agricultural consultation, agricultural extension and others.**		
7.1	Certificate of transferring wood and NTFP within the country, certificate of exporting wood and NTFP		
a	Certificate of transferring natural wood within the country	time	100,000
b	Certificate of transferring NTFP within the country	time	30,000
c	Certificate of exporting NTFP	time	100,000
d	Certificate of transferring wood from plantations (traditional	time	30,000

	breeding), NTFP from plantations and rubber products within the country		
e	Certificate of exporting wood from plantations (eucalyptus and Acacia), NTFP from plantations and rubber products	time	35,000

Article 22: Charge for agriculture and forestry sectors are as follows:

No.	Content	Unit	Rate (LAK)
III	**Charge for agriculture and forestry unit**		
1.4	**Agricultural products from natural and cultivated crops such as: Benzoin, mulberry paper etc.**		
a	Less than 5kg	time	10,000
b	Between 5 and 500kg	time	40,000
c	More than 500kg	time	65,000
2	Agricultural commodities		
2.1	**Coffee, rice, job tear, sesame, peanut, soy bean etc.**		
a	Less than 10 tons	time	10,000
b	Between 10 and 100 tons	time	65,000
c	More than 100 tons	time	90,000
d	Fiber crops: mulberry fiber, tobacco etc.…	time	45,000

Article 4: List of duty-free

- Agricultural products from production, plants and livestock.
- Industrial products that go through the production process or processing;
- Handicraft products;
- All products that are not included in the list of this regulation (article 6).

Article 6: List of export tax rate

Code	Sub-code	Descriptions	Unit	Export tax rate (%)
06.01	0601.10.00	Bulbs, tubers, tuberous roots, corms, crowns and rhizomes.	kg	30
12.11	1211.90.97	Bark of Persea (Persea Kurzii) (Bong bark)	kg	10
13.01	1301.90.40	Benzoin	kg	10
14.01	1401.10.00	Bamboos for handicraft	kg	15
14.01	1401.20	Rattans for handicraft	kg	10

Article 7: Calculation method for export tax rate

The calculation method for export tax is:

[total amount in export form] × [export tax rate (%)]

based on the list in article 6.

4. Annex 4. Additional district data

4.1 Nambak District, Luang Prabang

Benzoin growing area in Nambak district, Luang Prabang (area in ha).

Village name	2017			2022			
	Households	Total area	Harvesting area	Households	Total area	Age 1-7 years, area	Age over 7 years, area
Phatong	37	207.5	130.5	70	158	30	128
Houyseua	24	116.9	95.5	24	45	3	42
Khingkarng	16	40	16				
Larnkarng	21	32	12				
Namay	10	58.2	37				
Houyhid	19	37.8	21	19	33.8	15	18.8
Khong	66	116	50.5	66	100.2	50	50.2
Phonhom	51	38	18	32	51	38.5	12.5
Nammong	18	15	11	18	15	4	11
Krang	43	64	44	51	47	12	35
Kajet	56	68	8	30	37	7	30
Doklaow	47	48	17	50	75	30	45
Mhakphouk	23	36	24	32	36	16	20
Yalo	18	115	5	86	45	20	25
Longjok	58	118.5	93	48	70	25	45
Phouker	51	112.5	47				
Grand Total	**558**	**1223.4**	**629.5**	**526**	**713**	**250.5**	**462.5**

S. DFORES Benzoin growing areas only in Kajet village, Nambak, in 2021

Description	Unit	Total
Households	HH	23
Plantations	number	48
Total area	ha	59
Trees	number	49,537
Harvestable trees	number	27.55
Harvest volume	kg	1,070

4.2 Phonthong district, Luang Prabang

Production areas for sesame in Phonthong district, Luang Prabang, 2021

	Sesame area		
Village group	**Assigned area (ha)**	**Used area (ha)**	**Production (t)**
Phonthong	46.6	29	29
Naluang	12	1.5	1.5
Thongsi	0.8	2	2
Meuanghueb	21.5	17	12.5
Namluang	16.5	13	19.5
Total	97.4	62.5	64.5

Production areas for tung seed in Phonthong district, Luang Prabang, 2021

	Tung area		
Village group	**Assigned area (ha)**	**Used area (ha)**	**Production (t)**
Phonthong	23.9	23.9	358.5
Naluang	0	0	0
Thongsi	1	1	15
Meuanghueb	0	0	0
Namluang	0	0	0
Total	24.9	24.9	373.5

4.3 Hiem district, Luang Prabang

Target commodities produced in Hiem district in 2021

Commodity	Assigned area (ha)	Used area (ha)	Yield (t/ha)	Production (t)
Tung oil	130	61.46	7.5	460.95
White sesame	2.4	1.5	1.3	1.95
Black sesame	2.5	1.1	1.3	1.43
Sacha Inchi	22	3.11	2.5	7.78

Some of the villages producing target commodities in Hiem district in 2021

Village	Tung oil	White sesame	Black sesame	Sacha inchi
Natuan	6.15	0.5	0.1	
Houaysa	1			
Namsard	0.2	0.3	0.2	
Houaphou	6.65	0.35	0.2	
Naphon	1.3			
Phiengdon	2.1			
Napuak	1.5			
Viengthong	1.75			
Pounghai	1.06			
Korkieng	2			
Phouluang	11.3			
Phoudarn	2			
Nalae	4.4	0.25	0.1	
Phonsaad	2			
Nampoung	0.1			0.01
Sakok		0.01	0.15	0.01
Donkhoun		0.1	0.1	
Total	43.51	1.51	0.85	0.02

4.4 Houameuang District, Houaphan

For 2021-2022 the aimed for tung tree area in the district was 1,300 ha, of which 1,201 ha have been realized so far. By comparison, in 2012, the tung plantes area was 167.5 ha.

Benzoin planting area in 2011-2013 (summarized on 15.3.2018 by DAFO)

Village name	Area (ha)	Number of seedlings
Nampong	1.25	500
Phao	0.6	439
Total	1.85	939

No newer data have been collected by DAFO

4.5 Xam Tai district Houaphan

Benzoin growing area in Xam Tai district

Villages	Total Area	New area	Over 7 years old
Sankarng Houaymoun Houysala Houaysalame Nonghet Namtaeb Yodmeuang Hintang Houaygoum Ja eye Houayni Palaow Houaypoung Houaykhai Gaengmai Thabkhor Nongxai	436 ha	225 ha	269 ha

Tung growing area: 40 ha combined in Houylard, Xiengdee, Nalar, Houaykik, Phiengday, Namard, Nangiew, Phoulae, Vuen, Pheuaneau, Meuangkhan, Tinphou, Darn

4.6 Viengxay district Houaphan

Commodity	Area (ha)	Productivity(t)	Yield (t/ha)
Tung oil	560	1680	3
Sichuan pepper	22	33	1.5
Sesame	15	15	1
Total	**597**	**1728**	**5.5**

5. Annex 5. Bamboo species found in Lao PDR

Species name	Lao name	Engl. transliteration
Arundinaria petolotii Camus	ไม้ ຫຼອຍ	Mai loi
Bambusa Blumeana Schultes	ไม้ ໃผ่บ้าน	Mai phai ban
Bambusa sp	ไม้ ຮาງ	Mai hang
Bambusa tulda Roxb.	ไม้ บົງ/บົງຂົม	Mai bong/bong khom
Bambusa chunii Chai & Fung	ไม้ ກะຊะ	Mai kasa
Bambusa nutans Wall.ex Munro	ไม้ บົງหวาน	Mai bong van
Bambusa striata Lodd. Ex Lundl.(B. vulgaris)	ไม้ ซ่างคำ	Mai sang kham
Bambusa tuldoides (Munro)	ไม้ ปาะ	Mai po
Bambusa burmanica Gamble	ไม้ ป่องขงอ	Mai pong khiou
Bambusa thorelii Roxb.	ไม้ ຂວາง/ไม้ກอก	Mai khuang]mai kok
Bambussa arundiana var.spinosa Rez	ไม้ ใผ่ป่า	Mai phai pa
Bambusa balcooa Roxb.	ไม้ ปะอ๋	Mai pa oo
Bambusa polymorpha Munro	ไม้ เกิน	Mai keuan
Cephalostachyum sp	ไม้ ได	Mai dai
Cephalostachyum pergacile Munro	ไม้ เค้าหลาม	Mai khao lam
Chimonobambusa purpurea Hsueh & Yi	ไม้ ซาน	Mai san
Dendrocalamus sciens Munro (polymorphamunro)	ไม้ บົงคาย	Mai bong khai
Dendrocalamus branddisii (Munro) Kurk	ไม้ ซ่างใผหางซ้าง	Mai sang phai/Hang sang
Dendrocalamus giganteus Wall.ex Munro	ไม้ ด้ามขอ้น	Mai dam khuan
Dendrocalamus latifolius Munro	ไม้ หอิง	Mai ving
Dendrocalamus asper sch.&Bark. & Heyne	ไม้ ใผ่ตง/ธีกหวาน	Phai tong/hok van
Dendrocalamus menbranaceus Munro	ไม้ ใผ่หม่น/ซ้างหม่น	Mai phai mon/sang mon
Dendrocalamus longifimbriatus	ไม้ พาง	Mai phang
Dendrocalamus sinicus f.aequotus K.L. Wang*	ไม้ เบาะ/ไม้ บอก	Mai bo/ mai puak
Dinochloa scandense Buse	ไม้ แฮ้	Mai hae
Dendrocalamus barbatus Hsuch & D.Zli	ไม้ ห่ำฮาก	Mai ho hak
Dendrocalamus hamiltonii Neest & Arn.ex Munro	ไม้ ธีกหงอ/ธีกขงอ	Mai hok niou/mai Hok kiou
Dendrocalamus pendutus Ridley	ไม้ โล้	Mai lo
Dendrocalamus menbranaceus Munro	ไม้ องด	Mai viet
Gigantochloa apus Schytle & Kurz	ไม้ สะโนด	Mai sanot
Gigantochloa albociliata Munro & Kurz	ไม้ ไล่/ไล่ขีม	Mai lai/lai khom
Gigantochloa atter (Hask) Kurz	ไม้ ง้วนหวาน	Mai ngan van
Gigantochloa haskarliane Kurz,Barker & Hayne	ไม้ ลองมอก	Mai luoang mouak

Species name	Lao name	Engl. transliteration
Gigantochloa latifolia Ridle	ไม้ บ่	Mai bo
Gigantochloa parviflora (Keng f.)	ไม้ຊອດ	Mai sod
Indosasa sp	ไม้ ກ້ອງປີ່	Mai kong pi
Neobouzeana mekongensis Buse	ไม้ ກະແສນ	Mai ka sen
Oxytenanthera albociliata Munro & Kurz	ไม้ ໄລ่ຫວານ	Mai lai van
Phyllostachys sp	ไม้ ກະຊະ	Mai ka sa bominam
Phyllostachys sp	ไม้ ໜ່ໍ່ຫວານ	Mai no van
Indosasa sinica C.DD Chouy & C.S Chao	ไม้ ໜ່ໍ່ຂົມ	Mai no khom
Vietnamosasa ciliata (A. Camus)Nguyen	ไม้ ໂຈດ	Mai chot
Vietnamosasa pusilla (Chevalier & A. Camus)Nguyen	ไม้ ເພັກ	Mai phek
Unidentified	ไม้ ລວງເຂົ້າຄວາຍ	Mai louang khao khuay
Sirundinaria sp	ไม้ ລັນຫວານ	Mai lan van
Sirundinaria microphylla Munro & Chao	ไม้ ລັນຂົມ/ຈ້ຳຂົມ	Mai lan khom/cha khom
Sirundinaria sp	ไม้ ຈ້ຳຜາດ	Mai cha phat
Sirundinaria griftithiana Munro, Chao & Renv	ไม้ ແສນຕາລ້ອມ	Mai sen ta lom
Sirundinna sp	ไม้ ຈ້ຳແດງ	Mai cha deang
Schizostachum blumei (C. virgatum Munro & Kurz)	ไม้ ເຮ ້ຍ	Mai hia
Schizostachum branchy Kurz	ไม้ ຮົກໜາມ	Mai hok nam
Schizostachum grande Kurz	ไม้ ພຸງຈີນ	Mai phung chin

Source: NAFRI

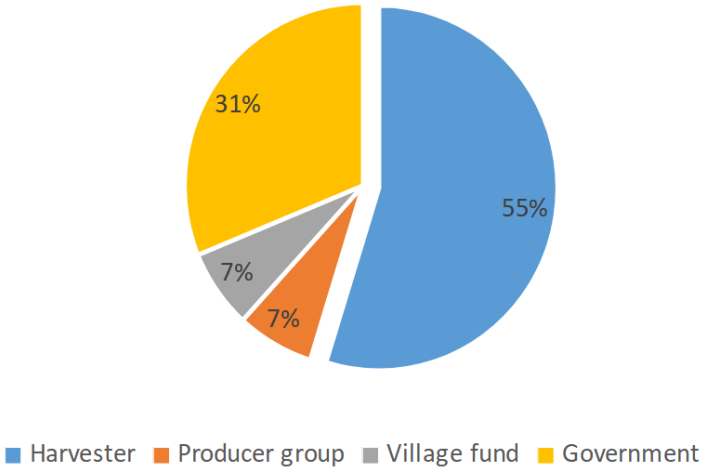
6. Annex 6. Detailed rattan expense listing

Taxes and fees for rattan harvesting and shipment from Xiengsien village, Bolikhan district, Bolikhamxay province in 2019, from Danlao Rattan Company, kindly provided by WWF Laos.

Description	Amount	Unit cost (LAK)	Total (LAK)	Fees paid by group members	Administrative fees paid	Paid to
Cost of rattan cane						
Rattan big diameter cane	2,015	13,000	26,195,000			
Rattan small diameter cane	2,000	10,000	360,000			
Document fee						
NTFP harvesting approval doc. For big cane						
Permit for NTFP harvest (small)						
Fee for NTFP management at provincial forest section				**110,000**	**20,000**	
Rattan big cane	2,000	50	100,000	100,000	20,000	Provincial Forestry Section
Rattan small cane	2,000	5	10,000	10,000		Provincial Forestry Section
Reforestation fee				**1,330,000**		
Rattan big cane	2,000	600	1,200,000	1,200,000		Provincial Forestry Section
Rattan small cane	2,000	65	130,000	130,000		Provincial Forestry Section
Natural resource fee				**6,505,000**		
Rattan big cane	2,015	3,000	6,045,000	6,045,000		District State Asset

Rattan small cane	2,000	230	460,000	460,000		Office District Office	State	Asset
Tax for harvesting				**956,000**				
VAT				646,000		Bank		
Profit tax				310,000		Bank		
Tax for moving and transportation				**1,420,000**	13.8			
Transportation cost					20,000	Bank		
Service fee								
Service fee								
Cost of rattan big cane[1]	2,015	13,000	26,195,000					
Cost of rattan small cane[2]	2,000	10,000	360,000					
Tax declaration from domestically transported big cane rattan			26,555,000					
VAT for moving rattan cane			651,000	651,000				
Profit tax for trasportation			312,000	312,000				
VAT for transport			457,000	457,000				
Total expenses				**10,321,000**				

1 - Big cane rattan 1 rod=1kg = 13.000 LAK
2 - Small cane rattan, 12 rods=1 kg = 10.000 LAK



7. Annex 7. Company summaries

The following section contains a summary of the information collected from companies and individuals involved in the assessed value chains. The transcripts of the company interviews follow the same numbering and can be found as a separate Annex.

#	Company name	Province	Location	Sourcing area	Selling product	Processing	Volume	Bought from 1	Buying price (LAK/kg)	Bought from 2	Buying price	Sold to	Selling price (LAK/kg)
1	Duk Hong Agricultural Promotion Co.	Houaphan	Xam Tai district	Xam Tai district	Tung oil	none	N/A	N/A	N/A			Vietnam	not specified
					Sichuan pepper (fresh seed)	N/A	N/A	Farmers	12,000			Vietnam	not specified
					Sichuan pepper (dry seed)	none	N/A	Farmers	40,000-45,000			Vietnam	not specified
					Bamboo shoots (fresh shoots)	drying	N/A	Farmers	1,000			Vietnam	not specified
					Bamboo shoots (dry shoots)	none	30 tons	Farmers	20,000			Vietnam	30,000
2	Houaphan Commercial State Enterprise Company	Houaphan	Viengxay district	Viengxay district	Bamboo	drying	1,425 tons	Farmers	300			Vietnam	8,000
3	Khamphan, Mr.	Houaphan	Houameuang district	Houameuang district	Tung seed	none	15 tons	Farmers	5,000			Vernicia Montana Company	5,300
4	Kounpanya, Mr.	Houaphan	Xam Tai district	Xam Tai district	Tung seed	none	12 tons	Brokers	5,000			Vietnam	6,500
5	Noud, Mrs	Houaphan	Hiem district	Hiem district	Sesame	none	1 ton	Farmers	6,000-8,000			Larger trader in Viengkham district	10,000
6	Thongsai, Mr.	Houaphan	Hiem district	Hiem district	Sesame	none	1.2 tons	Farmers	9,500			Chinese traders in Oudomxay	14,000-15,000
					Tung seed	none	4.7 tons	Farmers	5,000			Oulayvanh Company	5,700
					Bamboo worms	none	15 tons	Farmers	80,000-120,000			Chinese trader in Oudomxay	180,000
7	Tuan Cheuang Thang	Houaphan	Xam Tai district	Kone district	Tung seed	none	3 tons	Brokers	3,000			Opportunistic	3,500
					Sichuan pepper (fresh seed)	none	50 kg	Farmers	4,000			Opportunistic	20,000
8	Agricultural Fruitage Development IMP-EXP Co., and Construction with Complete Installation Electricity LTD.	Luang Prabang	Luang Prabang town	Luang Prabang province	Sesame	none	430 tons	Brokers & traders	Grade A: 15,000			Thailand	16,000
									Grade B: 14,000			Thailand	15,000
					Paper Mulberry	none	80 tons	Brokers & traders	5,500			1).Phetlama company (15 t) 2).Mulberry Pulp Dream international (5	1). 6,000 2). 7,000 3). 6,300

											t) 3). Thailand	
9	Agriculture trading and extension Co. Ltd	Luang Prabang	Luang Prabang town	Nambak, Pakseng	Paper Mulberry	none	1000 tons	Village group	6,700	Farmers 5,500	Thailand, China	14,000
10	Bounmee, Mr.	Luang Prabang	Nambak district	Nambak	Sesame	none	30 tons	Farmers	12,000		China	14,000
					Benzoin	none	2-3 tons	Farmers			S.DFORES	
					Paper Mulberry	none	30 tons	Farmers	4,000		China	9,000
11	Chanmany (Paew), Mrs.	Luang Prabang	Phonxay district	Phonxay district	Paper Mulberry	none	5,5 tons	Farmers	Grade A: 5,000		Mrs. Chanthy, Mrs Yai (Mrs. Sysamoud).	5,000
									Grade B: 4,000			6,000
					Sesame	none	400kg	Farmers	Grade A: 14,000			15,000
									Grade B: 13,000			14,000
12	Ging, Mrs.	Luang Prabang	Viengkham district	Viengkham district	Sichuan pepper (fresh seed)	drying	N/A	Farmers	8,000		Domestic buyers	50,000
13	Houmphan, Mr.	Luang Prabang		one district in Luang Prabang	Benzoin	none	3 tons	Farmers	130,000		Agroforex	not specified
14	Mairmeuang, Mr.	Luang Prabang	Phonthong district	Phonthong district	Paper Mulberry	none	6 tons	Farmers	4,500		Domestic buyers	5,500
					Bamboo worms	none	1.5 tons	Brokers	120,000		Domestic buyers	125,000
15	Mr. Soulisan	Luang Prabang	Nan district	Nan district	Paper Mulberry	none	105 tons	Brokers & traders	5,500	Farmers 5,000	Ms. Chanthy (70%) Ms. Buanin (30%)	not specified
16	Mulberry Pulp Dream International Co. Ltd	Luang Prabang	Luang Prabang town	Pakseung and XiengNgeun districts	Paper Mulberry	Paper Mulberry pulp	18 tons/ month	Brokers & traders	7,000		80% to China, 20% to Korea	45,000 USD/ contrainer/ month
17	Nick, Mr.	Luang Prabang	Chomphet district	2 villages in Chomphet district	Paper Mulberry	none	N/A	Farmers	6,000		Mrs. Sisamoud Indala in Pakseng.	6,500
				3 villages in Chomphet district	Sesame	none	15 tons	Farmers	Grade A: 15,000		Mrs. Noy Km 8	16,000
									Grade B: 12,000			13,000
18	Nouan, Mr.	Luang Prabang	Phonxay district	Nambor village, Phonxay district	Sacha Inchi (with shell)	none	1 ton	Farmers	8,000		Thanchai company	10,000
19	Onkeo, Mrs.	Luang Prabang	Nambak district	Nambak	Bamboo shoots	boiling	1.5 tons	5 villages	2,000-5,000		Market in Luang Prabang	15,000
					Sesame	makes river weed sheets	800 kg	Farmers	15,000	Trader 16,000	Used to make river weed sheets	
20	Phethrama Mulberry Company	Luang Prabang	Luang Prabang town	Luang Prabang and close by areas	Mulberry paper pulp, paper products	pulp production and full processing	200 tons	Farmers	6,000	Traders 7,500	South Korea, China	14,000
21	Somsy, Mr.	Luang Prabang	Viengkham district	Viengkham district	Paper Mulberry	none	60 tons	Farmers	3,000		Trader/Exporter	4,500

				Viengkham district	Sesame	none	4 tons	Farmers	10,000			Domestic buyers	11,000
				N/A	Bamboo worms	none	20 tons	Farmers	80,000			Domestic buyers	100,000
22	Sychan, Mr.	Luang Prabang		Ban Kalet	Benzoin	none	30-40 kg	-	Producer			Brokers	150,000
23	Thanchai company	Luang Prabang	Luang Prabang town	Luang Prabang province	Sacha Inchi	Cracking, sorting	170 tons	Farmers	12,000-13,000	Brokers & traders	14,000	Vietnam, Thailand	23,000
24	Thid Pheuy, Mr.	Luang Prabang	Ngoy district	Nambak, Pakseng, Ngoy	Paper Mulberry	none	100 tons	Traders	5,000			China	7,000
				Ngoy, Viengkham	Sesame	none	60 tons	Farmers	12,000			Domestic markets	16,000
25	Touy, Mrs.	Luang Prabang	Nan district	Nan district	Paper Mulberry	none	Just started	Brokers & traders	6,000			Opportunistic	6,800
26	Vanthong Phonthachanh, Mr.	Luang Prabang	Chormphet district	Chomphet district	Sacha Inchi	none	2 tons	Farmers	13,000-15,000			Thanchai company	16,000
					Paper Mulberry	none	3 tons	Farmers	4,000-5,000			Larger traders (see profile)	5,000-5,500
					Sesame	none	4 tons	Farmers	Grade A: 9,000			Larger traders (see profile)	11,000
									Grade B: 7,000			Larger traders (see profile)	8,500
27	Xiengbon, Mr.	Luang Prabang	Nambak district	Nambak	Sesame	none	15 tons	Farmers	9,000			Domestic buyers	10,000
					Bamboo worms	none	7 tons	Brokers	80,000			Trader/Exporter	90,000
28	Xienglong Company	Luang Prabang	Xiengngeun district	Luang Prabang and neighboring provinces.	Paper Mulberry	drying, sorting, grading, baling	200 tons	Brokers & traders	5,000-5,500			China (50 t) Thailand (80 t) Mulberry Pulp Dream Int.(80 t)	Grade A: 8,000-8,500 Grade B: 7,500-8,000
29	Xiengthone, Mr.	Luang Prabang	Viengkham district	Viengkham district	Paper Mulberry	none	50 tons	Farmers	2,500-5,000			China	11,000
				Viengkham district	Sesame	none	60 tons	Farmers	10,000	Brokers	12,000	China	16,000
				Kone, Houameuang, and Xam Tai districts	Bamboo worms	none	37 tons	Brokers	85,000-130,000			China	5,000 LAK/kg above buying price
30	Chansouk, Mrs.	Sayabouri	Hongsa district	Ban Huay Chuang	Sesame	none	3 tons	Farmers	14,000			Sonephan commercial company	14,500-15,000
31	Langsouliphong Import-Export Freight Limited Company	Sayabouri	Phiang district	Phiang and Sayabouri districts	Sesame	none	200 tons	Brokers & traders	14,500	Brokers & traders	15,500	Thailand	15,300-16,300
32	Many Phathana company ltd	Sayabouri	Xienghone district	Xienghone district	Bamboo shoots, dried	drying	270 tons fresh, 30 tons dry	Farmers	1,500			China	25 CNY/kg = 48,000

33	Norm, Mr.	Sayabouri	Xienghone district	Xienghone district	Rattan shoots dried	drying process	100 kg fresh	Farmers	1,000-1,200 LAK/shoot		Thailand	1000 THB/kg = 360,000
34	Saya Development Lao-Thai cooperation company	Sayabouri	Sayabouri district	Sayabouri district	Paper Mulberry	none	19 tons	Brokers & traders	5,500–7,000	Farmers 5,500 – 7,000	Thailand	22 and 29 THB/kg
35	Somvang Chitdavong, Mr.	Sayabouri	Hongsa district	Hongsa district	Rattan furniture	Furniture manufacturing	2 m3	Farmers	10,000,000 LAK/m3		Oudomxay, Luang Prabang and Sayabouri town	130,000,000 LAK/year
36	Sone, Mrs	Sayabouri	Phiang district	Ban Viengkham, Phiang district	steamer baskets	manufacturing	10 pcs/day	other villagers	2500 LAK per cane		Domestically	10,000 LAK / piece
37	Sonephanh Trading Company	Sayabouri	Sayabouri district	Sayabouri district	Paper Mulberry	none	30 tons	Brokers & traders	4,000-5,000		Luang Prabang (Bouanin)	6,000
				Hongsa district	Sesame	cleaning, sorting	30 tons	Brokers & traders	12,000		Pa Boualery	12,700
				Xaisathan and Hongsa districts	Black Sesame	none	400kg	Farmers	12,000		Retailer	19,000
38	Sor Agricultural Development company	Sayabouri	Sayabouri district	Sayabouri district	Paper Mulberry	shipping service charge	N/A	Charges others for commodity export, 1,300-1,600 LAK/kg			Thailand	
					Sesame		270 tons				Thailand	
39	Sounthone, Mr.	Sayabouri	Khop district	Khop district,	Rattan shoots dried	drying process	ca. 25,000 shoots	Farmers	1,200-2,000 LAK/shoot		Thailand (70kg) Vientiane (30kf)	900 THB/kg (dried) = 321,000
40	Agroforex	Vientiane Capital		Houaphan, Luang Prabang, Phongsaly	Benzoin	cleaning, grading, packaging	26 tons	Brokers	100,000		EU, India, USA	160,000
41	AT IMP - EXP sole Ltd (Anouphap) Company	Vientiane Capital		Houaphan, Luang Prabang, Phongsaly	Benzoin	cleaning, grading, packaging	3 tons	Brokers	110,000-115,000		Germany	160,000-200,000
42	DakDae Company	Vientiane Capital		Houaphan; Fueang district, Vientiane Prov.	Sichuan pepper (fresh seed)	drying	1.5 tons	Farmers	10,000		EU, India	N/A
43	Lao Vernicia montana Company	Vientiane Capital	Vientiane and Luang Prabang town	Northern Laos	Tung seed	cleaning, packing	600 tons	Company agent	Farm gate: 4,500		China	6,500
									Co. gate: 5,500			
44	Maï Savanh Lao	Vientiane Capital		Laos	Sacha Inchi oil	full processing	20 tons	Farmers	16,000		Domestic, Europe, Malaysia, Taiwan, and the USA	200,000
45	Society Development of Forest Export-Import Sole Company Limited, (S. DFORES Co)	Vientiane Capital		Luang Prabang, Houaphan	Benzoin	cleaning, grading, packaging	15 tons	Brokers	120,000		France	130,000-200,000

8. Annex 8. List of interviewees

#	Name	Position	Organization
Luang Prabang Province			
1	Mr. Koon Sisophon	DAFO Viengkham	Head
2	Mr. Savath Veuli Cheu	DAFO Xiengngeun	Head of Unit
3	Mr. Khamko Thammavong	PCCI	Dep. head of Section
4	Mr. Bounhom Sophabmesay	Forestry Section, PAFO	Technical
5	Mr. Sommay	Forestry Section, PAFO	Head of Section
6	Mr. Singkham	Forestry Section, PAFO	Deputy
7	Mr. Bounthan	Extension Center, PAFO	Head of Center
8	Mr. Keevang	PNCCI	Technical
9	Mr. Boliven Bandasack	DAFO Phoonthong	Deputy head
10	Mr. Soiliyo Sayasith	DAFO Nan	Head
11	Mr. Xayasith Lasy	Forestry Section, PAFO	Technical
12	Mr. Khamcha Kertnithkhammany	DAFO Phonthong	Deputy Head
13	Mr. Thongsouan	Extension Center	Technical
14	Mr. Thanom Latanaphoubai	Provincial Taxes Department	Head
15	Mr. Shuavang	POIC	Head of Section
16	Mr. Souliphone Vanalath	Provincial Transportation	Head of Section
17	Mr. Soulivanh	DPI	Head of Section
18	Mr. Somvanh Phommalychanh	DAFO, Nambak	Head
19	Mr. Bounsong	DAFO, Chormphet	Deputy Head
20	Mr. Pheng Xaypaserth	DAFO, Chormphet	Technical
21	Mr. Phone Southida	DAFO, Viengkham	Technical
22	Mr. Siphone Vilaphan	DAFO, Phonthong	Technical
23	Mr. Thongchanh Phalamysay	DAFO, Nambak	Deputy Head
24	Mr. Savarng Siripanya	DAFO, Phonthong	Head of Admind
25	Mrs. Umphay Thavongsy	DAFO, Viengkham	Deputy Head
26	Mr. Phone Southida	DAFO, Viengkham	Head of Plants Unit
Sayaboury Province			
1	Mr. Lamphong	Forestry Section, PAFO	Technical
2	Mrs. Somvang	Forestry Section, PAFO	Technical
3	Mr. Bounthom Chanthalangsy	Plants Section, PAFO	Deputy Head of Section
4	Mr. Vieng Phonsavanh	Import/ Export Section, PICO	Head of Section
6	Mr. Sithisok Sengchanh	DAFO, Khop	Deputy Head
7	Mr. Bounsong Vongthalisack	Namngeun border, PAFO	Representative of Plants Section
8	Mr. Khamchanh	DAFO, Hongsa	Deputy Head
9	Mrs. Bounmy	Plants Unit, DAFO Phiang	Deputy head
Houaphanh Province			
1	Mrs. Soulilack Khamvongsa	PAFO	Deputy Head
2	Mr. Noy Phosavay	Plants Section, PAFO	Technical
3	Mrs. Phonevanh Inthavong	PICO	Deputy Head
4	Ms. Phengvanh Sonemixay	Small Enterprise Promotion Division, PICO	Deputy head
5	Mr. Bounsack Thinnakhone	DAFO, Hiem	Head
6	Ms. Tengmany	DAFO Hiem	Technical
7	Ms. Vannalee	DICO, Hiem	Technical

8	Mr. Thongsack Bualapha	DAFO, Houameung	Deputy Head
9	Mr. Onthong	DICO, Houameung	Deputy Head
10	Mr. Phoukham	Finance Office, Houameung	Deputy Head
11	Mr. Somphone Phiain	DAFO, Houameung	Technical
12	Mr. Phaiboun Bounmixay	DAFO, Houameung	Technical
13	Mr. Viengphone	DAFO, Houameung	Technical
14	Mr. KhamPhiew Hiengpanya	DICO, Viengxai	Deputy Head
15	Mr. Sengmy	Finance Office, Viengxai	Technical
16	Ms. Phengvanh Khaluesy	DAFO, Viengxai	Technical
17	Mr. Vithipphavone Touyengher	DAFO, Viengxai	Dep. Head of Plant Unit
18	Mr. Thone Souvannatai	DAFO, Xamtai	Deputy Head
19	Ms. Thaimeuang Saenbounmy	DICO	Technical
20	Mr. Vanthong	Finance Office, Xamtai	Technical