Analysis of the Forestry and Wood Processing Sector in Laos

Final Report English Version

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LIST OF ABBREVIATIONS

ACIAR	Australian Centre for International Agricultural Research
BMZ	German Federal Ministry of Economic Cooperation and Development
CO	Certificate of Origin
CoViD	Corona Virus Disease
DAFO	District Agriculture and Forest Office
DIMEX	Department of Imports and Exports (Lao PDR)
DoF	Department of Forestry (Lao PDR)
DoIH	Department of Industry and Handicraft (Lao PDR)
FAO	Food and Agriculture Organization of the United Nations
FLEGT	Forest Law Enforcement and Governance
FSC	Forest Stewardship Council
FSIS	Forest Sector Industry Survey
GIS	Geographic Information System
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH
HS	Harmonized System
ILEO	Individuals, Legal Entities and Organizations
IRW	Industrial Roundwood
ISIC	International Standard Industry Classification
ISO	International Standardization Organization
IFC	International Finance Cooperation
ITC	International Trade Center
ITTO	International Tropical Timber Organization
Lao PDR	Lao People's Democratic Republic
LNCCI	Lao National Chamber of Commerce and Industry
LSIC	Lao Standard Industry Classification
M	Million
MAF	Ministry of Agriculture and Forestry (Lao PDR)
MAI	Mean Annual Increment
MDF	Medium Density Fiber Board
MGR	Malaysia Grading Rules
MoIC	Ministry of Industry and Commerce (Lao PDR)
MSME	Micro, Small and Medium Enterprises
N	Number
ODOP	One District one Product
OSB	Oriented Strand Board
OHS	Occupational Health and Safety
PAFO	Province Agriculture and Forest Office
PCCI	Provincial Chamber of Commerce and Industry

PMO	Prime Minister Order
PDR	People´s Democratic Republic
PPE	Personal Protective Equipment
ProFEB	Protection and sustainable use of forest ecosystems and biodiversity
RWE	Roundwood Equivalent
QM	Quality Management
SME	Small and Medium Enterprises
SPS	Sanitary and Phytosanitary Standards
TLD	Timber Legality Definition
TLAS	Timber Legality Assurance System
UN	United Nations
UNIDO	United Nations Industrial Development Organization
US$/USD	United States Dollar
VFMP	Village Forest Management Plan
VPA	Voluntary Partnership Agreement
VUF	Village Use Forest

INTRODUCTION

This document is a report on consultancy assignment on the 'Analysis of Needs and Potentials in the Development of the Forestry and Wood Processing Sector in Laos'. The consultancy was implemented as part of the BMZ commissioned program 'Protection and sustainable use of forest ecosystems and biodiversity (ProFEB)' together with the BMZ commissioned SEWOH Global Project "Forest Landscape Restoration and Good Governance in the Forest Sector" (Forests for Future; F4F). The assignment was carried out by UNIQUE forestry and land use GmbH from Germany during the period November 2020 – September 2021.

The report provides an overview of the status of forestry and wood processing in Laos. The specific objectives of the assignment were to:

1. Identify the needs and potentials of wood processing sector and the development of a sustainable plantation sector.
2. Support governmental and private stakeholders, associations, and companies in obtaining a solid basis for deciding on measures and activities for the future development of the forestry and wood processing sector.
3. Support the Lao VPA-FLEGT process.

This report consists of three parts: task 1) market analysis on timber supply, task 2) market analysis on process and product quality, and 3) conclusions and recommendations.

The separate part on market analysis on timber describes the status of timber supplies from three sources: plantation forests, conversion areas and national production forests. Furthermore, this part proposes a standard methodology for gathering information on timber supply from village use forests and natural timber from land of individuals, legal entities, and organizations. The analysis was based on secondary data and information; the data sources are described in the report.

The part on product and process quality describes the characteristics of the wood processing sector including the number of companies, their size, organization in associations, and product specialization. This part provides information on the status of production technology, occupational health and safety standards, personnel, and compliance with relevant regulations. The report also examines the willingness of companies to participate in the Lao-EU FLEGT-VPA process. The analysis on product and process quality is based on secondary data and information and a questionnaire that was conducted to collect additional information.

The conclusions and recommendations present a summary of main findings under five headings: timber supply, wood processing industry, linking timber supply and wood processing industry, information management and governance.

1 MANAGEMENT SUMMARY

The objectives of the assignment were:

1. To identify the needs and potentials of wood processing sector and the development of a sustainable plantation sector.

2. To support governmental and private stakeholders, associations, and companies in obtaining a solid basis for deciding on measures and activities for the future development of the forestry and wood processing sector.

3. To support the Lao VPA-FLEGT process.

Task 1 of the assignment was the Market Analysis on Timber Supply and task 2 the Market Analysis on Process and Product Quality (wood processing industry). The two parts are interlinked in a value chain that creates the goods to satisfy the demand on wood products.

The study focused on three timber sources: production forests, conversion areas and plantations. It was limited to solid wood products, hence bioenergy, and forest environmental services were excluded.

1.1 Market analysis on timber supply

Lao's wood processing industry sources only about half of the required wood from within the country. Timber plantations are the main source of roundwood representing about 90% of total domestic timber supply.

1. Gazetted Production Forest Areas are heavily depleted. The mean annual increment (MAI) of commercial species in these natural forests is estimated at only 0.27 m^3/ha/year. Harvesting in natural production forests is currently banned and the potential timber production would be very modest, with about 40,000m^3/year.

2. The conversion of natural forests, gazetted for production, protection and conservation, to other land uses is estimated to supply between 35,000 and 69,000 m³/year over the next five years.

3. An estimated 50% of the plantation area is dedicated to latex production. Old rubber plantations can supply upwards of 250,000 m³/year. However, at the moment, timber from old rubber plantations is utilized only by a small share of processing companies. Eucalyptus plantations are estimated to supply between 800,000 and 1 million m³/year.

Wood processing industries in Lao utilize about 2.9 million m³ wood each year. Of this volume, ca. 1.3 million m³ is consumed by the pulp and paper industry. The raw material is currently sourced from imported wood chips but shall be supplied from domestic plantations in the long term. Supply opportunities from sustainably managed natural production forests will remain low, even if the harvesting ban is lifted. Timber from forest conversion is likewise negligible and not a reliable source. Hence, the contribution from timber plantations is by far more important. Plantations can cover 30% or more of the total intake. Processing enterprises will have to adjust products and processing technology to transition from natural hardwood species to planation species.

The estimated annual timber supply potential over the next five years ranges between 1.1 and 1.9 million m³ roundwood. The forecasted timber supply is uncertain, since detailed and

comprehensive information about natural forests is not accessible or lacking. Furthermore, village use forests (VUF) are not used commercially and information about planted and natural trees on "private" land is not available. Next to the currently also not traded natural trees from areas owned by individuals, legal entities and organizations (ILEO), timber resources on these lands may be substantial. Yet, the biggest uncertainty factors are the unknown status of natural forests in Production Forest Areas, and timber plantation area. A key requirement for targeted sector development policy and planning is access to reliable data and information.

Hence, the two main barriers for timber production are: access to reliable data and information and cumbersome regulations. For instance, procuring and moving harvesting technology requires government approval; and timber auctioning in large volumes favors bigger operators.

As part of the assignment a standard methodology was developed, which describes the data collection for harvested natural timber from Village Use Forests and from Individuals, Legal Entities or Organizations.

The data collected can contribute to the monitoring of legality of natural timber traded within Lao PDR. The methodology applies to natural timber harvested on land belonging to villages, individuals, and legal entities or organizations, which is used commercially.

This methodology is based on the Forestry Law (revised) No 64., 2019 and the current version of the Timber Legality Definition 4: natural timber from village use forest and land of individuals, legal entities or organizations (TLD4, v6.0). The methodology can be further developed, once currently pending distinct legal provisions from TLD4 are available.

Data collection and reporting procedures are based on the already existing and proposed legal structures and processes for:

- forest management and operational planning, and
- issuance of permits and certificates for forest/trees in VUF or of ILEO.

Recommendations on timber supply

1. Assess the status of stocked natural forests in Production Forest Areas regarding their viability for commercial harvesting within the next five, ten, and fifteen years.

2. Prioritize management planning and utilization of forests with viable commercial stocks. An example from Vietnam: the state management agency, Vietnam Forest Administration establishes the forest status through periodic, nationwide inventories (National Forest Inventory and Statistics Program, NFIS). The inventories are carried out every five years. During the five-year period the local forest authority at province and district level, monitors forest cover change through computerized Forest Resource Monitoring System (FRMS) that synchronizes the data on changes to a central server. Forest management planning is regulated through a government circular covering all the forest categories (Circular on Sustainable Forest Management, 28/2018/TT-BNNPTNT).

3. Against the background of continued low supply of natural hardwood species, investment in timber plantations should be strengthened for instance by sharing data on potential areas for plantation investment and by enabling electronic submission of plantation concession applications. Support private sector, including individuals, legal entities, and organizations, in investing in timber plantations on suitable sites and inform plantation owners of the roundwood demand and the requirements related to wood assortments and timber quality.

The support could come from several organizations including PAFO, DAFO, the local level organizations aiding in silvicultural techniques as well as NGO's.

4. Support vertical integration of value chains from Village Use Forests and small holder forest owners to forestry enterprises. This requires mapping the plantations and forest falling under VUF & ILEO category.

5. Support the utilization of old rubber plantations for timber. Create awareness amongst the forest owners of the combined benefits of latex and timber production and of the demand for roundwood and, at the same time support market development. There is a moratorium on establishment of new, large scale rubber plantations.

6. Data and information collected by the Department of Forestry is recommended to be made available to the public through the Lao Statistics Bureau. Data for productive resources, forest production, wood products trade, processing and consumption should be harmonized at central level.

7. The Department of Forestry is advised to identify and create a focal point within the department which can provide any additional (e.g. more detailed) data and information to planners and investors. The Forest Inventory and Planning Division, under the DOF, would be a viable option for collecting, storing, analyzing, and sharing forest resource data to interested investors.

8. Overlapping and at times conflicting responsibilities for planning and administration of timber and rubber plantations. The following are examples of ways to improve the situation: Removing conflict between the Forestry Law 2019 and the Investment Promotion Law 2016 on approval procedure for concessions for commercial tree plantations; streamlining regulations on land survey and investment selection criteria between the Ministry of Planning and Investment, the Ministry of Environment and Natural Resources and the Ministry of Agriculture and Forestry.

1.2 Market analysis on wood processing industry

The Laotian wood industry is consuming ca. 2.9 million m³ of industrial roundwood (IRW). There are three major timber flows in Lao´s wood sector: 1) Domestic value chains that source from natural forests and plantations and produce products for the national market (ca. 28% of the total industrial roundwood (IRW) turn over). 2) Export value chains that produce (semi-) finished wood products from domestic timber resources (ca. 28% of IRW turn over). 3) An international pulp value chain, which is based on imported wood chips from Viet Nam and Thailand to supply one producer of wood pulp for the export market (ca. 44% of IRW turn over).

The implementation of PMO 15 and related regulation since 2016 has led to an increase of finished wood products exports (+ US$ 58 M since 2015), while unfinished wood products dropped substantially (- US$ 53 M since 2015).

The Laotian wood sector has seen a substantial decline in number of enterprises since 2015. The number has dropped from more than 1,300 to less than 1,000 in 2020. After enforcement of PMO 15 in 2016, many wood industry enterprises have sized down their activities or closed due to the lack of raw material or due to non-compliance with processing requirements.

The national regulatory framework provides for safeguards and guidelines on good industry practice for processing enterprises. It supports occupational health and safety and quality management of production processes. It provides for product definitions that support the enterprises´ compliance with the national legislation to avoid exports of illegal and unfinished products. However, there are no national quality standards (i.e., grading rules) for wood products, resulting in high transaction costs of buyers to ensure product quality and difficulties for manufacturing enterprises sourcing quality wood material inputs. While several projects in recent years have investigated and proposed quality management approaches, there have been no follow-up activities for establishing national wood product quality standards.

The domestic offer of sawn timber as input for secondary wood processing has declined due to firm closure of sawmills in recent years. Thus, the smaller enterprises are severely challenged by the current circumstances, since access to logs has been limited due to restricted capital endowment of these small firms.

Still, many wood processing enterprises directly source logs within their regions. This results in secondary processing enterprises investing in sawmilling equipment and sawn timber treatment capacities. These activities are locking up capital for possible expansion, require technical know-how and extends the process management requirements. On the other hand, during the conducted survey the vast majority of enterprises did not mention having concrete investment plans, i.e. due to lack of planning security (i.e. availability of timber) and poor access to finance.

Further, the lack of skilled workforce is restricting the enterprises´ business opportunities. The enterprises must invest in training of untrained labor. Many enterprises draw on foreign workers that are better trained and used to operate modern equipment. Generally, the situation of Occupational Health and Safety (OHS) in the wood sector enterprises requires improvement.

Recommendations on wood processing industry

1. Increase supply of standardized primary wood products, sawn timber and veneer, for the secondary wood industry. This requires reliable supply of roundwood, as described in the recommendations on timber supply to motivate the private sector investing in processing capacities. Easing the MOIC export regulations for "unfinished" wood products would be an additional stimulus.

2. Support private sector investments in improved wood processing technology and support enterprises in adapting to future supply of timber assortments including e.g., enhance resources efficiency in view of scarce supply, moving from natural timber to plantation timber, assess potential for new product lines. This requires detailed enterprise diagnostics and follow up of earlier work e.g., by Australian Centre for International Agricultural Research (ACIAR) and the German International Cooperation (GIZ). Providing information on market demand, potential for product innovations and related technical assistance would reduce the private sector investment risk.

3. Strengthen market acceptance of Lao wood products by promoting internationally recognized Quality Management Standards, including OHS standards and by developing grading rules for wood products.

4. Strengthen the competence at management and staff level in modern wood processing techniques and OHS requirements and apply internationally recognized standards. This

includes trainings developed by cooperation agencies in partnership with national institutions (MOIC, DOIH) and associations (Lao Wood Association and Lao Furniture Association).

5. Bridge the finance gap of domestic SMEs. Develop credit lines for enterprises upgrading processing technology to comply with the regulations as well as for start-up enterprises. In a first step, the existing credit lines, available funds for SME financing and relevant actors like intermediary banks need to be assessed to improve capital access and lending conditions of forest SMEs.

1.3   Linking timber supply and wood processing industry

Adequate and timely material flows are vital for managing the performance of forestry supply chains. The wood industry entrepreneurs need to know the availability and quality of roundwood in a particular area of interest. The availability of roundwood from plantations and natural forest will define the technology and investment requirements. Similarly, timberland investors need to know the demand for roundwood.

The actors on both sides need to improve quality as an essential part of 'business performance excellence' and need to be well connected to ensure, on the one hand smooth inbound logistics of timber to wood industry, and the other hand access to market to timber producers. Understanding of the structure of actors is the starting point for supply chain integration.

Recommendations on linking timber supply and wood processing industry needs

1. Data and information ought to be made available on current forest resources and existing on processing facilities. This type of spatial data infrastructure could be included in e-government services. The main principles of e-government, implemented also in Lao PDR, are to provide government services to individual people and enterprises through digital platforms. In this way it is possible to promote transparency, reduce costs, and stimulate economy in many ways.

2. In addition to the current availability and demand of timber, the investors need to be able to forecast future trends. Government can support such predictability through strategies and regulations that create a favorable operating environment to timber producers and wood processing industry.

3. Producers of commercial timber need to be supported by policies and regulations that enable optimization of timber assortments to the demands of wood industry (see also recommendations on Governance).

4. Wood processing industries need to be able to adjust the product standards to customer requirements.

5. While government regulations are needed to safeguard social and environmental benefits, they need to be written in such a way that they don't obstruct customer-oriented management of quality.

6. Digital marketing platforms for both timber producers and wood processing industry have proven an effective and cost-efficient way to connect actors along the value chain.

7. Both timber producers and wood industry need to have organizations to represent their interests and agree on collaboration practices with one another and to advocate their needs.

1.4 Governance and FLEGT in the forest sector

The national regulatory framework provides for safeguards and guidelines on good industry practice for processing enterprises and supports quality management of production processes. It provides for product definitions that support the enterprises´ compliance with the national legislation to avoid exports of illegal and low unfinished products.

Prime Minister's Order 15 (PMO 15, in 2016), under which only finished wood products can be exported, has had a significant impact in reducing the uncontrolled harvesting and export of large amounts of natural roundwood. The PMO 15 has succeeded in increasing export of finished wood products and in reducing the pressure on natural forests. On the other hand it has had an adverse effect on numerous wood processing enterprises that faced lack of raw material and at the same time were required to invest in processing equipment. Many enterprises have not been able to continue operations under the new conditions.

Amongst the wood industry enterprises there is a perception that the sector is over regulated, and the current regulations restrict companies' ability to respond to business opportunities. For instance, the industry perceives that the current wood products definitions can frequently be an obstacle in meeting customer requirements. Bureaucratic licensing practices in harvesting and transport affect wood supply and the regulations on timber auctions put micro- and small enterprises in a disadvantaged position requiring large working capital. The enterprises also perceive that lack of enforcement of regulations distorts competition and puts those enterprises that follow the regulations in a disadvantaged position.

The FLEGT-VPA process implementation can be supported by creating provincial FLEGT-VPA implementation plans, addressing specific challenges within the regions and streamlining forestry regulations related to timber supply and wood processing industry and engaging forest industry associations and other stakeholders in training on TLAS implementation and in providing information on FLEGT-VPA process.

Recommendations on governance of timber supply and wood processing industry

1. Streamlining the regulatory processes related to plantation management. The following are examples of ways to improve the situation: Removing conflict between the Forestry Law 2019 and the Investment Promotion Law 2016 on approval procedure for concessions for commercial tree plantations; streamlining regulations on land survey and investment selection criteria between the Ministry of Planning and Investment, the Ministry of Environment and Natural Resources and the Ministry of Agriculture and Forestry.

2. Increase staff resources and improve processes in government institutions (e.g. MOIC, DOF) to accelerate registration and licensing procedures and ensure wide scale enforcement of forest industry regulations ensuring fair competition between enterprises.

3. Support SME's in participating in auctions e.g, by forming bidder groups and providing access to working capital. This could be supported by wood and furniture sector associations in cooperation with international cooperation.

4. Facilitate exceptions from export restrictions to create opportunities for customized wood products. This may include avoiding restrictions of product dimensions and generally allow exports of plantation timber products.

5. Prepare provincial FLEGT implementation plans to address the specific challenges and opportunities of FLEGT- VPA. The Provincial Agriculture and Forestry Office (PAFO) would be an appropriate authority to take responsibility of the plans.

6. Engage industry associations, e.g., Lao Furniture Association and Lao Plated Forest Products Group in training and communication on quality management and compliance with FLEGT-VPA.

1.5 Information management in timber supply and wood processing industry

Wood industry operations and future investments require planning security. Adequate and timely material flows are vital for managing the performance of timber supply chains. The wood industry entrepreneurs need to know the availability and quality of roundwood in a particular area of interest. The availability of roundwood from plantations and natural forest will define the technology and investment requirements.

Similarly, timberland investors need to know the demand for roundwood. Therefore, data and information ought to be made available on current forest resources and existing processing facilities. This type of spatial data infrastructure could be included in e-government services. Data on forest resources, collected with government funding, is typically made available through such platforms.

In addition to the current availability and demand of timber, the investors need to be able to forecast future trends. Government, particularly the MAF and the MOIC, can support such predictability through strategies and regulations that create a favorable operating environment to timber producers and wood processing industry. Such predictability along timber supply chain could be improved e.g., by a clear regulation on natural timber produced in VUF & ILEO and by completing certification mechanisms for natural timber, plantation forests and planted trees. This would also make it possible for MOIC to implement the input-output control of wood processing industries. Furthermore, banking policies could be improved to allow long-term loans with low interest rates for plantation investors.

There is a lack of data on the status of production forests as well as plantations. Timber supply from Village Use Forests, land of individuals, legal entities and organizations is currently not monitored. Difficult access to data and information, and data gaps were the biggest challenge to the estimation of timber supply in this study.

The data related to wood processing industries is fragmented and incomplete because it does not cover all the provinces in a systematic, standardized way. There are considerable uncertainties in the data on roundwood balance and consumption of wood products. Data is available only from limited number of provinces and it cannot be aggregated because it is not following a standard format.

Recommendations on information management

1. Develop a standardized, nationwide, central database on forest resources and wood processing enterprises to support investments in wood production and wood processing. Data on forest resources and wood processing industry is typically managed by the responsible state management agency, in this case the Department of Forestry.

2. Start by making available the existing forest resource data in the Department of Forestry. Update data through national forest inventories and through forest management planning carried out in the PFA's and the VUF&ILEO forests.

3. Similar, the existing information systems, including the MOIC database on enterprise registration, would need to be identified to determine the possibility to use them and to identify the need for system integration.

4. Appoint focal points in the Department of Forestry and MOIC to support stakeholders in obtaining the data and information on forest resources and timber supply. Within the DOF, the Forest Inventory and Planning Division has the mandate to manage forest resource data. Within MOIC the mandates are not completely clear: The Department of Handicraft and Industry manages wood processing industries and wood products trade monitoring the existing operations. The Department of Enterprise registration and Management maintains registration data; however, it does not update closures of factories.

5. Ensure that data management systems are co-developed with TLAS digital infrastructure to make best use of synergies and information flows.

2 MARKET ANALYSIS ON TIMBER SUPPLY

2.1 Introduction

Following wide-spread illegal harvesting, the harvesting of timber in Production Forest Areas has been suspended since 2013. Since 2016, only finished wood products may be exported (LPDR, 2016) to promote domestic value addition. The Government of Laos, supported by development partners through the Lao-EU Forest Law Enforcement, Governance and Trade towards Voluntary Partnership Agreement (Lao-EU FLEGT VPA), is trying to reduce illegal timber harvest and trade. Despite the many advances in the forest sector, forestry and wood processing are characterized by low value and efficiency, and there is little reliable data on raw material sources.

Against this background GIZ commissioned UNIQUE to analyze the needs and potentials in the development of the forestry and wood processing sector in Laos. The assignment includes two main tasks:

1. Market analysis on timber supply, including the development of a standard methodology for natural timber from village use forests, individuals, legal entities, and organizations

2. Market analysis on process & product quality.

This report on task 1 covers the **analysis of timber supply for solid wood products**.[1] The objective of the analysis was to compile the existing data and information on timber supply and estimate the potential domestic timber supply from plantation forests, conversion areas, and natural production forests.

The following sections describe:

- Materials and methods used in the analysis
- Results of the analysis distinguishing between timber from conversion forests, natural production forests, and forest plantations
- Discuss the input parameters and limitations of the timber supply estimate.

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[1] Solid wood products in the context of this study, solid wood products refer to sawn timber, veneer, composite wood products such as fiber & particle boards and plywood used chiefly in the construction and furniture sectors, as well as wood used for pulp and paper production. It explicitly excludes wood for fuel (incl. charcoal).

2.2 Material & methods

The analysis covers timber from forests where trees can be harvested legally for commercial trade:

- Natural forests categorized as Production Forest Areas, commonly called Production Forest Area[2]
- Natural forest earmarked for conversion to other land uses[2]
- Forest plantations.

The methods for these three sources are described in sections 2.2.1 - 2.2.3.

Materials

Lao PDR does not have centralized documentation of forestry activities and statistics, or specific forest growth parameters. Therefore, several different datasets and information sources had to be used to estimate the potential timber supply for the next five years.

The analysis relied chiefly on statistics and geo-spatial data provided by various divisions of the Department of Forestry (DoF). Additional information sources were the Department for Planning and Cooperation, private sector plantation companies, and peer reviewed literature.

Figure 1 illustrates how the various data and information sources were combined. Parameters such as mean annual increment (MAI), standing timber stock, and share of commercial species were extracted from peer reviewed literature or official reports. Natural forest area by vegetation type and category, plantation area for species groups, and concessions falling within forest land were compiled from GIS data, reports and statistics provided by DoF.
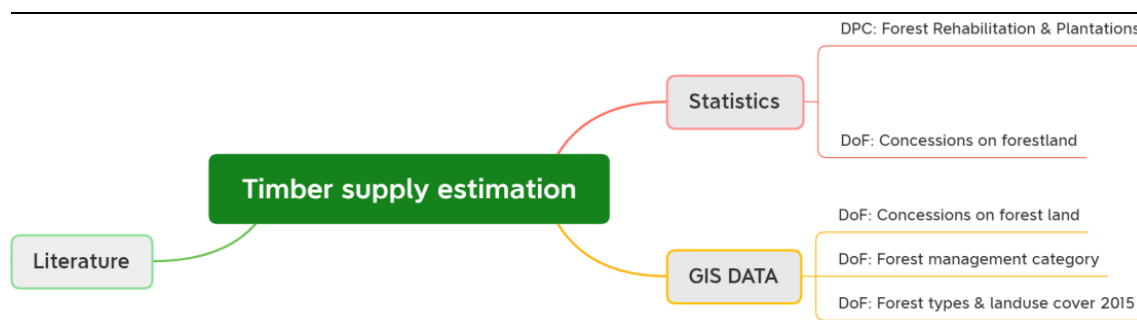
Figure 1: Data sources and data analysis for timber market study

Sources: Refer to chapter 2.5 for complete references.

Forestland is divided in three different forest categories and several forest types indicating the species composition and severely degraded forests (classified as "regenerating vegetation"). The categories and types overlap. Mapped forest and plantations are partially found outside the

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[2] Harvesting in Production Forest Areas and has been suspended since 2013 (PMO 15 (LPDR, 2016). When the suspension will be lifted is unknown. Harvesting of timber for commercial purposes is not permitted in the categories Protection Forestland and Conservation Forestland unless they are part of a legal concession for another land use.

boundaries of forest categories. To estimate timber supply, forest category and forest type had to be intersected, requiring the use of GIS data. The last available GIS data set for land cover/use map is for the year 2015.

Table 1: Forest categories and types

Forest category	Forest type
▪ Protection Forest ▪ Conservation Forest ▪ Production Forest	▪ Evergreen ▪ Mixed deciduous ▪ Coniferous ▪ Coniferous / broadleaved ▪ Dry dipterocarp ▪ Plantation ▪ Bamboo ▪ Regenerating vegetation
Source: Forestry Law (LPDR, 2019); DoF, 2021b	*Source: DoF, 2021c, 2021d, e, f, g)*

To fill data and information gaps, we applied the assumptions listed in Table 2. These assumptions were verified to the extent possible by Laotian forestry experts at the DoF. Reflecting the uncertainty arising from to incomplete information or data gaps, we estimated supply for different scenarios as listed in Table 2.

Table 2: Assumptions

Parameter	Details	Assumptions/scenarios
Natural forest area with viable stocks of commercial species	▪ In natural sustainable forest management harvesting cycles of 15 years are applied. ▪ GIS data and statistics showing the area logged-over legally or illegally, or natural forests otherwise significantly disturbed within the past 20 years were not available. ▪ Data compiled by the SUFORD project (Puustjärvi, 2019) indicates that as little as 7% of forestland has viable stocks.[1]	**Production Forest Areas with commercially viable timber:** 7 or 15% of land classified as Production Forest Areas and covered with evergreen, mixed deciduous, dry dipterocarp, and (mixed) coniferous forests **Natural forest to be converted to other land uses:** 7 or 15% of land covered with evergreen, mixed deciduous, dry dipterocarp, and (mixed) coniferous forests and listed in Concessions on forestland[1]
Mean annual increment (MAI) of commercially used timber species	▪ The MAI ($m^3ha^{-1}a^{-1}$) determines the harvestable volume at the end of the rotation. ▪ Very limited documentation is available for MAI of commercial natural species in forests in Lao PDR. ▪ MAI of species used in forest plantations varies widely with site characteristics and management practices.	**MAI natural forests:** Based on the past quotas set for natural forests (4 m^3/ha every 15 years; Puustjärvi, 2019) for all forest types (= 0.27 $m^3ha^{-1}a^{-1}$) **MAI forest plantations:** Teak: 11 or 16 $m^3ha^{-1}a^{-1}$ (Midgley, 2007) Eucalyptus spp.: 15 or 20 $m^3ha^{-1}a^{-1}$ (Kien & Harwood, 2017)
Timber plantations by year of	▪ Statistics provided list the total area planted per year (or 5 year period) and share of species across the total	**Area planted per species per year:**

Table 2: Assumptions

Parameter	Details	Assumptions/scenarios
establishment and species	planted area. The share of species established each year is unknown. ■ Plantations and woodlots established by smallholders are likely not fully represented in the statistics (Smith et al,. 2017).	We assumed the area planted per year and species was distributed as in the overall species distribution. Once established, plantations are continuously used for timber production.
Plantation management targets and rotation length	■ Rotation length varies with management target (e.g. production of biomass or chip wood or saw/veneer logs), site, and management practices.	**Rubber:** primary purpose is latex production, after 25 years logs can be used for lumber and panel production **Eucalyptus spp.:** veneer and sawlogs with an average rotation of 10 years; plantations established for pulp production were not included in the timber supply estimate. **Teak:** veneer and sawlogs with an average rotation of 21 years

[1] Information regarding degradation in Protection and Conservation forestland are not available. Hence the same values are applied as for Production Forest Areas.

2.2.1 Production forest area

The category Production Forest Area comprises different forest types and includes areas currently unstocked or severely degraded. The timber supply estimation only includes land mapped as stocked with natural forest in 2015.

The suspension of harvesting in Production Forest Area remains in place (LPDR, 2016). If and when it will be lifted is unknown.

A large share of the forests have been disturbed by harvesting or otherwise in the recent past (Kukkonen & Langner, 2018; Puustjärvi, 2019).[3] These areas will not be available for harvesting within the next five years or longer. Detailed information on the intensity, scale, and location of logging or other disturbances within the past 15 years is not available.

Against this background we present three scenarios:

1. The suspension remains in place.

2. The suspension is lifted effect immediately. Seven percent of forests within Production Forest Ares are viable for harvesting.

3. The suspension is lifted effect immediately. 15% of forests within Production Forest Areas are viable for harvesting.

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[3] Kukkonen & Langner estimate that one million hectares (10%) of natural forests were disturbed between 2014 and 2017 alone. Given that natural forests need 15 years to regenerate after harvesting and that both legal and illegal logging took place prior to the harvesting ban on Production Forest Areas implemented since 2013 (PMO 15 (LPDR, 2016)), the area not available for harvesting is probably much larger. This is supported by Puustjärvi. Based in forest management plans developed in the framework of the SUFORD project, less than 10% of Production Forest Areas is viable for harvesting within the next 15-year period from 2020 to 2034.

The annual timber output from Production Forest Areas is calculated as shown in equation 1.

Equation 1: Annual commercial timber volume from Production Forest Areas

$$V_{production} = A_{production\ (7,15\%)} * MAI$$

$V_{production}$	Annual commercial volume harvested in Production Forest Area [m³]
$A_{production\ (7,15\%)}$	Area of natural forest i (stocked) within the category Production Forest Area [ha] whereby 7 or 15% of the mapped area is viable for commercial harvesting within the next five years.
MAI	Average Mean Annual Increment of commercial timber species across all forest types [m³ha⁻¹a⁻¹]

2.2.2 Forest conversion

To estimate the timber supply from conversion of forests, projects that are in the "*start-up*" and "*operational*" phase were extracted from the GIS file *Concessions on Forest Land* provided by DoF (2021a).[4]

We assumed that these projects will be realized within the next five years, leading to the conversion of all forests within the concession. The selected shapefiles were intersected with *Forest management categories* and *Forest types & Land cover 2015*, also provided by DoF (2021b&c).

The timber output from the forest conversion is calculated as shown in equation 2.

Equation 2: Commercial timber volume from forest conversions

$$V_{conversion} = A_{concession\ (7,15\%),i} * V_i$$

$V_{conversion}$	Volume of commercial timber species within concessions [m³]
$A_{concession\ (7,15\%),i}$	Area of natural forest, mapped as forest type i, located within the concessions [ha], whereby 7 or 15% of the area contains species of commercial interest
V_i	Average standing volume of forest type i [m³ha⁻¹]; the average standing commercial volume for forest types is listed in Table 3.
i	Forest types: Evergreen forest, Mixed deciduous forest, Dry dipterocarp forest, and (mixed) coniferous forest

Table 3: Average standing volume of commercial species in natural forests

Forest Type	Standing volume [m³ha⁻¹]
Evergreen, mixed deciduous & dry dipterocarp[1]	30-60
Coniferous and mixed coniferous[2]	20

[1] Puustjärvi, 2019.

[2] Based on Yamane & Chanthirath (2000) and Zuidema et al. (2010) very low stocks were assumed.

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[4] Other project development stages listed in the database include "abandoned" and "not yet started". We assumed that "abandoned" was never implemented or forests had time to recover in the meantime. "not yet started" is assumed to take place after the forecasting period to reach a conservative estimate of timber supply from forest conversion.

2.2.3 Forest plantations

Rubber plantations

The wood of rubber trees can be used by the wood processing industry when the trees loose capacity for latex production after about 25 years. For the timber supply estimate, we consider plantations which are or will be 25 years old within the next five years (i.e. were established 1997 until 2001).

Likely, not all of these plantations can be used for timber, e.g. because they are poorly accessible, of very poor quality, or because the owner is not aware of the option. We provided two scenarios: 100% or 50% of the area is used for timber production.[5]

According to (Killmann, 2001), the average log volume of a 25-year-old rubber stand ranges between 52 and 161 m³/ha, with 100 m³/ha most commonly used.

Equation 3: Commercial timber volume from rubber plantations

$$V_{rubber} = A_{rubber\,(100,50),j} * V_{25\,years}$$

V_{rubber}	Annual volume of commercial timber species within concessions [m³]
$A_{rubber\,(100,50),j}$	Area of rubber plantations established in year j that is utilized for timber production at the end of the latex production [ha] whereby 100 or 50% of the area is actually utilized for timber
$V_{25\,years}$	Average standing volume of rubber plantations after 25 years: 100 m³ha^{-1}
j	Year of establishment (1997-2001)

Eucalyptus & teak plantations

Eucalyptus and teak are key species dedicated to commercial timber production in Laos. The annual volume of timber from teak and eucalyptus plantations is calculated based on DoF (2021f) statistics *for Plantations 1975-2020*, average MAI and rotation length (equation 4).

The plantation statistics do not contain information on the production target of (future) plantations. Concessions of about 60,000ha are held by Sun Paper and its subsidiaries (Smith et al., 2017) and are dedicated to pulp wood production. Plantation forests already established on these concessions are likely included in the Plantation statistics but could not be filtered out.

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[5] Depending on timber price and harvesting and transport costs. Rubber wood may also be used as fuel or for charcoal production or is burned on-site.

Equation 4: Commercial timber volume from teak and eucalyptus plantations

$$V_{plantation_i} = A_{i,j} * MAI_i * R_i$$

$V_{plantation_i}$	Annual volume of commercial timber species (group) i [m³]
$A_{species_{i,j}}$	Area of plantations for species (group) i established in year j [ha]
MAI_i	Mean Annual Increment for species (group) type i [m³ha⁻¹a⁻¹]
R_i	Rotation length [year]
i	Species or species group (teak & eucalyptus spp.)
j	Year of establishment

The assumed rotation length and MAI are listed in Table 4. For teak we assumed an average rotation length of 21 years and for eucalyptus 10 years. Accordingly, we considered plantations established until the year 2000 (teak) and eucalyptus (2011).

The average reported MAI for planted teak in Laos ranges between 5 to 16 m³ha⁻¹a¹. For eucalyptus spp. information from plantation companies in Laos and Vietnam indicates a MAI range of 10 to 20 m³ ha⁻¹a⁻¹. In the calculations we will apply the values stated in Table 4.

Table 4: Growth parameters used to calculate timber output from plantations

Plantation species	MAI [m³ha⁻¹a⁻¹]		Average rotation [year]
	low	high	
Eucalyptus spp.	15	20	10*
Teak	11	16	21

*Plantations dedicated to the production of pulp-wood as well as plantations established with high performing hybrid species targeting pole or sawlog production may have shorter rotation periods. How large the respective area is or when such plantations were established is unknown. The ten year rotation leads to a more conservative estimate.

Sources: Midgley, 2007; Burapha personal communication (May 2021); Kien & Harwood, 2017

2.3 Results

Timber can be legally sourced from sustainably managed production forests (Production Forest Area and registered timber plantations) and forests included in concessions determined for alternative land uses. About 2.7 million ha of natural forest and forest plantations are available for sustainable forest management. The forest area in concessions dedicated to other land uses is about 90,000 ha.

Plantations are expected to provide about 90% of timber in the next five years, with the annual supply estimated to be between 1.1 and 1.7 million m³ of roundwood if rubber plantations are utilized for timber at the end of the latex production cycle. If the harvesting ban is lifted, sustainably managed natural production forests would provide about 40,000 m³ per year. Forest conversion is likely to contribute another 35,000 m³ of timber per year.

Figure 2 shows the approximate contribution of the different sources to the annual timber supply over the next five years for different supply scenarios.

For details refer to the following sections.
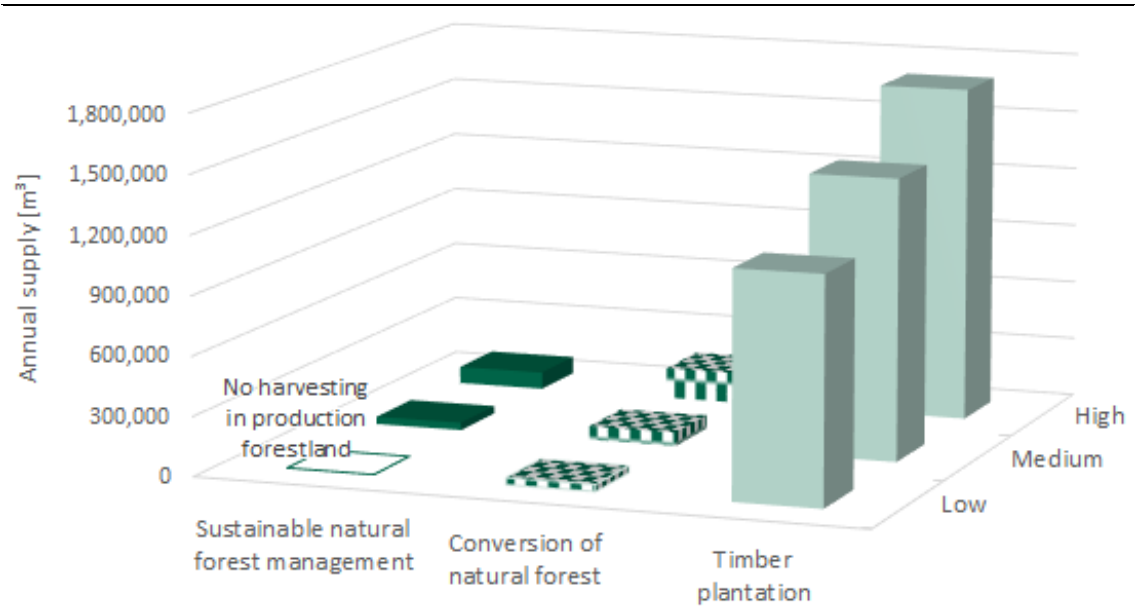
Figure 2: Annual timber supply from different sources and under different scenarios

2.3.1 Forests for legal timber supply

In 2015, about 19 million ha or 58% of Laos were mapped as forests. Most of this forest area is natural forest comprising five forest types (Figure 3). The area used for forest plantations is estimated to be 510,000ha (DoF, 2021f).

Regenerating vegetation is deemed to be not viable for timber production near to mid-term.[6]

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[6] Regenerating vegetation is "defined as the previously forested areas in which the crown density has been reduced to less than 20% because of logging or heavy disturbance. If the area is left to grow undisturbed it will become forest again. (FAO, 2020)
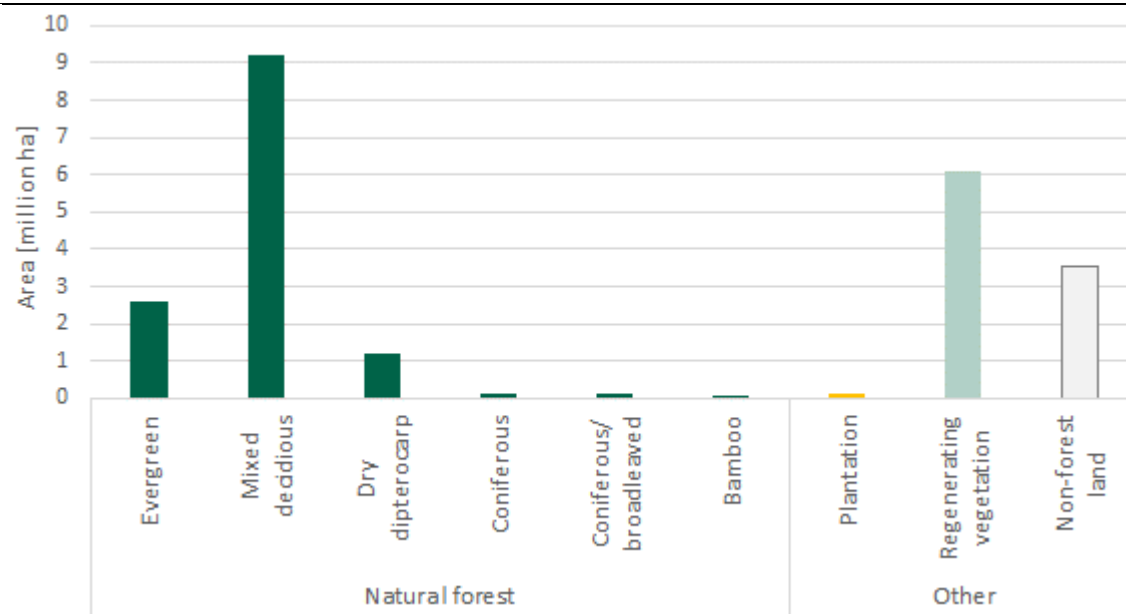
Figure 3: Land cover and use in 2015

Statistics for Plantation (DoF, 2021f) and land cover (DoF, 2021g) differ substantially for the plantation area: GIS land cover = 175,000ha; Statistics = 510,000ha.

Source: DoF, 2021c

Just over 70% of the mapped forest area is included in the three forest management categories (Figure 4). Mixed deciduous, evergreen and dry dipterocarp forests are the most important forest types by area covering 68%, 19% and 9% of the gazetted forest land respectively.
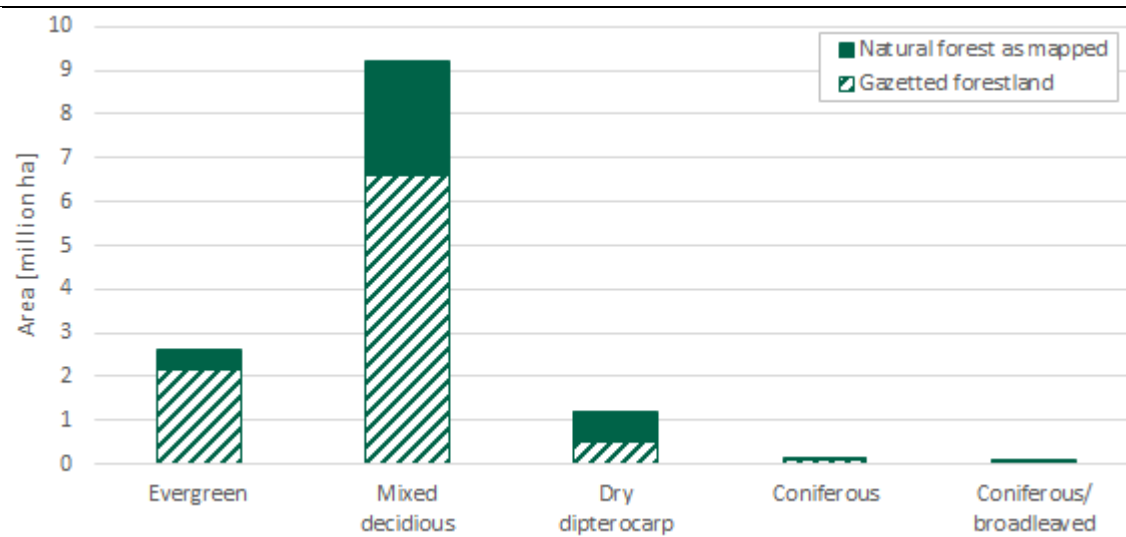
Figure 4: Land mapped as natural forest included in gazetted forest land

Gazetted forest land is categorized in Protection, Conservation, and Production Forest Areas. Only natural forest types potentially relevant for timber production are included.

Source: DoF, 2021b&c

Production Forest Areas, i.e. forests on land where timber can be harvested legally, constitutes only 23% of the gazetted area (Figure 5). The area is distributed across Laos (Figure 6). About 87,000 ha of gazetted natural forests are earmarked for conversion to other land uses.
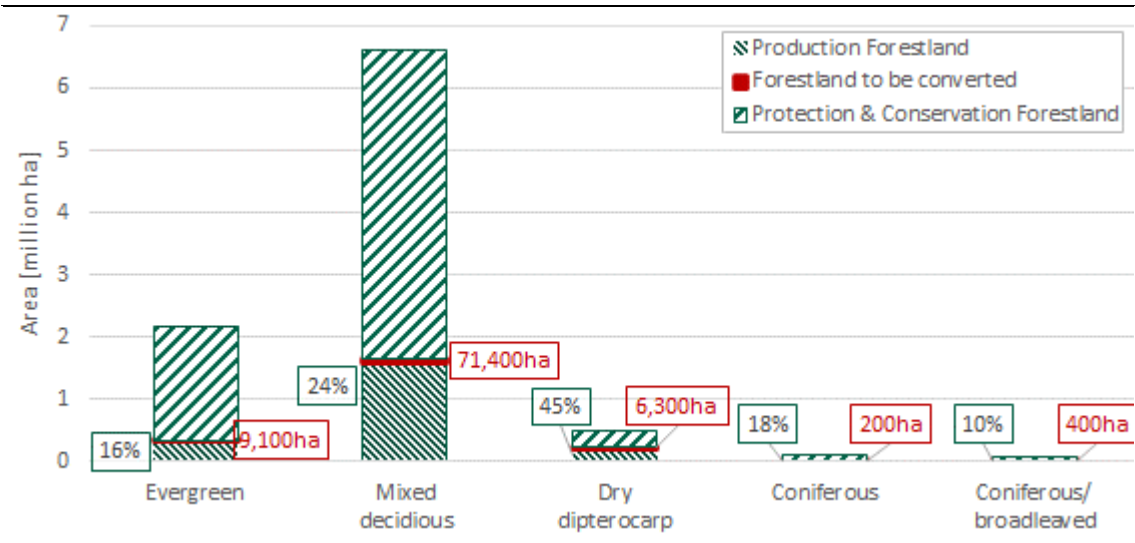
Figure 5: Share of Production Forest Area and area of gazetted forest to be converted

Forests on Forestland to be converted was estimated based on the database for concessions on forestland provided by DoF. According to DoF the database is not complete, i.e. the total area to be converted may be underestimated.

Source: (DoF, 2021 a, b, c)
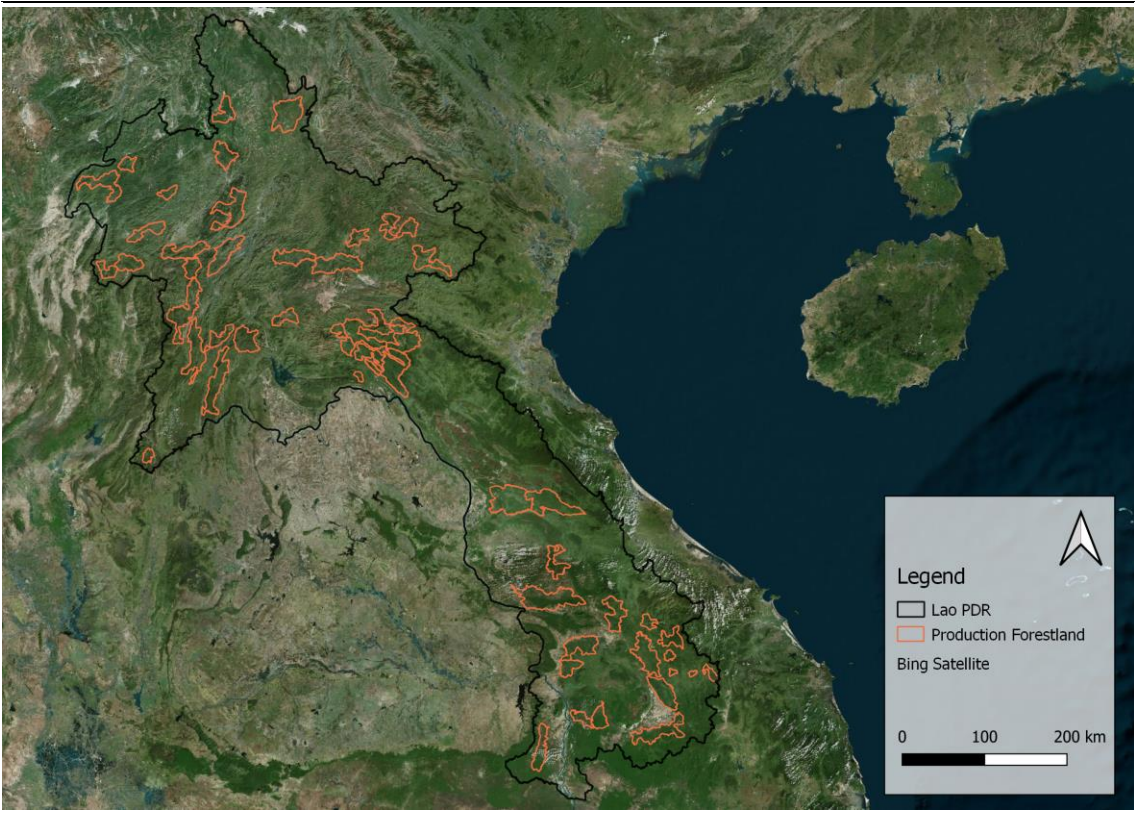
Figure 6: Distribution of Production Forest Areas

Source: DoF, 2021b

The statistics are provided in Annex 2 (2.6).

2.3.2 Timber from production forest area

Legal harvesting of timber in Production Forest Areas was suspended in November 2013 by the Prime Minister. In 2016, the suspension of harvesting was extended until further notice (LPDR, 2016), i.e. in the foreseeable future there will be no legal timber from Production Forest Areas unless the forest is legally converted to another land use (see section 2.3.3).

If the harvesting ban is lifted, gazette natural forests could supply between 40,000 and 90,000 cubic meter roundwood annually (Table 5). The two scenarios reflect the uncertainty regarding forest area with viable stocks of commercial timber species.

If the harvesting ban is lifted, forest management plans must be updated or compiled for all Production Forest Areas to identify areas where harvesting can take place.

Table 5: Timber supply from Production Forest Areas

Forest type	MAI $m^3ha^{-1}a^{-1}$	Annual timber supply [m³] if	
		7% 143,300ha	15% 325,600ha
		of the Production Forest Areasstocked with natural forest is viable for harvesting.	
Evergreen		6,000	14,000
Mixed decidious	0.27	28,000	63,000
Dry dipterocarp		4,000	9,000
Coniferous and mixed coniferous		0	1,000
Total annual volume		**38,000**	**87,000**
Volume over 5 years		**190,000**	**435,000**

Sources: Refer to assumptions in Table 2 and Table 3 in chapter 2.2. Statistics for Production Forest Areas are provided in Annex 2.

2.3.3 Timber from forest conversion

Forestland is converted into several other land use forms. Based on the concession data base (DoF, 2021a), a total of 87,000 ha is expected to be converted within the next five years. Mining was identified as the main reason for the conversion (84%), followed by tree plantations (9%), industry projects (4%), and agriculture (3%). Figure 7 shows the forest area to be converted for the four subsectors.
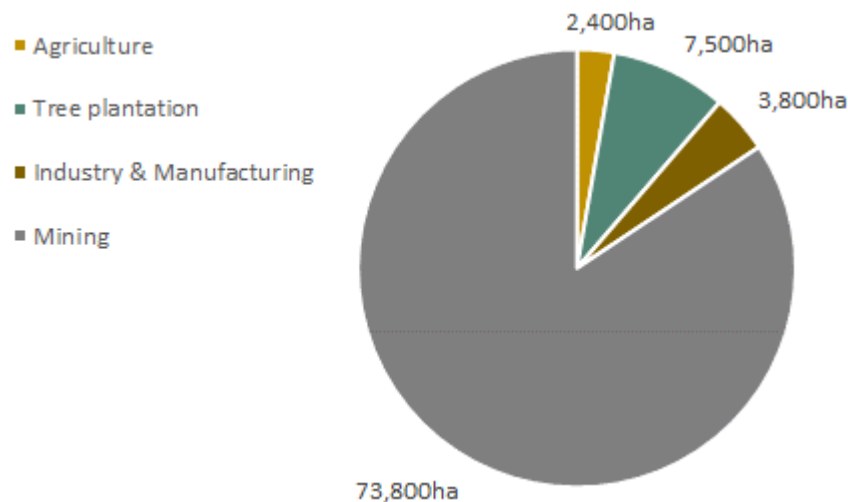
Figure 7: Land use sectors contributing to planned forest conversion

Reflects land in gazetted forestland stocked with natural forest in 2015 and included in a concession in the "start-up" and "operational" phase. These concessions are assumed to be fully implemented within five years.

The use of land cover data from 2015 may lead to an overestimation of forest area to be converted (e.g. in case of forests in "operational" concessions that had already been converted in the period 2016-2020).

Source: DoF, 2021 a, b, c

Table 6: Timber supply from forest conversion

Forest type	Commercial stock m³ha⁻¹	Timber supply [m³] if	
		7% 5,800ha	15% 13,100ha
		have significant stock of commercial timber species.	
Evergreen, mixed decidiuos & dry dipterocarp[1]	high: 60	346,000	780,000
	low: 30	173,000	390,000
Coniferous & mixed coniferous/broadleaved[2]	20	1,000	2,000
Annual volume	**high**	**69,000**	**156,000**
	low	**35,000**	**78,000**
Total volume (5-year period)	**high**	**347,000**	**782,000**
	low	**174,000**	**392,000**

[1] Values in Puustjärvi (2019). Stock depends on the time past after the last harvest took place. Stocks in forests not previously logged may be higher. Evergreen, mixed deciduous & dry dipterocarp forests cover 99% of the area earmarked for conversion.

[2] According to (Yamane & Chanthirath, 2000) timber stocks in coniferous forest were severely reduced in the past. Given their low growth rate the average standing stock of these forests is considered to be very low, although no concrete evidence was available.

Sources: Refer to assumptions in Table 2 chapter 2.2. Statistics for conversion of forests in gazetted forestland are provided in Annex 2.

Table 6 summarizes the potential timber output for different scenarios, whereby 7% or 15% of the 87,000 ha contain a significant volume of commercial timber species. The estimated annual

timber supply from legal forest conversion within land concessions ranges between 35,000 and 156,000 m³.

2.3.4 Timber from plantations

The official records for established forestry plantations in Laos PDR go back to 1975. Since then, about 510,000 hectares of forest plantation have been established.[7] The establishment of new tree plantations peaked from 2006 to 2010. In that period alone more than 172,000 ha were planted.
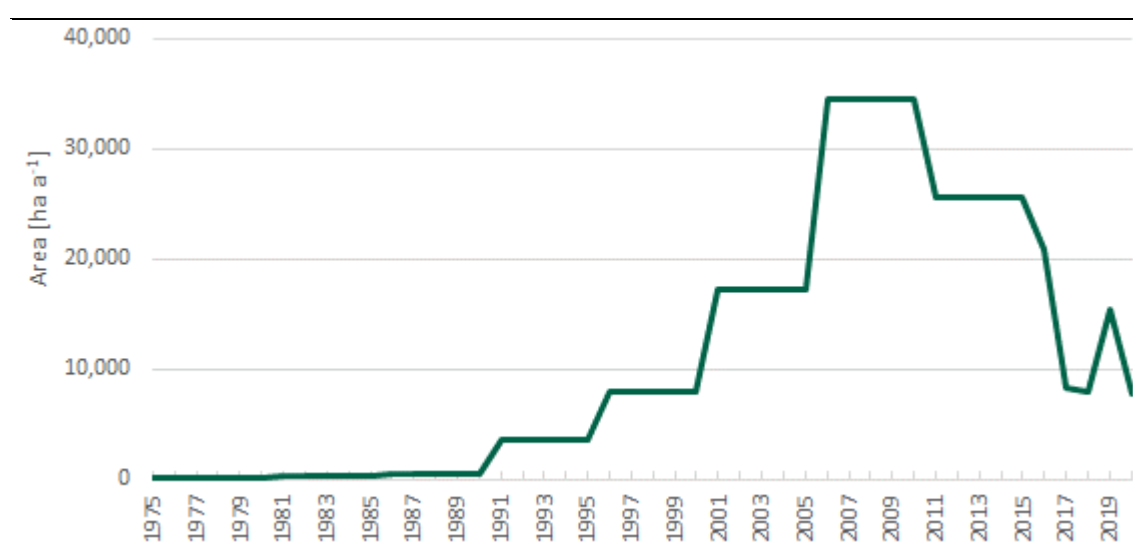
Figure 8: Establishment of tree plantations from 1975 to 2020

Source: DoF, 2021 d, e, f

Three species (groups) are of relevance for timber supply: Rubber (at the end of latex production), eucalyptus spp., and teak (Figure 9). Large companies also grow Acacia. Other species planted at larger scale are typically used for non-timber products (e.g. for incense or oil production, white charcoal).[8] Other native timber tree species planted include *Pterocarpus macrocarpus*, *Afzeleia xylocarpa* and *Alstonia scholaris* (Smith et al., 2017). However, the area share of these species is unknown. Agarwood and other native species were not considered in the estimation for timber production.

Plantations are estimated to supply between 1.1 and 1.7 million m³ of roundwood annually (Table 7). Plantations can contribute about 90% of sustainable timber supply despite the conservative growth rates assumed by this study. The amount of rubber plantations utilized for timber at

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[7] According to the Land cover assessment (DoF, 2021g), 175,000 ha of forest plantations exist. The discrepancy likely results from a misclassification of plantations to other land cover classes. Also, some of the older plantations registered by the DoF (2021f) may have been converted to other land use forms after their registration. On the other hand, plantations registered with DoF just prior to harvesting are not captured in the statistic (personal communication June 2021, GIZ ProFLEGT; Smith et al., 2017).

[8] DoF records do not list Acacia spp. separately. Other species include Agarwood (estimated at 30,000ha), Benzoin, Yang, Pink Mampat. All "other" species are estimated to cover about 75,000ha.

the end of latex production and growth performance of eucalypt plantations influence supply most. According to Smith et al. (2020), rubber wood is expected to become available at scale from 2030 onwards. The authors do highlight the high level of uncertainty in predicting rubber wood entering the market.
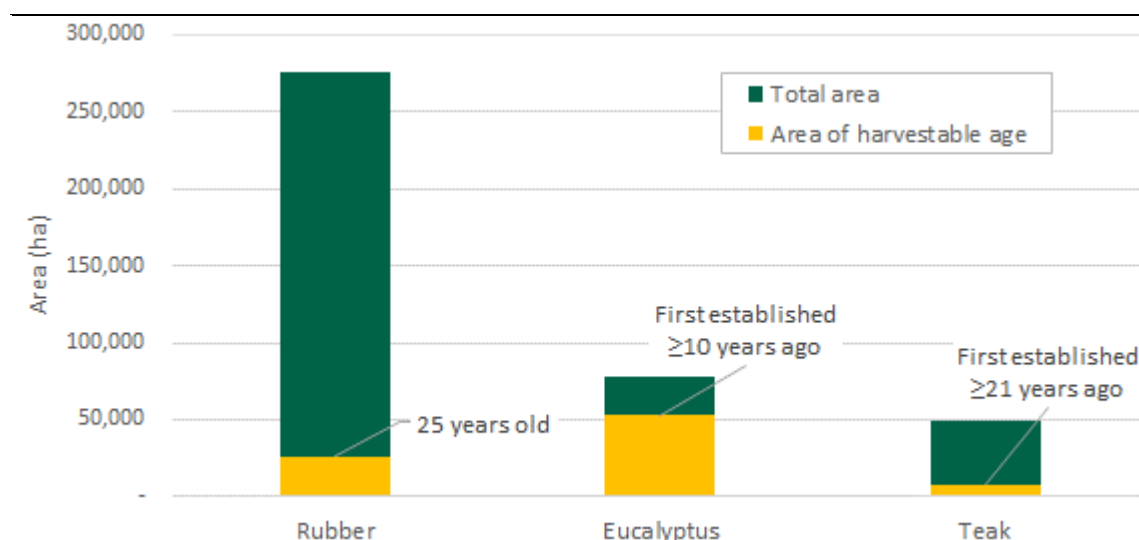
Figure 9: Plantations established since 1975 and of harvestable age in the forecasting period

The available statistics do not specify how much area was established per species each year. The area planted per species and year was based on the relative proportion of the species in the entire plantation estate.

Source: DoF, 2021 d, e, f

Table 7: Timber supply from plantations

Species	Relevant area [ha]	Harvestable volume [m³ha⁻¹]		Annual supply [m³a⁻¹]		5-year period [m³]	
		Low	High	Low	High	Low	High
Rubber[1]	26,400	100		264,000	528,000	1,320,000	2,640,000
Eucalyptus spp.[2]	52,700	150	200	791,000	1,054,000	3,955,000	5,270,000
Teak[2]	7,700	231	336	85,000	123,000	425,000	615,000
			Total	1,140,000	1,705,000	5,700,000	8,525,000

[1] The low supply scenario for rubber assumes that only half of the rubber plantations are utilized for timber production at the end of latex production.

[2] Supply is calculated using the mean annual increment (MAI) over the entire area (refer to Table 4).

2.4   Discussion and recommendations

Lao's wood processing industry sources only about half of the required wood from within the country. The existing timber plantations can cover about 30% of the industry's intake. Supply from natural forests will remain low, even if the harvesting ban is lifted. Processing enterprises

will have to adjust products and processing technology to transition from natural hardwood species to planation species.

Wood processing industries in Lao utilize about 2.9 million m³ wood (round wood equivalents in 2019) each year. Of this volume, ca. 1.3 million m³ is consumed by the pulp and paper industry. The raw material is currently sourced from imported wood chips, but shall be supplied from domestic plantations in the long term. The typical micro, small, and medium enterprises prefer teak and other hardwoods. Larger companies use eucalypts as well. The use of rubberwood from latex plantations, a major source, seems to be very limited (see part 3, page 55).

Owing to unsustainable logging activity in the past, the supply from sustainably managed natural production forests will remain low, covering only about 1% of the industries' total intake volume. Timber from forest conversion is likewise negligible and not a reliable source.[9] The contribution from timber plantations is by far more important. Plantations can cover 30% or more of the total intake, if wood processing companies increase the use of plantation timber, especially rubber wood and eucalyptus. This likely requires investments in processing technology (see part 3, pages 67 f.).

- Plantation owners, including smallholder farmers and organizations with woodlots/small plantations, need to be aware of the processing sector's requirements and preferences (timber dimensions and quality) and should adjust their species choice and management accordingly.

- The necessary support to smaller plantation owners can be provided by professional wood processing or plantation companies (e.g. in outgrower schemes) or through forest sector development projects implemented by the government and development partners.

The potential annual timber supply over the next five years ranges between 1.1 and 1.9 million m³ roundwood. The forecasted timber supply is uncertain, although the estimated supply from natural forests compares well to past records of utilization. The biggest uncertainty factors are the unknown status of natural forests in Production Forest Areas, and timber plantation area.

- The forecast is based on secondary data and information provided by the DoF, and literature.

- Land cover data showing the extend of natural forests by type is comprehensive. The last available GIS data set for land cover is for the year 2015.

- Detailed and comprehensive information about natural forests is not accessible or lacking. This concerns the production potential (e.g. share, growth rate, and stocks of commercial species for forest types) and degradation status (past legal and illegal logging, and other disturbances). The low supply scenario of 70,000-80,000 m³/year from production forests and conversion compares well with past utilization statistics.[10]

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[9] Assuming that mid- to long-term very few new concessions will be issued in forested areas.

[10] About 70,000 m³/year before the harvesting ban (large, but undefined share of forest conversion) and 20,000-30,000 m³/year since 2016, i.e. only from forest conversion. (personal communication DoF, August 2021)

- Forests under the management of villages (village use forest, VUF) could not be separated from state managed production forests. Timber from VUF can currently not be used commercially.[11]

- Individuals, legal entities and organizations can currently not trade timber from natural trees, nor is information about planted and natural trees on "private" land available.[11] Timber resources on these lands are likely substantial but could not be included in the estimate.[12]

- The data for concessions on forestland is very detailed, but, according to DoF, not complete. How much of and how fast forest will be converted by the concessionaires is unknown.[13] Forests may have been partly converted in the past five years (i.e. after 2015, see above).

- The DoF registry of plantations goes back to 1975. The area planted per species per year and status of these plantations was not provided. Smaller plantations and woodlots are likely not fully captured in the data set.

To reflect the uncertainty resulting from the listed data and information gaps, different timber supply scenarios were provided. The estimate can be updated and improved as more and better information becomes available.

DoF should consider to:

- (Re)assess the status of the natural forests in Production Forest Areas regarding their viability for commercial harvesting within the next five, ten, and fifteen years;

- Prioritize management planning (and utilization) of forests with viable commercial stocks;

- Support private sector, including individuals, legal entities, and organizations, to invest in timber plantations on suitable sites; and

- Support the utilization of old rubber plantations for timber.

Access to reliable data and information is a key requirement for targeted sector development policy and planning. Statistics and information for the forestry and wood processing sector should be harmonized and made accessible to the public through the Lao Statistics Bureau. The Department of Forestry should ensure that more detailed information is accessible to investors.

The difficult access to data and information, and data gaps were the biggest challenge to the estimation of timber supply for the coming years.

Reliable statistics are required for the development of well-designed policies, strategies and plans for the forestry and wood processing sector by government, development partners and private sector. At the moment, statistics for productive forests, wood production, and wood products trade, processing, and consumption have to be sourced from different ministries, departments, and department units, and are not complete nor harmonized (see also part 3, 50 f.).

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[11] Regardless of the harvesting suspension for Production Forest Areas. A regulation for timber from VUF and individuals, legal entities and organizations is under preparation.

[12] Individuals, legal entities and organizations manage a large share of the 9.5 million ha of land classified as non-forest and regenerating vegetation (DoF, 2021c).

[13] Concession owners may preserve part of the forest to comply with legal requirements or company policies. The speed of conversion depends on the development plans and financial resources of an individual company.

- Data and information collected by the Department of Forestry should be made available to the public through the Lao Statistics Bureau. Data for productive resources, forest production, wood products trade, processing and consumption should be harmonized at central level.

- The Department of Forestry should identify or create a focal point within the department which can provide any additional (e.g. more detailed) data and information to planners and investors.

Against the background of continued low supply of natural hardwood species, investment in timber plantations should be strengthened. Overlapping and at times conflicting responsibilities for planning and administration of timber and rubber plantations should be removed and regulations simplified to create a more favorable business environment for both smallholders and large investors.

Reliable supply of timber from plantations is of high importance for the development of the Lao wood processing sector. The opportunities and barriers for large and small investors in forest plantations value chains have been analyzed at depth by Smith et al. (2018) for teak, Smith et al. (2020) for rubber, and are documented by Ozarska & Redman (2017) and ECCIL (2020) for plantation investments and value chains in general. Key opportunities are:

- Recent and planned investments in medium to large scale processing industries with offtake capacities larger than current production and strong demand for plantation timber in neighboring countries (especially Vietnam and China, see part 3, p. 60)

- Improving infrastructure connecting producers and industries/markets

- Transfer of technology and know-how from within the region

- Pro-forest and plantation policies and legislation (e.g. target to increase forest cover to 70%, promotion of tree planting for commercial purposes (PM 247, 2019)

- Large areas of severely degraded lands (deforested) in Production Forest Areas are in principle available for plantation establishment

At the same time plantation owners and investors are constraint by:

- Responsibilities within and between government ministries and agencies are complex, making it hard to plan and implement investments.

- Regulatory procedures are unnecessarily complex and result in high transaction costs.

- The interpretation and application of regulations at local level varies. This can make processes more efficient but creates uncertainties for investors and plantation owners.

- Timber legality requirements are likely to make "local" regulation less "flexible", raising transaction costs and potentially leading to the exclusion of smallholders from export-oriented value chains.

- Smallholder would benefit from vertical integration. Owing to the scattered plantations and unknown wood volume, few enterprises actively integrate them into their value chains at the moment. The potential volume from smallholder plantations is hard to estimate without reliable mapping.

- The potential of rubber wood is not understood by many stakeholders, including the combined income from latex and wood to the owner, and the growing potential supply for wood

processing industries. Domestic markets are currently lacking. The moratorium on rubber concessions (2012)[14] has created a policy vacuum and lack of regulatory clarity. Growers may have little incentive to replant after harvesting, potentially negatively impacting on the incentive to invest in rubber processing technology and product marketing.

Stakeholders should seek to remove these barriers, i.e.:

- Reduce complexity by streamlining the mandates of the involved ministries and authorities, and simplifying regulatory processes
- Support the mapping of smallholder plantations and the establishment of transparent, vertically integrated wood value chains
- Create awareness of rubber wood as source of income and suitable material for processing, support product and market development, and assess the lifting of the rubber moratorium linked to the issuance of appropriate (simple) regulations.

2.5 Reference list

Spatial data sets

DoF, 2021a: Concessions on Forestland; shape file

- Location and boundaries of concession
- Type (target) of the concession
- Time of agreement and status of implementation
- Area leased and implemented

DoF, 2021b: Forest management categories; shape file

- Boundaries of Production, Protection & Conservation forestland

DoF, 2021c: Land cover for the years 2010 & 2015; raster file

- Land cover
- Forest types

Statistics

DoF, 2021d: Forest rehabilitation and plantations 2016-2019 by province

DoF, 2021e: Forest plantations 2020

- Area planted, species, purpose, implemented by state/village/company

DoF, 2021f: Forest rehabilitation & plantation summary 1975-2020, national

DoF, 2021g: Land cover change matrix for the years 2000, 2005, 2010, 2015 & 2019

- Land cover
- Forest types

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[14] 2012 Prime Minister's Order No. 13

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2.6 Annex: Forest area statistics

Land cover

Land cover		Area [ha]		
		LCU 2015	**LCU 2019**	**Change**
Natural forest	Evergreen	2,605,557	2,594,961	-10,596
	Mixed deciduous	9,205,036	9,036,761	-168,275
	Dry dipterocarp	1,188,198	1,171,873	-16,325
	Coniferous	124,772	124,009	-763
	Coniferous/ broadleaved	107,880	106,854	-1,026
	Bamboo	88,900	88,859	-41
Other	Plantation	137,965	175,441	37,476
	Regenerating veg- etation	6,073,581	6,120,988	47,407
	Non-forest land	3,522,370	3,634,513	112,143
Total		23,054,258	23,054,258	

Source: DoF, 2021c

Land cover and forest types in concessions and Production Forest Areas

Land cover (as mapped in 2015)	All catego-ries	Production Forest Ar-eas	Concessions in …		Effective area	
			Protection & Conservation Forest Areas	Production Forest Areas	Forest conversion	Sustainable natural forest management
Evergreen	2,182,199	341,330	6,701	2,430	9,131	338,900
Mixed deciduous	6,598,276	1,595,867	60,502	10,928	71,430	1,584,939
Dry dipterocarp	492,773	222,330	5,678	657	6,335	221,673
Coniferous	98,467	17,396	235	0	235	17,396
Coniferous/ broadleaved	75,211	7,720	387	0	387	7,720
Bamboo	54,539	8,975	876	0	876	8,975
Plantation	8,901	6,321	3,977	0	3977	6,321
Regenerating vege-tation	3,702,778	626,575	33,330	5,392	38,722	621,183
Non-forest land	1,107,115	271,931	22,872	4,116	26,988	267,815
Total forest area of relevance for timber production					87,518	2,170,629

Source: DoF, 2021a, b, c

2.7 Standard Methodology

Included in Task 1

2.7.1 Introduction to standard methodology

Objective

This methodology describes the data collection for harvested natural timber from Village Use Forests (VUF) and from Individuals, Legal Entities or Organizations (ILEO). The data will contribute to the monitoring of legality of natural timber traded within Lao PDR.

Applicability

The methodology applies to natural timber harvested on land belonging to villages, individuals, and legal entities or organizations, which is used commercially.

Commercial, natural timber is harvested by (or on behalf of) the landowners, i.e. villages, individuals, legal entities or organizations. Transfer of ownership takes place after harvested logs have been extracted from the forest.

The methodology explicitly excludes timber movement or trade.

This methodology is based on the Forestry Law (revised) No 64., 2019 and the current version of the Timber Legality Definition 4: natural timber from village use forest and land of individuals, legal entities or organizations (TLD4, v6.0). Since the Timber Legality Definition 4 is expected to undergo revision, in conformance with the new Forest Law, this regulation will need to be updated later.

Data collection and reporting procedures are based on the already existing and proposed legal structures and processes for:

- forest management and operational planning, and
- issuance of permits and certificates for forest/trees in VUF or of ILEO.

Definitions

In this methodology, the following definitions are applied:

Natural timber

Logs from native tree species that occur:

- in forests on state-owned forestland or
- on other land managed by the authorized holder of land use rights[15]
- that are not established/managed by holder of land use rights

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[15] Naturally occurring trees outside forests may not be easily distinguished from natural trees that were established/are managed by the holder of the land use rights (unless established in a formal plantation setting). For practical reasons, the definition applied in this methodology may have to be adjusted to include all native tree species that are found on non-forest land.

Authorized holder of land use rights

Legal or customary custodians of land that is not managed by the state or is a land concession granted by the state:

- Village (represented by the village administration)
- Individuals (persons or households)
- Legal entities or organizations

Commercial, natural timber

Logs from native tree species that are harvested and traded in compliance with all legal requirements and procedures. Excludes logs used for public benefit or dedicated to household and customary uses.

Structure

The methodology contains three sections:

1. Role of entities responsible for VUF and ILEO related to commercial, natural timber
2. List of parameters to be collected
3. Definitions and acronyms

2.7.2 Responsible agencies for data collection and reporting

The proposed responsibilities and tasks for data collection and reporting of natural timber harvested for commercial purposes in VUF and by ILEO are listed in Table 9 and Table 10. To provide context, the responsibilities for forest/tree management and issuance of related permits or licenses are listed first.

The TLD 4, v6.0 provides options (listed in Table 8) for the establishment and approval of harvesting plans in VUF and for the issuance of permits for movement of natural timber (applicable to VUF and ILEO).

These options are mirrored in the proposed data collection and reporting of natural timber harvested for commercial purposes. References to the options are highlighted. Each color refers to a particular section and option in the TLD 4.[16]

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[16] The appropriate option should be selected after the finalization of the TLD 4 and transfer to a regulation.

Table 8: Options in TLD 4, v6.0

Criterion 4.3.1: Establishment and approval of harvesting plan in the village use forest

The Village Administration has collaborated with District of Agriculture and Forestry Office to formulate the village annual harvesting plan based on results of pre-harvest inventory …

Option 1:	Option 2:
… integrated in the annual provincial harvesting plan.	… certified by Provincial Office of Agriculture and Forestry.
The government has approved the annual harvesting plan based on the notification of Prime Minister Office.	
Ministry of Agriculture and Forestry has issued notification of annual harvesting plan.	

Provincial Agriculture and Forestry Office has issued harvesting permit for village use forest.

Criterion 4.5.1: Conducting movement of natural timber

Before the movement of natural timber from village use forests and the land of individuals, legal entities, or organizations

Option 1:	Option 2:
− logs have been marked and stamped with forestry hammer	… district agriculture and forestry sector has
− a transport permit from agriculture and forestry sector has been issued	− marked the logs
	− issued a transport permit

Table 9: Roles and responsibilities of stakeholders involved in the planning and management of, harvesting in, and data collection and reporting for VUF

Organization or entity	Tasks	
	Village forest planning and management	Data collection and reporting of natural timber harvested
Village forest authority*	Support the DAFO in village forest management planning, pre-harvest inventory, and annual harvest planning The sub-unit implements/supervises harvesting and grades timber	The sub-unit: - compiles log lists for harvested timber from VUF (and forestland conversion) - Includes sales details (see Village sales committee) in the record of trees harvested The village administration forwards the list to DAFO
Village sales committee	Sells timber from VUF	Reports the logs sold to the village administration using the marking reference provided by DAFO/PAFO
District Agriculture and Forest Office (DAFO)	Village forest management planning VUF pre-harvesting inventory & preparation of the annual harvesting plan TLD 4, Criterion 4.5.1, Option 1: Marking of logs and issuance of a transport permit	Verify the timber harvested against the VUF annual harvest plan Aggregate data received from village administrations and forwarding aggregated data to PAFO

District governor	Acknowledges the village forest management plan (VFMP) and issues letter of agreement for the VFMP Issues the natural tree list certificate for timber from VUF	-
Province Agriculture and Forest Office (PAFO)	Village forest management planning Integrates the VUF annual harvesting plans into the provincial harvesting plan Certifies the village annual harvesting plan and issues the VUF harvesting permit (TLD 4, criterion 4.3.1.2/3, Option 1: with approval by MAF or Option 2: without approval by MAF, see below) TLD 4, criterion 4.5.1, Option 2: Marking of logs and issuance of a transport permit	Aggregate data received from the districts, incorporating it into the overall provincial harvesting report** and forwards it to DoF
Department of Forestry (DoF), Ministry of Agriculture and Forestry (MAF)	TLD 4, criterion 4.3.1.2/3, Option 1: MAF approves the provincial annual harvesting plan with notification by the PMO; Option 2: approval not required	DoF aggregate provincial data

*Sub-agriculture and forestry unit & village administration

**Records for timber from state managed forests.

Table 10: Timber from ILEO Roles and responsibilities of stakeholders involved in the management, harvesting, data collection and reporting for natural timber trees of ILEO

Organization or entity	Tasks	
	Management & ownership of natural timber	**Data collection and reporting of natural timber harvested**
Forest/tree owner	Planting and managing trees Request the village sub-agriculture unit to record natural trees and issuance of the tree ownership certificate harvesting of trees with tree cutting permit	Report natural trees harvested to the village sub-agriculture and forestry unit
Village sub-agriculture and forestry unit & village administration	The sub-unit compiles and updates the list of natural trees* The administration issues ownership certificate and updates the certificate after harvesting*	The sub-unit: - compiles records of trees harvested - verifies the legal ownership against the list of natural trees, ownership certificates, and tree cutting permits The village administration forwards the list to DAFO.
District Agriculture and Forest Office (DAFO)	Acknowledges the ownership certificate for natural trees on private land	Aggregate data received from village administrations and forwards it to PAFO

	TLD 4, Criterion 4.5.1, Option 1: Marking of logs and issuance of a transport permit	
Province Agriculture and Forest Office (PAFO)	Issuance of tree cutting permits for tree lists II and III TLD 4, criterion 4.5.1, Option 2: Marking of logs and issuance of a transport permit	Aggregate district level private harvesting data. Records for timber used commercially are integrated into the overall provincial harvesting report[+] and forwarded to DoF
Department of Forestry (DoF), Ministry of Agriculture and Forestry (MAF)	MAF issues tree cutting permit for tree list I	DoF aggregates provincial data

* The update of the list of natural trees and ownership certificates is not included in the TLD 4, v6.0. The procedures to update ownership certificates and recording harvested timber must be aligned. This includes trees harvested for non-commercial, i.e. subsistence or customary uses.

[+] Records for timber from forests managed by the province.

2.7.3 Parameters

The parameters to be collected are similar for VUF and ILEO. Timber from both VUF and ILEO can be used for commercial and non-commercial purposes. To ensure comparability between the harvesting / tree cutting permit and timber harvested, non-commercial timber has to be registered as well.

The following parameters should be recorded:

- **Administrative area** is required for easy aggregation of records at district, province and national level.
- The combination of **harvesting permit & tree list certificate** (VUF, see Table 9) or **tree cutting permit & tree ownership certificate** (ILEO, see Table 10) are unique identifiers for the source of timber. Permits and certificates must have a unique running number. The full permit and certificate records, including location, owner, management unit or VUF compartment, etc. should be captured in a database accessible by the district and province.
- The **species name** (e.g. according to the Master Tree species list under development by NAFIR) of trees harvested.
- **Purpose** of the tree harvested: public benefit or commercial or customary.
- **Log ID** for trees harvested for commercial use; one tree may have several logs. Logs not to be traded (i.e. used for village projects (public) or by households) do not require a log ID.
- **Log diameter** and **length** and **calculated log volume**.

Table 35 and Table 36 contain the list of parameters and examples for VUF and ILEO respectively.

3 MARKET ANALYSIS ON PROCESS AND PRODUCT QUALITY

3.1 Introduction and objectives

The Lao government receives support from the BMZ commissioned program 'Protection and sustainable use of forest ecosystems and biodiversity (ProFEB)' together with the BMZ commissioned SEWOH Global Project "Forest Landscape Restoration and Good Governance in the Forest Sector" (Forests for Future; F4F) in negotiating a voluntary partnership agreement (VPA) with the EU on forest law enforcement, governance, and trade (FLEGT).

The VPA sets out the legal obligations and the measures to be taken by the partners, Lao PDR and the EU, to combat illegal logging and improve governance in the forestry sector. The Timber Legality Assurance System (TLAS) is the corner stone of the VPA.

The purpose of a TLAS is to provide a reliable means to distinguish between legal and illegally produced forest products. Issuance of licenses by Partner Countries requires a system for ensuring that only legally produced timber is licensed for export. This must include checks of forest operations and control of the supply chain from harvesting to export.

Since implementation of an operational TLAS is not yet ready and due to increasing pressure on the forest resources in Lao PDR, Prime Minister Order 15 (PMO 15) entered into force in 2016, under which only finished wood products from traceable sources can be exported. In sub-sequent years the exports of wood products have declined considerably, since (1) enterprises were increasingly facing lack of raw material and (2) their capacities to upgrade technologies in line with the production requirements of PMO 15 were limited.

Since there are hardly any studies that provide an overview of the status of the forestry and wood processing sector under the current regulations, GIZ together with its Lao partners implemented the present market analysis.

The detailed objectives of this study according to the original ToR were:

1. to characterize the wood processing sector, including the number of companies, size, organization in associations, product specialization, main sources of raw materials, etc.;

2. to determine the current status and to update on the requirements for adaptation/modernization to reach regional/international markets with regard to machinery, equipment and production lines, occupational safety and health regulations, quality standards and personnel, compliance with legality requirements and challenges (process quality);

3. to obtain information about the products and the raw materials required of the companies interviewed and to examine to what extent the products comply with the requirements of MoIC regulations and regional and international market requirements (product quality);

4. to obtain quantitative and qualitative information on the current status of the wood processing sector and relevant policy and legal framework in Laos to remedy the information deficit in the sector and to develop recommendations for Lao actors and development cooperation, incl. organization of the private sector for better participation and positioning in national decision making, addressing specific challenges, reform of the legal framework etc;

5. to examine the ability and willingness of companies interviewed to participate in the implementation of the Lao-EU FLEGT VPA.

3.2 Summary

Since 2015, Lao PDR has introduced a series of regulations with the aim to halt illegal logging in natural forests, promote the establishment and commercialization of plantation timber and enhance value adding by domestic industries. The regulations affect forest sector activities along the full value chain and have yielded ambivalent effects for Laotian enterprises. In this highly dynamic context, this study aimed at actualizing the knowledge base on Lao´s wood sector and identify entry points for resolving bottlenecks and barriers to wood sector development.

This summary is combing the results of a secondary data review and a survey of wood processing enterprises that was conducted in six provinces in early 2021:

- Luang Prabang and Xayabury in the region "North",
- Khammouane and Vientiane in the region "Central", and
- Champasak and Attapeu in the region "South".

Actual timber flows in Lao´s wood sector

Lao´s industrial roundwood balance shows a total volume of 2.9 million m³ in 2019. Of this volume, ca. 49% is produced from domestically produced roundwood, and ca. 51% is based on imported materials (i.e., wood chips for pulp production). The consumption constitutes of 28% domestic market and 72% exports.

There are three major timber flows in Lao´s wood sector: 1) Domestic value chains that source from natural forests and plantations and produce products for the national market (ca. 28% of the total industrial roundwood (IRW) turn over). 2) Export value chains that produce (semi-)finished wood products from domestic timber resources (ca. 28% of the IRW turn over). 3) An international pulp value chain, which imports wood chips and produces wood pulp for the export market (ca. 44% of the IRW turn over).

The implementation of PMO 15 and related regulation since 2016 has led to an increase of finished wood products exports (+ US$ 58 M since 2015), while unfinished wood products dropped substantially (- US$ 53 M since 2015). The main export partners of sawn timber products are China and Viet Nam. For veneer and plywood, the main importing countries are Viet Nam, India, and Thailand. The export destinations of finished wood products are mainly China and Thailand (i.e., furniture and carpentry products).

Regional structure of the wood sector

The Laotian wood sector has seen a substantial decline in number of enterprises since 2015. The number has dropped from more than 1,300 to less than 1,000 in 2020. After enforcement of PMO 15 in 2016, many wood industry enterprises have sized down their activities or closed due to the lack of raw material or due to non-compliance with processing requirements. In the Central region almost 35% of enterprise closed since 2015. In the North, the loss of enterprise was ca. 19%. Only in the South, the number of enterprises was more robust: loss of 6% of enterprise since 2015.

Since 2015, the export values for the regions Central and South have increased by 17% and 103% respectively. On the other hand, in the North exports dropped by 10%. Apparently, the enterprises in Central and South could deal with the transition from unfinished to finished wood products. The enterprise structure in the North has been characterized by smaller enterprise units.

Most of these firms has not been able to upgrade technologies to participate in finished products value chains.

Quality management in Lao´s wood sector

The national regulatory framework provides for safeguards and guidelines on good industry practice for processing enterprises and supports quality management of production processes. It provides for product definitions that support the enterprises´ compliance with the national legislation to avoid exports of illegal and low unfinished products.

However, there are no national quality standards (i.e., grading rules) for wood products, resulting in high transaction costs of buyers to ensure product quality and difficulties for manufacturing enterprises sourcing quality wood material inputs. There have been no follow-up approaches for establishing national wood product quality standards.

General perception on impact of regulations

Many enterprises that participated in the wood industry survey mentioned that the PMO 15 of 2016 and related decisions for its enforcement restricted their business opportunities. In general, they mentioned an over-regulation of the wood sector activities and that the implementation of these regulations would restrict the competitiveness of their enterprises. Due to weak law enforcement structures on Lao, the enterprises that comply with the regulations would experience competitive disadvantages compared to informal activities in the sector.

Raw material sourcing and quality

According to survey results, the most important raw material for enterprises is industrial roundwood (logs). I.e., larger enterprise source logs as raw material, while smaller enterprises rely on primary processed wood products as inputs.

The survey participants mentioned that the reduced offer of natural wood due to implementation of PMO 15 has led to massive competition for the remaining legal timber sources. The actual bidding system would disadvantage small and medium enterprises, since the bidding lots are comparatively big and require substantial pre-financing capabilities.

The domestic offer of sawn timber as input for secondary wood processing has declined due to firm closure of sawmills in recent years. Thus, the smaller enterprises are severely challenged by the current circumstances: reduced offer of industrial roundwood, increasing requirements for finished wood products manufacturing and limited offer or basic sawn timber.

Further, many enterprises reported substantial quality problems of raw materials. The share of raw material that had to be discarded due to quality deficiencies was considerable and ranged between ca. 10% and 25% for various product groups.

Product quality and quality management

The most common quality problems that caused rejections by buyers were induced by high moisture content / inappropriate drying of the processed wood.

None of the surveyed enterprises applied an audited quality management system (e.g. ISO). Although national regulations (i.e., MOIC decisions 0222 of 2021 and 0777 of 2020) provide for the basic elements of process quality and clearly articulate the intention to raise process quality, they were not actively mentioned as being supportive.

As stated before, most enterprises directly source logs. This results in secondary processing enterprises investing in sawmilling equipment and sawn timber treatment capacities. These activities are locking up capital for possible expansion, require technical know-how and extends the process management requirements. An extended offer by specialized sawmills offering standardized quality sawn timber products could free these resources and enhance the secondary processor´s capacities to invest in product development and processing technology.

No international product quality standards were mentioned by the respondents that would guide the production process. Product quality criteria are defined by the clients. Commonly, international buyers´ implement a strict quality control themselves. I.e., the buyers inspect the product order before shipping or are directly involved in the production process, since they were shareholders of the enterprise.

Enterprises also stated that the current regulatory framework (i.e. product definitions by MOIC decision 0939 of 2019) has negative effects on their export opportunities. The specifications defined by the related regulations were perceived as an obstacle, since foreign buyers frequently demand products which deviate from these specifications.

Condition of equipment and investments

On average, most of the machinery in use was purchased less than 10 years ago and the enterprises rated the condition of their equipment as good, with only low intensity of repairs across all size classes and sub-sectors.

Several enterprises plan investments in new machinery or upgrades. The planned investment volumes were from several thousand up to 100,000 US$.

The enterprises did barely mention serious problems in accessing the required capital. Most commonly they mentioned commercial and private lending being the main sources for financing. Others planned to use own equity to realize the investment.

On the other hand, enterprises mentioned that the regulations on wood processing enterprises would disadvantage household business and small enterprises, i.e., due to the capital requirements for upgrading. These enterprises frequently mentioned restricted access to finance due to unfavorable lending condition of commercial banks and lack of alternative financing opportunities.

Occupational health and safety (OHS) and working conditions

In general, company level OHS systems were not widespread: complaints management, emergency response measures or written manuals were only available in medium and large enterprises.

Most permanent and casual employees did not have written contracts. Health insurance, paid vacations and paid maternal leave were not common, though some larger enterprises were offering these benefits.

Ca. 50% of the companies indicated that they regularly train their permanent staff in the use of the machines. Permanent staff is usually endowed the personal protective equipment (PPE). In contrast, the majority of casual workforce was not regularly trained. However, also casual labor was regularly equipped with PPE, though a lower rate than permanent staff. Frequently, workers are not well trained in using PPE properly.

The respondents also stated that the lack of skilled workforce is restricting their business opportunities, saying that the Laotian education and training system would not deliver the required qualification. The enterprises have to invest in training of untrained labor. Many enterprises draw on foreign workers that are better trained and used to operate modern equipment.

FLEGT

Most surveyed enterprises (47 of 87) wasn´t aware of the FLEGT process in Lao. The knowledge of FLEGT was more common among large and medium enterprises than in small enterprises and household businesses.

Enterprises operating in the carpentry and in the veneer/plywood sub-sectors seemed to be more aware than e.g., in the furniture and sawmilling sub-sector. Positive expectations and willingness to be part of the process prevailed across all sub-sectors.

Proposed plan of actions

The following table describes the proposed actions that are derived from the results of the wood industry survey. The address the following main topics:

Regulatory framework: Process and products quality, export regulations

Timber resource base: Teak silviculture, rubber wood, access to natural wood

Wood processing: Primary wood processing, training, access to finance

Sector governance: Law enforcement, FLEGT awareness, sector associations

Context	Recommendation	Expected impact
Regulations		
Quality management of processes	Promoting existing regulations as tool for Process Quality Management. E.g., by labeling products, developing a national quality brand (see also national product quality standards). Identify synergies with internationally recognized QM systems (e.g. ISO or IFC performance standards). The approach is also recommended with a view to future FLEGT licensing.	Higher acceptance of wood sector enterprises and willingness to comply. Higher recognition and comparability of Laotian wood products in international markets.
Product quality standards	Develop national grading rules for most common wood products. These may be derived and adjusted from existing grading rules. Follow-up on ACIAR research work.	Quality assurance for buyers. Reduction of transaction cost. Better participation in international markets.
Export regulations	Facilitate exceptions from export restrictions for customized product specifications.	Enable export opportunities that are currently prohibited.

Context	Recommendation	Expected impact
	Timber resource base	
Teak silviculture	Assess suitability of currently applied silviculture to produce quality Teak, i.e., with view to heartwood ratio (see also Midgley et al, 2015). Introduce a Teak log grading system; follow up on relevant research work.	Improved Teak log quality. Improved market opportunities and value adding opportunities.
Promoting the use of plantation timber from Rubber and others	Assess commercial volumes from rubber and related wood specifications. Follow up on research work done by ACIAR. Support the shift from natural wood processing SMEs no plantation species. Connect the resource and wood processing SMEs.	Enlarge the usable timber resource base in Lao.
Accessibility of natural wood	Support SMEs in participating in auctions (forming bidder groups or providing access to working capital; see Access to Finance)	Facilitates improved access to natural wood
	Wood processing	
Primary processed wood products	Assess in detail the domestic market demand and demand in key export markets for wood products. Ensure supply of primary processed wood products (sawn timber, veneer) according to quality standards. Promote specialized sawmilling operations through technical assistance. Elaborate wood processing manuals (drying, treatment, grading) for most important plantation species. Draw on existing research work and industry best practices.	Improved supply of quality products for secondary processing SMEs. Specialization of primary and secondary processing enterprises and enhanced product quality. Frees capital for investments.
Upgrading	Support technology upgrades of enterprises based on detailed enterprise diagnostics, i.e. follow up and role out work realized by GIZ in 2015/16[17]. Factoring in the future timber supply and raw material qualities, i.e. small dimensioned planation timber (i.e. Eucalyptus, Teak, Rubber). Implement wood processing enterprises cluster support as proposed by GIZ 2015/16[18].	Improved technological capacities and efficiency to match future timber species and dimensions. Enhanced competitiveness of enterprises.

[17] Applikatio (2016)
[18] Applikatio (2015)

Context	Recommendation	Expected impact
Training and occupational health and safety	Provide training opportunities (staff and management level) in use of modern wood processing technologies and OHS. Combine training with technology upgrading approaches. Continue work started by GIZ and others. Promoting existing regulations for wood industries and labor regulations as tool for OHS. Identify synergies with internationally recognized OHS safeguards/guidelines (e.g. ISO or IFC performance standards). Produce specific OHS guidelines for processing industries.	Improve knowledge of domestic labor force in modern wood processing techniques. Improve implementation of OHS requirements.
Access to Finance	Develop credit lines for 1) wood processing to enable compliance with wood sector regulations and technology upgraded, and 2) enterprises starting operations in primary processing.	Bridging the finance gap of domestic SMEs. Increase the number of wood processing SMEs.
Sector governance		
Law enforcement	Ensure that regulations are endowed with sufficient resources for enforcement.	Avoid unfair competition by non-compliers. Accelerating licensing processes.
FLEGT awareness	Disseminate FLEGT relevant knowledge i.e. among small enterprises. Use inspection on compliance with regulations (e.g. MOIC decision 0777 of 2020) to clarify the nexus of law compliance and advantages of FLEGT VPA. Establish provincial FLEGT implementation plans that address the specific challenges and opportunities of the FLEGT VPA (to be coordinated with recommendations on upgrading, training and sector associations).	Increased FLEGT preparedness.
Sector associations	Involve sector associations in selected activities, e.g. quality management, training or FLEGT awareness dissemination.	Higher mobilization of enterprises in sector associations. Wider dissemination of activities.

3.3 Study design and scope

To obtain the expected results, the following activities were conducted:

1. Analysis of the national and international market environment for Lao wood products.
2. Analysis of secondary data for the regional characterization of the wood sector in Lao.
3. Wood industry survey in six provinces: two in each of the three regions (1) north, (2) central and (3) south.

The compilation of aforementioned data and information was analyzed with focus on:

- Resolving information deficits in the sector, i.e., with a view to product and process quality and impact of current regulation on the wood sector enterprises` development potentials.
- Recommendations for development cooperation partners and Lao actors, addressing specific challenges in the enterprises and the legal framework etc.
- Assessment of the ability and willingness of wood sector enterprises to participate in the implementation of the Lao-EU FLEGT VPA.

3.3.1 Analysis of the national and international market environment

The analysis of the national market environment compiled information on wood products consumption and timber flows in Lao. It drew on secondary data and statistics to describe the raw materials used, domestic consumption and international trade. It further considered the national legal framework governing wood sector operations and wood products trade, and finally provided and overview of international wood products standards that are of relevance for Lao`s wood sector.

The analysis was based on the following data and sources:

- Volumetric production and trade of primary processed wood products was mainly based on FAO ForesStat data and ITTO data.
- Monetary values for international trade data of wood products were analyzed using UN Comtrade data.
- Wood products production and export data since 2015 provided by the national statistics and provincial offices was used to validate international statistics. However, the data was not consistent to produce comprehensive information at national or regional level. I.e., data was only available for a limited number of provinces, and the available data was not harmonized (e.g. using different aggregation levels for wood products and enterprises).
- The analysis of the statistical information was complemented by a review of case studies and project documents of universities and donor funded programs.
- Review of national legislation governing wood processing industries` operations, product quality and wood products trade.
- Review of international quality standards for wood products.

3.3.2 Analysis of secondary data for the characterization of the wood sector

The regional characterization of the status of the wood industry in Lao provided an overview of aggregated information on the current distribution of enterprises by sub-sector, their employees and production. The analysis tried to identify regional trends regarding the changes in number of enterprises by size classes and wood processing sub-sectors.

The analysis was based on the following information:

- The structure for the wood industry prior to implementation of PMO 15 was described by analyzing the National Manufacturing Establishment Survey of 2016.[19] The published information enabled analyzing and characterizing the wood industry in the three regions north, central, and south at aggregated level.

- MOIC provided enterprise data for the years 2016 to 2020. However, these data sets were not as detailed as the baseline data from UNIDO for 2015. I.e., the regional disaggregation of enterprise number by sub-sector and size class was not possible. Still, general trends in changes of Lao´s wood industry could be identified.

- Detailed records of provincial wood products production data were only available for a limited number of provinces and/or did not disaggregate production according to product types. Thus, characterization of regional production remained fragmented.

3.3.3 Wood industry survey in six provinces

The wood industry survey delivered a set of micro data to analyze the actual situation of enterprises and to answer specific questions of this study as summarized in Table 11. I.e., the survey aimed at resolving information gaps at enterprise level for:

- Situation and trends for supply and sales
- Status of productivity and product quality
- Status of processes, technologies and planned investments
- Situation of employees and Occupational Health and Safety (OHS)
- Impact of regulations and FLEGT

The wood industry survey was conducted in six provinces:

- Luang Prabang and Xayabury (North),
- Khammouane and Vientiane (Central),
- Champasak and Attapeu (South).

The companies participating in the survey were selected with support from MoIC/DoIH and DIMEX, as well as from wood sector associations. Thereby, the selection criteria aimed at

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[19] In 2015, the Ministry of Industry and Commerce (MoIC) by Department of Industrial and Handicraft (DoIH) conducted two surveys on manufacturing establishments during the implementation of the Enhancement of Industrial Statistics in the Lao PDR project by technical assistance of UNIDO.

covering enterprises from all wood industry sub-sector across the three regions and include all enterprise size classes from household businesses (HHB), small and medium enterprises (SMEs) and large enterprises.

The final selection of survey participants was guided by a pre-selection of associations and MoIC/DoIH, drawing on previous experiences with enterprises and their willingness to cooperate.

The survey covered 87 enterprises from wood processing sub-sectors, of which 64 were registered small, medium and large scale enterprises, and 23 were household enterprises (see chapter D 3.6 p. 72 ff. for details on the sample of survey enterprises).

The enterprises were surveyed along a set of main topics (Table 11), using a structured questionnaire for data collection. The full questionnaire is available as attachment to this document (Annex 3.9.1 p. 114).

Table 11: Content of structured questionnaire

Questionnaire chapter	Content
General information	Background, actual turnover and employees
Supply and sales	Actual situation and recent trends of sourcing of raw materials/inputs and sales structure (markets and clients)
Productivity and quality	Physical and financial intake-output and product quality
Processes and investments	Technical conditions, quality management and upgrading requirements
Occupational Health and Safety (OHS)	Occupational Health and Safety in enterprises, work conditions, safety and training
Regulations and FLEGT	Experiences with existing regulations (obstacles and chances)
	Perceptions and expectations for FLEGT and motivation to participate

3.3.4 Basic definitions

Provinces and regions

Table 12: List of provinces and regions

Province	Region
Vientiane Capital	Capital
Phongsaly	North
Luangnamtha	North
Oudomxay	North
Bokeo	North
Luang Prabang	North
Huaphanh	North
Xayabury	North
Xiengkhuang	Central
Vientiane	Central
Borikhamxay	Central

Province	Region
Khammouane	Central
Savannakhet	Central
Xaysomboun	Central
Saravane	South
Sekong	South
Champasak	South
Attapeu	South

Enterprise classification

The size of firms is based on the classification set out in the Decision 0222/MOIC of 2021, using number of employees as the metric[20]. However, older study data is based on a different classification according to Decree No. 25/MOIC on the Classification of Small and Medium Enterprises, 2017 (Table 13).

Table 13: Enterprise definition by number of employees

Enterprise size class	Old employee threshold (Decree No. 25/MOIC, 2017)	New Employee threshold (Decisions 0222 (MOIC, 2021)
Micro enterprises / Household Business	<5	<10
Small enterprise	6-50	10-50
Medium enterprise	51-99	51-200
Large enterprise	>100	>200

Wood industry classification

The classification of Lao´s wood industry sub sectors for this study followed the Lao Standard Industry Classification (LSIC), which is in line with the International Standard Industry Classification (ISIC rev. 4). Details are explained in Decision 0222/MOIC of 2021. Table 14 lists the relevant sub-sectors as they were identified and recorded by national statistics in Lao.

NOTE: Data and information provided by the provincial departments of industry and commerce and by MOIC frequently aggregated the LSIC classes 1621, 1622 and 1629 as one group called "Finished wood products manufacturing" or "Wood processing".

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[20] The MoIC decision 0222 is using the installed capacity of machinery (measured in Horse Powers) as second defining criterion for enterprise size class categories. The higher figure (either number of employees or installed capacity) is used to define the enterprise size class. This study is showing the employees thresholds for enterprise size class categories since this enables comparison with size class definition in other countries.

Table 14: Wood industry sub-sectors according to Lao industry classification

Sector	Sub sectors	LSIC/ISIC class
Wood industry	Sawmill	1610
	Veneer sheets and plywood	1621
	Carpentry and joinery	1622
	Other wood products	1629
Pulp and paper	Wood pulp, paper and paper board	1701
	Corrugated paper and paper board	1702
	Articles of paper and paper board	1709
Furniture	Furniture	3100

Wood products classification

According to FAO, the following products are commonly defined as primary processed wood products (Table 15). Within this group the level of processing varies widely. However, the products have in common that they need further processing to be used by end-consumers. In contrast, secondary processed wood products (as listed in Table 16) are almost "ready-to-use" products.

The following tables shows the corresponding codes according to the Harmonized System´s products classification, which is used by international trade statistics and also by the MOIC to describe the wood products that are allowed or prohibited for export.

MOIC decision 2005 of 2015 is defining processing levels for wood products according to three types, which categorizes the wood products according to HS code into:

1. Sawn wood products (lowest level of processing)
2. Semi-processed products
3. Finished wooden product

Table 15: Classification of primary processed wood products according to Lao regulations and international trade system

Primary processed wood product according to FAO	Classes according to MOIC decision 2005 of 2015	Harmonized System code	NOTE
Sawnwood	Sawnwood products	4406, 4407, 4409	The level or processing varies and ranges from rough sawn and undried boards to highly processed kiln dried, planed and chemically treated boards (HS 4407) or railway sleepers (HS 4406).
Sawnwood	Semi-processed products	4409	Includes sawn timber based glued and joint boards.
Veneer	Semi-processed products	4408	Includes peeled or sliced veneer
Plywood	Semi-processed products, but also mentioned under finished wood products	4412	Includes all types of plywood and related treatments and coatings.
Particle board / OSB	Not listed, but likely to be included as semi-processed products	4410	Includes various specifications and densities, e.g., for structural uses or water resistance classes.
Fiber board (MDF/HDF/other fiber boards)	Not listed, but likely to be included as semi-processed products	4411	Includes various specifications and densities, e.g., for structural uses or water resistance classes.
Wood pulp	Not included	4701-4706	Includes mechanical, chemical, and semi-chemical wood pulp for production of paper and paper board.

Secondary processed wood products are typically products derived / made from primary processed wood products. I.e., these include:

Table 16: Classification of secondary processed wood products according to Lao regulations and international trade system

Selected secondary processed wood products	Classes according to decision 2005 of 2015	HS code
Wooden frames for paintings, photographs, mirrors, or similar objects	Finished wooden product	4414
Packing cases, boxes, crates, drums, and similar packings, of wood cable-drums of wood pallets, box pallets and other load boards	Finished wooden product	4415
Casks, barrels, vats, tubs and other coopers' products and parts thereof, of wood, including staves	Finished wooden product	4416
Tools, tool bodies, tool handles, broom or brush bodies and handles, of wood boot or shoe lasts and trees, of wood	Finished wooden product	4417
Builders' joinery and carpentry of wood, including cellular wood panels, assembled flooring panels, shingles and shakes	Finished wooden product, but also mentioned under semi-processed products	4418
Tableware and kitchenware, wood marquetry and inlaid wood caskets, wooden articles not included elsewhere in HS group 44	Finished wooden product	4419 - 4421
Paper and paper board, articles of paper	Not included	4801-4823
Seats of bamboo / wood	Finished wooden product	94015/94016
Wood furniture	Finished wooden product	940330-940360
Bamboo/Rattan furniture	Finished wooden product	940381-940382
Prefabricated buildings of wood	(Finished wooden product)	940610

3.4 Market environment

3.4.1 Legal framework for wood processing industries and wood products trade

Lao PDR has introduced a series of legislations with the aim to halt illegal logging in natural forests, promote the establishment and commercialization of plantation timber and enhance value adding domestic industries. The regulations affect forest sector activities along the full value chain and have yielded ambivalent effects for Laotian enterprises.

To protect its natural resources, the Government of Lao PDR has introduced legislation to a) restrict logging and b) ban unprocessed wooden products from being exported. The most important regulations in these contexts are listed in Table 17.

The revised forest law of 2019 is generally defining the sources of timber according to forest types and production systems and is setting the rules for harvesting and mobilization of timber to supply the wood processing industries.

Raw material supply from natural forests has been restricted by PMO 15 (2016). Thus, wood harvested during infrastructure projects remains the only legal source of natural forest timber for processing. This conversion wood is only irregularly accessible since it is only available as a by-product of regional development projects. The timber is sold through a bidding process, which is partly by-passing domestic SMEs (compare Smith et al, 2018 and Flint, 2019; see also survey results chapter 3.6).

In addition to restricting access to raw material, the PMO 15 is also restricting the export of unprocessed wood products with the aim to further disincentivize illegal logging. Only finished natural wood products defined by export lists (Decision 0939/MoIC, 2019 and precedent decisions) are allowed to be exported and semi-finished items originating from plantation wood. These restrictions are perceived as an important obstacle for the private sector. Foreign buyers demand customized products that may deviate from the specifications set out on the export list, and the impossibility of exporting such customized products results in missed business opportunity (Flint, 2019; compare also survey results chapter 3.6).

The requirement to export finished products has also increased processing and documentation requirements along the value chains (see GIZ (2021) for a thorough assessment of these aspects). As shown by Smith et al (2018 and 2021), the resultant increase in investment requirements and processing costs has resulted in closures (temporarily or permanently) of numerous enterprises (see chapter 3.5.1 on development of number of enterprises since 2015).

A series of regulations has been issued that define and guide implementation of the PMO 15. The most recent revised regulations aimed at resolving unclarities regarding the definitions and requirements for exporting wood products made from plantation timber. With the Decision 0939/MoIC.DIH (2019), plantation timber and derived wood products are widely exempted from export restrictions.[21]

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[21] Eucalyptus, Acacia auriculiformis, Acacia mangium, Rubber and Teak. Also Agarwood from plantation for export only of flour, wood chips and sawn wood. Other tree species from plantations have to comply with the general regulations as for natural timber.

Further, the recent Decision 0222/MoIC.DIH (2021) on Wood Processing Factories has brought some easement for micro and small enterprises to comply with PMO 15 processing requirements.

Table 17: Table of legal references

Regulation	Impact on raw material supply	Impact on wood industry processes	Impact on sales/markets/export
Forestry Law (Revised). No. 64 /NA, 13 June 2019	Defines legal sources of timber and related management and harvesting rules	Requires approval from MAF for establishment of wood processing business. Foresees log grading rules.	Defining legal timber sources and species and their eligibility and rules for export
Prime Minister Order on Strengthening Strictness of Timber Harvest Management and Inspection, Timber Transport and Business No. 15/PM, 13.05.2016	Restricts availability of natural forest timber	Requires upgrading of processes to produce to higher value-added products	Defines exportable products (general)
Revised Regulation of the list of wooden products eligible to export. Decision 0939/MOIC.DIH, dated 01 Aug 2019 [A]	Contributes to restricting the use of illegal timber	Indirect: Enterprises may have to adjust technologies/processes to comply with export requirements	Defines sizes and specifications of exportable products and products prohibited for export
Guidance on the implementation of the Decree on the origin of import and export goods No. 1031/MOIC.DIMEX, 25 May 2010	Contributes to restricting the use of illegal timber	Requires compliance with documentation of wood products sources and supplier.	Requires legality documentation for target markets
Decision on the Management and Monitoring of Timber Input and Output. No.: 0777/MOIC.DIH, 25 AUG 2020	Contributes to restricting the use of illegal timber	Facilitates quality management of processes by monitoring timber quality, input-output ratios and legal compliance	Requires proof of legality documentation and traceability for buyers
Decision on Wood Processing Factories. No.: 0222/MOIC.DIH, 23 Mar 2021[B]	n.a. Enables household businesses to participate in timber purchase/auctions.	Defines the requirements for setting up and operating wood processing industries. Facilities quality management of processes. Differentiates between enterprise size classes.	Requires production of products eligible for export. Requires companies to comply with input/output monitoring before issuing an operational license.
Decision on wood processing products,	n.a.	Defines types of wood products, i.e.	Defines sizes and specifications of products

Regulation	Impact on raw material supply	Impact on wood industry processes	Impact on sales/markets/export
no.2005/MOIC.DIH, 28 Sep 2015		differentiates between low value added products, semi-finished products and finished products. Defines enterprises monitoring of production according to wood products types.	eligible for sale in the country
Regulations on the Sale and Purchase of Timber, No. 1726/MoIC, 23 August 2012	Regulates the access to legally available timber from the government by defining rules of sales and purchase, e.g., defining requirements the buyer must comply with.	Industries have to comply with requirements to purchase timber from the government.	n.a.

A This is the most recent regulations to define the list of wood products for export. This regulation follows a series or precedent / related regulations: Instruction on the List of Exported Wood Products (revised) No: 186/DIH.PHD, 27 February 2018; Decision on the Approval of the List of Wooden Products for Export (revised) No. 0002/MoIC.DIH, 03 January 2018; Decision on an adoption of eligible and prohibited list of Wooden Products for Export No. 1833/DIH.SD, 03 October 2016.

B This is the most recent regulations to define the requirements for setting up and operating wood processing industries. This regulation follows a series or precedent / related regulations: Notification on "Continue combining and improving timber processing manufactures". No. 2228/MoIC.PO, 22 November 2011; Decision on Timber Processing Manufacture Standards No. 0719/MoIC, 03 April 2009.

3.4.2   Lao industrial wood balance 2019

Lao´s industrial roundwood balance shows a total volume 2.9 million m³ in 2019. Of this volume, ca. 49% is produced from domestically produced roundwood, and ca. 51% is based on imported materials. The consumption constitutes of 28% domestic market and 72% exports.

Lao´s industrial roundwood balance for the year 2019 shows a volume of ca. 2.9 M m³ roundwood equivalents (RWE), excluding paper and paper board. However, there are blind spots in national records on wood processing outputs and consumption patterns of domestic industries. The full extent of production and consumption of wood products within Laos is not known. Thus, the data presented in the following chapters is subject to uncertainties.

While production of medium and large industries is well covered by statistics, the highest uncertainties are posed by production of households, micro enterprises, and small enterprises.

In absence of the full knowledge on wood products produced in Laos, the volume of industrial roundwood harvesting seems to be the most reliable indicator for wood industries´ potential production. However, this information is also subject to uncertainties and knowledge gaps. These are caused by lack of central records for legal timber harvesting and ongoing informal timber harvesting activities.

By triangulating national[22] and international[23] sources, the present study estimates that domestic production of industrial roundwood in 2019 was ca. 1.1 to 1.4 M m³. Of these volumes, between 1. 0 and 1.3 M m³ were processed in-country by domestic industries. In addition, Lao imported ca. 0.2 M m³ (RWE) roundwood and primary wood products and ca. 1.3 M m³ wood chips.

The various data sources indicate that the domestic consumption of wood products in 2019 equaled ca. 0.8 M m³ roundwood equivalents. On the other hand, wood products equaling a volume of ca. 2.1 M m³ RWE were exported.

Table 18: Lao industrial wood balance 2019

Supply	M m³ RWE	M m³ RWE	Use
Domestic industrial roundwood production	1.40	0.80	Domestic primary wood products consumption
Imports primary wood products	0.10	0.40	Primary wood products exports
Furniture and secondary wood products imports	< 0.10	0.30	Furniture and secondary wood products exports
Wood chip imports	1.30	1.30	Wood pulp exports
Industrial roundwood imports	0.10	0.10	Industrial roundwood exports
Total supply	**2.90**	**2.90**	**Total use**

Sources: FAO ForestryStat and UN Comtrade

3.4.3 Industrial timber flows in Lao 2019

There are three major timber flows in Lao´s wood sector: 1) Domestic value chains that source from natural forests and plantations and produce products for the national market (ca. 28% of the total industrial roundwood (IRW) turn over). 2) Export value chains that produce (semi-)finished wood products from domestic timber resources (ca. 28% of the IRW turn over). 3) An international pulp value chain, which is mainly based on imports wood chips and produces wood pulp for the export market (ca. 44% of the IRW turn over).

Raw material supply

Domestic production

Timber harvesting in natural forest has sharply decreased since 2016, after PM order No.15 was issued in May 2016. The official harvesting volume in 2017 was ca. 12,000 m³. Since 2016, the major sources of roundwood for Lao´s wood industry are volumes of confiscated timber, timber

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[22] Data on production and exports provided by the MoIC and provincial departments of industry and commerce.
[23] FAO Forestry Statistics and UN Comtrade trade statistics.

produced in the course infrastructure projects, and timber produced by rural communities and plantations.

From 1975 to 2020, Lao recorded ca. 510,000 ha of tree plantations, including ca. 294,000 ha of rubber (DoF, 2021), which is currently not systematically used for timber production. Total tree plantation areas are a cumulative figure of each year without counting timber harvesting. Harvesting data from plantation is not officially recorded and traceable.

According to estimates based on official data on implemented harvesting from conversion, existing planation areas and common growth rates in Lao, the available industrial roundwood volume for the year 2019 was estimated at ca. 1.4 M m³ (Table 19).

Table 19: Lao PDR national timber potential 2021-2025.

Source	Volume in m³
Plantation forest	1,100,000
Forest conversion	269,000
Other sources (i.e. confiscated timber, village use forests)	< 50,000 (est)
Total	**1,419,000**

Sources: Assumptions and calculations for plantations provided in the methodology of the Task 1 report. Forest conversion based on implemented volumes in 2019 as provided by DoF. Confiscated timber volumes in 2019 based on data provided by DoF. NOTE: There are additional volumes from auctions of confiscated timber and from village use forest (VUF). The volumes from VUF are not known, but are estimated to be below 50,000 m³ (see task 1 report). Actually, these volumes cannot be used commercially. A regulation for timber from VUF and individuals, legal entities and organizations is under preparation.

Raw material imports

Currently, Lao is heavily depending on imports of wood chips for the domestic pulp industry. Since the start of wood pulp production in Lao, imports of wood chips have significantly increased peaking at 1.3. M m³ in 2019. However, in the long run, these imports will reduce when domestic plantations will be able to supply this industry`s demand.

Industrial roundwood imports do not play a major role for raw material supply of Lao´s wood processing industries. Official industrial roundwood trade seems to be marginal with only 0.1. M m³ imports in 2019.

Primary processing

The most important product of Lao´s wood industry is sawnwood, which constituted ca. 50% of the industry output volume in 2019 (0.6 M m³ RWE)[24]. Veneer and plywood production was estimated at 0.2 M m³ (RWE). A substantial share of wood products is exported: in total, ca. 50% of production. The vast majority (> 90%) of it is semi-processed sawnwood (i.e., HS code 4409).

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[24] According to the Department of Industry and Handicraft, Ministry of Industry and Commerce, sawnood production in 2017 was ca 0.8 M m³ (RWE) in 2017 (recorded as flooring lumber). This figure is roughly consistent with FAO and ITTO data. Both recorded ca. 0.9 M m³ (RWE) sawnwood production in 2017. Hence, the sawnwood production volumes presented in this analysis seem to be realistic.

Significant volumes of industrial roundwood are directly used by manufacturers of secondary processed wood products (i.e. furniture and carpentry). Thus, these volumes are not recorded in production statistics of the primary processing industries.

In 2018, wood pulp production started in Lao. The production volume reached 1.3 M m³ RWE in 2019. The wood pulp production is primarily based on imported wood chips. However, small volumes originating from domestic plantations are also used. Wood pulp producers plan to increase the share of domestic raw material in its supply chains over the coming years[25]. In 2019, wood pulp produced in Lao was almost exclusively exported.

Secondary processing

Based on the raw material intake supplied by primary processing industries, the secondary wood processing industries in Lao had an estimated output of ca. 1.1 M m³ (RWE) in 2019 (estimate based on data provided by MOIC in the annual statistical yearbooks for Lao PDR and on exported product volumes). The most important products were wood furniture and builder's joinery and carpentry products. Out of the total production volume, ca. 0.3 M m³ (RWE) of secondary processed wood products were exported, while 0.8 M m³ (RWE) were consumed by the domestic market

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[25] According to investment and supply plans of the pulp producing industries, the production shall increase to 650,000 tons of virgin wood pulp. The estimated wood demand is ca. 2million m³, of which domestic supply shall cover up to 350,000 m³ in the future.
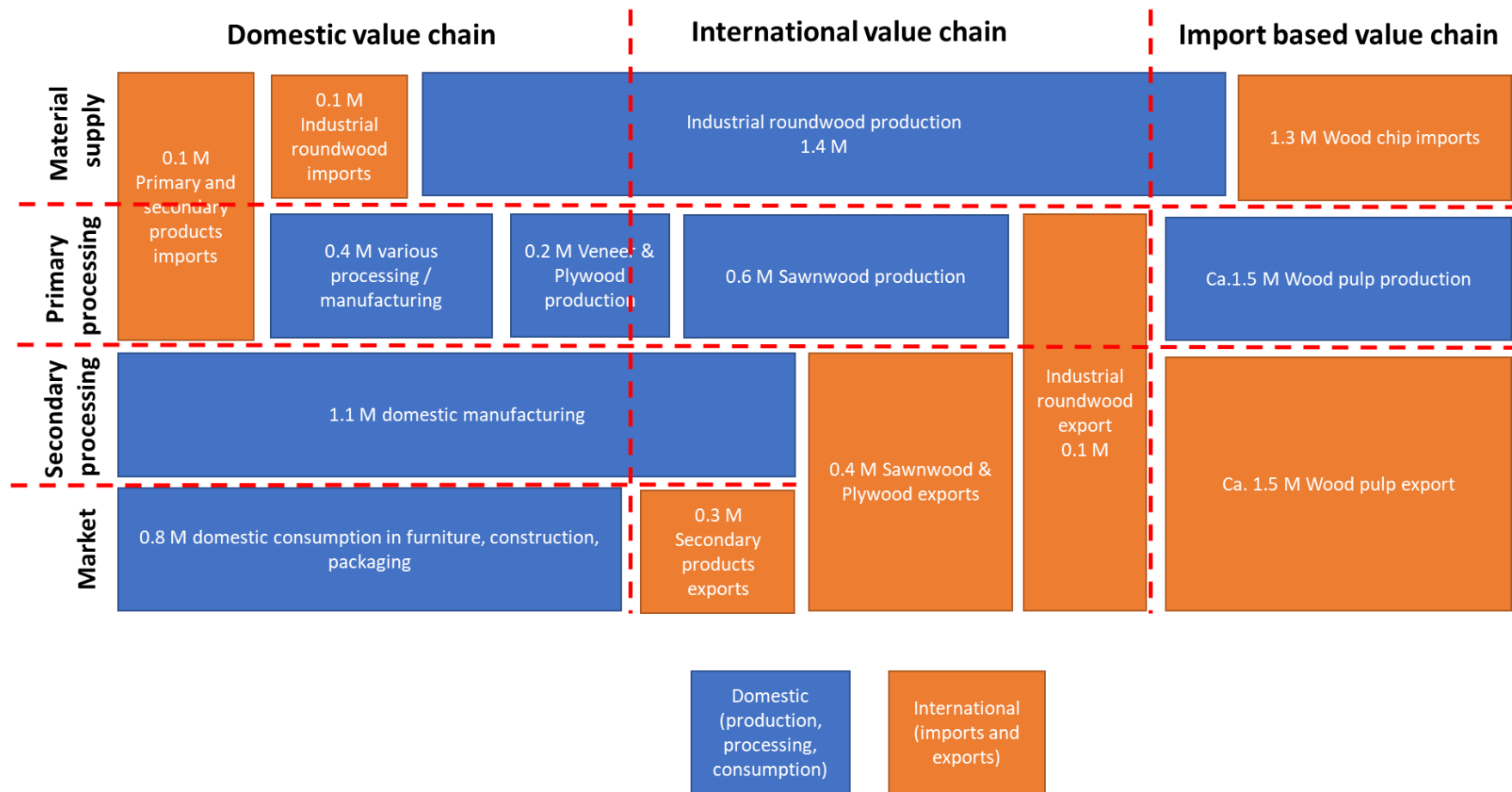
Figure 10: Lao wood sector timber flows 2019 (in million m³ RWE)

Sources: FAO ForestryStat and UN Comtrade, Lao statistical yearbooks; Table 19 for industrial roundwood supply.

3.4.4 Trends in consumption of primary processed wood products

Since 2016, the domestic consumption of sawnwood has decreased, while consumption of veneer and plywood shows increasing consumption figures.

The information for time series on national production of primary processed wood products is fragmented. The numbers provided by the Lao Bureau of Statistics are not consistent due to breaks in data collection methodology and not all provinces provided data on production of wood products. Thus, the following analysis is based on FAO data, which presents the most comprehensive source for time series of wood products consumption, though partly based on estimates.

Since enforcement of PM order No. 15 in 2016, sawnwood consumption has decreased (Figure 11). On the other hand, consumption of veneer and plywood have increased since 2016/17. Veneers and plywood are mainly consumed in Lao´s secondary processing industries and supply the increasing exports of finished wood products (chapter 3.4.5).

Since start of Lao´s wood pulp production in 2017/18, imports of wood chips have increased. Imports are currently covering the intake requirements of this industry. Simultaneously wood pulp exports from Lao have increased.

Figure 11: Development of primary wood products consumption volumes 2015-2019

Sources: FAO ForestryStat

3.4.5 Trends in wood products exports

The implementation of PMO 15 and related regulation since 2016 has led to an increase of finished wood products exports (+ US$ 58 M since 2015), while unfinished wood products dropped substantially (- US$ 53 M since 2015). The main export destinations for semi-processed sawnwood products are China and Viet Nam. For veneer and plywood, the main importing countries are Viet Nam, India and Thailand. The export destinations of finished wood products (i.e. furniture and carpentry products) are China and Thailand.

As identified by other studies over recent years, the Lao trade data and related statistics on wood products exports are not reliable (e.g. Flint, 2019; ERIA,2019; Smirnov, 2015), and as exemplified for the year 2019 in Figure 12. Thus, the data of key export markets are presented from the trade partners´ perspective.

The figure illustrates that the difference between Lao exported values and values reported by importing countries can be substantial. E.g., China reported US$ 46 M more imported sawnwood products than Laotian export data. In the case of China, this difference may be explained by different classification of the wood products by Lao and Chinese customs. The Laotian reporting gap for sawnwood is almost equal to the reporting difference for furniture, where China reported US$ 35 M less imports than Lao´s export data indicated.

Nonetheless, in the case of Viet Nam`s import records, there is no such match. According to the trade statistics, Viet Nam imported sawnwood at US$ 47 M more than Lao officially exported to Viet Nam.

Across all trade data and wood products, the Laotian data seems to understate the export values.
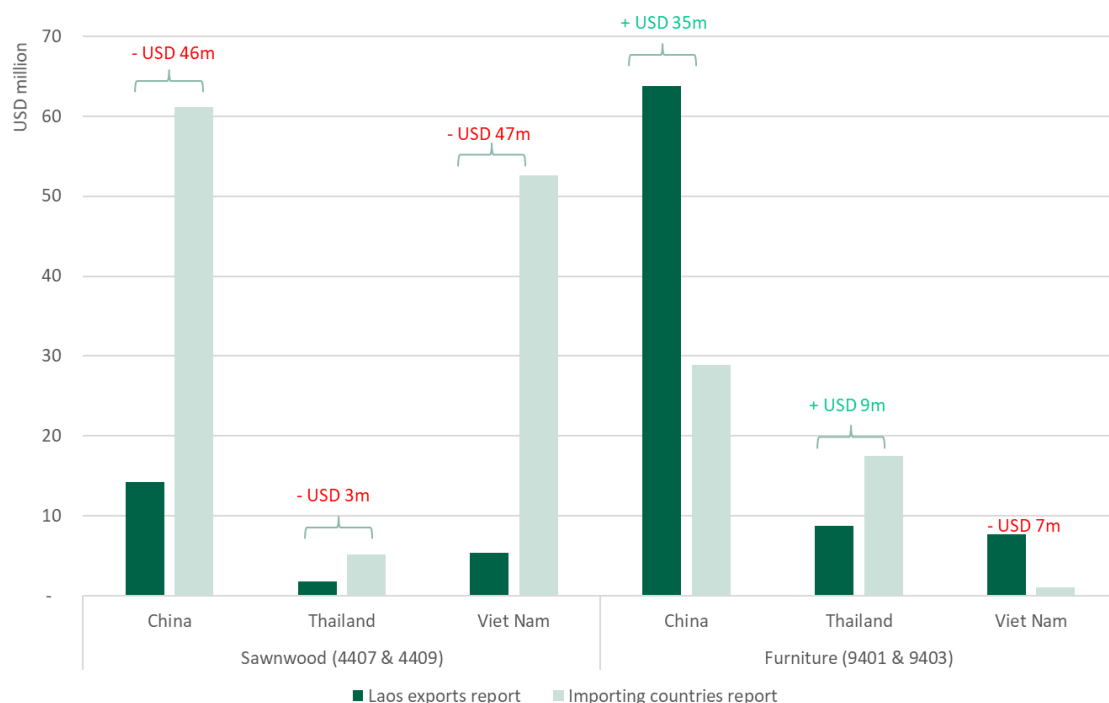
Figure 12: Differences in reported trade values by Lao and trade partners´ sources in 2019

Sources: UN Comtrade

Lao´s main trade partners for wood products are China, Viet Nam and Lao, and India in the case of plywood. The following figures illustrate the trend in wood products imports by these countries since 2015.

Export of sawnwood products has substantially declined since 2016 due to export restrictions on unfinished wood products. China and Viet Nam are the main importing countries of sawnwood.

Also veneer and plywood exports have decreases, but in contrast to sawnwood these products are now used by domestic industries (see domestic consumption trends in Figure 13). These products are used as inputs for secondary processed wood products (e.g. furniture, doors).

The exports of wood furniture and carpentry and joinery products has massively grown. The main importers of furniture and carpentry are China and Thailand.
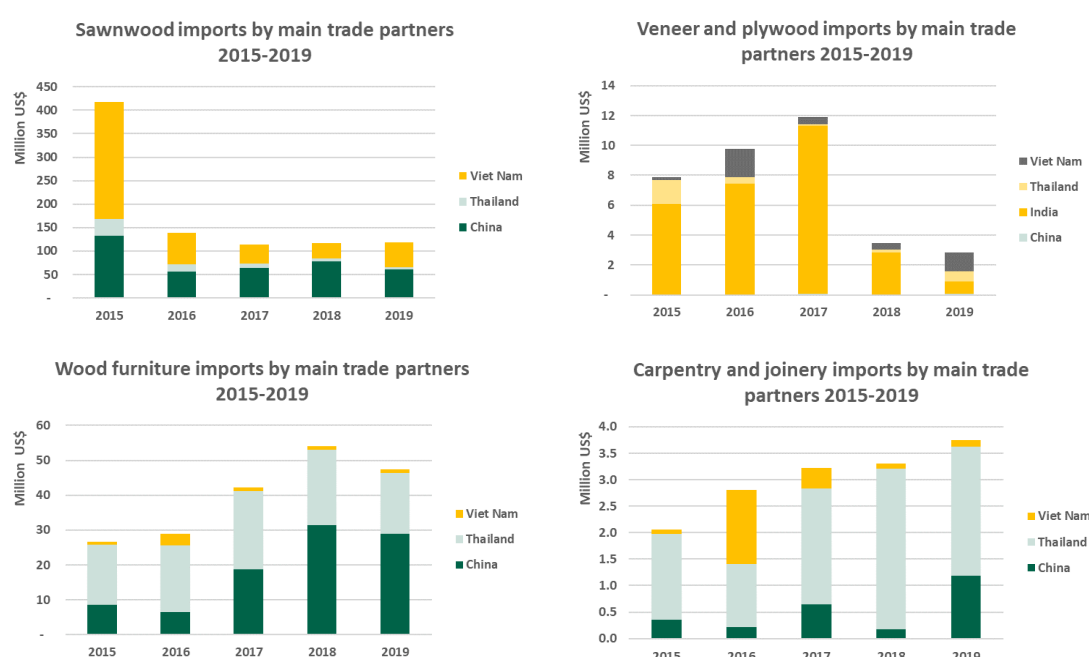
Figure 13: Development of wood products import values from Lao by main trade partners 2015-2019

Sources: UN Comtrade

3.4.6   Impact of the CoViD-19 pandemic on the wood sector in 2020

Apparently, the CoViD-19 pandemic has not severely affected the production and export of wood products from Lao. According to data provided by the MOIC and the Provincial Departments of Industry and Commerce on production and exports of wood products, the year 2020 has not shown significant deviations compared to fluctuations in previous years. The fast economic recovery of Lao´s key export markets in Chain and Viet Nam has outweighed the temporary difficulties Laotian enterprises faced in the early months of 2020.

No comprehensive national wood industry production data could be provided for 2020, but data for two provinces suggest that production has not been severely declining in 2020, and fluctuations in production values were well within the range of previous years (Figure 14).

More comprehensive data was obtained from DIMEX for export values of wood products. A slight reduction of export values was observed in 2020 compared to export values in 2019 (Figure 15). But the drop has been less severe than e.g., the reduction of export values in 2018. The robustness of Lao export values in 2020 was caused by fast recovery of the key export markets in Viet Nam and China.

Value of wood products distribution 2016-2020
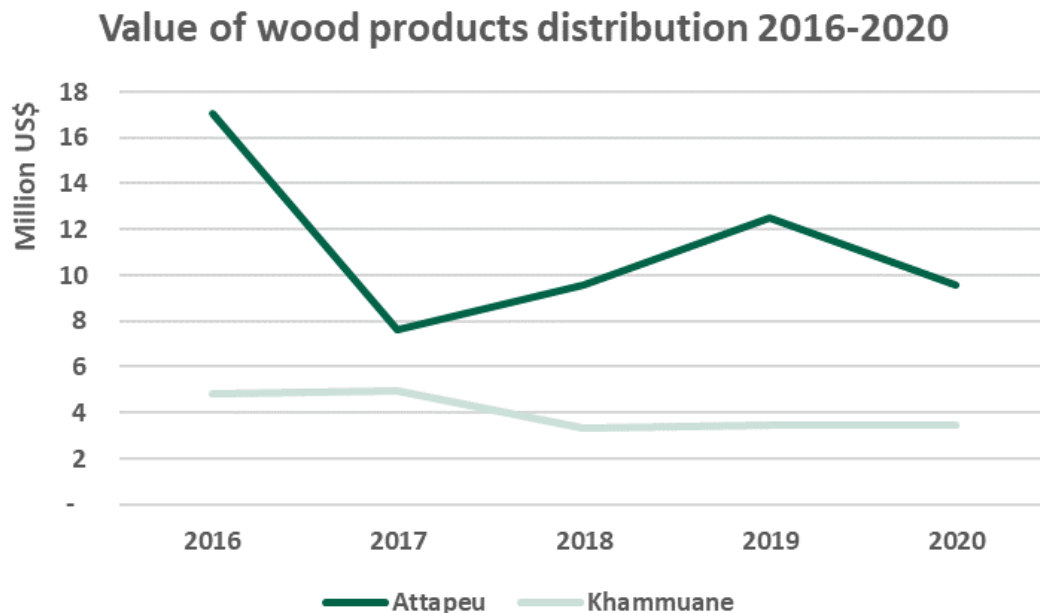
Figure 14: Value of wood products distribution in Attapeu and Khammuane 2016 to 2020

Sources: Provincial Departments of Industry and Commerce; Distribution value = value of domestic and export sales.

Regional export values 2017-2020
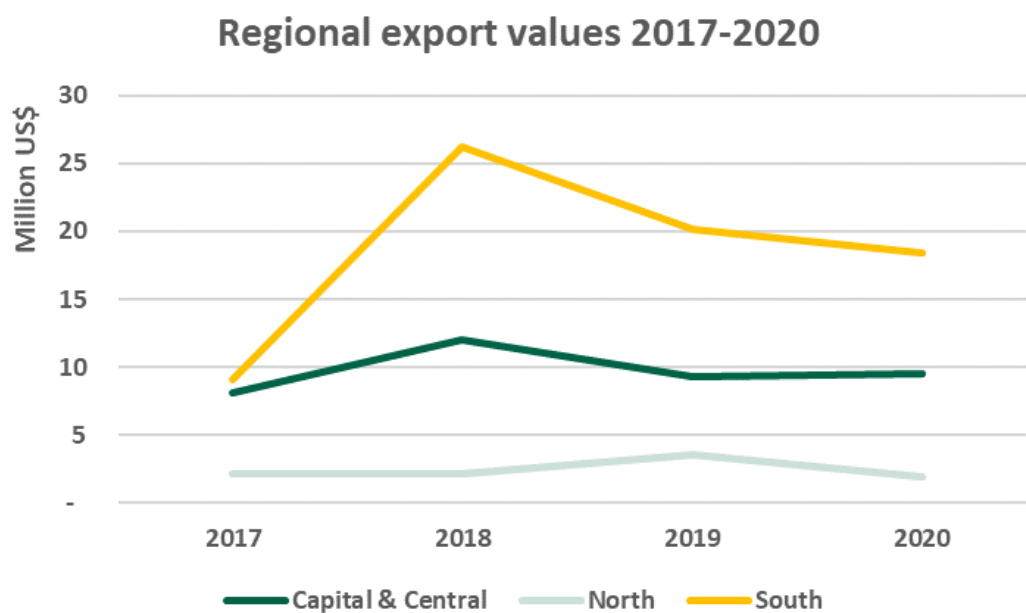
Figure 15: Value of wood products exports by region 2017 to 2020

Sources: MOIC; Value of export sales in US$.

The robustness of the measurable performance figures of the Laotian wood sector during 2020 (production and export values) is supported by the results of an ITC commissioned survey that aimed at assessing the impacts of the crisis on the Lao wood sector (ITC, 2020b).

The study concluded that the Lao wood sector enterprises were more affected by the measure taken to control the pandemic in Lao than by reduction of market demand, i.e.:

- Lao wood manufacturers were most affected by the temporary shutdown of the country, effecting on firms' ability to sell outputs or buy inputs domestically. Many industry survey participants (chapter 3.6.5) mentioned a decrease in sales and demand in recent years, which can be partly attributed to the impact of the CoViD induced restrictions.

- Enterprises experienced difficulties to export due to reduced availability of logistic services.

- Firms were particularly impacted by employees' absence and immigration restrictions for foreign staff. This was also highlighted by the participants of the industry survey (chapter 3.6.12).

- Limited availability of certification and licensing services hampered the production and sales processes.

3.4.7 Wood products quality standards

The national regulatory framework provides for safeguards and guidelines on good industry practice for processing enterprises and supports quality management of production processes. It provides for product definitions that support the enterprises´ compliance with the national legislation to avoid exports of illegal and unfinished products. However, there are no national quality standards for wood products, resulting in high transaction costs of buyers to ensure product quality and difficulties for manufacturing enterprises sourcing quality wood material inputs. There has been no follow-up to approaches for establishing national wood product quality standards.

The aim of product quality standards is to facilitate smooth transactions along the entire value chain (from log to product), by guaranteeing compliance with agreed standards for wood products. It supports the transparency of product pricing. Common standards are of special importance for raw materials (logs) and primary processed wood products (i.e., sawnwood and wood-based panels) that serve as input for other manufacturing industries (e.g. furniture). For producers of secondary processed wood products, reliance on agreed quality standards is crucial for internal quality management and compliance with product requirements for their outputs.

In absence of an extended offer of standardized and quality graded primary processed wood products, many secondary processing enterprises in Lao invest in sawmilling equipment and sawnwood treatment capacities (compare chapter 3.6.3). These activities are locking up capital for possible expansion, require technical know-how and extends the process management requirements. An extended offer by specialized sawmills offering standardized quality sawnwood products could free these resources and enhance the secondary processor´s capacities to invest in product development and processing technology.

Further, quality grading of these products enable participation in global marketplaces where these products are traded as commodity and actors rely on common grading rules (Table 20).

While introduction and compliance with standards will require investment and additional efforts in the early stages, it will permanently reduce transaction costs for all actors in the long run. Further, compliance with internationally agreed quality standards enables easier access to foreign markets.

The wood sector in Lao is drawing on commonly agreed wood product definitions, which come with specifications for dimensions and shape and general descriptions of treatments/processing. However, wood product quality standards go beyond these product definitions, as they define product quality according to end user requirements.

The following table summarizes international best practices with relevance for Lao´s wood sector. It describes the grading rules for the most important wood products: logs, sawnwood products, veneer/plywood. Annex 3.9 shows examples for international grading rules and proposed standards elaborated by the ACIAR co-funded project FST/2010/012 "Enhancing key elements of the value chains for plantation-grown wood in Lao PDR for the Lao wood sector".

Current log grading practices in Lao`s wood sector

- Log grading into A, B, C and other logs is foreseen by the Forestry Law (rev. 2019), Art. 32. The grading follows species and diameter classes.

- Scaling and grading rules for natural timber from PFAs and conversion areas (Decision 0116/MAF 2007, revised).

- The ACIAR co-funded aid project FST/2010/012 "Enhancing key elements of the value chains for plantation-grown wood in Lao PDR" describes a possible log grading approach for Teak logs, which follows international practices and standards. It includes dimensional and quality related grading factors (see Annex 3.9), i.e., the recoverable heartwood content.

- According to the wood industry survey (see chapter 3.6.7), grading (if applied at all) was not actively mentioned as a tool for the enterprises` quality management.

- Due to lack of an agreed log grading system, enterprises need to thoroughly inspect the logs before buying.

- However, due to the actual shortage of raw material, quality plays a minor role for sourcing.

Current wood products quality practices in Lao`s wood sector

- The decisions on Wooden Products. No. 2005/MoIC.DIH, 2015 provide wood product definitions and describe them within the range of typical forms, sizes and treatments. However, these regulations do not define quality standards.

- Log grading of natural timber from PFAs and conversion areas. However, logs are frequently sold in in batches of mixed dimensions, qualities, species, which makes deand specif assortment of logs difficult and hinders enhanced value adding for timber sellers.

- Wood products grading and quality standards for the domestic market are not systematically applied. In general, grading is done case to case.

- Many secondary wood processing industries directly source logs themselves and produce the sawnwood products they require for their internal processes.

- The sawmilling enterprises in Lao mainly produce according to client´s requirements, which can be a) individual specifications, or b) based on international sawnwood standards required by the respective export markets.
- The export regulations for wood products (0939/MOIC.DIH, 2019 and its predeceasing regulations) set out dimensional limits for wood products and require minimum levels of processing. This is not contradicting product quality standards but restricts the range of the enterprises possibility to respond to client specific requests.
- In absence of a reliable grading system, which is in line with international best practice, international buyers apply on-site inspections before shipment to ensure product quality. This results in transaction costs for the buyer.
- The ACIAR project FST/2010/012 "Enhancing key elements of the value chains for plantation-grown wood in Lao PDR" describes a possible sawnwood standardization approach for Lao Teak sawn-wood, which follows international practices and international standards. It includes dimensional and quality related grading factors.
- Any sawnwood standard that would find application in Lao, should come with kiln drying schedules and process requirements for the most common species.
- According to the authors knowledge, quality grading of veneer and plywood in Lao follows client requirements in line with the target markets` veneer/plywood standards.
- Domestic and international buyers would benefit from a Lao veneer / plywood standard. This could be derived from one of the existing standards, e.g. from China/Viet Nam.

Table 20: International quality standards with relevance for Laotian wood products

Product	Common international standards
Tropical sawlogs and veneer logs	- Tropical hardwood logs (natural forest and plantations) are generally graded according to durability/resistance classes. - The ITTO Tropical Timber Atlas provides a comprehensive overview of tropical timber species, their grading, suggested treatment, processing and end uses (see Table 37 for example *of Dipterocarpus alatus*). - Tropical log grading is further detailed by regional and country level grading systems. E.g., the Southeast Asia Lumber Producers Association draw on log grading system (see Table 38) to better distinguish between high value veneer logs, sawlog classes and other qualities. The entry criteria for log grading are diameter classes and standard defects (knots, bending, etc). - This log grading scheme has been widely applied in the region, though it has undergone country specific adjustments.
Plantation logs (i.e. Teak)	Grading of plantation logs largely follows the aforementioned grading criteria. However, there are no widely agreed grading schemes for individual species.
Sawnwood products	There exists a wide range of sawnwood standards and grading systems. The standards can be differentiated according to: - Visual appearance grading - Structural grading, i.e.: physical wood properties and technical treatment Several standards combine the factors to define sawnwood quality categories to ultimately suit specific end uses (e.g., in construction, outdoor furniture, etc.).

Product	Common international standards
	▪ The standards with widest global relevance are ISO standards (they typically combine/align the standards commonly used in the OECD regions). However, these standards are mainly used for globally traded softwood and temperate hardwood species. In this context, regional standards are provided by the American Hardwood Export Council (AHEC) or European Norms (EN). ▪ For tropical hardwood sawnwood (natural and plantations), regional standards are of higher relevance. E.g., across Asia, the Malaysian Grading Rules (MGR 2009, see Table 40) is widely acknowledged. Further, there are country specific sawnwood standards that are of special importance for Lao`s key export markets China, Viet Nam, Thailand and other Asian countries. ▪ In 2011, ITTO compiled the most important international standards for wood products from tropical hardwoods. Most prominently, China has issued a set of relevant standards. ▪ With a view to potentially enhanced production of sawnwood from Lao´s rubberwood resources, the Indian standard (Table 42) is highlighted. This, because rubberwood is not of high durability and requires special treatment. ▪ Definition of humidity is of special importance for any sawnwood product. Though, it is not a standard criterion for sawnwood as such, it is a prerequisite for use of sawnwood in various applications. A relative humidity of less than 10-15% is compulsory for most uses in secondary processing, like flooring, furniture, etc. There are no regional differences for this value. ▪ Details of humidity requirements are usually described in the respective standards of the wood products.
Veneer and plywood	▪ There are no differences for grading natural and plantation species veneer. ▪ Veneer from planation species has rapidly increased market shares in recent years. I.e., Eucalyptus peeler veneer and plywood has become a widely traded product. Teak veneer/plywood is also high in demand. Thereby, consumer preference is still given to natural Teak. However, plantation grown Teak veneer is constantly gaining market shares. ▪ Grading rules for veneer classify according to the end use of the sheets in visual and/or structural applications. Hence, they are closely linked to the use of the plywood that is made from the sheets. ▪ There are several grading systems around that use similar criteria for grading veneer sheets (see Table 43). In Southeast Asia, the Australian/New Zealand and the Chinese veneer grading rules are probably the most suitable for Eucalyptus and Teak veneer. ▪ For plywood, being a globally traded commodity, ISO standards (Table 43) are widely recognized. Of special importance for plywood products is compliance with the importing countries requirements for Formaldehyde Emissions. These may deviate from the ISO basic standards.

3.5 Regional characterization of the wood sector

3.5.1 Trends in regional enterprise structure

The Laotian wood sector has seen a substantial decline in number of enterprises since 2015. The number has dropped from more than 1,300 to less than 1,000 in 2020. After enforcement of PMO 15 in 2016, many wood industry enterprises have sized down their activities or closed due to the lack of raw material or due to non-compliance with processing requirements. In the Central region almost 35% of enterprise closed since 2015. In the North, the loss of enterprise was ca. 19%. Only in the South, the number of enterprises was more robust: loss of 6% of enterprise since 2015.

The most comprehensive data on Lao´s wood sector has been compiled in 2015 in the course of the National Manufacturing Establishments Survey 2016 (UNIDO, 2016). The survey identified 1,325 small, medium, and large wood sector enterprises in 2015 (Table 21). More than 50% of the enterprises were furniture manufacturing establishments. Ca. 45% of all registered enterprises were small enterprises; most of them in the furniture sub-sector. Enterprises in sawmilling and wood processing were mainly medium and large scale. The survey covered registered small, medium, and large enterprises.

Over the past years a multitude of studies were produced on small scale producers of timber and wood products in Laos (e.g., Smith, 2018; Midgley, et al, 2015). The studies indicate the importance of micro and household enterprises in primary and secondary wood processing. MOIC shows that number of licensed household business has been only around 100 in 2020. On the other hand, number of unlicensed household business was estimate at ca. 1,300 in 2015. However, unlicensed household business had to stop activities. The number of unlicensed household enterprise has drastically declined from 1,154 in 2015 to only 19 in 2021 (Table 23). It is currently discussed how this important income generating branch can be re-activated in line with existing regulations.

After enforcement of PM No. 15 in 2016, many wood industry enterprises have sized down their activities or closed due to the lack of raw material or due to non-compliance with processing requirements. According to most recent data provided by MoIC (2020a and 2020b), the total number of wood sector enterprises has decreased to around 1,000 in the year 2020.

Since 2015, the regions North and Central lost more than 19% and 34% of their businesses. In the South, the decline was less severe (only 6%) (Table 22). However, no detailed disaggregation by regions and sub-sectors was available.

Among the sub-sectors, the sawmilling industry has experienced the most dramatic exits of enterprises: Since 2015, almost 83% seized operations. Also, the number of other wood processing enterprises declined by more than 40%. Only the number of furniture enterprises has shown to be a bit more robust losing only 11% of its enterprises since 2015 (Table 23).

Table 21: Number of enterprises in the wood sector by size class and region 2015

Industry type	Sawmill			Wood processing			Veneer			Furniture			Household enterprises	
Size class	Large	Medium	Small	Large	Medium	Small	Large	Medium	Small	Large	Medium	Small	Licensed	Unlicensed
North	4	-	-	67	87	6	1	1	1	1	42	157	52	1,154
Central & Capital	24	8	-	150	83	104	11	2	-	16	109	285	48	
South	-	3	-	47	31	4	7	6	-	1	19	48	21	
Total	28	11	-	264	201	114	19	9	1	18	170	490	121*	1,154

*Source: UNIDO, 2016 and FSIS,2018. Data for registered small, medium, and large enterprises. Large > 200 employees, Medium 51-200 employees, Small 10-50 employees. A factory with less than 10 employees is classified as a household enterprise. *The original MOIC data sums up 198 licensed household enterprises, but only for 121 the location was indicated.*

Table 22: Development of enterprise numbers in the wood sector by region 2015 to 2020

Region	Number Enterprises 2015	Number Enterprises 2020	Loss in %
Small, medium, and large enterprises			
North	367	296	-19.4%
Central & Capital	792	519	-34.5%
South	166	156	-6.0%

Source: 2015 UNIDO, 2016; 2016 MOIC, 2021; only small, medium, and large enterprises

Table 23: Development of enterprise numbers in the wood sector by sub-sector 2015 to 2020

Sub-sector	Number Enterprises 2015	Number Enterprises 2020	Loss in %
Small, medium, and large enterprises			
Sawmilling	35	6	-82.9%
Finished wood processing factory	608	364	-40.1%
Furniture	678	599	-11.7%
Household enterprises			
Licensed	198	102	-48.5%
Unlicensed	1,154	19	-98.4%

Source: 2015 UNIDO, 2016; 2016 MOIC, 2021

The number of employees shows a correlation with number of establishments in the three regions. Most employment in 2015 was recorded in Central (ca. 17,000 of the total of 25,000). Total employment in North and South is ca. 4,000 each. Thereby, the average operations in the South are larger than in the North (Table 24).

Unfortunately, no updated disaggregated data by regions and sub-sectors was available. However, assuming proportional correlation of employment loss with enterprises closures, the actual number of employees in the wood processing sub-sectors is estimated at ca. 16,500 in 2020.

Table 24: Number of employees in the wood sector by region 2015

Industry type	Sawmilling		Wood processing		Veneer		Furniture	
Employees and employees per enterprise	N	*N/enter-prises*	N	*N/enter-prises*	N	*N/enter-prises*	N	*N/enter-prises*
North	150	*38*	2,443	*15*	269	*90*	1,059	*5*
Central & Capital	511	*16*	11,521	*34*	1,062	*82*	4,243	*10*
South	136	*45*	2,574	*31*	416	*32*	885	*13*
Total	797	*20*	16,538	*29*	1,747	*60*	6,187	*9*

Source: UNIDO, 2016 and FSIS,2018. Data for registered small, medium, and large enterprises.

3.5.2 Trends in regional exports

Since 2015, the export values for the regions Central and South have increase by 17% and 103% respectively. On the other hand, in the North exports dropped by 10%. Apparently, the enterprises in Central and South were capable in dealing with the transition from unfinished to finished wood products. The enterprise structure in the North has been characterized by smaller enterprise units. These firms have not been able to upgrade technologies to participate in finished products value chains.

No comprehensive production data is available at provincial level. Though this may change with improving monitoring and reporting in the cause of the FLEGT VPA / TLAS implementation. Only export data is reliably recorded at provincial level and allows for characterizing the production capacities and economic importance of the wood industries for the three regions north, central and south (Figure 16).

NOTE: for the years 2019 and 2020 data is missing for three provinces (see Table 25). However, the missing values do not change the overall assessment of the data since these provinces do not hold significant export shares.

The South has been the region with the highest export values of finished wood products in the period 2017 to 2020, though fluctuations are huge: between almost US$ 10 M and US$ 30 M. The recent trends since 2018 shows constantly declining export values for this region.

The region Central (incl. Vientiane Capital) has shown stable export values since 2017, oscillating around US$ 10 M per year. The North represents the lowest export values of the three regions.

Comparing the development of enterprise numbers and export values at regional level shows that the regions Central and South have gone through a transition with less enterprises producing higher export values than in 2016 (Figure 17). Apparently, the enterprise that have not left the sector have been able to mobilize capital and modernize their production processes to comply with the post PMO 15 regulations and requirements.

On the other hand, in North, the enterprises have not been able to make the transition from unfinished to finished wood products. The number of enterprise and export values have constantly declined. The UNIDO (2016) data for 2016 shows that the wood processing and furniture enterprises were significantly smaller than in the other regions. I.e., these small firms have not been able to upgrade technologies to participate in finished products value chains. Similar results have been produced by other studies (e.g., Smith, 2018; Smith et al, 2021).
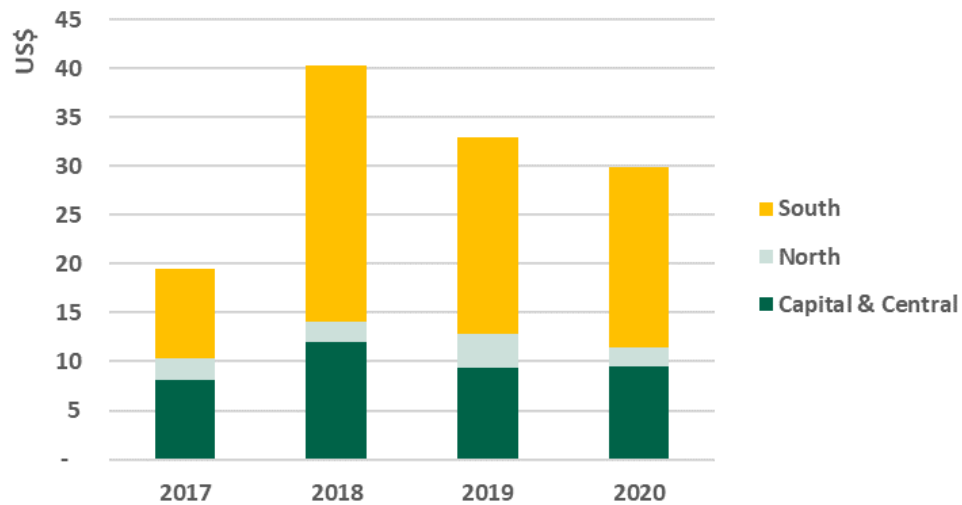
Figure 16. Export values of finished wood products by region 2017 to 2020

Source: MOIC data on exported finished wood products from 2016-2020

Table 25: Finished wood products exports in US$ by provinces 2017 to 2020

Province	2017	2018	2019	2020
Attapeu	4,914,093	10,577,302	9,988,492	7,727,479
Bokeo	42,086	31,691	125,342	67,757
Bolikhamxay	677,880	822,813	1,279,776	2,407,531
Champasack	3,288,817	12,934,106	5,580,691	5,180,134
Houaphanh	8,091	20,550	61,830	60,236
Khammouane	605,971	1,257,956	1,192,720	306,360
Luangnamtha	395,780	15,359	56,791	118,399
Luangprabang	1,210,223	1,008,018	1,217,935	671,115
Phongsaly	123,455	3,277	85,991	
Salavan	304,138	727,012	3,828,188	4,978,435
Savannakhet	5,229,600	4,746,550	4,590,524	3,495,484
Sayabury	280,289	731,724	980,263	605,646
Sekong	603,494	1,975,810	730,404	569,943
Udomxay	131,919	303,426	1,034,900	457,495
Vientiane Cap.	1,183,476	2,903,568	1,036,658	2,432,560
Vientiane Prov.	116,020	171,865		
Xaisomboun	6,300	8,842		
Xieng Khouang	319,405	2,096,037	1,217,319	861,060
Total	**19,441,036**	**40,335,906**	**33,007,826**	**29,939,635**

Source: MOIC data on exported finished wood products from 2016-2020
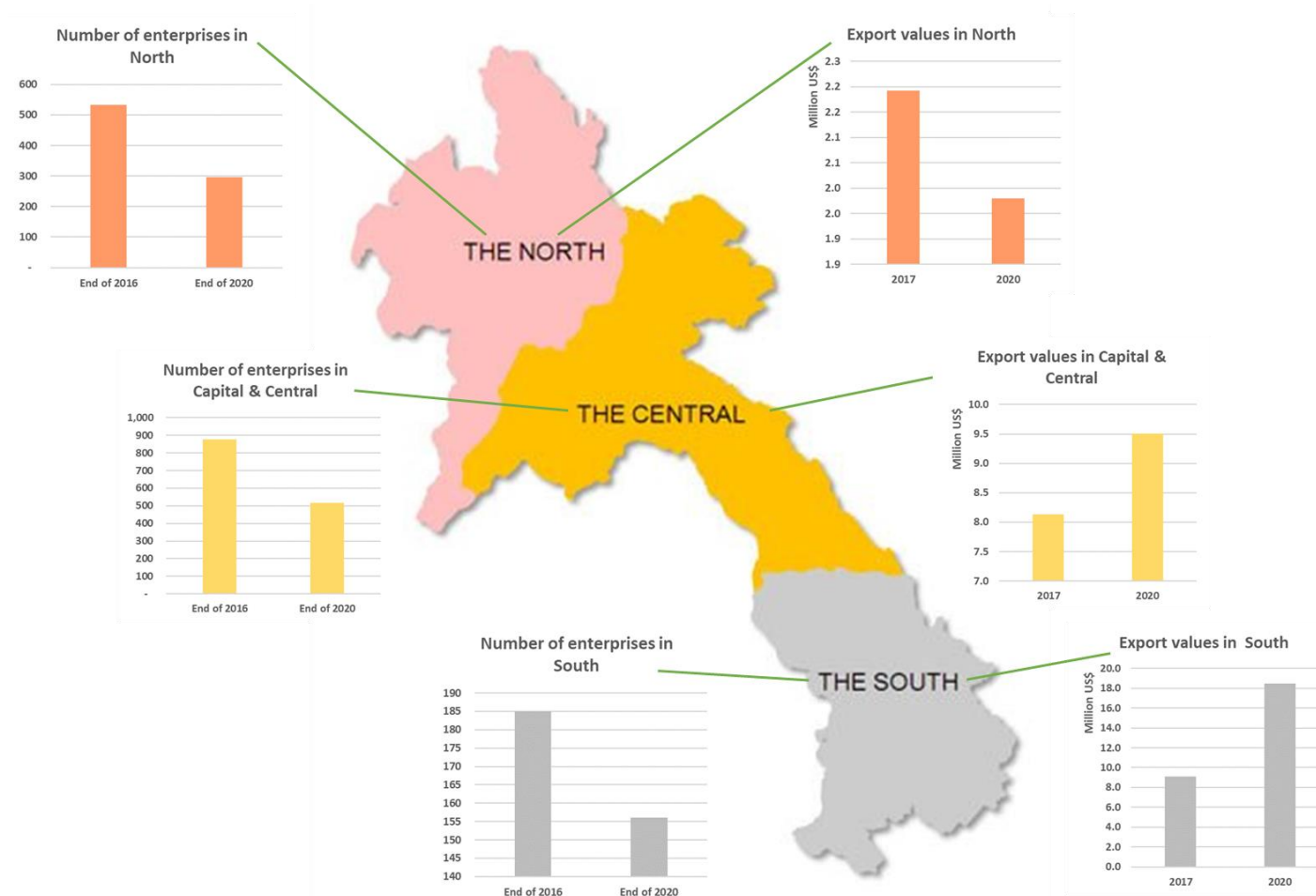
Figure 17: Regional patterns of wood sector enterprises and wood products exports 2016/17 and 2020

Source: MOIC data on exported finished wood products from 2016-2020 and national data on wood processing inudstries

3.6 Results of the wood industry survey

3.6.1 Summary of survey results

Study sample and enterprise structure

- In total, the survey covered 87 enterprises, of which 31 were in the North, 26 in Central and 30 in the South. Most of the surveyed enterprises belonged to the "Carpentry and joinery" (20 of 87) and "Furniture" (37 of 87) sub-sectors.

- The enterprises covered by the survey in the Southern region tended to be smaller than in North and Central. This was caused by the higher share of household enterprises included in this sample. Among the sub-sectors, veneer and plywood manufacturing enterprises were the largest and sawmills the smallest enterprise units in terms of employment.

- Most of the surveyed enterprises were formally registered. Only in the Southern region, the level of formalization was significantly lower. Most enterprises were more than 10 years in business.

Raw material sourcing

- The most important raw material for enterprises was industrial roundwood (logs). I.e., larger enterprise sourced logs as raw material, while smaller enterprises relied on primary processed wood products as inputs. All enterprises sourced raw materials almost exclusively within their regions.

- Larger enterprises were sourcing more plantation species, smaller enterprises were more involve in natural wood processing.

- In the North, Teak was the major species for intake. In Central and South, natural forest species were more important. Other plantation species (i.e., Eucalyptus and Rubberwood) were not widely used across all regions.

- Raw material availability has become increasingly difficult over the past years. Only in North, the trend was more positive.

- The smaller enterprises are severely challenged by the current circumstances (reduced offer of industrial roundwood and increasing requirements for finished wood products manufacturing) and limited offer or basic sawnwood due to reduced number of sawmills.

Raw material quality

- Many enterprises reported substantial quality problems of raw materials. The share of raw material that had to be discarded due to quality deficiencies was considerable and ranged between ca. 10% for planed sawnwood and kiln dry sawnwood to more than 25% for logs and rough sawnwood.

- The most important quality deficits resulted from inappropriate harvesting, storing and drying processes.

- Further, problems resulted from poor heartwood recovery rates and log dimension (too small or too big) that were not suitable for the processing equipment.

- None of the enterprises mentioned that they source logs and other inputs in line with technical quality standards or grading systems.

Products and buyers

- The most important products for sale were furniture and builder´s joinery. Most of these products were made of natural forest hardwoods, but Teak products also held substantial shares. Basic sawnwood derived products were mainly produced from Teak. Veneer and plywood were produced from Eucalyptus (peeled) and natural hardwoods (sliced).

- Across all regions, the share of domestic market destination ranged between ca. 60% and 70%. The highest export shares were identified for the enterprises in the Northern region.

- The domestic demand trends over the past three years were perceived negative, with most of the enterprises identified decreasing demand for the main products groups. However, this perception may be biased by the CoViD-19 induced market distortion ins 2020.

- Furniture was also the main product for the international market. The main buyers originated from the furniture sectors abroad. Other important export products were glued and joint sawnwood products and veneers and plywood. These products were mainly sold to foreign wood industries or retailers.

- Overall, the international market trends were perceived more positively than domestic market developments. Nonetheless, for furniture, diverging market experiences were shared, with a substantial share of responses indicating a decrease in international demand.

Condition of equipment and investments

- On average, most of the machinery in use was purchased less than 10 years ago and the enterprises rated the condition of their equipment as good, with only low intensity of repairs across all size classes and sub-sectors.

- Several enterprises plan investments in new machinery or upgrades. The planned investment volumes were from several thousand up to 100,000 US$.

- The enterprises did barely mention serious problems in accessing the required capital. Most commonly they mentioned commercial and private lending being the main sources for financing. Others planned to use own equity to realize the investment.

Product quality and quality management

- The most common problems that caused buyers` rejections in the domestic market occurred in the manufacturing of other wood products (namely doors and windows). The quality deficits in this product group were mainly induced by high moisture content / inappropriate drying of the processed wood.

- Export products did not experience as many quality issues as products directed to the domestic market. Nonetheless, the most common problems across all product groups for export were drying related problems and color errors. Further, transport damage was a common reason for buyers to reject the product.

- None of the surveyed enterprises applied an audited quality management system (e.g. ISO). Although national regulations (i.e., MOIC decisions 0222 of 2021 and 0777 of 2020) provide

for the basic elements of process quality and clearly articulate the intention to raise process quality, they were not actively mentioned.

- No international product quality standards were mentioned by the respondents. Only four enterprises mentioned that they complied with standards set by the buyers in Thailand and Japan.

- Commonly, international buyers´ implement a strict quality control themselves. I.e., the buyers inspect the product order before shipping or are directly involved in the production process, since they were shareholders of the enterprise.

Employment structure

- The total employment in the surveyed enterprises amounted to 1,469. Of these, 46% were employed in the Northern region, 34% in Central and 20% in the South. The share of female employees was particularly low in the South.

- Most employees did not have a formal degree relevant for their job profile in the enterprise. Only in the Central region, a relevant share of employees held basic and advanced degrees.

- In the Northern region, most employment was recorded in the carpentry and furniture subsectors. In the Central region, most employment was identified in veneer and plywood manufacturing, and in the South in carpentry and joinery enterprises.

- The largest enterprises were veneer and plywood producers in the North and in Central. In general, the smallest units were recorded in the South.

Occupational health and safety (OHS) and working conditions

- In general, company level OHS systems were not widely spread: complaints management, emergency response measures or written manuals were only available in medium and large enterprises.

- Ca. 50% of the companies indicated that they regularly train their permanent staff in the use of the machines. Permanent staff is usually endowed the personal protective equipment (PPE) and had regular breaks.

- In contrast, the majority of casual workforce was not regularly trained. However, also casual labor was regularly equipped with PPE, though a lower rate than permanent staff.

- Most permanent and casual employees did not have written contracts.

- Health insurance, paid vacations and paid maternal leave were not common, though some larger enterprises were offering these benefits. Thereby, permanent employees benefited more often from these them than causal employees.

Role of associations

- 40% of the enterprises stated that they were members of an association. The enterprises rated the usefulness of the membership quite differently. Ca. half of them mentioned at least a certain level of usefulness of the memberships, the other half was more reluctant or negative about their membership´s usefulness.

- As main benefits of the membership in the associations, the enterprises identified access to information and improved access to markets.

- The respondents saw room for improvement of the associations` benefits. I.e., they requested more support from associations to access financing for investments and improved dissemination of relevant sector information.

Impact of regulations

- The enterprises mentioned that the PMO 15 of 2016 and related decisions for its enforcement restricted their business opportunities. In general, the respondents mentioned an over-regulation of the wood sector activities and that the implementation of these regulations would restrict the competitiveness of their enterprises. Due to weak law enforcement structures on Lao, the enterprises that comply with the regulations would experience competitive disadvantages compared to informal activities in the sector.

- Enterprises also stated that the current regulatory framework has negative effects on their export opportunities. The specifications defined by the related regulations perceived as an obstacle, since foreign buyers frequently demand products which deviate from these specifications.

- The survey participants mentioned that the reduced offer of natural wood due to implementation of PMO 15 has led to massive competition for the remaining legal timber sources. The actual bidding system would disadvantage small and medium enterprises.

- Enterprises mentioned further that the regulations would disadvantage household business and small enterprises, i.e., due to the capital requirements for upgrading.

- The respondents were not satisfied with the system to collect taxes and fees, i.e., they felt that the system is not consistent and would charge two or more times for the same services/products along the value chain.

- The respondents also stated that the lack of skilled workforce is restricting their business opportunities, saying that the Laotian education and training system would not deliver the required qualification.

- Restricted access to finance due to unfavorable lending condition of commercial banks was mentioned by several enterprises.

FLEGT

- 47 of 87 surveyed enterprises weren´t aware of the FLEGT process in Lao. The knowledge of FLEGT was more common among large and medium enterprises than in small enterprises and household businesses.

- Enterprises operating in the carpentry and in the veneer/plywood sub-sectors seemed to be more aware than e.g., in the furniture and sawmilling sub-sector. Positive expectations regarding FLEGT prevailed across all sub-sectors.

3.6.2 Characterization of study sample

The data presented in the subsequent chapters draws on the results of a survey that was conducted among wood sector enterprises in six provinces in early 2021 (see chapter 0 for details on the methodological approach):

- Luang Prabang and Xayabury in "North",
- Khammouane and Vientiane in "Central", and
- Champasak and Attapeu in "South".

In total, the survey covered 87 enterprises, of which 31 were in the North, 26 in Central and 30 in the South (Table 26). Most of the surveyed enterprises belonged to the "Carpentry and joinery" (20 of 87) and "Furniture" (37 of 87) sub-sectors. As shown in chapter 3.6.3, the carpentry and furniture enterprises frequently source logs as primary raw material.

Table 26: Wood sector survey sample

Wood sub-sector / Region	North	Central	South
Sawmilling (LSIC 1610)	10	0*	1
Veneer, plywood and panels (LSIC 1621)	2	2	2
Carpentry and joinery (LSIC 1622)	8	4	8
Furniture (LSIC 3100)	9	14	14
Other wood products (LSCI 1629)	2	6	5
Total	**31**	**26**	**30**

*In fact, many of the enterprises in Central that identified themselves as furniture manufacturing or manufacturers of carpentry and joinery operate integrated sawmilling lines.

Sources: Survey data for the year 2021

The enterprises covered by the survey in the Southern region tended to be smaller than in North and Central. This was caused by the higher share of household enterprises included in this sample (Figure 18). Among the sub-sectors, veneer and plywood manufacturing enterprises were the largest and sawmills the smallest enterprise units in terms of employment.

Most enterprises were more than 10 years in business. Only 20 of 87 spent 10 years and less in business, most of them were operating in furniture manufacturing (11 of 20).
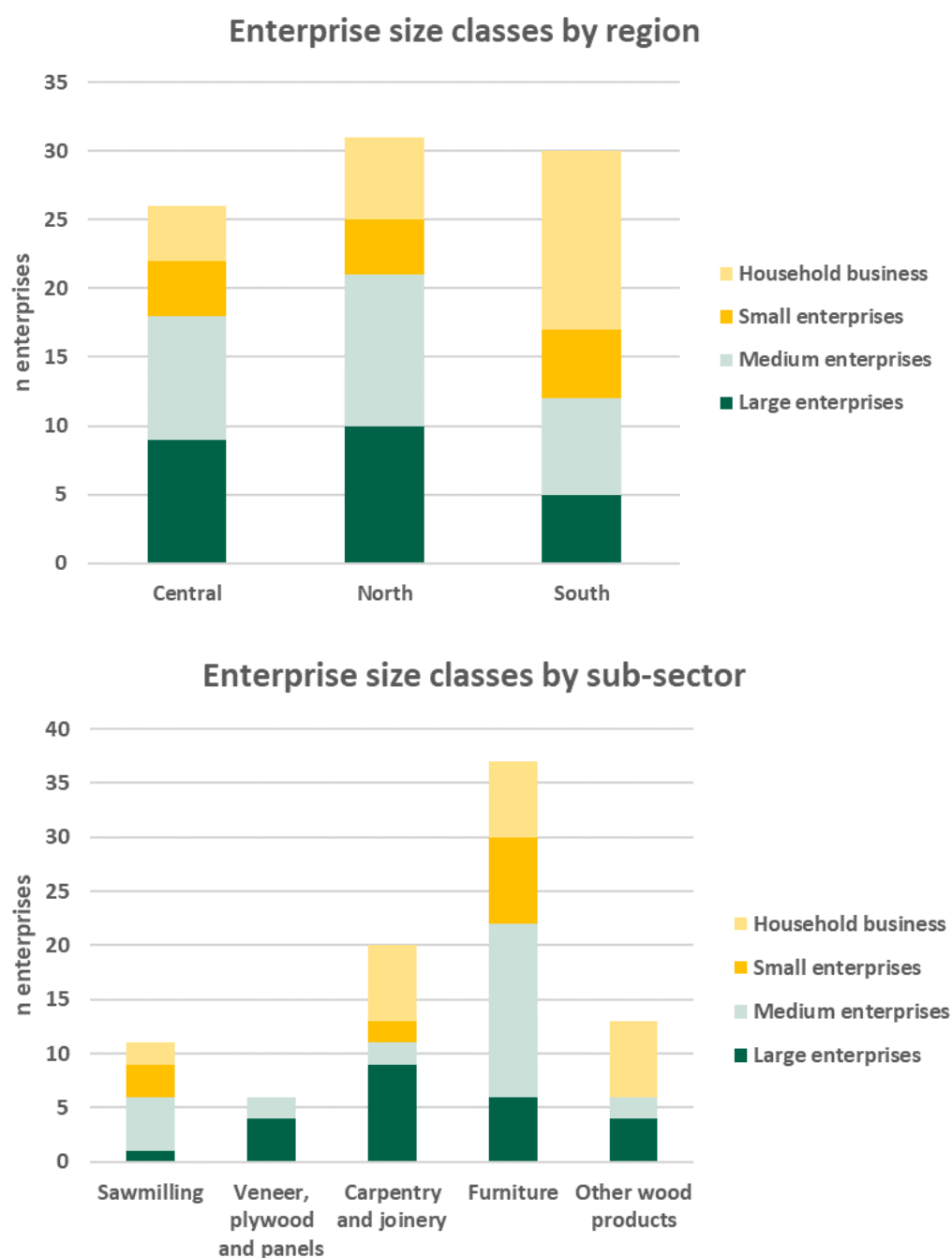
Figure 18: Size classes of survey enterprises by region (top) and by sub-sector (bottom)

Sources: Survey data for the year 2020 (N=87)
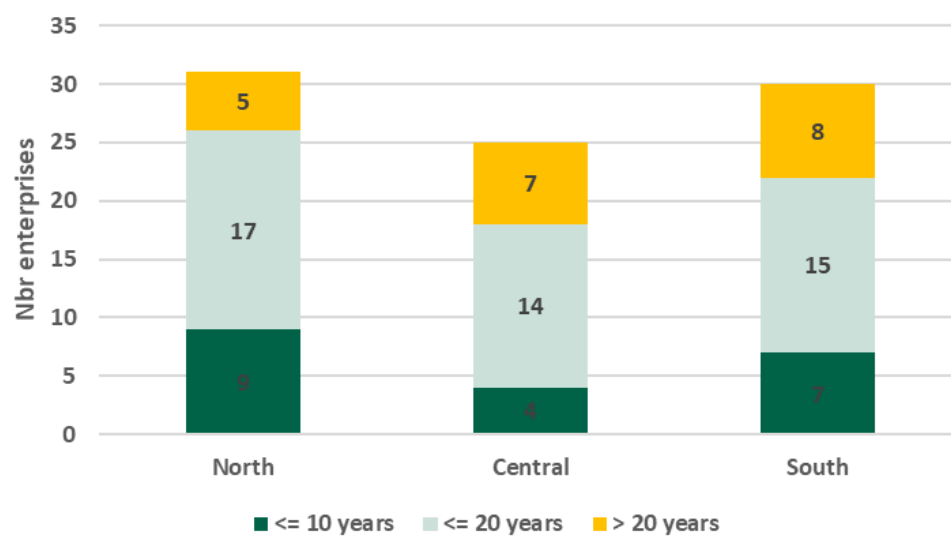
Figure 19: Age of surveyed enterprises

Sources: Survey data for the year 2020 (N=87)

3.6.3 Raw material sourcing

The surveyed enterprises sourced raw materials almost exclusively within their regions. The main sources of industrial roundwood in the Northern regions were small plantations (Figure 20). In contrast, the enterprises in the South were mainly sourcing from villages and communities. In Central, the enterprises drew on a broad mix of roundwood suppliers. Only two of the enterprises sourced certified raw materials (FSC certified).

According to the survey results, raw material availability has become increasingly difficult over the past years. Only in North, the trend was more positive.
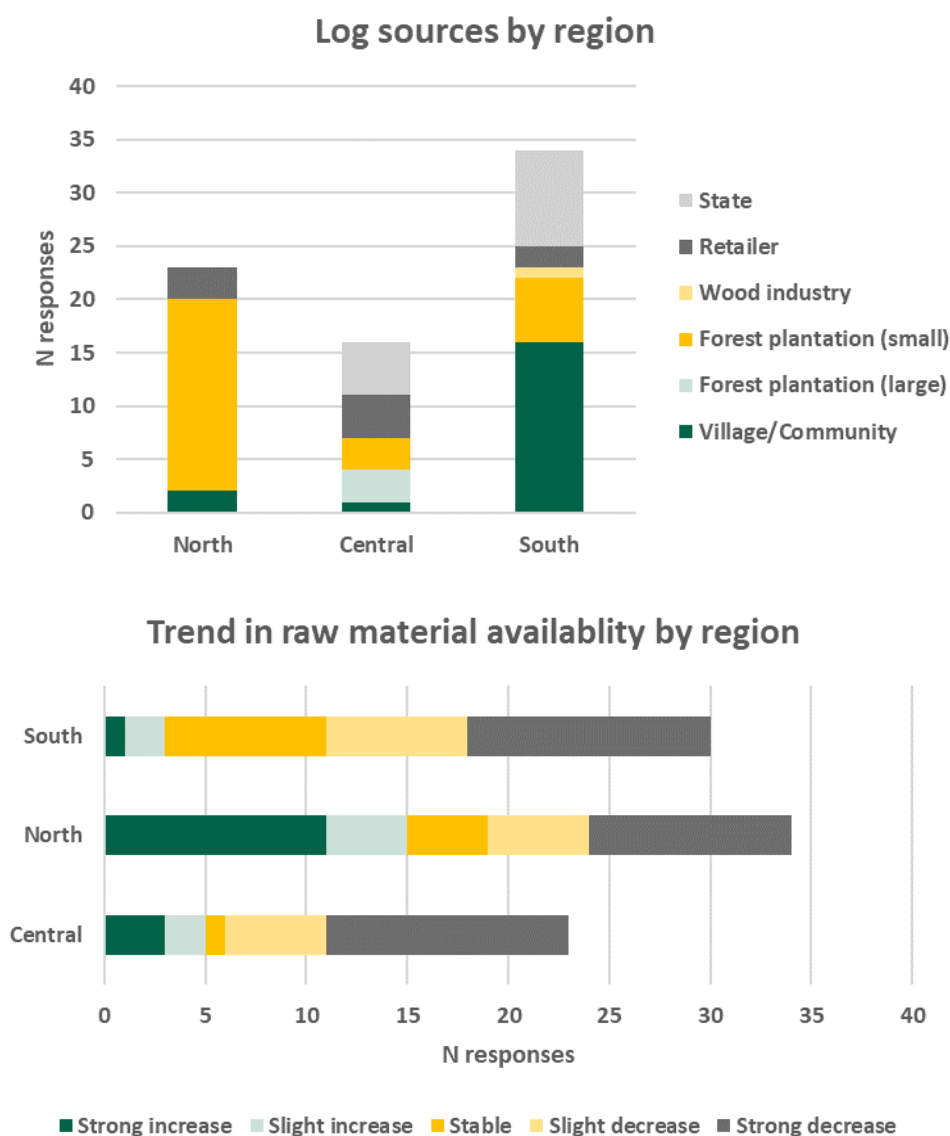
Figure 20: Sources of industrial roundwood (top) and trends in raw material availability (bottom) by region

Sources: Survey data for the year 2020 (N=87; multiple answers)

The most important raw material for enterprises was industrial roundwood (logs). Especially the enterprises in South rely on roundwood intake, whereas the enterprises in Central and North put more emphasis on a wide mix of raw materials. (Figure 21)

Raw material intake by region

Raw material intake by sub-sector
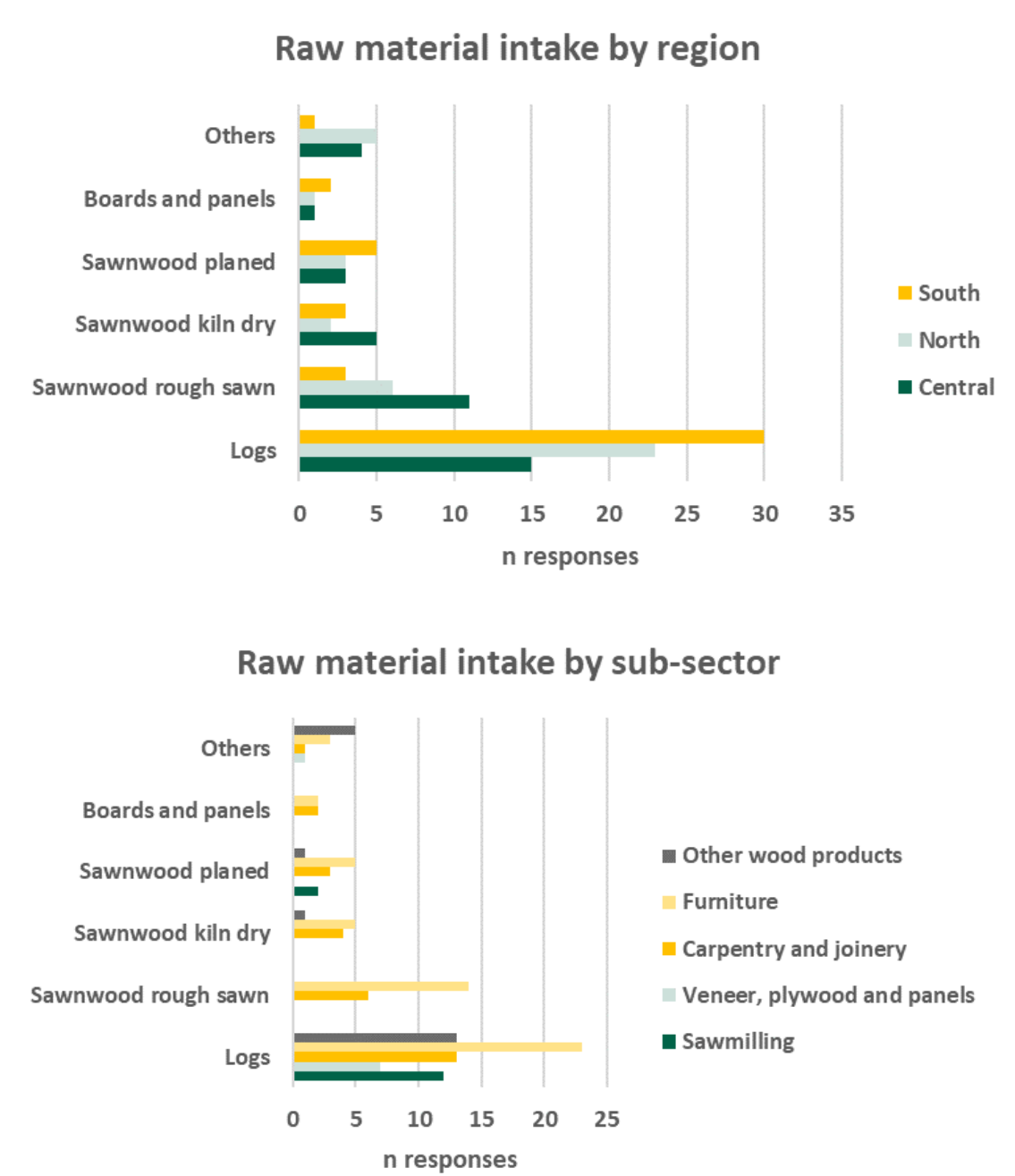
Figure 21: Raw material intake by region (top) and by sub-sector (bottom)

Sources: Survey data for the year 2020 (N=87; multiple answers)

There is a clear regional differentiation regarding species consumption in wood processing in-dustries. In the North, Teak was the major species for intake. In Central and South, natural forest

species were more important. Other plantation species (i.e., Eucalyptus and Rubberwood) were used across all regions, but at lower frequency[26].

In total, Teak was the most important source of industrial roundwood. On the other hand, enterprises that sourced pre-processed products, mainly drew on natural hardwood sawnwood. (Figure 22)
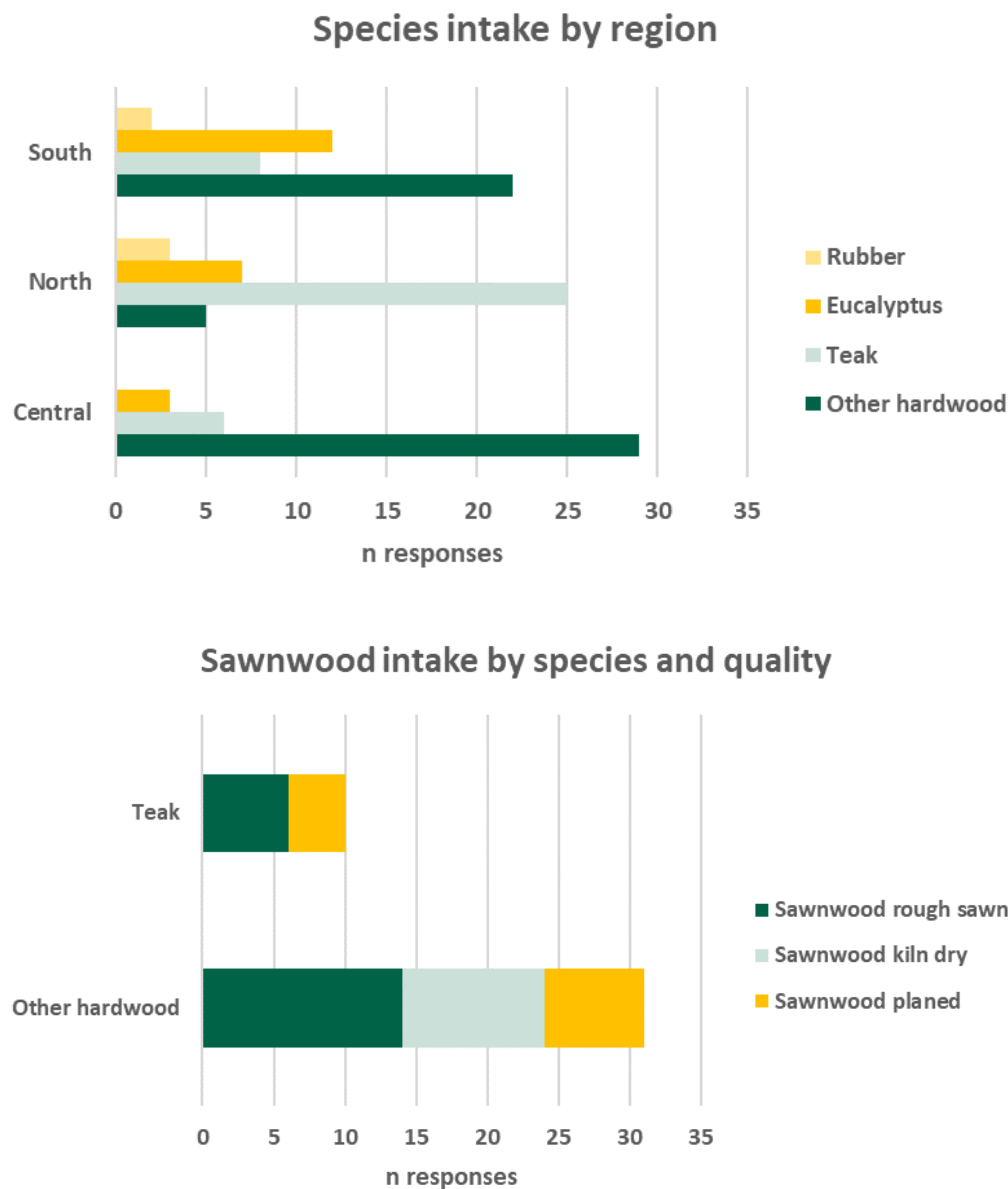
Figure 22: Raw material species use by region (top) and sawnwood species (bottom)

Sources: Survey data for the year 2020 (N=87; multiple answers)

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[26] This despite the potentials offered by the substantial rubberwood resources and increasing eucalyptus areas (See Midgley, 2019; Smith,2021). Reasons for low employment of rubberwood and eucalyptus were not assessed for this study.

The analysis of intake products by size of surveyed enterprises revealed a gradient from large to micro scale business units: Larger enterprises were sourcing more logs and more plantation species, while small enterprises increasingly drew on pre-processed products and used a higher share of natural forest species (Figure 23).

Sourcing logs, enables the enterprises to optimize internal value adding and to control product quality from start to end. However, it requires investments in sawmilling technology, drying facilities and related process management. The smaller enterprises are severely challenged by the current circumstances (reduced offer of industrial roundwood and increasing requirements for finished wood products manufacturing; chapter 3.4.1) and limited offer or basic sawnwood due to reduced number of sawmills (chapter 3.5.1).
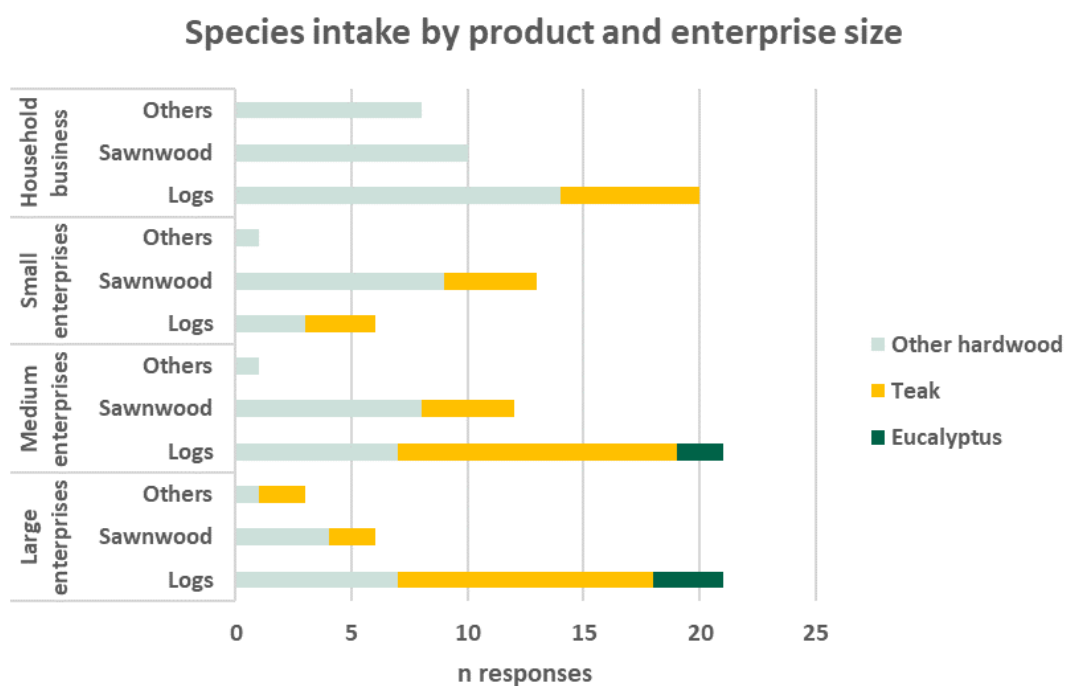
Figure 23: Raw material intake by products, species, and enterprise size class

Sources: Survey data for the year 2020 (N=87; multiple answers)

3.6.4 Raw material quality

Quality deficiencies of intake raw materials occurred frequently (68 of 87). Many enterprises reported substantial quality problems. The share of raw material that had to be discarded due to quality deficiencies was considerable and ranged between ca. 10% and 25%. (Figure 24)

Quality problems of intake raw material

■ Logs   ■ Sawnwood rough sawn   ■ Sawnwood kiln dry   ■ Sawnwood planed

Discard of raw material due to quality deficits

■ Logs   ■ Sawnwood rough sawn   ■ Sawnwood kiln dry   ■ Sawnwood planed
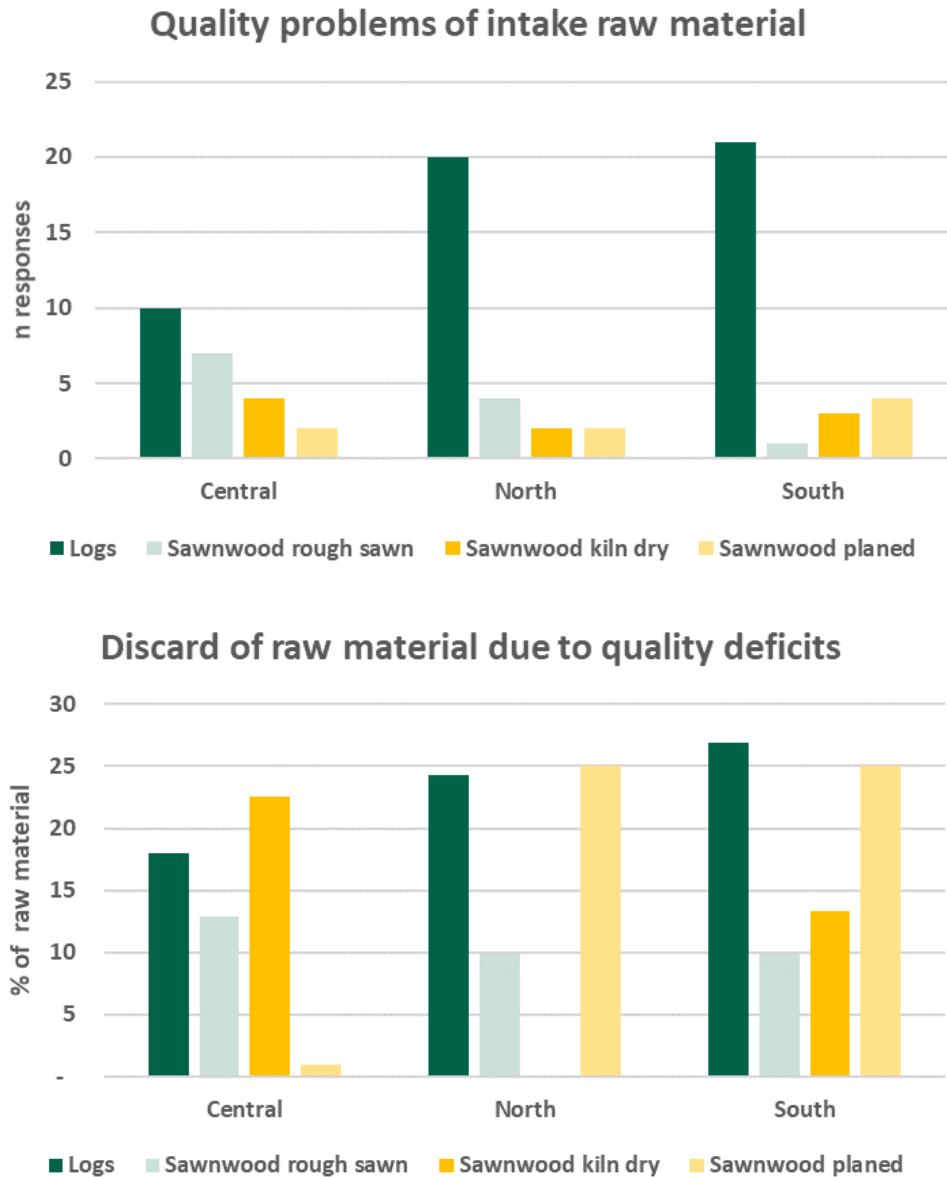
Figure 24: Quality problems (top) and raw material discard rate (bottom) by intake product

Sources: Survey data for the year 2020 (N=68; multiple answers)

The most important quality deficit mentioned by the surveyed enterprises were cracks and splits of logs and sawnwood. This was result of inappropriate harvesting, transport, storing and drying processes (Figure 25).

Another common quality problem resulted from premature harvesting of trees (natural hardwoods and teak), resulting in poor heartwood recovery rates and small dimension logs that are not suitable for the processing equipment.

Further, natural hardwood showed a high share of quality deficiencies resulting from wood decay. As main reason was mentioned that these logs and boards had been on stock for several years (i.e. confiscated timber, pre PMO 15 stocks).

Insects induced quality problem seemed to be more relevant for Teak raw materials than for natural hardwoods.

The enterprises` good overview of raw material quality deficiencies may be attributed to the Decision 0777/MOIC.DIH, 2020 on monitoring of inputs and outputs in the wood industry. Though, the regulation was not actively articulated as a quality management support tool (compare chapter 3.6.7).

None of the enterprises mentioned that they source logs and other inputs in line with technical quality standards as e.g. proposed by Fitzgerald and Hopewell (2014) or grading systems as required by the Forest Law. The later was probably not mentioned because it is not perceived as a tool for quality management.
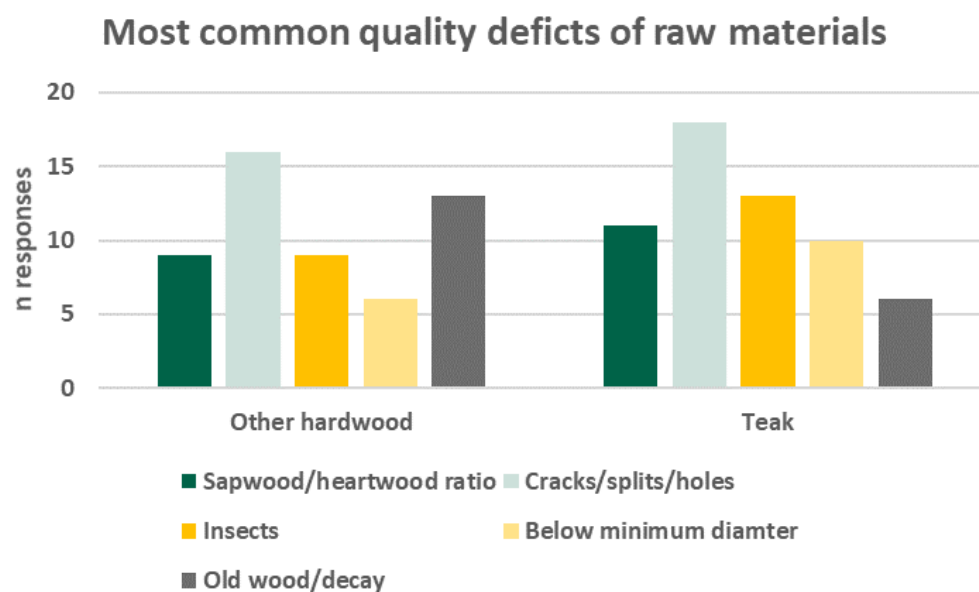
Figure 25: Most common quality deficiencies by main species groups

Sources: Survey data for the year 2020 (N=68; multiple answers)

3.6.5 Products and buyers

The most important products for sale were furniture and builder´s joinery (Figure 26). Most of these products were made of natural forest hardwoods, but Teak products also held substantial shares. Basic sawnwood derived products were mainly produced from Teak. Veneer and ply-wood were produced from Eucalyptus (peeled) and natural hardwoods (sliced).

Products by species
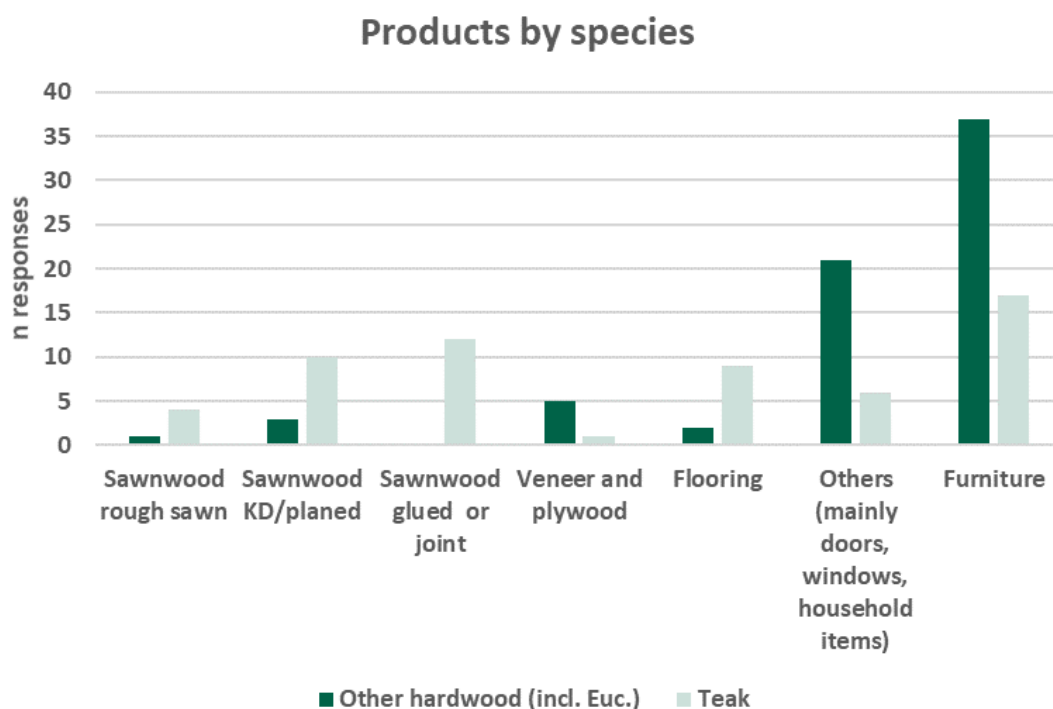
Figure 26: Wood products produced by species

Sources: Survey data for the year 2020 (N=87; multiple answers)

According to the buyers´ analysis, the predominant market destinations of the surveyed enter-prises in Central and South were within the producers´ regions (Figure 27). Across all regions, the share of domestic market destination ranged between ca. 60% and 70%. The highest export shares were identified for the enterprises in the Northern region.
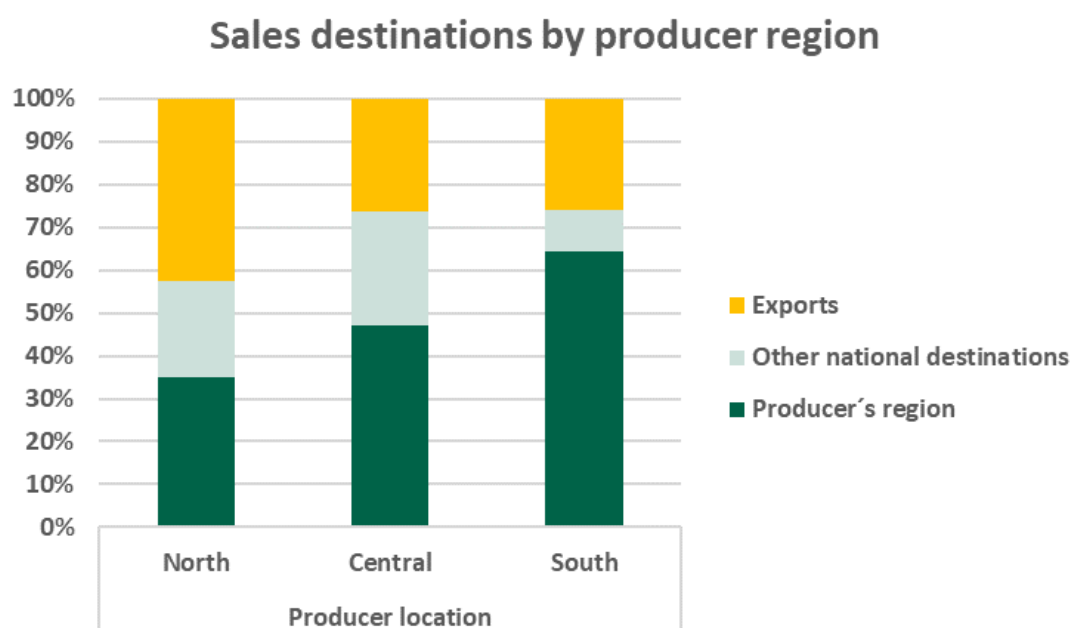
Figure 27: Sales destinations by producer location

Sources: Survey data for the year 2020 (N=87; multiple answers)

The vast majority of the surveyed enterprises produced furniture (complete or parts) for private households in the domestic market (Figure 28). Other wood products were the second important products group, mainly sold to households and retailers.

The domestic demand trends over the past three years were perceived negative, with most of the enterprises identified decreasing demand for the main products groups. However, this perception may be biased by the CoViD-19 induced market distortion ins 2020.

Furniture was also the main product for the international market (Figure 29). The main buyers originated from the furniture sectors abroad. Other important export products were glued and joint sawnwood products and veneers and plywood. These products were mainly sold to foreign wood industries or retailers.

Overall, the international market trends were perceived more positively than domestic market developments. Nonetheless, for furniture, diverging market experiences were shared, with a substantial share of responses indicating a decrease in demand.

Product sales by domestic buyers

Legend:
- Furniture sector
- Other secondray wood processing
- Construction sector
- Retailer/Intermediary
- Private household

Domestic demand trends by products

Legend:
- Strong decrease
- Slight decrease
- Stable
- Slight increase
- Strong increase
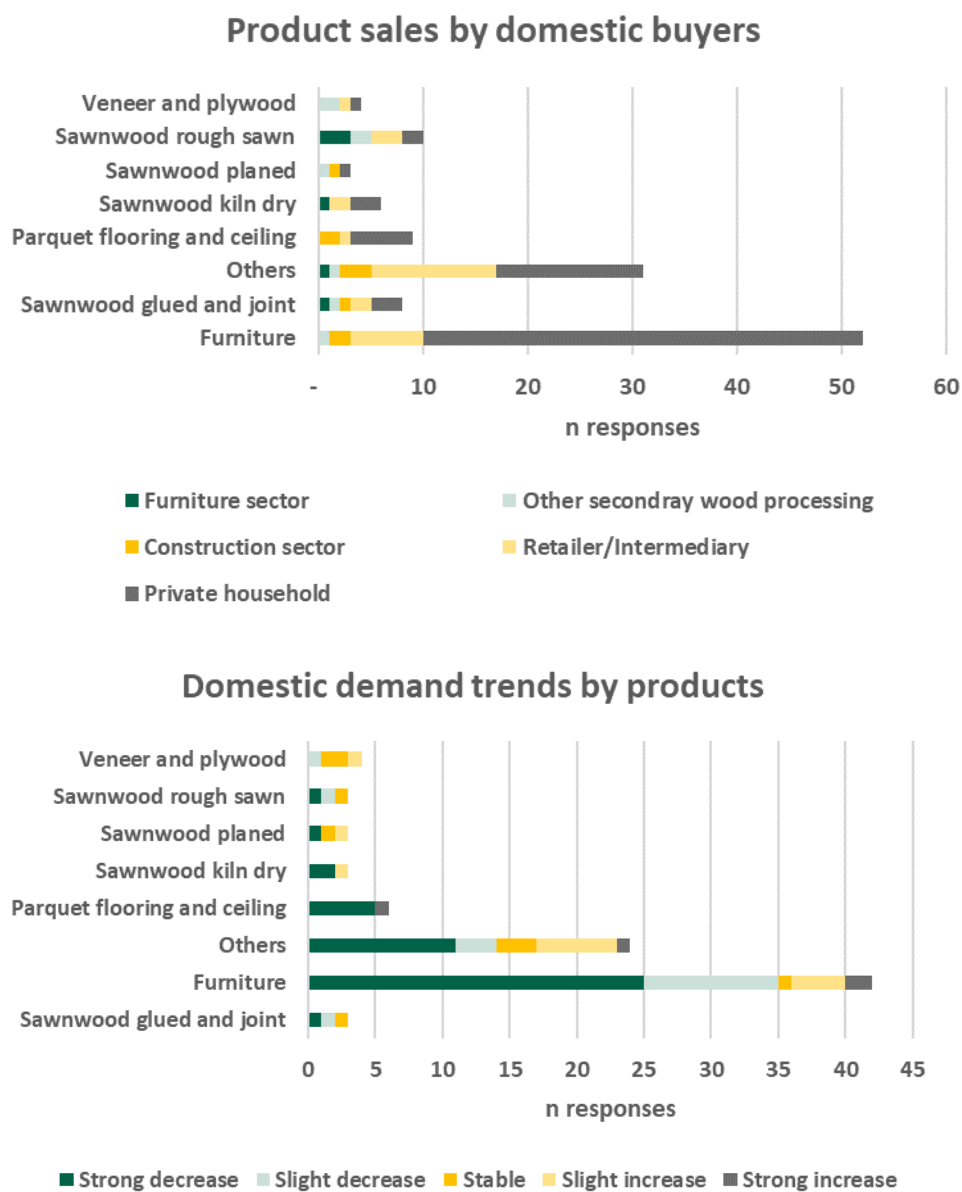
Figure 28: Products sold by buyer type (top) and demand trends (bottom) in domestic markets

Sources: Survey data for the year 2020 (N=87; multiple answers)

Product sales by export buyers

Export demand trends by products
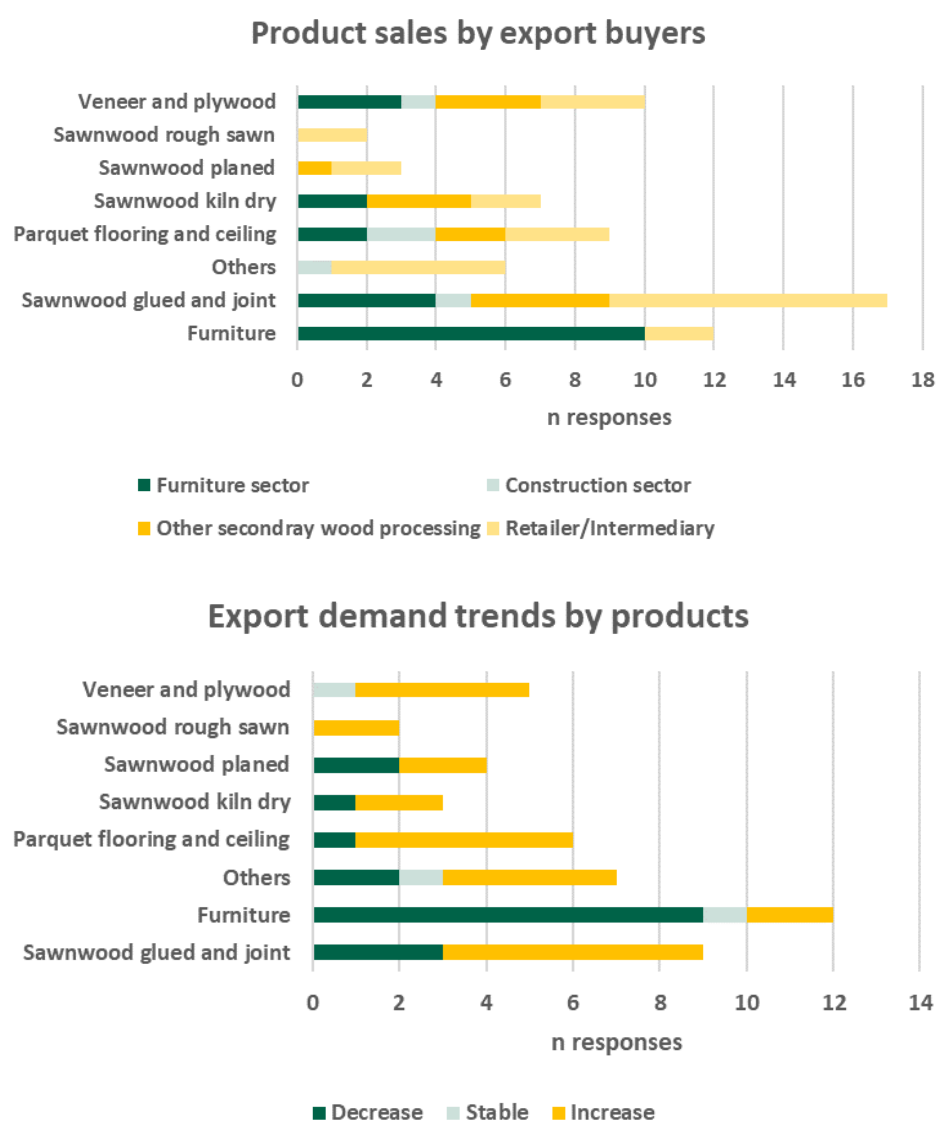
Figure 29: Products sold by buyer type (top) and demand trends (bottom) in export markets

Sources: Survey data for the year 2020 (N=87; multiple answers)

3.6.6 Condition of equipment and investments

The enterprises generally stated that the equipment they are currently operating is suitable for their purposes and production targets. Nonetheless, the survey revealed that knowledge about the equipment's optimal production capacities and technical specifications was low. Hence, a detailed analysis of the machinery was not possible due to lack of a critical mass of responses to the related questions.

On average, most of the machinery in use was purchased less than 10 years ago (Figure 30). Exceptions were found in medium sized carpentry and sawmilling enterprises and small furniture business. The age of machinery in these enterprises was more than 12 years (on average).

Overall, the enterprises rated the condition of their equipment as good, with only low intensity of repairs across all size classes and sub-sectors.

Age of main equipment

Condition of main equipment

Good (less than monthly repairs) ■ *Medium (monthly repairs)* ■ *Poor (weekly repairs)* ■
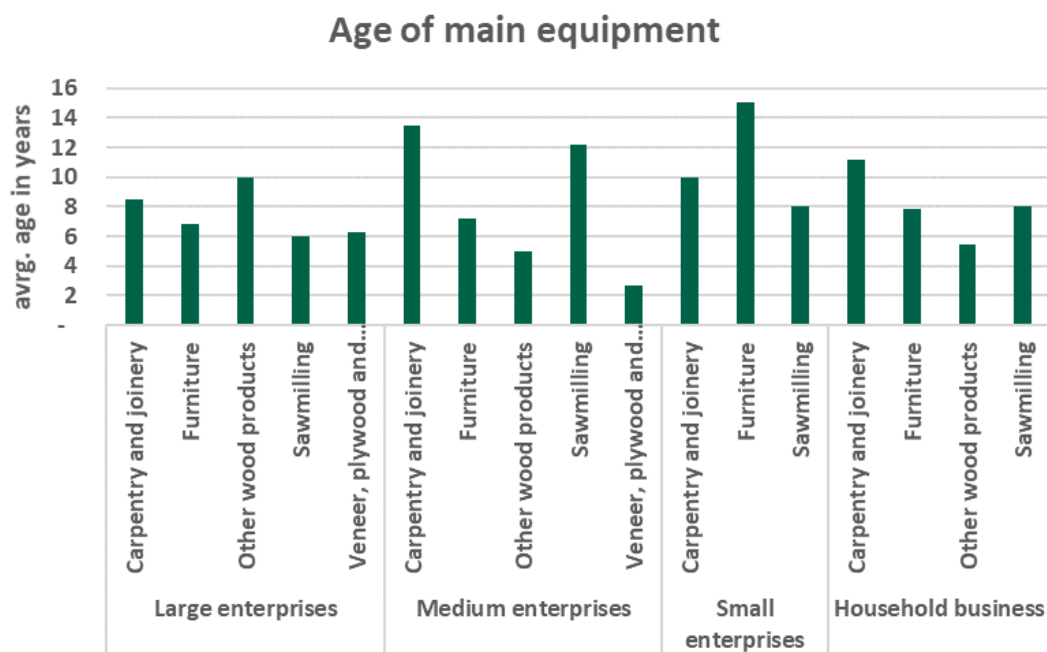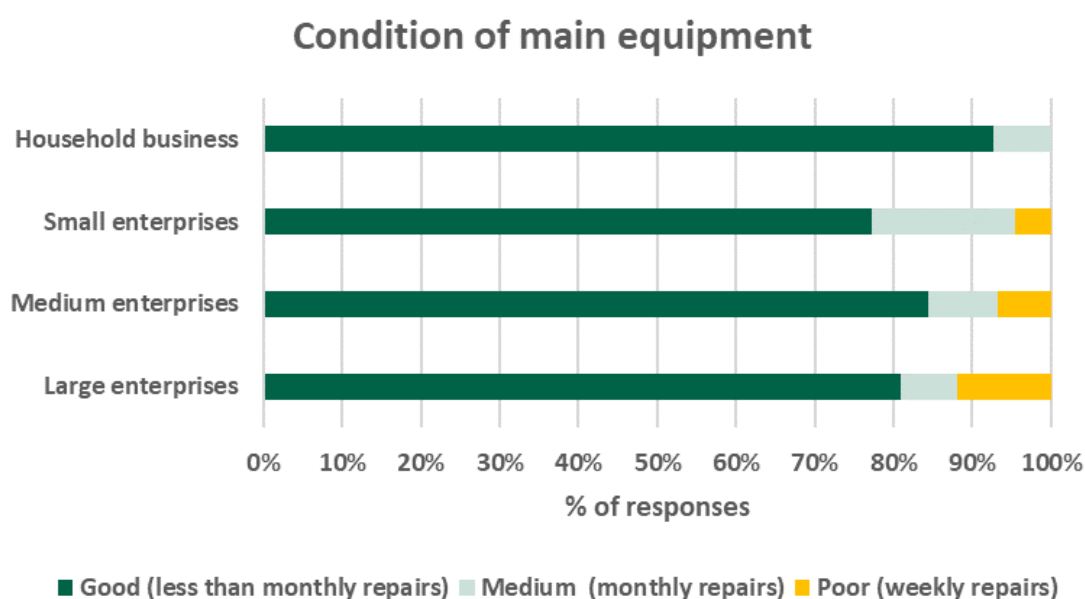
Figure 30: Age (top) and condition (bottom) of equipment by size class and sub-sector

Sources: Survey data for the year 2020 (N=87; multiple answers)

Many enterprise plan investments in new machinery or upgrades (Figure 31). The analysis could not identify a specific pattern according to sub-sectors or enterprise size classes.

Large and medium enterprises` average planned investment volume was from several thousand up to 100,000 US$. One small enterprise even planned to invest 200,000 US$. However, the investment volume analysis was based on a very low number of responses (20 of 87).

The enterprises, who planned investments did barely mention serious problems in accessing the required capital. Most commonly they mentioned commercial and private lending being the main sources for financing. Others planned to use own equity to realize the investment[27].

It is important to note that previous surveys in manufacturing sectors in Lao indicate general capital shortage among enterprise and significant difficulties in accessing financing for investments (a common problem for Laotian SMEs as described by World Bank 2018a, 2019 and OEC, 2018).

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[27] NOTE: The question on financing sources was only answered by the enterprises who planned investments, and thus may have secured access to finance.
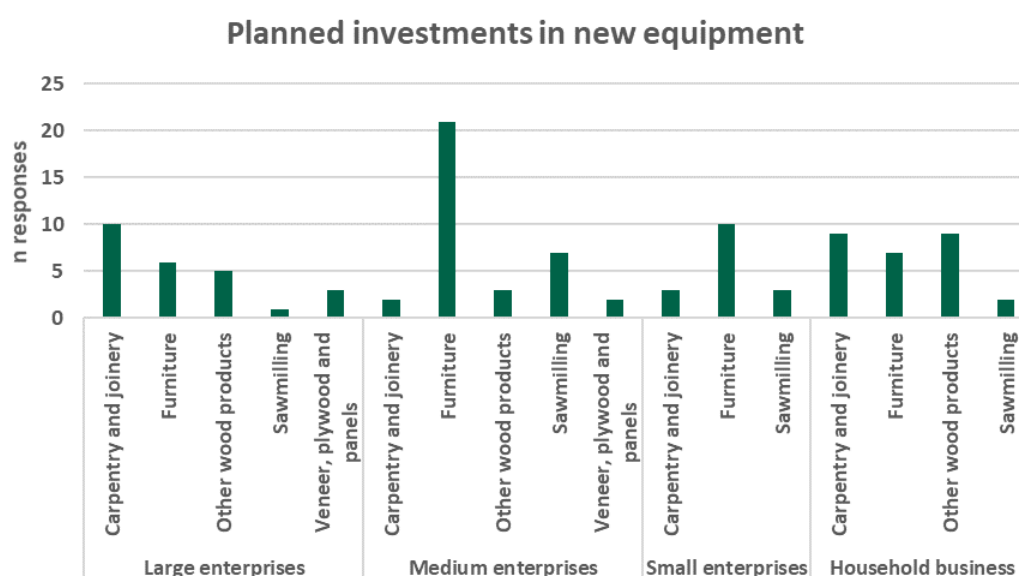
Figure 31: Planned investments by size class and sub-sector

Sources: Survey data for the year 2020 (N=20; multiple answers)

3.6.7 Product quality and quality management

Although the enterprises stated that their equipment would produce the quality required by the market, numerous product quality issues were raised. Thereby, rejection of products was more common by domestic buyers than by foreign buyers (Figure 32).

The most common problems that caused buyers` rejections in the domestic market occurred in the manufacturing of other wood products (namely doors and windows) (Figure 33). The quality deficits in this product group were mainly induced by high moisture content / inappropriate drying of the processed wood. The quality issues identified for furniture products were mainly related to color defects or to production errors (e.g., poor joints and surface treatment).

Export products did not experience as many quality issues as products directed to the domestic market. Nonetheless, the most common problems across all product groups for export were drying related problems and color errors. Further, transport damage was a common reason for buyers to reject the product.

Rejections due to quality problems

Percent rejected due to quality problems
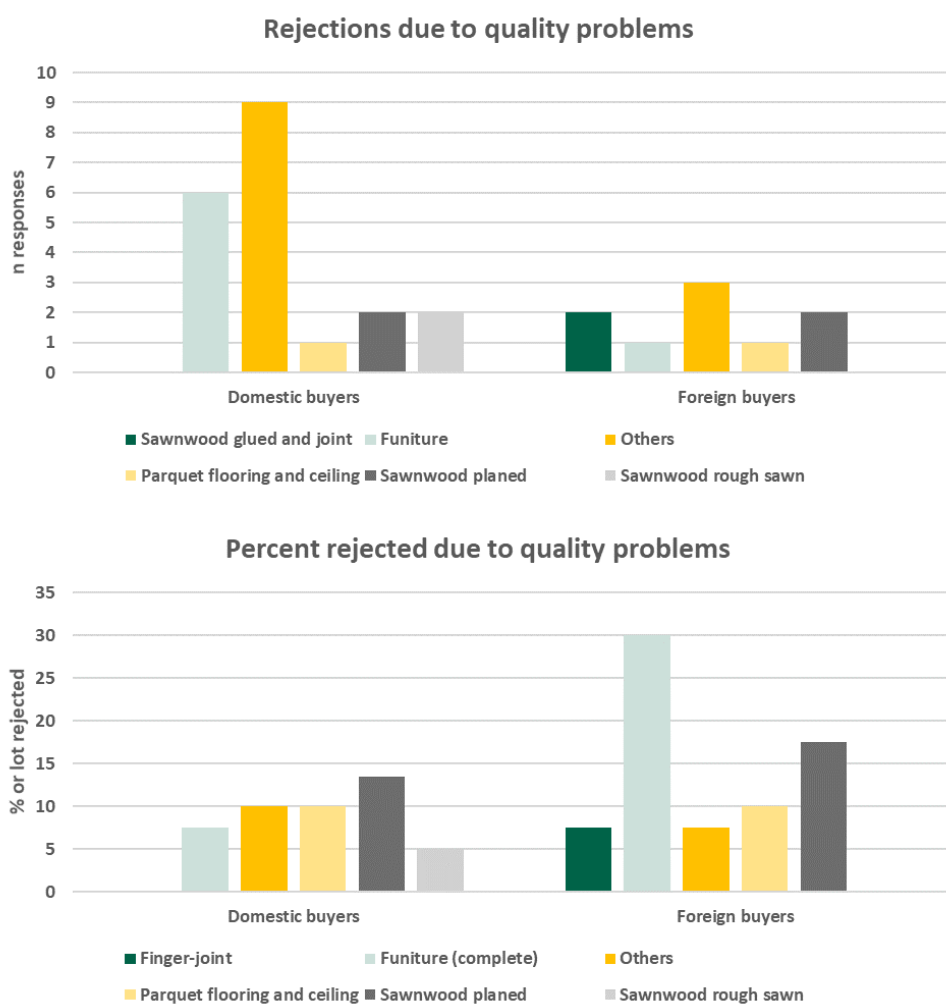
Figure 32: Buyers´ rejections due to quality problems by location (top) of buyer and sub-sector (bottom)

Sources: Survey data for the year 2020 (N=29; multiple answers)
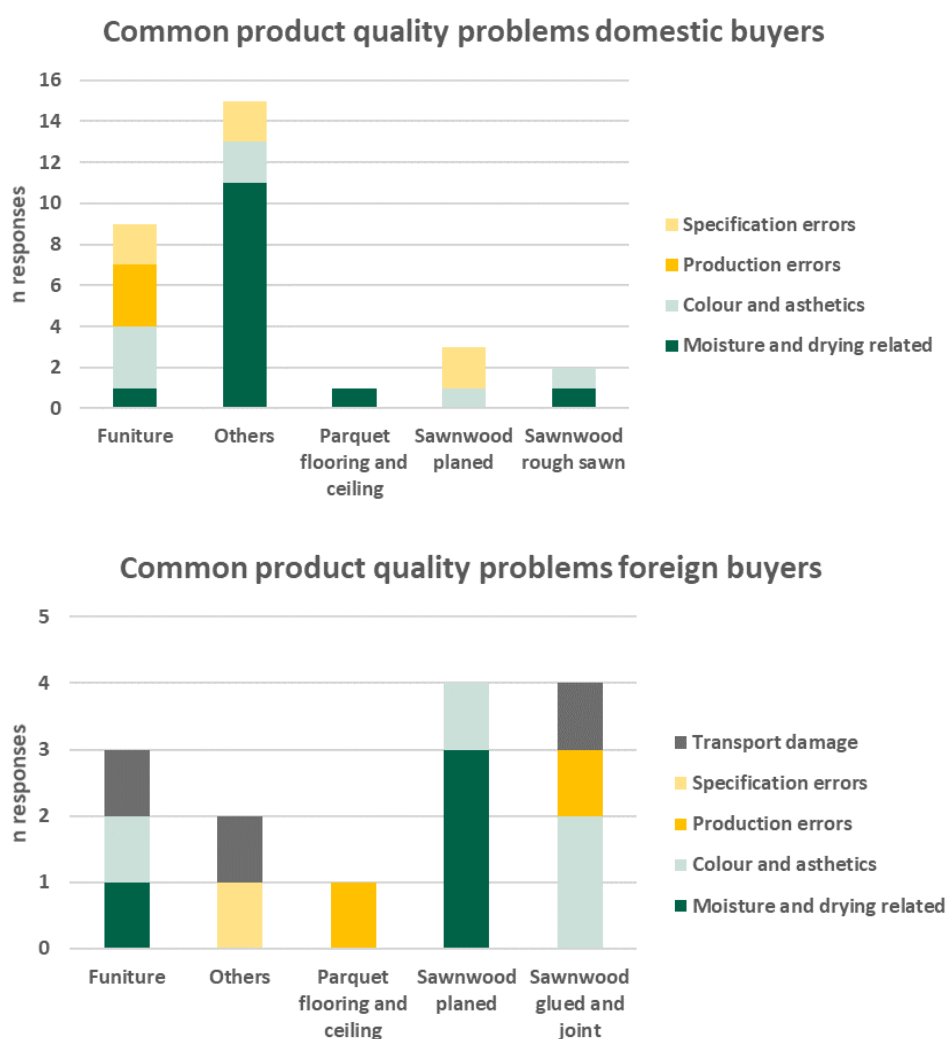
Figure 33: Common product quality problems by sub-sector (top) and market destinations (bottom)

Sources: Survey data for the year 2020 (N=29; multiple answers)

None of the surveyed enterprises applied an audited quality management system (e.g., according to ISO). When asked for quality standards, they mainly stated compulsory product declarations, i.e., the Lao Certificate of Origin (CO) and the Sanitary and Phytosanitary (SPS) requirements. In fact, both are not quality standards (see also Table 17 for legal references governing the wood sector in Lao).

The MOIC decisions 0222 of 2021 on Wood Processing Factories and 0777 of 2020 on the Management and Monitoring of Timber Input and Output, were not actively mentioned as national regulations that influences quality management of processes. Though, both regulations provide for the basic elements of process quality and clearly articulate the intention to raise process quality in Lao´s wood processing enterprises.

No international standards (as e.g. listed in Table 20) were mentioned by the respondents. However, product requirements for export are specified by the clients, who may draw on such standards when describing their order requirements.

The results to these questions show a low awareness in the enterprises regarding product and process quality management.

Only four enterprises, supplying the Asian export market, mentioned that they complied with standards set by the buyers in Thailand and Japan; i.e., to ensure the color of furniture and wood products` surfaces.

Buyers are frequently implementing quality control themselves (Figure 34). This, mainly in the furniture sector and production of other wood products (doors, windows, household items). There were three major approaches of such buyers` implemented quality management:

- In many cases the buyers inspect the product order before shipping.
- Further, several enterprises were run by expats that understand international market requirements and product grading.
- As a third reason for good export qualities, the enterprise mentioned that they employed foreign labor with better skills for operating the machinery.
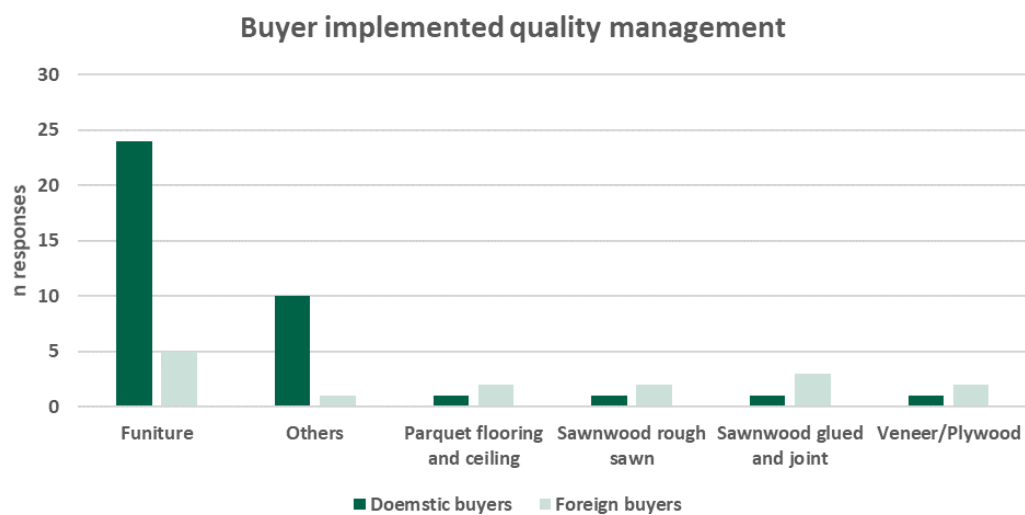
Figure 34: Buyer implemented quality management by product group

Sources: Survey data for the year 2020 (N=87; multiple answers)

3.6.8 Employment structure

The total employment in the surveyed enterprises amounted to 1,469. Of these, 46% were employed in the Northern region (678 workers), 34% in Central (504) and 20% in the South (287). (Table 27)

The enterprises in Central and South reported that they mainly employ permanent personnel (58% and 66%of employees). On the other hand, the employment structure in the North indicates a higher share of casual labor (52% of employees). The share of female employees was particularly low in the South.

Table 27: Permanent and casual employment in survey enterprises by gender and region

Region	Permanent contract			Casual contract			% permanent	% casual	Total
	To-tal	Wo-man	% woman	To-tal	Wo-man	% woman			
North	327	137	42%	351	138	39%	48%	52%	678
Central	292	131	45%	212	76	36%	58%	42%	504
South	189	41	22%	98	23	23%	66%	34%	287

Sources: Survey data for the year 2020 (N=87)

In the Northern region, most employment was recorded in the carpentry and furniture sub-sectors, and sawmilling, compared to other regions. In the Central region, most employment was identified in veneer and plywood manufacturing, and in the South in carpentry and joinery enterprises. The lowest share of female employees was identified in the South (Table 28).
The largest enterprises were veneer and plywood producers in the North and Central regions. In general, the smallest units were recorded in the South. A significant difference occurred in the furniture sub-sector, where enterprises in the North employed three times more persons than the furniture manufacturers in Central and South.

Table 28: Total employment and average employees per enterprise in survey enterprises by region and sub-sector

Wood sub-sector / Region	Total employment			Average employees per enterprise		
	North	Central	South	North	Central	South
Sawmilling	123	0	5	12	-	5
Veneer, plywood and panels	120	150	74	60	75	37
Carpentry and joinery	201	100	108	25	25	14
Furniture	205	107	91	23	8	7
Other wood products	29	147	9	15	25	2
Total	**678**	**504**	**287**	**22**	**19**	**10**

Sources: Survey data for the year 2020 (N=87)

Most employees did not have a formal degree relevant for their job profile in the enterprise. Only in the Central region, a relevant share of employees held basic and advanced degrees. (Figure 35)
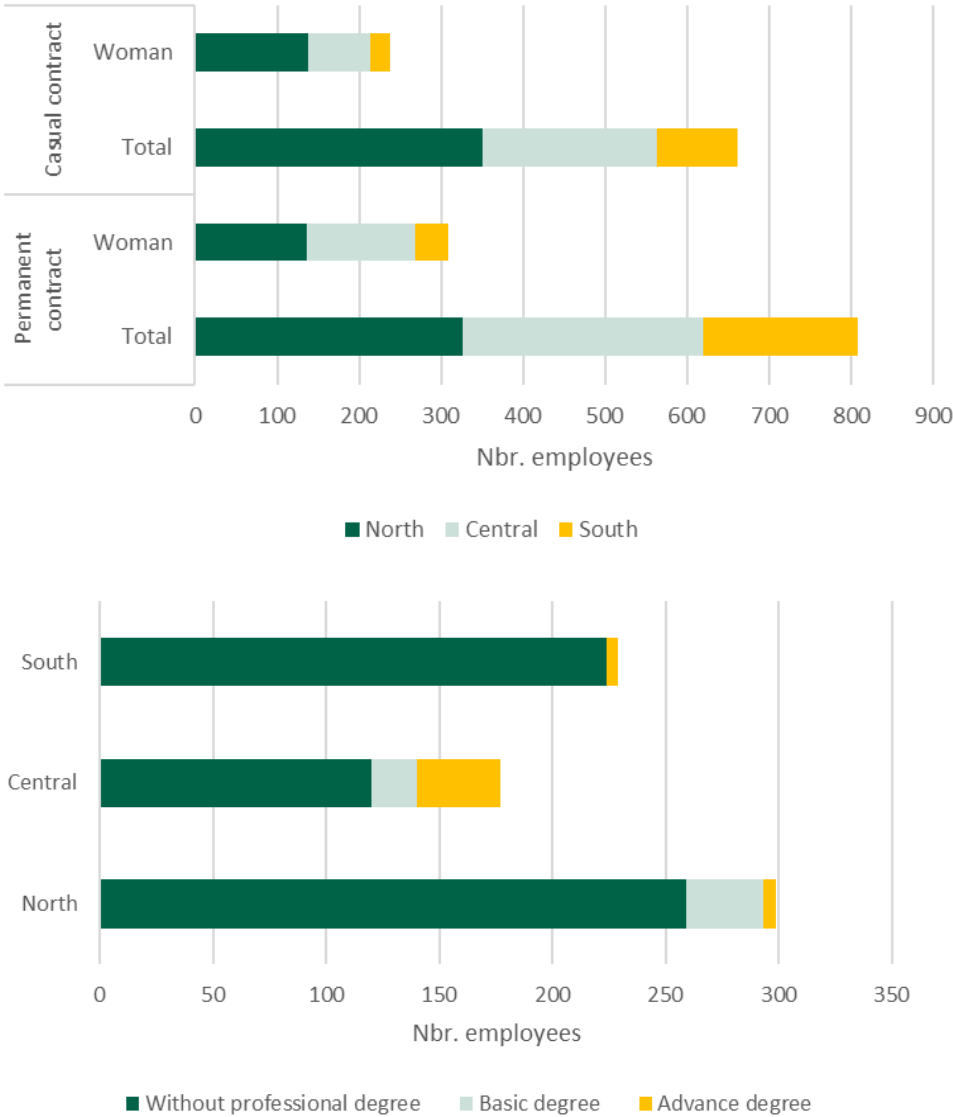
Figure 35: Employment by gender (top) and education (bottom) in survey enterprises

Sources: Survey data for the year 2020 (N=87)

3.6.9 Occupational health and safety[28]

Most of the companies did not have a position for human resources management. In general, company level OHS systems were not widely spread: complaints management, emergency response measures or written manuals were only available in medium and large enterprises (Figure 36).

Figure 36: HR and OHS systems in survey enterprises by region (top) and size class (bottom)

Sources: Survey data for the year 2020 (N=87)

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[28] The assessment of the OHS situation in the survey enterprises was based on the self-assessment of the companies. When respondents said that they apply a specific HR or OHS systems, this may be true. However, it is not clear whether they reach the levels of standards as e.g. required by ISO of IFC performance standards.

Ca. 50% of the companies indicated that they regularly train their permanent staff in the use of the machines. Permanent staff is usually endowed the personal protective equipment (PPE) and had regular breaks (Figure 37).

In contrast, the majority of casual workforce was not regularly trained. However, also casual labor was regularly equipped with PPE, though a lower rate than permanent staff. [29]

There were no significant differences between the regions in this analysis loop.
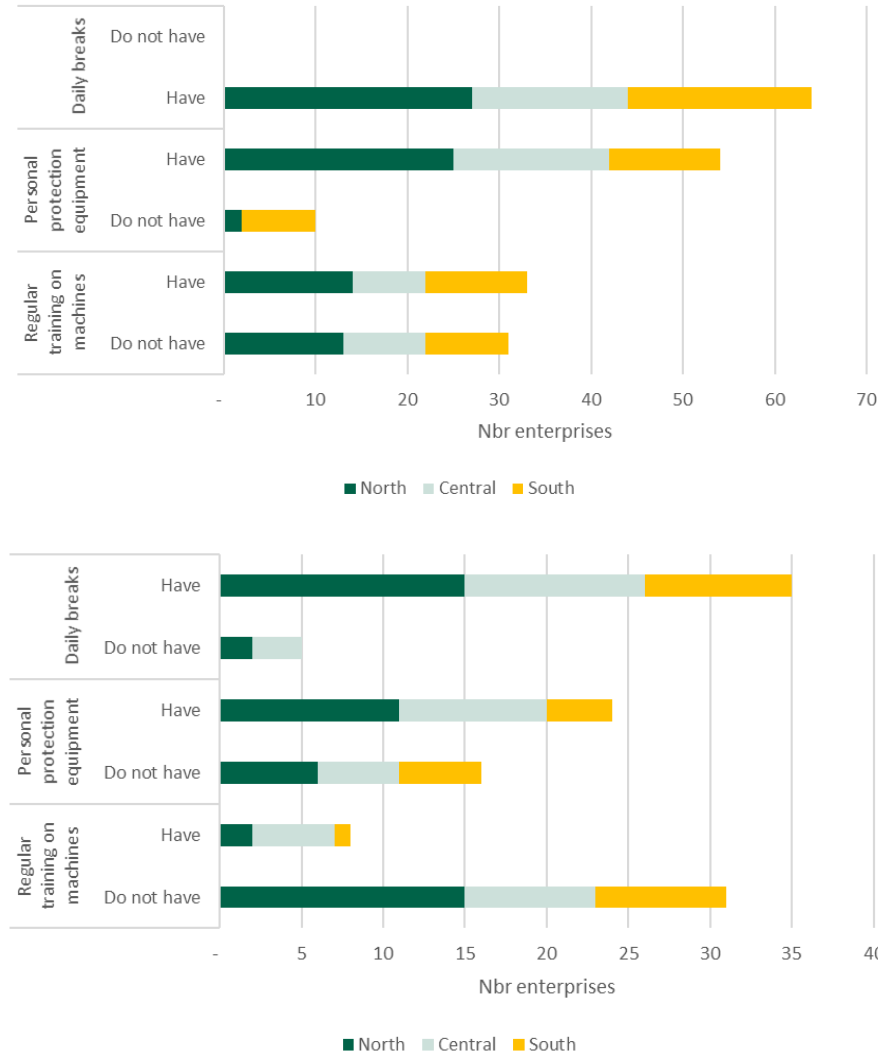
Figure 37: Safety and health conditions for permanent (top) and casual (bottom) employees in survey enterprises

Sources: Survey data for the year 2020 (N=87)

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[29] During company visits, it was observed that the facilities to apply varnishing and painting in smaller companies, are barely endowed with ventilating systems.

3.6.10 Working conditions

Most permanent and casual employees did not have written contracts, indicating that compliance with national labor legislation in this regard is low.[30] Permanent employees received monthly fixed salaries above the minimum wage in Lao. However, also performance-based payment schemes were common. Casual labor was mainly paid per hour, but some also received a fix monthly salary. (Figure 38)

Health insurance, paid vacations and paid maternal leave were not common. However, some larger enterprises were offering these benefits. Thereby, permanent employees benefited more often from these than causal employees. (Figure 39)
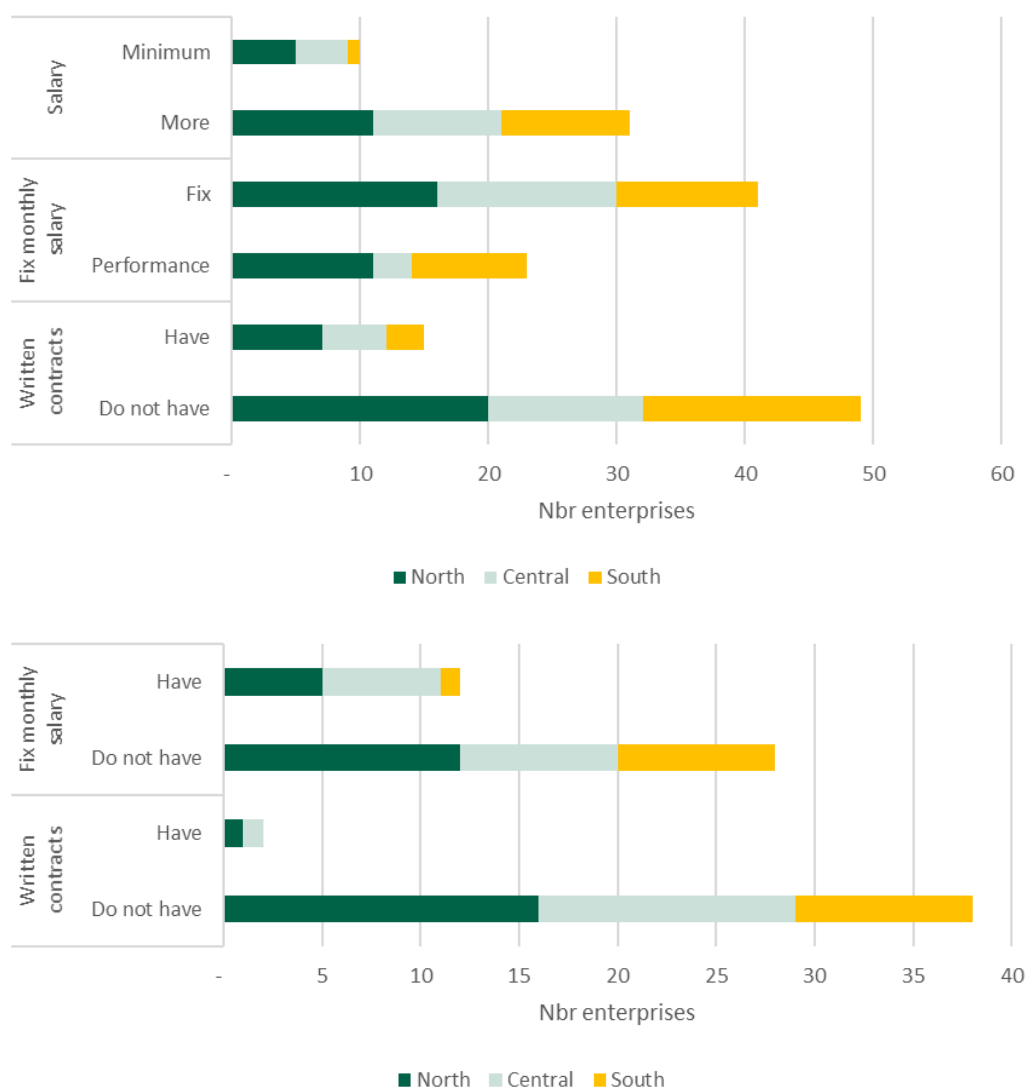
Figure 38: Salary arrangements for permanent (top) and casual (bottom) employees in survey enterprises

Sources: Survey data for the year 2020 (N=87)

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[30] According to Law 43/NA 2013: 77 employment contracts must be made in writing in cases where one party or both parties are a legal entity or organization.
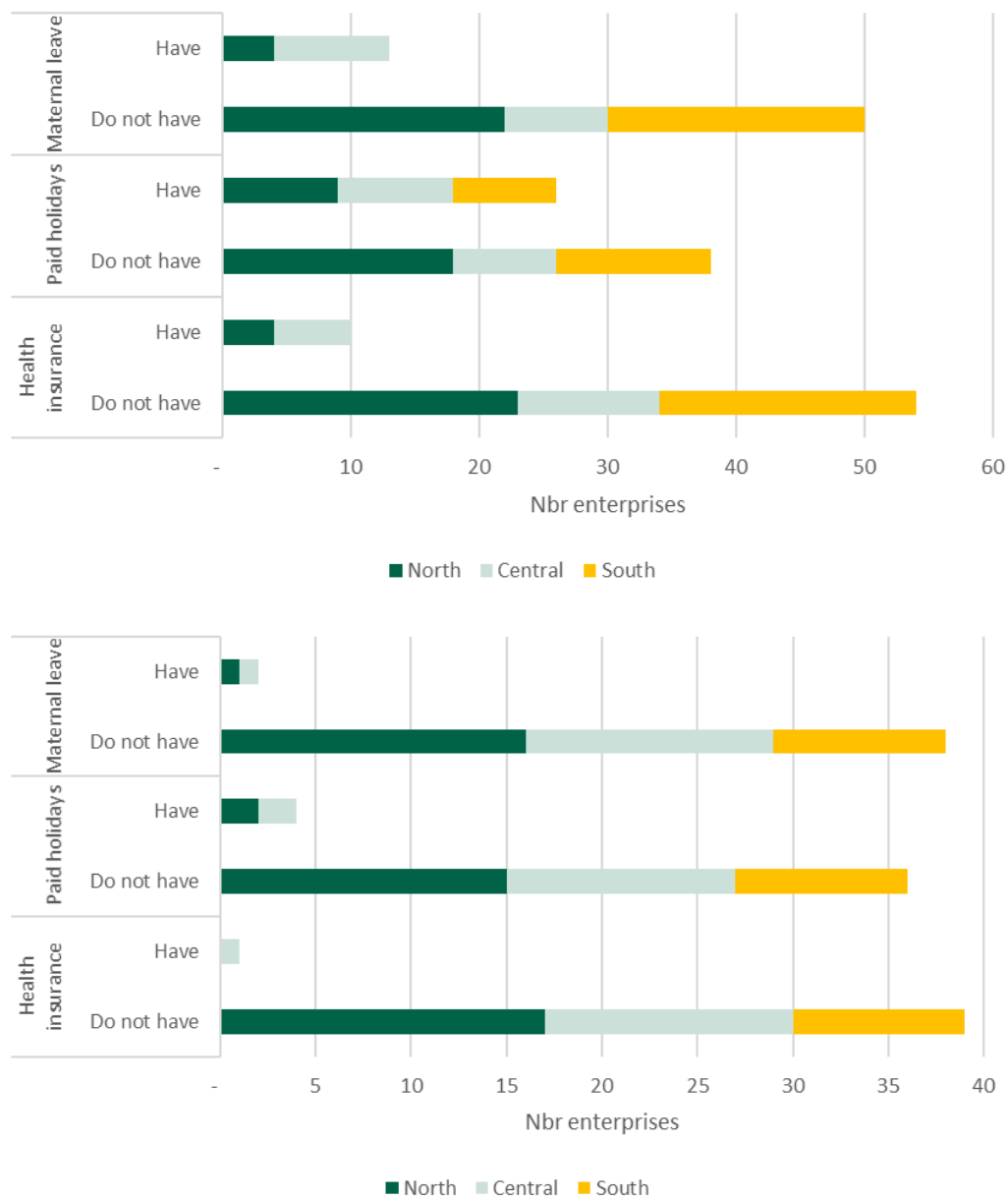
Figure 39: Social benefits for permanent (top) and casual (bottom) employees in survey enterprises

Sources: Survey data for the year 2020 (N=87)

3.6.11 Role of sector associations

Only 40% of the enterprises stated that they were members of an association (Table 29). Thereby, the list of associations was led by PCCI/LNCCI membership, membership in local level wood processing/furniture groups and membership in the national furniture/wood processing associations.

Table 29: Membership in associations of survey enterprises

Level of organization	Name of association	N responses
National	PCCI/LNCCI	14
Local	Furniture and wood processing groups/One District One Product (ODOP)[31]	11
National	Lao Furniture Association	7
National	Lao Wood Processing Association	2
local	Plantation cluster products	2
	Total	36

Sources: Survey data for the year 2020 (N=36)

The enterprises rated the usefulness of the membership for them quite differently. Ca. half of them mentioned at least a certain level of usefulness of the memberships, the other half was more reluctant or negative about their membership´s usefulness (Table 30). As main benefits of the membership in the associations, the enterprises identified access to information and improved access to markets (Table 31).

Table 30: Usefulness of association membership rated by survey enterprises

Usefulness of membership	Nbr enterprises	Percentage
Very useful	2	6%
Useful	17	47%
Neutral	7	19%
Not useful	10	28%
Total	36	100%

Sources: Survey data for the year 2020 (N=36)

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[31] One District One Product (ODOP) is a program run by the Government of Lao and the Japanese International Cooperation (JICA). It aims at creating marketable products by improving quality and market access, among other constraints. The program specifically promotes local small businesses.

Table 31: Benefits of association membership rated by survey enterprises

Benefits of membership	Nbr Enterprises
Information about relevant topics	9
Improved access to markets	7
Discounts and access to fairs	4
Contacts to customers and suppliers	4
Others	5

Sources: Survey data for the year 2020 (N=29)

When asked for potential to improve the usefulness of the membership in sector associations, the enterprises listed several topics. Most importantly, the enterprises would like to see more support from associations to access financing for investments and improved dissemination of relevant sector information. (Table 32)

Table 32: Improvements of membership association proposed by survey enterprises

Improvements of membership	Nbr responses
Facilitate access to finance	4
Dissemination of information	4
Facilitate access to markets	3
Dissemination of wood quota information	3
Improved lobbying at policy level	2
Organizing and visiting exhibitions	2

Sources: Survey data for the year 2020 (N=18)

3.6.12 Impact of regulations

The surveyed enterprises mentioned several adverse effects of regulations on their activities. Thereby, the mentioned regulations were either directly interfering with the enterprises` business operations or were caused by the enabling business environment at national level. Frequently, the respondents did not identify the name or source of a specific regulation. Thus, the interpretation of the answers remains vague for certain contexts. Table 33 provides an overview of the most frequently mentioned regulations and their level of interference. Figure 40 illustrates the frequency of answers corresponding to the regulatory context in Table 33.

Table 33: Overview of adverse effects of regulations on wood sector enterprise operations

Level of interference with operations	Respondents mentioned adverse effects on their business operations due …	Related regulations
General competitiveness	PMO 15 in general	PMO 15 of 2016
	Unfair competition by informal sector	Lack of law enforcement.
Sales	Export regulations/restrictions	MOIC Decision 0939 of 2019 and precedent and related regulations.
Sourcing	Poor raw material access/shortage	PMO 15 of 2016 and Forest Law 2019
	Timber bidding process (poor notification, large lot sizes)	Way how MOIC Decision 1726 of 2012 is implemented. PMO 15 worsened situation by restricting raw material access.
	Crowding out by foreign buyers (large lot sizes, timber auctions)	
Business processes	Bureaucratic harvesting and transport license	General sector governance; situation worsened due to CoViD induced restrictions.
	Complicated Certificate of Origin procedures	MOIC Decision 1031 of 2010 and successor / related regulations.
	Licensing requirements for household enterprises	MOIC decision 0222 of 2020 and national level legislation.
Doing business in general	Lack of skilled labor	General poor level of domestic education and industry specific training Travel restrictions for foreign workers due to CoViD pandemic worsened the situation.
	Taxes and fees	Fiscal regulations at national level; fees as stipulated by forest sector regulations
	Access to finance/loan conditions	Regulations of the commercial banking system.
	Difficult starting a business	Enabling environment for doing business in Lao.

79 out of 87 enterprises mentioned adverse effects of regulations on their enterprises` business operations.

Adverse effects on general competitiveness

31 of the enterprises mentioned that the PMO 15 of 2016 and related decisions for its enforcement restricted their business opportunities. In general, the respondents mentioned an over-regulation of the wood sector activities and that the implementation of these regulations would restrict the competitiveness of their enterprises.

Further, 15 survey participants argued that, due to weak law enforcement structures on Lao, the enterprises that comply with the regulations experience competitive disadvantages compared to informal activities in the sector.

Adverse effects on export opportunities

32 enterprises stated that the current regulatory framework has negative effects on their export opportunities. The specifications defined by MOIC decision 0939 of 2019 were perceived as an obstacle, since foreign buyers frequently demand products which deviate from these specifications. Several other studies have also identified such effects (see also Xuan, 2017; ITC, 2020a and 2021; ERIA, 2019).

Adverse effects on raw material sourcing

16 survey participants mentioned that the reduced offer of natural wood due to implementation of PMO 15 has led to massive competition for the remaining legal timber sources. In this context, 16 respondents stated that the auctioning process is not transparent, i.e., the bidding lots are too big for individual SMEs and require substantial working capital. As a result, 9 respondents stated that foreign led companies with strong capital backup are crowding out domestic SMEs during the bidding process (See also Smith, 2021).

Adverse effects on business processes

18 enterprises mentioned that the decisions precedent to MOIC decision 0222 of 2020 would disadvantage household business, i.e., due to the capital requirements for upgrading (see also Smith et al, 2018). Difficulties in obtaining harvesting and transport licenses and related costs were mentioned by 11 respondents. Providing the documentation for the Certificates of Origin (CO) were experienced as hindering the business processes by 6 of the surveyed enterprises.

Adverse effects of the national enabling environment

33 respondents were not satisfied with the system to collect taxes and fees, i.e., they felt that the system is not consistent and would charge two or more times for the same services/products along the value chain.

32 respondents stated that the lack of skilled workforce is restricting their business opportunities: the Laotian education and training system would not deliver the required qualification to operate modern equipment[32]. The situation was worsened by the CoViD induced travel restrictions that prevented foreign workers entering the country.

Restricted access to finance for investment was mentioned by 15 enterprises. This due to unfavorable lending condition of commercial banks and lack of alternative financing sources with preferential conditions for SMEs (see also ADB, 2016; OECD, 2018).

Difficulties in starting new business were experience 5 of the respondents (See World Bank, 2018a and 2019 for general description of doing business in Lao and related challenges).

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[32] NOTE: According to Smith (2018) the Lao Wood Industries Association in cooperation with international donors are developing a trainings Vientiane, and a training facility is also being developed at NUOL through this ACIAR project. Both are in Vientiane. Access to these facilities for micro and small enterprises is likely to remain elusive unless supported by government, association or donors.
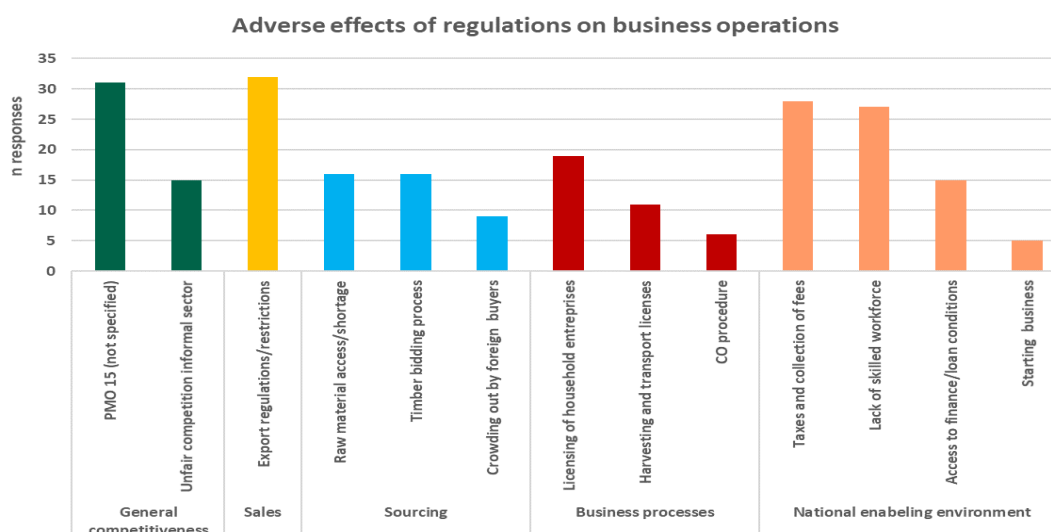
Figure 40: Adverse effects of regulations and enabling environment on wood sector enterprises´ business operations.

Sources: Survey data for the year 2020 (N=81; multiple answers)

3.6.13 FLEGT

Across all enterprises, 47 of 87 weren´t aware of the FLEGT process in Lao (Figure 41). The knowledge of FLEGT was more common among large and medium enterprises than in small enterprises and household businesses. Hence, the results for the surveyed enterprises in the South show lower levels of FLEGT awareness than in the other regions, since the share of interviewed household businesses in this region was higher.
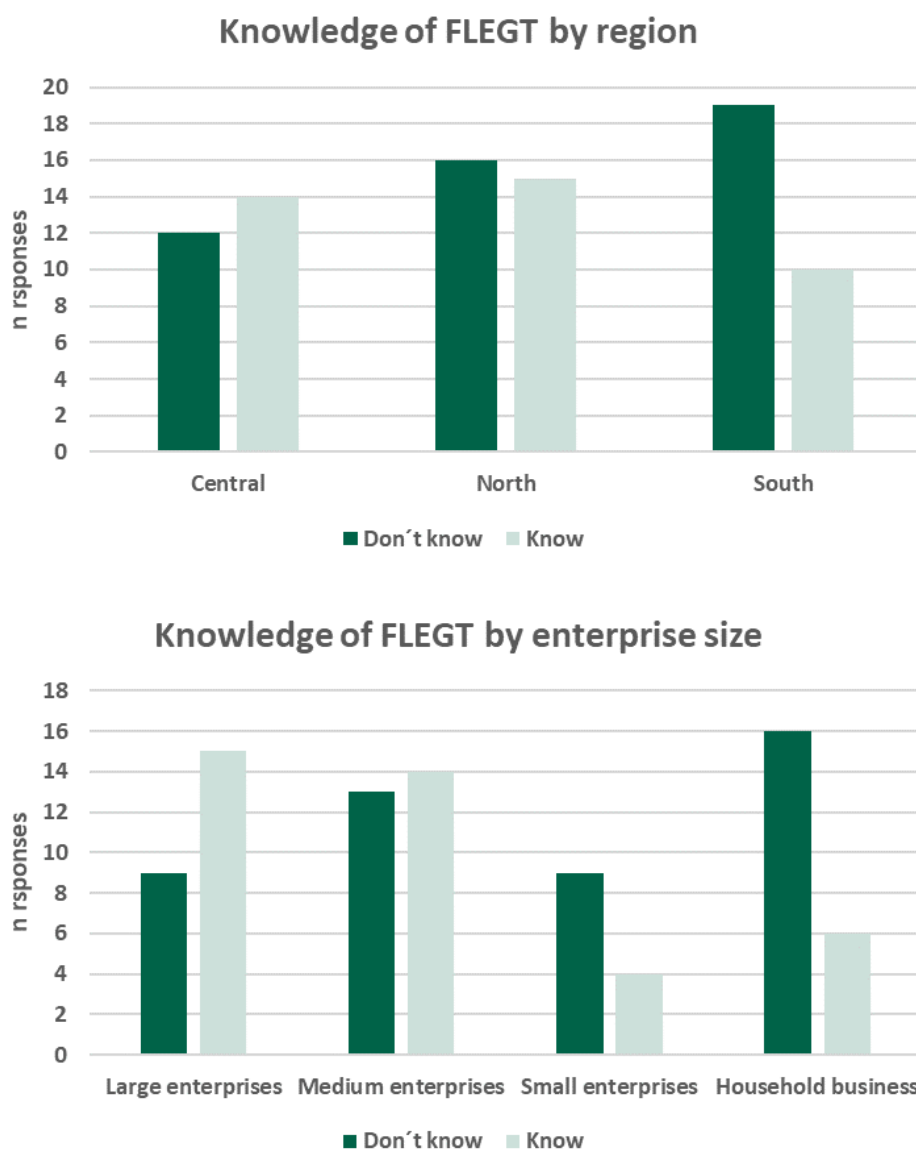
Figure 41: Knowledge of FLEGT by region (top) and enterprise size (bottom)

Sources: Survey data for the year 2020 (N=87)

No clear patterns were identified when comparing the knowledge of FLEGT in the various sub-sectors. However, enterprises operating in the carpentry and in the veneer/plywood sub-sectors seemed to be more aware than e.g., in the furniture and sawmilling sub-sector. Positive expectations with regard to FLEGT prevailed across all sub-sectors. (Figure 42)

Knowledge of FLEGT by sub-sector

Legend: Don´t know, Know

Expectations for FLEGT by sub-sector

Legend: Positive, Indefinite, Negative
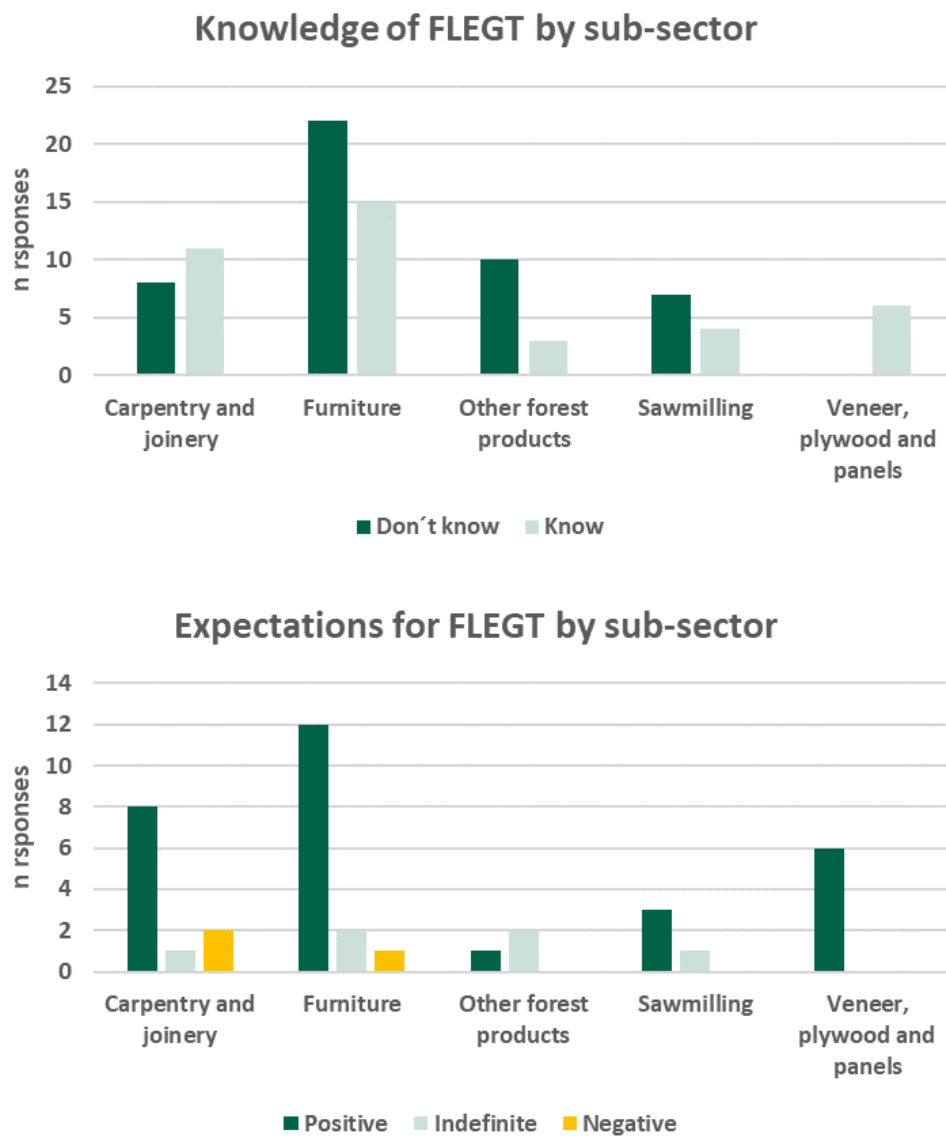
Figure 42: Knowledge of FLEGT (up) and related expectations (bottom) by sub sector

Sources: Survey data for the year 2020 (N=87)

To assess the enterprises` preparedness for adopting FLEGT related legality assurance systems, they were asked for their actual practice in accounting material flows and tracing supplies and sales. Most enterprises stated that they keep detailed records on material in- and outflows and the respective suppliers and buyers as required by MOIC Decision 0777 of 2020. However, a moderate share (14 of 87) doesn´t do so. (Figure 43)

Material accounting

Supplier and buyer records

Figure 43: Material flow and tracing instruments by sub-sector

Sources: Survey data for the year 2020 (N=87)

3.7 Recommendations

The following table describes recommendations that are derived from the results of the wood industry survey. The proposed actions address the following main topics:

Regulatory framework: Process and products quality, export regulations

Timber resource base: Teak silviculture, rubber wood, access to natural wood

Wood processing: Primary wood processing, training, access to finance

Sector governance: Law enforcement, FLEGT awareness, sector associations

Table 34: Proposed plan of actions

Context	Recommendation	Expected impact
Regulations		
Quality management of processes	Promoting existing regulations as tool for Process Quality Management. E.g., by labeling products, developing a national quality brand (see also national product quality standards). Identify synergies with internationally recognized QM systems (e.g. ISO or IFC performance standards). The approach is also recommended with a view to future FLEGT licensing.	Higher acceptance of wood sector enterprises and willingness to comply. Higher recognition and comparability of Laotian wood products in international markets.
Product quality standards	Develop national grading rules for most common wood products. These may be derived and adjusted from existing grading rules. Follow-up on ACIAR research work.	Quality assurance for buyers. Reduction of transaction cost. Better participation in international markets.
Export regulations	Facilitate exceptions from export restrictions for customized product specifications.	Enable export opportunities that are currently prohibited.
Timber resource base		
Teak silviculture	Assess suitability of currently applied silviculture to produce quality Teak, i.e., with view to heartwood ratio (see also Midgley et al, 2015). Introduce a Teak log grading system; follow up on relevant research work.	Improved Teak log quality. Improved market opportunities and value adding opportunities.
Promoting the use of plantation timber from Rubber and others	Assess commercial volumes from rubber and related wood specifications. Follow up on research work done by ACIAR. Support the shift from natural wood processing SMEs no plantation species.	Enlarge the usable timber resource base in Lao.

Context	Recommendation	Expected impact
	Connect the resource and wood processing SMEs.	
Accessibility of natural wood	Support SMEs in participating in auctions (forming bidder groups or providing access to working capital; see Access to Finance)	Facilitates improved access to natural wood
Wood processing		
Primary processed wood products	Assess in detail the domestic market demand and demand in key export markets for wood products. Ensure supply of primary processed wood products (sawnwood, veneer) according to quality standards. Promote specialized sawmilling operations through technical assistance. Elaborate wood processing manuals (drying, treatment, grading) for most important plantation species. Draw on existing research work and industry best practices.	Improved supply of quality products for secondary processing SMEs. Specialization of primary and secondary processing enterprises and enhanced product quality. Frees capital for investments.
Upgrading	Support technology upgrades of enterprises based on detailed enterprise diagnostics, i.e. follow up and roll out work realized by GIZ in 2015/16[33]. Factoring in the future timber supply and raw material qualities, i.e. small dimensioned planation timber (i.e. Eucalyptus, Teak, Rubber). Implement wood processing enterprises cluster support as proposed by GIZ 2015/16[34].	Improved technological capacities and efficiency to match future timber species and dimensions. Enhanced competitiveness of enterprises.
Training and occupational health and safety	Provide training opportunities (staff and management level) in use of modern wood processing technologies and OHS. Combine training with technology upgrading approaches. Continue work started by GIZ and others. Promoting existing regulations for wood industries and labor regulations as tool for OHS. Identify synergies with internationally recognized OHS safeguards/guidelines (e.g., ISO or IFC performance standards). Produce specific OHS guidelines for processing industries.	Improve knowledge of domestic labor force in modern wood processing techniques. Improve implementation of OHS requirements.

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[33] Applikatio (2016)
[34] Applikatio (2015)

Context	Recommendation	Expected impact
Access to Finance	Develop credit lines for 1) wood processing to enable compliance with wood sector regulations and technology upgraded, and 2) enterprises starting operations in primary processing.	Bridging the finance gap of domestic SMEs. Increase the number of wood processing SMEs.
Sector governance		
Law enforcement	Ensure that regulations are endowed with sufficient resources for enforcement.	Avoid unfair competition by non-compliers. Accelerating licensing processes.
FLEGT awareness	Disseminate FLEGT relevant knowledge i.e. among small enterprises. Use inspection on compliance with regulations (e.g. MOIC decision 0777 of 2020) to clarify the nexus of law compliance and advantages of FLEGT VPA. Establish provincial FLEGT implementation plans that address the specific challenges and opportunities of the FLEGT VPA (to be coordinated with recommendations on upgrading, training and sector associations).	Increased FLEGT preparedness.
Sector associations	Involve sector associations in selected activities, e.g. quality management, training or FLEGT awareness dissemination.	Higher mobilization of enterprises in sector associations. Wider dissemination of activities.

3.8 Reference list

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3.9 Annexes

3.9.1 Annex: Questionnaire

Attached as electronic archive.

4 ANALYSIS OF NEEDS AND POTENTIALS IN THE DEVELOPMENT OF THE FORESTRY AND WOOD PROCESSING SECTOR IN LAOS

Conclusions and Recommendations

4.1 Introduction

The objectives of the assignment were:

1. To identify the needs and potentials of wood processing sector and the development of a sustainable plantation sector.
2. To support governmental and private stakeholders, associations, and companies in obtaining a solid basis for deciding on measures and activities for the future development of the forestry and wood processing sector.
3. To support the Lao VPA-FLEGT process.

The study focused on three timber sources: production forests, conversion areas and plantations. It was limited to solid wood products, hence bioenergy, and forest environmental services were excluded.

The conclusions and recommendations present a synthesis of the analysis made in two parts: timber supply and wood processing industry. The two parts are interlinked in a value chain that creates the goods to satisfy the demand on wood products. Good performance in the value chain requires data and information and a supporting regulatory framework. Consequently, the conclusions and recommendations are grouped under four headings: timber supply and wood processing as the core productive processes; and information management and governance as the necessary supporting processes.

4.2 Key messages

The land available for wood production in Laos holds a significant potential for increasing timber supply, particularly from commercial timber plantations. However, it will be important to address the root causes of the ongoing deforestation and degradation to turn the trend towards sustainable forest management. The root causes were not analyzed in this study, but they are well covered elsewhere, particularly under the REDD+ program.

The new Forest Law and the forthcoming forestry strategy, FS2035 are expected to improve the situation in this regard by e.g., providing for Village Forest Management that delegates decision making power to local level.

As experience also from Laos has shown, control-based regulations alone cannot be a solution, particularly considering the limited government resources available for supervision. Forest use rights must be such that the timber producers have long-term security of tenure and the mandate to harvest and sell the products without excessive, time-consuming bureaucracy. Government policies must move from control towards providing services to timber producers and wood processing industries.

Providing data and information and building capacity amongst the timber producers and wood industry are examples of government services that will be vital for improving the performance in the forestry sector. It is obvious that significant additional effort will be required in enhancing the organizational- and human capacity along the supply chain.

The ability of public and private stakeholders to participate in and make more accurate and timely decisions on forestry sector development can best be supported by deploying modern Information and Communication Technology (ICT) to enable easy access to reliable data and information on forest resources, timber supply and wood industry. Data is mentioned separately because investment in digitalization requires raw data in computer readable format. When the data is opened to the relevant stakeholders, it can be used for many purposes. For instance, forest resource data, typically used by the government for forest cover change monitoring, can also be used by enterprises for investment planning. Digitalization in forestry is a major driver in improving productivity, transparency, and good governance.

The FLEGT-VPA implementation can be supported by creating provincial FLEGT-VPA work plans, streamlining forestry regulations related to timber supply and wood processing industry and engaging forest industry associations and other stakeholders in training on TLAS implementation and in providing information on FLEGT-VPA process. The VPA will eventually provide a financial incentive for sustainable forest management, and therefore it can become a significant factor in curbing the trend in deforestation and degradation.

4.3   Conclusions on timber supply

The three sources for timber supply, examined in this study, are[35]:

1.   Production Forest Areas, 2.1 million ha of natural forest
2.   Plantations, 510,000 ha
3.   Conversion areas, 87,000 ha

The annual timber supply over the next five years is estimated to be between 1.1 – 1.7 million m^3. Timber plantations are the main source of roundwood representing about 90% of total domestic timber supply.

▪   Gazetted Production Forest Areas are heavily depleted. The mean annual increment (MAI) of commercial species in these natural forests is estimated at only 0.27 m^3/ha/year[36]. Harvesting in natural production forests is currently banned and the potential timber production would be very modest, with about 40,000m^3/year.

▪   The conversion of natural forests, gazetted for production, protection and conservation, to other land uses is estimated to supply between 35,000 and 69,000 m³/year over the next five years.

▪   An estimated 50% of the plantation area is dedicated to latex production. Old rubber plantations can supply upwards of 250,000 m³/year. However, st the moment, timber from old rubber plantations is utilized only by a small share of processing companies. Eucalyptus plantations are estimated to supply between 800,000 and 1 million m³/year.

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[35] DoF, 2021: Forest management categories and land cover for the years 2010 & 2015;

[36] Based on the past quotas set for natural forests: 4 m³/ha every 15 year. Puustjärvi, E. (2019). Funding of PFA Management – Update on Projections on Revenue and Costs. Technical Report. SUFORD-SU. Vientiane, Lao PDR.
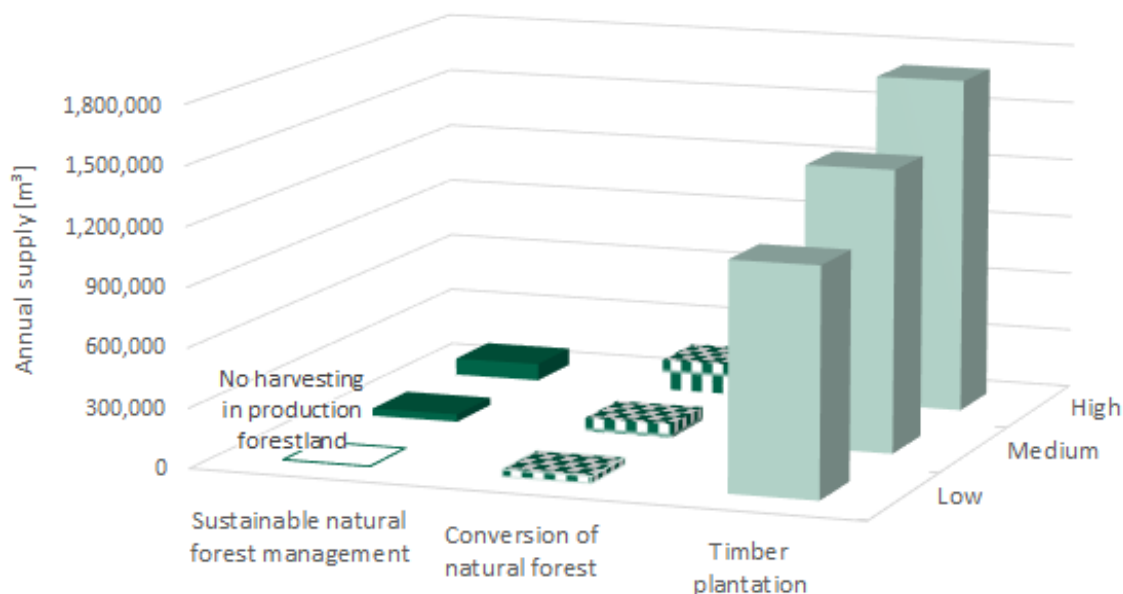
Figure 44: Annual Timber Supply from Different Sources and Under Different Scenarios

There is a significant opportunity for timber production in Village Use Forests and in land allocated to individuals, legal entities, and organizations that manage a large share of the 9.5 million ha of land classified as non-forest and regenerating vegetation.[37] However, information on timber supply is not available.

The domestic timber supply currently satisfies only 30% of the industrial intake, which is approximately 2.9 million m^3/year. Considering the currently poor status of forests there is an opportunity in substituting import in the future through sustainable forest management.

The two main barriers for timber production are: access to reliable data and information and cumbersome regulations (see Chapters 4.6 and 4.7).

4.4 Recommendations on timber supply

1. Assess the status of stocked natural forests in Production Forest Areas regarding their viability for commercial harvesting within the next five, ten, and fifteen years.

2. Prioritize management planning and utilization of forests with viable commercial stocks.

3. Support private sector, including individuals, legal entities, and organizations, in investing in timber plantations and inform plantation owners of the roundwood demand and the requirements related to wood assortments and timber quality.

4. Support vertical integration of value chain from Village Use Forests and small holder forest owners to forestry enterprises. This requires mapping the plantations and forest falling under VUF & ILEO category (see chapter 4.6, information management).

5. Support the utilization of old rubber plantations for timber. Create awareness amongst the forest owners of the combined benefits of latex and timber production and of the demand

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[37] DoF, 2021: Land cover for the years 2010 & 2015

for roundwood and, at the same time support market development. There is a moratorium on establishment of new, large scale rubber plantations (see chapter 4.7).

4.5 Conclusions on wood processing industry

Timber flows in Lao´s wood sector

There are three major timber flows in Lao´s wood sector: 1) Domestic value chains that source from natural forests and plantations and produce products for the national market (ca. 28% of the total industrial roundwood (IRW) turn over). 2) Export value chains that produce (semi-)finished wood products from domestic timber resources (ca. 28% of the IRW turn over). 3) An international pulp value chain, which is based on imported wood chips from Viet Nam and Thailand to supply one producer of wood pulp for the export market (ca. 44% of the IRW turn over).

The implementation of PMO 15 and related regulation since 2016 has led to an increase of finished wood products exports (+ US$ 58 M since 2015), while unfinished wood products dropped substantially (- US$ 53 M since 2015). The main export partners of sawn timber products are China and Viet Nam. For veneer and plywood, the main importing countries are Viet Nam, India and Thailand. The export destinations of finished wood products are mainly China and Thailand (i.e., furniture and carpentry products).[38]

Regional structure of the wood sector

The Laotian wood sector has seen a substantial decline in number of enterprises since 2015. The number has dropped from more than 1,300 to less than 1,000 in 2020. After enforcement of PMO 15 in 2016, many wood industry enterprises have sized down their activities or closed due to the lack of raw material or due to non-compliance with processing requirements. In the Central region almost 35% of enterprise closed since 2015. In the North, the loss of enterprise was ca. 19%. Only in the South, the number of enterprises was more robust: loss of 6% of enterprise since 2015.

Since 2015, the export values for the regions Central and South have increased by 117% and 103% respectively. On the other hand, in the North exports dropped by 110%. Apparently, the enterprises in Central and South could deal with the transition from unfinished to finished wood products. The enterprise structure in the North has been characterized by smaller enterprise units. Most of these firms has not been able to upgrade technologies to participate in finished products value chains.[39]

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[38] Sources: UN Comtrade data for Lao and trade partners (i.e., China, Viet Nam, Thailand, and India.
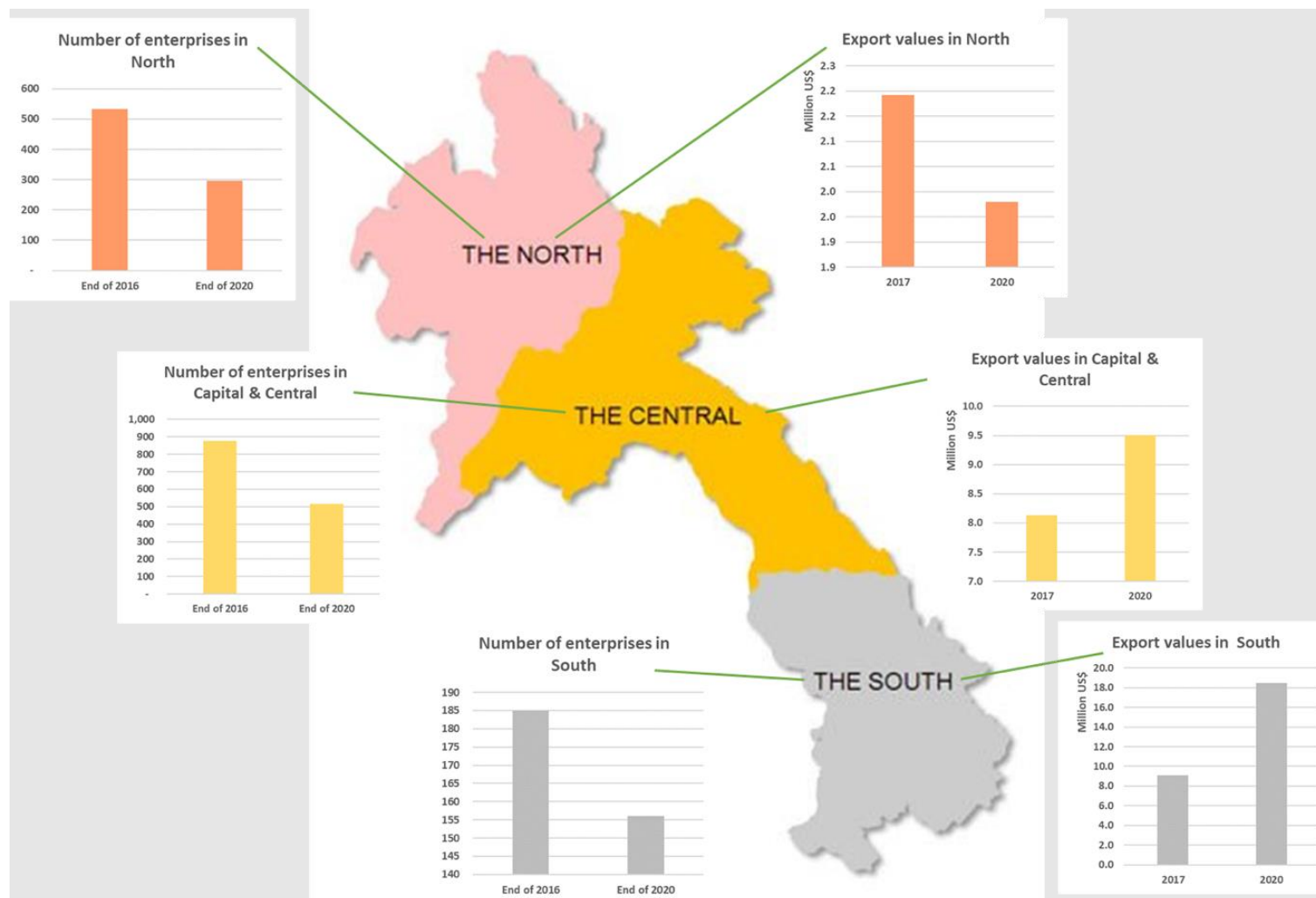[39] Sources: MOIC/DOIH data on number of wood processing enterprises and data on exports if wood products.

Figure 45: Regional pattern of wood sector enterprises and wood products exports 2016/17 and 2020

Quality management in Lao´s wood sector

The national regulatory framework provides for safeguards and guidelines on good industry practice for processing enterprises and supports quality management of production processes[40]. It provides for product definitions that support the enterprises´ compliance with the national legislation to avoid exports of illegal and unfinished products.

However, there are no national quality standards (i.e., grading rules) for wood products[41], resulting in high transaction costs of buyers to ensure product quality and difficulties for manufacturing enterprises sourcing quality wood material inputs. While several projects[42] in recent years have investigated and proposed quality management approaches, there have been no follow-up activities for establishing national wood product quality standards.[43]

Raw material sourcing and quality

According to survey results, the most important raw material for enterprises is industrial roundwood (logs). I.e., larger enterprises source logs as raw material, while smaller enterprises rely on primary processed wood products as inputs.

The domestic offer of sawn timber as input for secondary wood processing has declined due to firm closure of sawmills in recent years. Thus, the smaller enterprises are severely challenged by the current circumstances: reduced offer of industrial roundwood, increasing requirements for finished wood products manufacturing and limited offer of basic sawn timber.

Further, many enterprises reported substantial quality problems of raw materials. The share of raw material that had to be discarded due to quality deficiencies was considerable and ranged between ca. 10% and 25% for various product groups.[44]

Product quality and quality management

The most common quality problems that caused rejections by buyers were induced by high moisture content / inappropriate drying of the processed wood.

Most enterprises directly source logs. This results in secondary processing enterprises investing in sawmilling equipment and sawn timber treatment capacities. These activities are locking up capital for possible expansion, require technical know-how and extends the process management requirements. An extended offer by specialized sawmills offering standardized quality sawn timber products could free these resources and enhance the secondary processor´s capacities to invest in product development and processing technology.

No international product quality standards were mentioned by the respondents that would guide the production process. Product quality criteria are defined by the clients. Frequently,

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[40] I.e., Decision no.: 0777/MOIC.DIH, 25 Aug 2020, Decision no.: 0222/MOIC.DIH, 23 Mar 2021, Decision no.2005/MOIC.DIH, 28 Sep 2015.

[41] NOTE: There are scaling and grading rules for natural timber from PFAs and conversion areas (Decision 0116/MAF 2007, revised), but no rules unfinished and finished wood products.

[42] ACIAR project FST/2010/012 Enhancing key elements of the value chains for plantation-grown wood in Lao PDR; GIZ project report: Support to the Lao – EU FLEGT Process (ProFLEGT) P.N. 12.2256.1-001.00

[43] Sources: Survey of wood industry enterprises conducted for this study in 2021 in 87 enterprises.

[44] Sources: Survey of wood industry enterprises conducted for this study in 2021 in 87 enterprises.

foreigners are invested in exporting enterprises, which enables quality management according to export markets´ requirements. Commonly, international buyers´ implement a strict quality control themselves. I.e., the buyers inspect the product order before shipping or are directly involved in the production process, since they were shareholders of the enterprise.[45]

Condition of equipment and investments

On average, most of the machinery in use was purchased less than 10 years ago and the enterprises rated the condition of their equipment as good, with only low intensity of repairs across all size classes and sub-sectors. Several enterprises plan investments in new machinery or upgrades. The planned investment volumes were from several thousand up to 100,000 US$.

Those enterprises that were planning investments did barely mention serious problems in accessing the required capital. Most commonly they mentioned commercial and private lending being the main sources for financing. Others planned to use own equity to realize the investment.

On the other hand, the vast majority of enterprises did not mention having investment plans, i.e. due to lack of planning security (i.e. availability of timber) and poor access to finance.[46]

Occupational health and safety (OHS) and working conditions

In general, company level OHS systems were not widespread: complaints management, emergency response measures or written manuals were only available in medium and large enterprises.

Most permanent and casual employees did not have written contracts, indicating that compliance with national labor legislation in this regard is low. Health insurance, paid vacations and paid maternal leave were not common, though some larger enterprises were offering these benefits.

Ca. 50% of the companies indicated that they regularly train their permanent staff in the use of the machines. Permanent staff is usually endowed the personal protective equipment (PPE). In contrast, the majority of casual workforce was not regularly trained. However, also casual labor was regularly equipped with PPE, though a lower rate than permanent staff. Frequently, workers are not well trained in using PPE properly.

The respondents also stated that the lack of skilled workforce is restricting their business opportunities, saying that the Laotian education and training system would not deliver the required qualification. The enterprises must invest in training of untrained labor. Many enterprises draw on foreign workers that are better trained and used to operate modern equipment.[47]

FLEGT

Most surveyed enterprises (47 of 87) were not aware of the FLEGT process in Lao. The knowledge of FLEGT was more common among large and medium enterprises than in small enterprises and household businesses.

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[45] Sources: Survey of wood industry enterprises conducted for this study in 2021 in 87 enterprises.
[46] Sources: Survey of wood industry enterprises conducted for this study in 2021 in 87 enterprises.
[47] Sources: Survey of wood industry enterprises conducted for this study in 2021 in 87 enterprises.

Enterprises operating in the carpentry and in the veneer/plywood sub-sectors seemed to be more aware than e.g., in the furniture and sawmilling sub-sector. Positive expectations and willingness to be part of the process prevailed across all sub-sectors.[48]

4.6   Recommendations on wood processing industry

1. Ensure supply of standardized primary wood products, sawn timber and veneer, for secondary wood industry. This requires detailed assessment of market demand, potential for product innovations and related technical assistance.

2. Invest in improved wood processing technology and support enterprises in adapting to future supply of timber assortments including e.g., enhance resources efficiency in view of scarce supply, moving from natural timber to plantation timber, assess potential for new product lines. This requires detailed enterprise diagnostics and follow up of earlier work e.g., by the ACIAR[49].

3. Improve market acceptance of Lao wood products by promoting internationally recognized Quality Management Standards, including OHS standards and by developing grading rules for wood products.

4. Improve the competence at management and staff level in modern wood processing techniques and OHS requirements and apply internationally recognized standards.

5. Improve capacity of household- and other microenterprises in compliance with VPA-FLEGT and in improving the quality of products.

6. Bridge the finance gap of domestic SMEs. Develop credit lines for enterprises upgrading processing technology to comply with the regulations as well as for start-up enterprises.

4.7   Linking timber supply and wood processing industry

This chapter highlights three overarching improvement opportunities that are vital for the productivity and efficiency in managing the wood industry value chain. Specific recommendations are included in the relevant chapters on timber supply, wood processing industry, information management and governance.

Wood industry operations and future investments require planning security and adequate and timely timber flows

Adequate and timely material flows are vital for managing the performance of forestry supply chains. The wood industry entrepreneurs need to know the availability and quality of roundwood in a particular area of interest. The availability of roundwood from plantations and natural forest will define the technology and investment requirements. Similarly, timberland investors need to know the demand for roundwood. Therefore, data and information ought to be made available on current forest resources and existing processing facilities. This type of spatial data infrastructure could be included in e-government services.

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[48] Sources: Survey of wood industry enterprises conducted for this study in 2021 in 87 enterprises.
[49] ACIAR project FST/2010/012 Enhancing key elements of the value chains for plantation-grown wood in Lao PDR

In addition to the current availability and demand of timber, the investors need to be able to forecast future trends. Government can support such predictability through strategies and regulations that create a favorable operating environment to timber producers and wood processing industry.

Wood industry quality management starts in the forest

Continuous improvement of quality is an essential part of 'business performance excellence' also in forestry. In this context quality refers to the raw material and the finished products as well as their timely delivery. As the first step, entities that have the necessary rights to produce timber for commercial purposes need to be supported by policies and regulations that enable optimization of timber assortments to the demands of wood industry. Similarly, wood processing industry needs to be able to adjust the product standards to customer requirements. While government regulations are needed to safeguard social and environmental benefits, they need to be written in such a way that they don't obstruct customer-oriented management of quality.

Connecting actors

The actors on both sides, timber supply and wood processing industry need to be well connected to ensure, on the one hand smooth inbound logistics of timber to wood industry, and the other hand access to market to timber producers. Understanding of the structure of actors is the starting point for supply chain integration. For instance, the local market for furniture is quite different compared to national and international market. Digital marketing platforms for both timber producers and wood processing industry have proven an effective and cost-efficient way to connect actors along the value chain.

Apart from data and information on actors, which has already been mentioned under 'adequate and timely timber flows', both timber producers and wood industry need to have organizations to represent their interests and agree on collaboration practices with one another. Out grower schemes for timber plantation owners, where industry enters contracts with producers and supports them with certain inputs, e.g., seedlings and know-how, can be the first step. In the longer term, however, timber growers need an organization that can represent them and advocate their interests.

4.8 Conclusions on information management

There is a lack of data on the status of production forests as well as plantations. Timber supply from Village Use Forests, land of individuals, legal entities and organizations is currently not monitored. Difficult access to data and information, and data gaps were the biggest challenge to the estimation of timber supply in this study.

The data related to wood processing industries in this study is derived from a combination of international and national statistics. There are considerable uncertainties in the data on roundwood balance and consumption of wood products. It was not possible to obtain comprehensive information on wood products processing at national level because the data is inconsistent and fragmented. Data is available only from limited number of provinces and it cannot be aggregated because it is not following a standard format.

4.9 Information management for timber supply

Recommendations:

1. Develop a standardized, nationwide, central database on forest resources to support investments in wood production and wood processing. The data can serve production of forestry statistics and the analysis of spatial information on the status of forest land. Forest resource data typically includes both spatial and attribute data against standard parameters related to administrative areas, forest areas (e.g., stand), status (e.g., forest function, -type, - standing volume, species composition, soil type), use rights (e.g., registration number, name of use rights holder).

2. Start by making available the existing forest resource data in the Department of Forestry. Update data through national forest inventories and through forest management planning carried out in the PFA's and the VUF&ILEO forests.

3. Open access to the data to support the monitoring of the legality of the source of timber, e.g., Chain of Custody Systems, input-output monitoring, and connecting wood producers to wood processing industry. The data can be used for many purposes including for instance strategic, tactical, and operational planning of investments, timber sales and wood procurement. Data can be opened by publishing web services. Permissions to access data can be defined with a permission policy issued by the data owner, e.g, the Department of Forestry. The permission policy establishes the data owner, the data resources to be opened for access, the terms and conditions of access, and the responsibilities related to managing the access and maintaining the technology.

4. Appoint a focal point in the Department of Forestry to support stakeholders in obtaining the data and information on forest resources and timber supply.

4.10 Information management for wood processing industry

Recommendations:

1. Establish a standardized, nationwide central database on wood processing enterprises. The database ought to contain the location and key characteristics of each mill and enterprise to support investment planning and the planning of timber supply. In this connection the existing information systems, including the MOIC database on enterprise registration, would need to be identified to determine the possibility to use them and to identify the need for system integration.

2. Complete the development and deploy an information system for monitoring the input and output of forest enterprises to support implementation of Decision No. 0777/MOIC.DIH, 25 AUG 2020 on the Management and Monitoring of Timber Input and Output.

3. Identify discrepancies of export figures between the reporting of Lao PDR and partner countries.

4. Open access to wood industry information and data which is not confidential. Opening data (in computer readable format) needs to conform with the legislation on information security and -privacy. Typically, the data on e.g., company name, registration number, ownership, location, products & production, environmental- and social impacts, and financial report can be opened for public access. Detailed input/output data, if considered confidential, can be

published at aggregated level, for instance at the level of administrative areas. Sharing data between government agencies may include also confidential data if so agreed. Following best practices, the agencies involved would need to publish data privacy policy and, in some cases, get the consent of the enterprises in question.

4.11 Conclusions on governance

The government of Lao PDR has passed several influential regulations on forestry over the past five years, the most important ones being:

- Forestry Law, 13.06. 2019
- Prime Minister Order on Strengthening Strictness of Timber Harvest Management and Inspection, Timber Transport and Business No. 15/PM, 13.05.2016
- Revised Regulation of the list of wooden products eligible to export, Decision 0939/MOIC.DIH, 01 Aug 2019

The national regulatory framework provides for safeguards and guidelines on good industry practice for processing enterprises and supports quality management of production processes. It provides for product definitions that support the enterprises´ compliance with the national legislation to avoid exports of illegal and low unfinished products.

Prime Minister's Order 15 (PMO 15, in 2016), under which only finished wood products can be exported, has had a significant impact in reducing the uncontrolled harvesting and export of large amounts of natural roundwood. While PMO 15 has succeeded in increasing export of finished wood products and in reducing the pressure on natural forests, it has had an adverse effect on the domestic wood industry that faced lack of raw material and were required to invest in processing equipment, leading to the closure of many enterprises.

Amongst the wood industry enterprises there is a perception that the sector is over regulated, and the current regulations restrict companies' ability to respond to business opportunities. For instance, the industry perceives that the current wood products definitions can frequently be an obstacle in meeting customer requirements. Bureaucratic licensing practices in harvesting and transport affect wood supply and the regulations on timber auctions put micro- and small enterprises in a disadvantaged position requiring large working capital. The enterprises also perceive that lack of enforcement of regulations distorts competition and puts those enterprises that follow the regulations in a disadvantaged position.

4.12 Recommendations on governance

1. Reduce complexity by streamlining the mandates of the involved ministries and authorities, and simplifying regulatory processes related to plantation management.
2. Accelerate registration of enterprises and increase resources in enforcing forest industry regulations to accelerate processes and ensure fair competition between enterprises.
3. Support SME's in participating in auctions e.g, by forming bidder groups and providing access to working capital.
4. Facilitate exceptions from export restrictions to create opportunities for customized wood products.

5. Prepare provincial FLEGT implementation plans to address the specific challenges and opportunities of FLEGT- VPA.

6. Engage industry associations in training and communication on quality management and compliance with FLEGT-VPA.

Table 35: Parameters to be recorded for timber harvested in VUF

Administrative area			Reference VUF harvesting permit	Reference tree list certificate	Species (trade) name	Purpose	Log ID(s) as issued by DAFO/PAFO	Log diameter (cm)	Log length (m)	Log volume (m³)
Province	District	Village								
			May include permits for trees harvested in the conversion of conservation or protection forest land to agriculture or settlement.		Can be species and/or species group depending on the level of detail in the harvesting plan	- Community / public benefit - **Business / commercial** - Household / customary use	Only applies to timber dedicated to "business / commercial"			
Khammo	Hinboun	Ban Pak Veng	Kha/Hin/BPV/2021/23	285	Dipterocarpus alatus	Commercial	01.1.02.03.1	30	4.0	0.28
Khammo	Hinboun	Ban Pak Veng	Kha/Hin/BPV/2021/23	285	Dipterocarpus alatus	Commercial	01.1.02.03.2	27	4.0	0.23
Khammo	Hinboun	Ban Pak Veng	Kha/Hin/BPV/2021/23	285	Dipterocarpus alatus	Commercial	01.1.02.04.1	35	4.0	0.38
Khammo	Hinboun	Ban Pak Veng	Kha/Hin/BPV/2021/24	300	Anisoptera cochinchinensis	Public	N/A	40	4.0	0.50

Administrative area			Reference VUF harvesting permit	Reference tree list certificate	Species name	Purpose	Log ID(s) as issued by DAFO/PAFO	Log diameter (cm)	Log length (m)	Log volume (m³)
Province	District	Village								
			May include permits for trees harvested in the conversion of conservation or protection forest land to agriculture or settlement.		Can be species and/or species group depending on the level of detail in the harvesting plan	- Community / public benefit - **Business / commercial** - Household / customary use	Only applies to timber dedicated to "business / commercial"			
Khammou	Hinboun	Ban Pak Veng	Kha/Hin/BPV/2021/23	285	Dipterocarpus alatus	Commercial	01.1.02.03.1	30	4.0	0.28
Khammou	Hinboun	Ban Pak Veng	Kha/Hin/BPV/2021/23	285	Dipterocarpus alatus	Commercial	01.1.02.03.2	27	4.0	0.23
Khammou	Hinboun	Ban Pak Veng	Kha/Hin/BPV/2021/23	285	Dipterocarpus alatus	Commercial	01.1.02.04.1	35	4.0	0.38
Khammou	Hinboun	Ban Pak Veng	Kha/Hin/BPV/2021/24	300	Anisoptera cochinchinensis	Public	N/A	40	4.0	0.50

Table 36: Parameters to be recorded for timber harvested by ILEO

Administrative area			Reference tree cutting permit	Reference tree ownership certificate	Species (trade) name	Purpose	Log ID(s) as issued by DAFO/PAFO	Log diameter (cm)	Log length (m)	Log volume (m³)
Province	District	Village								
					Can be species and/or species group depending on the level of detail in the tree cutting permit	- **Business / commercial** - Household / customary use	Only applies to timber dedicated to "business / commercial"			
Khammo	Hinboun	Ban Pak Veng	Kha/Hin/BPV/ILEO/20	534	Dipterocarpus alatus	Commercial	BPV.ILEO20.01.1	25	4	0.2
Khammo	Hinboun	Ban Pak Veng	Kha/Hin/BPV/ILEO/21	534	Dipterocarpus alatus	Commercial	BPV.ILEO20.01.2	20	4	0.13
Khammo	Hinboun	Ban Pak Veng	Kha/Hin/BPV/ILEO/20	534	Anisoptera cochinchinensis	Household	N/A	20	6	0.19

Administrative area			Reference tree cutting permit	Reference tree ownership certificate	Species name	Purpose	Log ID(s) as issued by DAFO/PAFO	Log diameter (cm)	Log length (m)	Log volume (m³)
Province	District	Village								
					Can be species and/or species group depending on the level of detail in the tree cutting permit	- **Business / commercial** - Household / customary use	Only applies to timber dedicated to "business / commercial"			
Khammou	Hinboun	Ban Pak Veng	Kha/Hin/BPV/ILEO/20	534	Dipterocarpus alatus	Commercial	BPV.ILEO20.01.1	25	4	0.2
Khammou	Hinboun	Ban Pak Veng	Kha/Hin/BPV/ILEO/21	534	Dipterocarpus alatus	Commercial	BPV.ILEO20.01.2	20	4	0.13
Khammou	Hinboun	Ban Pak Veng	Kha/Hin/BPV/ILEO/20	534	Anisoptera cochinchinensis	Household	N/A	20	6	0.19

4.13 Annex. Examples of relevant quality standards for wood products

Table 37: Tropical log grading according to durability and resistance – Example of Dipterocarpus alatus

Natural durability and treatability

Resistance to decay. Class 3 - moderately durable

Resistance to dry wood borers. Class D - durable (sapwood demarcated, risk limited to sapwood)

Resistance to termites. Class S - susceptible

Treatability. Class 3 - poorly treatable

Use class covered by natural durability Class 2 - inside or under cover (dampness possible)

Notes. This species is listed in the NF EN 350 standard. Several species are grouped under the name Keruing of the genus *Dipterocarpus* and the natural durability is variable from one species to another. It is thus recommended to limit use of this wood without preservation treatment for end uses under use class 2.

Preservation treatment

Against dry wood borer attacks. This wood does not require any preservation treatment

In case of temporary humidification. This wood requires appropriate preservation treatment

In case of permanent humidification. Use of this wood is not recommended

Drying

Drying rate. Slow

Risk of distortion. High risk

Risk of case hardening. No known specific risk

Risk of checking. High risk

Risk of collapse. No known specific risk

Notes. Moisture content very variable especially for the most resinous species. Careful stacking and end coating are recommended.

Suggested drying schedule. Schedule #8 (see explanatory note)

Sawing and machining

Blunting effect. High

Tooth for sawing. Stellite-tipped

Machining tools. Tungsten carbide

Suitability for peeling. Good

Suitability for slicing. Not recommended or without interest

Notes. Silica content is variable. Some species are very resinous and tend to clog tools. Occasional tearing on quartersawn.

Assembling

Nailing/screwing. Good but pre-boring necessary

Notes. Resin exudations: to be taken into account when gluing.

Commercial grading

Sawn timber appearance grading

According to MGR grading rules (2009)

Possible grading: Prime, Select, Standard, Sound, Serviceable, Utility

Visual structure grading

According to European standard EN 1912 (2012) and associated national standards (see explanatory note), strength class D50 can be provided by visual grading. Strength class D40 can also be provided by visual grading according to French standard NF B 52-001-1 (2011).

Fire safety

Conventional French grading

Thickness > 14 mm: M3 (moderately flammable)

Thickness < 14 mm: M4 (readily flammable)

Euroclass grading. D-s2, d0

Default grading for solid wood that meets requirements of European standard NF EN 14081-1 (April 2016): structural graded timber in vertical uses and ceilings with minimal mean density of 0.35 and minimal thickness of 22 mm.

Main end uses

- Heavy carpentry
- Ship building (planking and deck)
- Boxes and crates
- Stairs (inside)
- Veneer for back or face of plywood
- Vehicle or container flooring
- Veneer for interior of plywood
- Panelling
- Exterior joinery
- Interior joinery
- House framing
- Flooring
- Bridges (parts not in contact with water or ground)
- Exterior panelling

Notes. Plywood for light woods. Resin and shakes may restrict end uses. In Asia, this species is used for sleepers and poles with a treatment.

Source: ITTO (2017). Tropical Timber Atlas

Table 38: Summary of the South East Asia Lumber Producer Association log grading rules

South East Asia Lumber Producers Association (SEALPA)

The SEALPA member countries are Malaysia, Indonesia, Papua New Guinea and the Philippines. In 1980 the group developed standardised grading rules for hardwood logs other than teak (SEALPA, 1981). Rules are given as to how log volume, length and diameter are calculated, as well as definitions for standard defects (knots, splits, bend and borer holes) and the equivalent units given to the defects for grading purposes. This approach is comparable to the Sri Lankan log grading scheme. At the high value level, grading separates the logs into three peeler log grades:

- special peeler grade (SSP)
- prime peeler grade (SP1)
- prime peeler grade (SP2)

A series of allowable dimension measurements and units for defects are set out for each grade of peeler log. For the special peeler grade, the diameter must be 60 cm or larger and at least 8 m long. For the remaining two peeler classes, the diameter must be 50 cm or greater and the length reduces to a minimum of 2.5 m.

Additionally, there are five sawlog grades and a wood chip class:

- prime sawlog grade (SS.1)
- standard sawlog grade (SS.2)
- low sawlog grade (SS.3)
- saw-able low grade (SS.4)
- short logs (SS.5)
- wood chip (SC)

The special and prime grade peeler logs are graded only on the value of the visible defects, whereas the remaining sawlog grades are graded on the value of the visible defects given as a percentage of the recoverable sound volume of timber (Oldeman et al. 1982). Permissible dimension measurements and units of defect are set out for each sawlog grade. The grades are segregated sequentially by dimensions and the inability to meet the specifications of the grade immediately above it.

The lowest defined log grade is wood chip (SC) and this grade will select a log not covered by any of the grades above it. There are 15 defect classes listed with detailed descriptions of each of the defects (SEALPA, 1981). As with the Sri Lankan STC log grading rules, defects are defined as either form defects and surface defects.

Indonesia

The SEALPA rules are not specific to teak logs, so in Indonesia a separate set of rules were developed ('Indonesian Standard Grading Rules for Teak Logs') to provide criteria specifically for teak (Oldeman, 1982). Grading is based on estimated 'sound volume yield' of timber that will result from converting the log. The grading is governed by the form of the log, the abundance, the location and the relationship between the defects and the size of the logs.

The logs are segregated into three groups – poles, small round logs and large round logs. All are governed by the diameter at the small end. Poles are divided into four quality classes, small logs into six and large logs into nine classes.

Malaysia

The 'Sabah Log Grading Rules' (Oldeman, 1982) were formulated in 1965 and define five grades of logs based on the value of visible defects in relation to the percentages of the sound volume of logs. As in other systems used in the region, logs are graded according to their dimensions, form, array of defects present and the limitations posed by these defects, expressed as units (the unit system for evaluating standard defects). These rules also pertain to Sarawak.

Philippines

The 'Grading Rules for Philippine Logs' were formulated in 1964 and encompass four grades of veneer logs and three grades of sawlogs. Grading is based solely on the percentage yield of sound volume. The highest grade of veneer log will subsequently produce the highest percentage of sound volume of timber when compared to any of the other grades (Oldeman, 1982).

Sources: Fitzgerald, C. and Hopewell, G. (2014). Log grading Part 1. CIAR project FST/2010/012 Enhancing key elements of the value chains for plantation-grown wood in Lao PDR

Table 39: Proposed grading rules for Teak logs in Lao

A grade

- best quality sawlog or square section billet
- suitable to produce feedstock for exposed components in high quality furniture, doors, windows, flooring and decking.

| Heartwood | visual estimate of heartwood proportion on log or billet end: ≥60% |

Square section billets- minimum diameter heartwood for A grade

Section size (cm)	Minimum heartwood diameter (mm)
10 x 10	87
15 x 15	131
20 x 20	175
25 x 25	219

Round logs- minimum diameter heartwood for A grade

Log diameter (cm)	Minimum heartwood diameter (mm)
10	77
15	116
20	155
25	194
30	232

Decay	not permitted, check billet/log ends and knots
Knots	<5 cm Ø maximum of 3 knots per 2.0 m length >5 cm Ø not permitted
Knot holes	not permitted
Insect holes/galleries	not permitted, includes beetle, moth and termites
Sweep	maximum deviation 3% of length (e.g. 6 mm per 2.0 m length) double bends are not permitted
Want/ wane	visual estimate of face area: ≤5%
Splits	severe splits: reduce measured length to allow for effect of split
Stain	not permitted, unless within the want and wane tolerance
Fluting	diameter of rounds logs with excessive fluting shall be measured excluding the irregularity (diagram)

B grade

- medium quality sawlog or square section billet
- suitable for feedstock for some exposed components and all hidden components in furniture, doors, windows, flooring and decking

| Heartwood | visual estimate of heartwood proportion on log or billet end: ≥40% |

Square section billets- minimum diameter heartwood for B grade

Section size (cm)	Minimum heartwood diameter (mm)
10 x 10	71
15 x 15	107
20 x 20	143
25 x 25	178

Round logs- minimum diameter heartwood for B grade

Log diameter (cm)	Minimum heartwood diameter (mm)
10	63
15	95
20	127
25	158
30	190

Decay	not permitted, check billet/log ends and knots
Knots	no limits if sound
Knot holes	permitted if <5 cm Ø maximum of 3 knot holes per 2.0 m length holes >5 cm Ø not permitted
Insect holes/galleries	permitted if within the surface area limits equivalent to knot hole limits
Sweep	maximum deviation 5% of length (e.g. 10 mm/2.0 m) double bends are not permitted
Want/ wane	visual estimate of face area: ≤20%
Splits	severe splits- reduce measured length to allow for effect of split
Stain	permitted
Fluting	diameter of rounds logs with excessive fluting shall be measured excluding the irregularity (diagram)

Source: Fitzgerald, C. and Hopewell, G. (2014). Log grading Part 1. CIAR project FST/2010/012 Enhancing key elements of the value chains for plantation-grown wood in Lao PDR

Table 40: Malaysia Grading Rules (2009) for sawnwood

	Width	Length	Clear cuttings	Sapwood	Knots	Spring	Warp (other than spring)	Minimum cuttings
PRIME	6 inches and up	6 feet and up	91 % of cuttings exempt of defects	Must be excluded from clear face cuttings	The average diameter of any sound knot shall not exceed 1/3 the width of the face on which it appears.	Must not exceed 1 inch per 12 feet of the piece's width	Not admitted if sufficient to prevent the whole piece from surfacing two sides to standard surfaced thickness.	4 inches x 5 feet or 5 inches x 4 feet
SELECT	5 inches and up	6 feet and up	75 % of cuttings exempt of defects	Bright sapwood may be included in clear face cuttings unless it exceeds in the aggregate 1/3 the width of the piece or is present on both faces.	Same as for PRIME	Same as for PRIME	As in Prime grade provided that slightly warped pieces 10" and wider are admitted if they can be ripped to produce 2 pieces each of which would grade Select and then not contain warp which would prevent those 2 pieces from surfacing two sides to standard surfaced thickness.	4 inches x 3 feet or 3 inches x 4 feet
STANDARD	4 inches and up	6 feet and up	66 % of cuttings exempt of defects	Bright sapwood may be included in clear face cuttings.	The average diameter of any sound knot shall not exceed 1/2 the width of the face on which it appears.	Shall not exceed the proportion of 1" per 8' of length of the piece	Not admitted if sufficient to prevent the clear face cuttings from surfacing two sides to standard surfaced thickness should they be removed from the piece	4 inches x 2 feet or 3 inches x 3 feet
SOUND or BHND	BHND : Borer Holes No Defect As for Prime, Select and Standard grades except that pin and unstained shot holes are admitted in the cuttings							

	Width	Length	Clear cuttings	Wane	Brittle heart	Spring and warp	Recommended cuttings	
SERVICEABLE	4 inches and up	6 feet and up	66 % of cuttings exempt of defects	Allowed on the worse face and one edge only, as follows: in widths 6" and up it should not exceed 1/6 the width of the piece - and in widths less than 6", it should not exceed 1/8 the width of the piece.	Allowed on one face and edge only provided that the strength of the piece is not materially affected	Same as in STANDARD	4 inches x 2 feet or 3 inches x 2 feet	

SELECT AND BETTER	SELECT and PRIME
STANDARD AND BETTER	STANDARD, SELECT and PRIME
SOUND AND BETTER	SOUND, STANDARD, SELECT and PRIME
MERCHANTABLE (or SERVICEABLE AND BETTER)	SERVICEABLE, SOUND, STANDARD, SELECT and PRIME

Source: Malaysia Timber industry Board

Table 41: Proposed Sawnwood Grading Rules for Lao

Criteria	Select	Medium Feature	High Feature
Tight knots	≤ 15 mm wide, ≤ 1/4 board width	≤ 40 mm wide, ≤ 1/3 board width	≤ 50mm wide, ≤ 1/2 board width
Loose knots and knot holes	Not permitted		Same for holes
Knot checks	Not permitted	≤ 2 mm wide	≤ 3 mm wide
Holes – borer, termites etc.	≤ 2 mm wide maximum 6 in 100 x 100 mm area maximum 12 in 300 x 300 mm area	≤ 3 mm wide maximum 20 in 100 x 100 mm area maximum 30 in 300 x 300 mm area	≤ 3 mm wide maximum 20 in 100 x 100 mm area maximum 30 in 300 x 300 mm area ≤ 10 mm wide 3 per 1m length > 10 mm not permitted
Tight gum vein	≤ 2 mm wide, ≤ 250 mm long ≤ ½ total board length (added)	≤ 60 mm wide, ≤ 1 m long ≤ 2 mm deep	≤ 2 mm deep
Loose gum vein	Not permitted	Not one surface to another ≤ 3 mm wide ≤ 1/5 total board length (added)	
Gum pocket and Over growth injury	Not permitted	Not one surface to another ≤ 10 mm wide, ≤ 50 mm long ≤ 2 mm deep	Not one surface to another ≤ 15 mm wide, ≤ 75 mm long ≤ 2 mm deep
Checks - external	≤ 1 mm wide, ≤ 250mm long (each)	≤ 2 mm wide, ≤ 250mm long (each)	≤ 2 mm wide, length unlimited
Stain - natural	Slight (up to consumer)	Unlimited	
Stain – other including sticker mark	Not permitted		
Want and wane	Exposed surface = not permitted Concealed surface ≤ 1/3 of surface width, ≤ 300 mm long		
End split, decay, termite galleries	Not permitted – splits can be removed		
Lyctus susceptible sapwood	Not permitted		

Source: Redman, A (2016). Sawn timber grading in Lao PDR. Product grading manual: rules and recommendations. CIAR project FST/2010/012 Enhancing key elements of the value chains for plantation-grown wood in Lao PDR

Table 42: Indian Rubberwood Products Standard

IS 14960 : 2001

Table 1 Permissible Defects for Processed Rubber Wood

(*Clause 6*)

SI No.	Defects	Grade A	Grade B	Grade C
(1)	(2)	(3)	(4)	(5)
i)	Live knots (maximum size) number per metre	25 mm One on one face only	30 mm One on either face only	40 mm One on either face only
ii)	Dead knots	Nil	Nil	Pin knots upto 6 mm
iii)	Checks (maximum depth)			
	a) Up to 50 mm thickness	1 mm	2 mm	2 mm
	b) 51-100 mm thickness	2 mm	3 mm	3 mm
	c) Above 100 mm thickness	4 mm	6 mm	6 mm
iv)	End splits (largest at the end and added together)	Nil	3 percent of length	3 percent of length
v)	Cup	1 mm per 100 mm	2 mm per 100 mm	3 mm per 100 mm
vi)	Spring	2 mm per m	3 mm per m	5 mm per m
vii)	Twist	2 mm per m	3 mm per m	5 mm per m
viii)	Bow	2 mm per m	3 mm per m	5 mm per m
ix)	Centre heart	Nil	Nil	May be permitted without a split
x)	Tapping marks	Tight tapping marks on one face only	Tight tapping marks on two faces	Tight tapping marks on all four faces
xi)	Mineral streaks	Nil	Nil	150 mm in 1 m
xii)	Sapstain	Shall not be permitted unless otherwise specified	Shall not be permitted unless otherwise specified	Shall not be permitted unless otherwise specified

Source: Bureau of Indian Standards (2001). Indian Standard. Preservative treated and seasoned sawn timber from rubber wood (Hevea brasiliensis)

Table 43: Overview of international veneer standards (left) and ISO plywood standards (right)

Country	Aus. / NZ	USA	Europe	Russia	China	Finland
Standard	2269.0:2012	PS 1-95	EN 635.2	GOST 99-96.1&2	LYT-1519	SFS 2413
Grade	S & A	N & A	E & I	E & I	I	B
	B	B	II	II	II	S
	C	C	III	III	III	BB
	D	D	IV	IV	IV	WG
					V	

ISO 1954, *Plywood — Tolerances on dimensions*

ISO 2074, *Plywood — Vocabulary*

ISO 2426-2, *Plywood — Classification by surface appearance — Part 2: Hardwood*

ISO 2426-3, *Plywood — Classification by surface appearance — Part 3: Softwood*

ISO 9426, *Wood-based panels — Determination of dimensions of panels*

ISO 9427, *Wood-based panels — Determination of density*

ISO 12466-1, *Plywood — Bonding quality — Part 1: Test methods*

ISO 12466-2, *Plywood — Bonding quality — Part 2: Requirements*

ISO 16572, *Timber structures — Wood-based panels — Structural properties* [1]

ISO 16978, *Wood-based panels — Determination of modulus of elasticity in bending and of bending strength*

ISO 16979, *Wood-based panels — Determination of moisture content*

Chinese standard LYT 1599:2011

The Chinese standard applies to rotary cut veneer and specifies grade criteria for hardwood face veneer, softwood face veneer and substrate or core veneer (can be either softwood or hardwood) for the construction of veneer-based panels.

The hardwood face veneer is classified into five grades, softwood face veneer into four grades and substrate veneer two grades. The grade nomenclature is I to V where I is considered the highest quality grade and V the lowest. Application descriptions for each grade are unspecified.

Vietnamese standard TCVN 10316:2014

The Vietnamese standard is a replica of the Chinese standard in Vietnamese language.

Sources: Redman, A. (2020). International Hardwood Veneer Grading Rules. BURAPHA Agro-Forestry (left); ISO Online Browsing Platform (www.iso.org) (right)