MAY 2022

AGRICULTURAL VALUE CHAIN UPGRADING IN NORTHERN LAO PDR

An assessment of the coffee, rice, maize, and pork value chains in Northern Lao PDR

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Executive Summary

The objective of this study is to identify the key value chain upgrades necessary for smallholders and local agribusiness enterprises in Northern Lao PDR to increase global competitiveness and improve market access in light of increased regional connectivity[1] for four value chains: coffee, rice, maize, and pork. The report presents an action plan for achieving these upgrades while promoting social inclusion and environmental sustainability through strategic investments and policy alignment.

Lao PDR is the key country linking land trade routes across northern Southeast Asia and could benefit substantially from becoming a land-linked country. Recent investments in Lao's transportation infrastructure mean that market access and regional connectivity is expanding. Over 30% of Lao's exports are in the agriculture sector, therefore in order to maximize recent investments in transport networks smallholder farmers must be linked to new markets through improved rural transport networks, increased access to capital, and accelerated digital transformation to enable market access.

Value chain analysis (VCA) is a tool that enables the identification of opportunities to improve market connectivity and competitiveness for agricultural commodities while accounting for social and environmental risks. The World Bank commissioned this value chain analysis (VCA) to guide interventions within and across target value chains within Northern Lao PDR. The study team chose four commodities based on the following criteria: potential competitiveness in international markets, potential development impact (poverty reduction) for smallholder farmers, and feasibility regarding the willingness of stakeholders and government to support upgrades in the supply chains. The supply chains chosen for study were: coffee, rice, maize, and pork.

Coffee production currently occurs predominantly in the South; however, the nascent production of coffee in Northern Lao PDR presents promising opportunities for growth. Currently, coffee in Northern Lao PDR is grown within agroforestry systems scattered across all 8 provinces. Infrastructure plays a crucial role in the value chain, and has thus far constrained growth in this chain. Coffee has high private and public sector engagement and has great potential for expanded production in Northern Lao PDR. The following upgrades are recommended in the coffee chain:

- Quality and Price: positioning coffee as a market-driven commodity which leverages the motivation of farmers to produce high-quality coffee and thereby increase its market price.
- Ownership, Capacity Building and Collective Action: creating a local ownership of the production of coffee.

Rice is Lao PDR's staple crop, cultivated on over 80% of agricultural land, primarily by smallholder producers. Upgrades in the rice value chain can have a far-reaching impact due to its predominance in Lao's agricultural system. Despite continued national prioritization and government investment, farmers still lack knowledge and technical tools to improve rice productivity. Lao rice is regionally competitive in terms of cost of production. However, post production processes must be improved to increase quality, and thereby market price. Additionally, rural transportation networks must be improved to enable improved market access for rice exports. The following upgrades are recommended in the rice chain:

- Improvement in extension service: expanding Farmer Field Schools (FFS) programs and digitalization of extension services.

[1]A new Lao-China railway that commenced operations in December 2021. Additionally, Lao PDR's National Road No. 2 (NR2) has the potential to fill a major connectivity gap to support regional integration. It crosses the new Lao-China rail corridor in Muang Xai, creating the potential for multimodal transport connectivity for both north-south and east-west routes connecting Laos, Vietnam, Thailand, Myanmar, and China. Improvement of border crossings and facilitation of cross-border processes on both ends of NR2 (with Thailand and Vietnam) mean that these benefits can reach beyond borders. The governments of Lao PDR, Thailand, and Vietnam are currently actively considering trade enhancement and economic development along the NR2 corridor and connecting roads within Thailand and Vietnam.

- Organic Production: certifying smallholders as organic can help farmers gain a price premium, improve the environment, and improve farmers' health.
- Promotion of specialty rice: glutinous native rice varieties like Khao Kai Noi rice should be promoted and efforts to certify specialty varieties via Geographical Indication should be pursued.

Maize is a key agricultural export for Lao PDR and is positioned to benefit greatly from increased regional connectivity. Maize is the second most widely farmed crop after rice, with production concentrated in Northern Lao PDR. Competitiveness of the maize value chain is constrained by poor rural road networks, land degradation and soil erosion caused by continuous production in the sloping highlands, and a lack of credit available to farmers well-positioned to scale production. The following upgrades are recommended in the maize chain:

- Increased finance for producers in the maize value chain to enable investments in scaling operations and invest in the efficiency and resilience of their operations.
- Long term soil health concerns are a threat to Lao maize production, specifically in the northern Lao upland areas; investing in legume intercropping and market development for legumes to improve soil fertility and address erosion should be explored. Strategic use of fertilizer should also be considered though its use may be constrained by the currently high fertilizer prices.
- Increased access to storage facilities, promotion of proper drying techniques, and increased access to shelling machinery can all greatly improve income potential for the farmgate price fetched by producers.

Pork plays an important role in the Lao diet and demand is increasing both domestically and in China and Vietnam. The Lao government has been consistently promoting meat production for import substitution and export. Eighty-five percent of pigs in Northern Lao are indigenous breeds which have high potential for generating income for smallholder farmers. The spillover effects from increased pork production can increase demand for maize and rice. The following upgrades are recommended in the pork chain:

- Improvement of small scale production systems in regards to farrowing management, disease prevention, and sanitation improvements.
- Improved mechanisms for delivering extension, training, and important market or weather information to farmers, especially via mobile technology

While this report presents specific recommendations and upgrading strategies for each commodity, it is important to note that smallholder farmers in Northern Lao PDR face a common set of constraints: poor linkages to larger transportation networks, poor access to credit, little access to quality extension, and increasing threats from climate change. Investments in Lao's agricultural system must integrate crop-specific investments and wider regional investments in transportation and financial infrastructure in order to maximize market access for the four commodities covered.

To further this point, this report outlines investment opportunities that are integral to driving growth as the region becomes more connected to its neighboring countries across five cross-cutting themes: building resilience to climate change, improving access to finance, providing opportunities to increase gender equity, addressing global political risks and shocks, and improving extension services.

Acknowledgements

The capstone team is very grateful for the guidance and support received from many individuals throughout the research and writing process of this report.

First and foremost, the capstone team would like to thank Professor Glenn Denning for the integral role he played bringing this project to Columbia University and providing a high level of support as the team worked through many challenges. Professor Denning provided countless resources, ideas, and feedback to shape our final project and was always available to review our work and provide detailed feedback impressively fast. We would not have been able to get this project done without him.

The team is also immensely grateful to the entire team at the World Bank who worked with us at every step of the way. They made themselves available both early in the morning and late at night to ensure that we could meet regularly and keep the project moving forward. They provided invaluable feedback and resources at every step of the project and they provided honest feedback. The team is grateful to the World Bank for this opportunity to learn and to contribute to the excellent work that they do. Special thanks to: Chanin Manopiniwes, Phil Sayeg, Mio Takada, Phonthanat Uruhamanon, and Chitlatda Keomuongchanh.

The capstone team also received support and project feedback from Columbia professors Zaki Raheem and Bryanna Mills and thanks them for their contributions to this project, especially regarding the maize value chain.

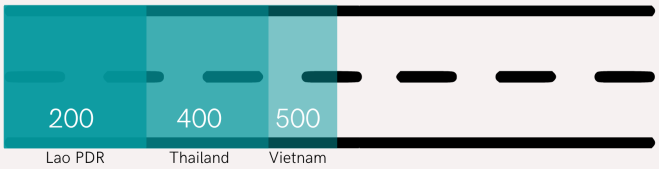
The capstone team interviewed many experts and stakeholders from each value chain and thanks each person who took the time to speak with us.

1. Introduction[2]

Lao PDR is the key country linking land trade routes across Northern Southeast Asia and could benefit substantially from becoming a land-linked country. Lao PDR's important development gains during the past decade have a strong linkage with its integration and connectivity to the countries in the region. Lao PDR connects with Myanmar and China to the northwest, Vietnam to the east, Cambodia to the southeast, and Thailand to the west and southwest. Improved regional connectivity and integration offer significant opportunities for Lao PDR to increase exports of agricultural products produced by smallholder farmers.

With the strategic geographic location of Lao PDR, improvements of major regional transport corridors and cross-border trade procedures are expected to have significant regional spill-over benefits. The economic activities from the new Lao-China railway that commenced operations in December 2021 and are estimated to be over US$40 billion per year.[3] The World Bank is currently preparing the Northern Lao PDR Regional Economic Corridor and Connectivity (NLRECC) Project, which is expected to be approved in 2022. The project aims to improve regional transport, logistics connectivity, and cross-border trade. These transport infrastructure developments create opportunities to improve market access and livelihoods for smallholder farmers in the northern provinces of Lao PDR. However, to take full advantage of these improvements, smallholder farmers will need to improve the productivity and competitiveness of commodities in high demand, and local infrastructure and road networks will need to improve in order to facilitate connections between rural areas and new road and rail networks.

"Lao PDR has some of the lowest levels of rural road coverage in developing Asia, which reduces connectivity between value chain segments. Reduced rural access limits access to services and markets and reduces the market value of outputs, hindering value chain development."
-Asian Development Bank, 2018



Road per 1,000 square km of land area

Value chain analysis (VCA) is a tool that enables the identification of opportunities to improve market connectivity and competitiveness of Lao smallholder farmers. At the same time, the Project Concept Note for the Northern Lao PDR Regional Economic Corridor and Connectivity Project identified significant social and environmental risks. **The objective of this study is to identify value chain upgrades to improve market access and competitiveness for smallholder farmers and local agribusiness enterprises in northern Lao PDR to help them maximize recent investments in transportation networks and present an action plan for achieving these upgrades while promoting social inclusion and environmental sustainability through strategic investments and policy alignment.**

1.1 Lao Socio-economic Status: Lao PDR has made significant development gains in the last two decades greatly reducing poverty and making gains across development indicators. However, there are still major challenges. Overall 36.6% of the country is estimated to live on less than $3.20 per day, and

[2]This background information is extracted and adapted from: World Bank (2021) Project Concept Note, Northern Lao PDR Regional Economic Corridor and Connectivity Project (P176088). January 14, 2021, and World Bank (2020)

[3] According to the World Bank: "The Lao-China Railway, which will connect Lao People's Democratic Republic (Lao PDR) to the entire network of the Belt and Road Initiative (BRI), has the potential to transform Lao PDR from a landlocked to a land-linked economy. The 414-km railway will connect the country's capital of Vientiane with the city of Boten at the northern border with China. At Boten, the railway will connect with the BRI network at Kunming, China, through another 595-km railway link." *From Landlocked to Land-Linked: Unlocking the Potential of Lao-China Rail Connectivity © World Bank, 2020.*

stunting still affects over 30% of children under five. These issues are especially pronounced within rural communities.

Agriculture in Lao PDR is primarily smallholder based, with over 80% of the total population dependent on agriculture. More than half of the population are smallholder, subsistence farmers with annual incomes below US$300.[4] Northern Lao is characterized by sloping hilly terrain which presents challenges for agriculture, transportation, and general development.

COVID-19 threatens to cause backsliding in some of Lao PDRs recent progress. According to the World Bank, "in the Lao PDR, COVID-19 has exacerbated the challenges of external debt, compressed social spending and jobless growth. The country is therefore looking to reform to restore development momentum."[5] Furthermore, according to recent analysis in the World Bank Economic Monitoring report, "to benefit from new infrastructure and trade agreements, momentum on business reforms and trade facilitation needs to increase enough to boost private investment and exports."[6]

1.2 Lao Agriculture Sector Overview: According to the World Bank Economic Monitor "the agriculture and industry sectors are expected to drive growth, supported by solid external demand as key trading partners recover."[7] Eighty percent of Lao PDR's population are reliant on the agricultural sector, accounting for 16% of GDP. Agricultural commercialization has gradually brought about structural changes in several value chains (i.e., increased production volume, processing, packaging, and exports), albeit on a small scale. Agriculture grew slowly during the past decade due to low agricultural productivity, mainly constrained by inadequate access to farm inputs and low adoption of agricultural technologies, poor compliance with product standards, and high transportation and logistics costs to access markets.

Rice is the Lao PDR's staple crop, accounting for 85% of total crop production and 39% of agricultural GDP; more than 80% of the nation's agricultural land is devoted to rice production.[8] Most rice is produced for domestic consumption, with banana, cassava, maize, taro and few other crops dominating agricultural exports. Table 1 summarizes the production of key crops.

Commodity	Production (tonnes)	Area (ha)
Rice	3,400,000	877,600
Rubber	130,000	275,000
Vegetables	1,466,850	178,757
Maize	717,000	150,000
Cassava	2,313,834	100,000
Banana	761,602	28,577
Sugarcane	1,490,470	24,243
Taro	106,000	9,460
Fruits	45,927	7,887
Coffee	185,721	88.6

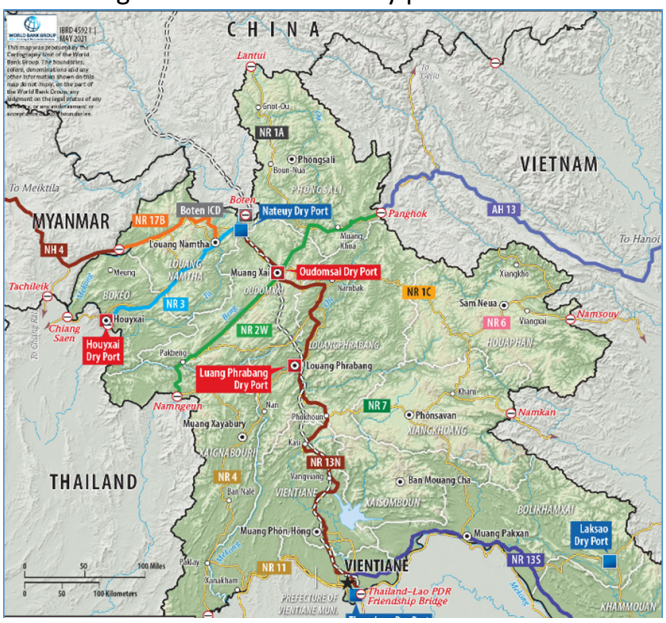
Source: Compiled from various sources

1.3 Northern Lao Logistic and Transport Overview: The domestic value-added logistics in Lao PDR is underdeveloped, and transportation prices are significantly more costly in Lao PDR than in neighboring countries.[9] According to the World Bank, Lao PDR's road density (per sq. km. of land area) is about 30 percent lower than the ASEAN average, closer to that of Philippines and Myanmar. According to the World Bank, only 50% of the roads observed in Laos were in

[4]IFAD. (n.d.). Lao People's Democratic Republic. IFAD. Retrieved April 2022, from https://www.ifad.org/en/web/operations/w/country/laos
[5] "Overview." World Bank, 2018, www.worldbank.org/en/country/lao/overview#1. Accessed 22 Apr. 2022.
[6] Phouthavisouk, Boualamphanh. "Lao PDR Economic Monitor August 2021." 24 Aug. 2021. Link.
[7] ibid.
[8] "Lao PDR | CCAFS: CGIAR Research Program on Climate Change, Agriculture and Food Security." Ccafs.cgiar.org, ccafs.cgiar.org/regions/southeast-asia/lao-pdr. Accessed 22 Apr. 2022.
[9] World Bank. (2020)."From Landlocked To Land-Linked Unlocking The Potential Of Lao-China Rail Connectivity".

fair or good condition and only 56% of the rural population in Laos had access to an all-season road.[10] This transportation limitation is especially prominent within Northern Lao, which is largely mountainous and most susceptible to floods and landslides in the country, making roads difficult to use.

Figure 1.1 Main regional corridors and dry ports in the Northern Laos PDR



(Source: World Bank Project Concept Note for Northern Lao PDR Regional Economic Corridor and Connectivity Project (P176088).)

High rainfall often limits access to the rural villages, preventing smallholder farmers in Northern Lao PDR from exporting crops to other countries or even transporting agricultural commodities to the market nearby.[11] The poor infrastructure has also had a large impact on fertilizer utilization. In 2019, a 50 kg Urea bag was sold at LAK 180,000-190,000 in well-connected areas, such as the most productive southern and central provinces, while in the most remote areas the price averaged LAK 200,000, reflecting higher transportation costs and traders margins.[12]

According to an Asian Development Bank study conducted in 2017, improved road networks were associated with increased sales of agricultural outputs, especially for non-rice crops. Researchers concluded that "improvements in road infrastructure can play a significant role in encouraging agricultural diversification and better value addition through more commercialized agriculture."[13]

Even though value-added services are increasingly growing in ASEAN countries, most of those services are not available or only to a limited extent in Northern Lao PDR. While partial cold chain services and packaging services exist for food produce, many other value-added logistics services are not available,

[10]World Bank. (2016). "International Development Association Project Appraisal Document On A Proposed Credit in The Amount Of Sdr 18 Million (Us$25 Million Equivalent)To The Lao People's Democratic Republic For A Lao Road Sector Project 2"
[11] Daniel F. Runde, Romina Bandura, and Rachel Lee. (2022). "*Opportunities for Development Cooperation in Lao Strategic Sectors*" https://csis-website-prod.s3.amazonaws.com/s3fs-public/publication/220307_Runde_Lao_Strategic_Sectors.pdf?YSwIIZcoCfsNpsNgER1di8tP7vFM3g7d
[12] World Food Programme. (2020). "Special Report - 2019 FAO/WFP Crop and Food Security Assessment Mission to the Lao People's Democratic Republic"
[13] ADB. (2017). [Review of Lao PDR Accelerating Structural Transformation for Inclusive Growth]. Retrieved from https://www.adb.org/sites/default/files/publication/378726/lao-pdr-accelerating-structural-transformation.pdf

including vendor managed inventory and inventory and supplier management services, for example.[14] This limited service availability is mainly due to the lack of demand, as most logistic companies focus on traditional services, such as transport, warehouse, and customs brokerage services. However, demand is expected to grow as Lao PDR is becomes increasingly connected to neighboring countries.

[14] World Bank. (2020).”FROM LANDLOCKED TO LAND-LINKED UNLOCKING THE POTENTIAL OF LAO-CHINA RAIL CONNECTIVITY".

2. Methodology and Value Chain Selection

2.1 VC Selection: The objective of this study is to identify opportunities to improve market access and competitiveness for smallholder farmers and local agribusiness enterprises in northern Lao PDR and policies and actions to realize these opportunities. The Columbia team worked in tandem with the World Bank to narrow the commodities chosen for this study. A list of preliminary commodities was chosen by the Agriculture Global Practice World Bank team as priority crops of the government of Lao PDR and the World Bank.

From the initial selection of commodities, a separate World Bank team chose to focus on cattle, beans, citrus (orange, pomelo and lemon) and cassava, based on their selection criteria. On the advice of the World Bank, the Columbia team evaluated the remaining crops (rice, maize, coffee, pigs, banana, watermelon, sweet potato, peanut, passionfruit, mango and tea) based on the following criteria:

- **Competitiveness**: The potential for growth of the value chain, accounting for market growth potential, export potential, long term competitive advantage, upgrading potential, and potential to attract foreign and domestic investment, suitability and production potential in Northern Lao PDR;
- **Development Impact**: Breadth and depth of the impact on value chain growth, which considers potential to increase incomes, potential reach (number of producers and MSMEs involved in value chain), potential opportunities for women and youth, and potential for spillover benefits in other sectors;
- **Feasibility**: Potential to generate increased sales and exports within a 5-7 year timeframe, strength of private sector leadership in the value chain, willingness of stakeholders in the chain to adopt new practices and alignment with priorities of the national Government.

Based on the above criteria, the team selected **rice, maize, coffee, and pork** to focus further research on. See the below table of all crops considered and how they were ranked against the above criteria.

Table 2.1: Crop Ranking

Crop	Competitiveness	Development Impact	Feasibility
Coffee	- High demand for upper-level commodity coffee in the region - High demand for specialty coffee	- Medium income potential for smallholders by contributing income diversification	- High level both private and public sector engagement - High production potential with new trees coming in production
Rice	-High competition but potential opportunities for niche prod (sticky rice, organic, etc)	-High income potential for rice farmers by adopting organic rice farming and organic certification	-High government support for rice, improved rice production also key for food security
Maize	-High maize yields in Lao PDR; competitive with other exporting countries - Growing demand for maize from neighbor countries	-High income potential especially for smallholders who shift from subsistence to maize production	-High priority for export in Lao agriculture plans -Existing connections with foreign traders and importers

Pork	-Low potential to achieve export in 5-7 years -Medium potential to substitute imports -High market growth to meet growing domestic demand	-Median income increase potential for smallholder farmers -High potential spillover effects from developing mechanizalied production system -Median potential for creating demand pull from other agricultural products	-High potential to attract foreign investments due to lower costs -Lack of investment in skills needed to build competitiveness (processing, veterinary services, etc)

2.2 Methodology: In order to conduct the value chain analysis (VCA) the team underwent a process of desk research and interviews with key informants in each value chain. The value chain analysis consisted of commodity selection, end market analysis, analysis of VC governance, identification of key value chain actors, mapping of value chain structure (vertical and horizontal linkages), identification of environmental and social factors at play within the value chain, and identification of upgrading opportunities within each chain. For more information on the value chain approach visit: USAID MarketLinks.

The following four chapters present the value chain analysis for each target commodity. Chapters 7-11 presents information on key cross-cutting issues affecting smallholder farming in Northern Lao. In the conclusion we summarize the key findings and recommendations for investment in the value chains identified.

It is important to note that due to the ongoing COVID-19 some price and demand data has fluctuated abnormally between 2020 - 2022. The research team was unable to travel to Lao PDR and all research and interviews were conducted remotely. Due to this, all results in the study should be validated via field research in Lao PDR when travel conditions allow.

3. Coffee Value Chain Analysis

3.1 Sector Profile: In efforts to better understand coffee VCA dynamics, the team conducted ten interviews with various coffee players and surveys with smallholder farmers in Northern Lao including: Todd Moore (Saffron Coffee), Erlend Falch (United Nations Office on Drugs and Crime), and Andrew Bartlett (Helvetas), the full list of interviewees can be found in the appendix. Our findings from the interviews are complemented by desk research.

(Image Source: Keoset Community Coffee)

3.1.1 Overview and History: Lao PDR has a long history of coffee production, though the vast majority of Lao coffee is grown on the Bolaven Plateau in the south, where it was introduced by the French in the 1920s.[15] In the early 2000s, before the rise in global popularity of specialty coffees, as part of a forward-thinking initiative, coffee was brought into Houaphan province in the north as a cash crop. It was intended to bring economic stability to struggling subsistence farmers in the region; however, after the coffee trees matured the market never developed. The remote province with high levels of poverty was ill-positioned to compete with the Bolaven Plateau for investors.[16] The terrain of Northern Lao PDR is challenging and the quality of infrastructure is poor, making coffee production especially challenging. Despite this, in the past ten years, coffee production in the north has expanded rapidly with the strong support provided by development agencies and the private sector – primarily coffee roasters.

3.1.2 Production and Export: The coffee production in Northern Lao PDR is still nascent and scattered across 8 provinces in the region. According to the Lao Coffee Board, the total processed parchment last season was 35,522 kg among the farmers getting support from Agence française de Développement (AFD) (corresponding to less than 1% of the national production).[17] This number does not cover all production in the northern region, yet still the closest number to it given AFD has launched 21 projects

[15] Moldvaer, A. (2021). *The coffee book*. Dorling Kindersley Limited.
[16] Agence française de développement (AFD) (2021). *Laos: Increasingly Sustainable Coffee Production*. Retrieved April 13, 2022, from https://www.afd.fr/en/actualites/laos-increasingly-sustainable-coffee-production?origin=/en/rechercher?query=laos%20
[17] Lao Coffee Board. (n.d). *Coffee Areas in Laos.* Retrieved April 13, 2022 from *https://www.laocoffeeboard.org/about-us-copy-3/*

over all the 8 provinces so far. Production is expected to increase rapidly as many young coffee trees are coming into production soon. The most common coffee variety in the region is Catimor, which has its roots in *C. arabica* and *C. canephora* (Robusta) species. Many coffee trees are planted in the natural forests. By doing that, farmers can earn more money and prevent deforestation spreading across the region. This style is also known for the resilience to extreme weather conditions such as frost or drought[18]. The forest coffee, however, also poses a challenge for smallholder farmers, as it is hard for farmers to bring coffee cherries or parchments to collective processing facilities. Based on our interviews Northern Lao coffee was often consumed the cafes in Luang Prabang or Vientiane before COVID-19 hit, and little was exported[19]. There are two key reasons. First, the price of the coffee is two times higher than the coffee from the south mainly because of the export quantity. The transportation cost per kg is very expensive in the north. Second, as a non-member state of the International Coffee Organization (ICO), Lao PDR faces disadvantages such as discounted prices in exporting.[20] Main end markets are upper commodity markets and specialty coffee markets in Thailand, Vietnam, Japan, France, Germany, and US, which are elaborated in the following section.

Table 3.1 Coffee Production in Each Province

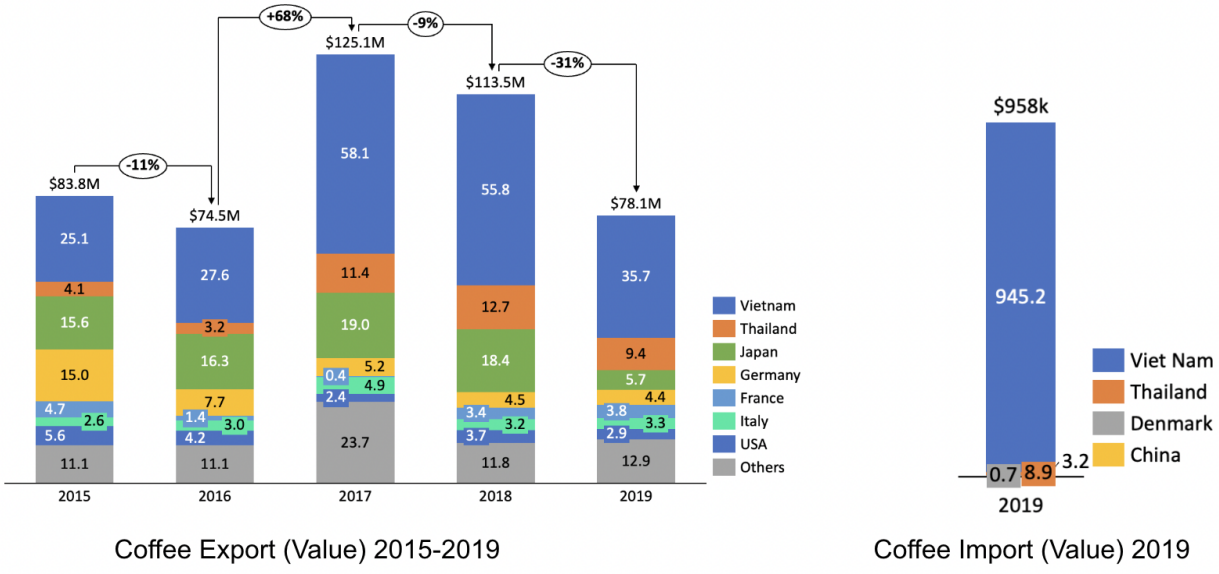
Region	Province	Year		
		2017	2018	2019
Northern Region	Sub Total	4,130	5,670	10,516
	Phongsaly	875	970	3,515
	Luangnamtha	-	-	-
	Oudomxay	735	1,030	1,635
	Bokeo	-	-	-
	Luangprabang	2,310	3,460	5,038
	Huaphanh	210	210	328
	Xayaboury	-	-	-
Central Region	Sub Total	675	675	1,479
	Vientiane Capital	-	-	-
	Xiengkhuang	675	675	1,479
	Vientiane	-	-	-
	Borikhamxay	-	-	-
	Khammuane	-	-	-
	Savannakhet	-	-	-
	Xaysomboon	-	-	-
Southern Region	Sub Total	145,990	149,625	159,385
	Saravane	28,030	2,875	39,413
	Sekong	40,615	40,615	23,085
	Champasack	75,575	78,305	94,932
	Attapeu	1,770	1,955	1,955
Total		**150,795**	**155,970**	**171,380**

(Source: Ministry of Agriculture and Forestry, Lao PDR, 2019)

[18] Lao Upland Rural Advisory Service (LURAS). (2020). *Lao Coffee Book*. https://laocoffeeorg.files.wordpress.com/2020/10/lao-coffee-notebook-english-final.pdf
[19] Interview with Todd Moore from Saffran Coffee
[20] Interview with Phengkhouane Manivong

3.1.3 End Market Analysis: Figure 2 shows the end markets that imports coffee from Lao PDR from 2015 to 2019 and the 2019 exporter of coffee to Lao PDR. From 2018 to 2019, the amount of coffee exported from the Lao PDR to other end markets such as Vietnam, Thailand and Japan declined by 31%. Despite the lack of clear explanations for the drop in exports from Lao PDR to end markets, it is important to clarify that this data represents the whole country; mostly the south and north. This translates to the fact that coffee quality of Southern Lao PDR is not as high as international prices, nevertheless is stable. Another reason could be related to the end markets. Vietnam and Thailand, for example, could have produced a large amount of coffee, so they did import it in 2019. Insufficient data may have also played a part. No matter the reasons behind the decline in Lao PDR's coffee exports to end markets, the largest importer of the country's coffee is Vietnam (despite a decline from 2018 to 2019). Thai and Japanese imports of Lao PDR's coffee have also increased, even if there is a decline in 2019. Likewise, Vietnam is the biggest exporter of coffee to Lao PDR, showing that it exported more than 95% of Lao PDR's coffee imports in 2019.

Figure 3.1: End Markets of Lao Coffee



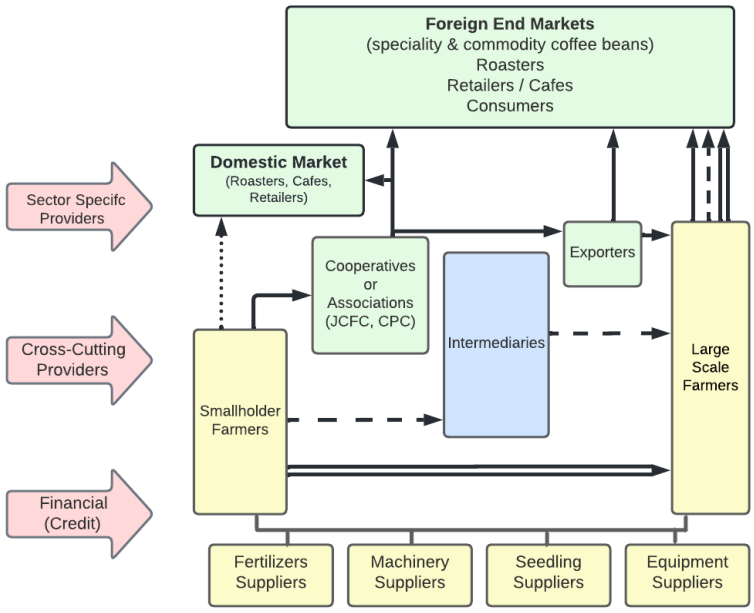
Coffee Export (Value) 2015-2019

Coffee Import (Value) 2019

(Source: UN COMTRADE)

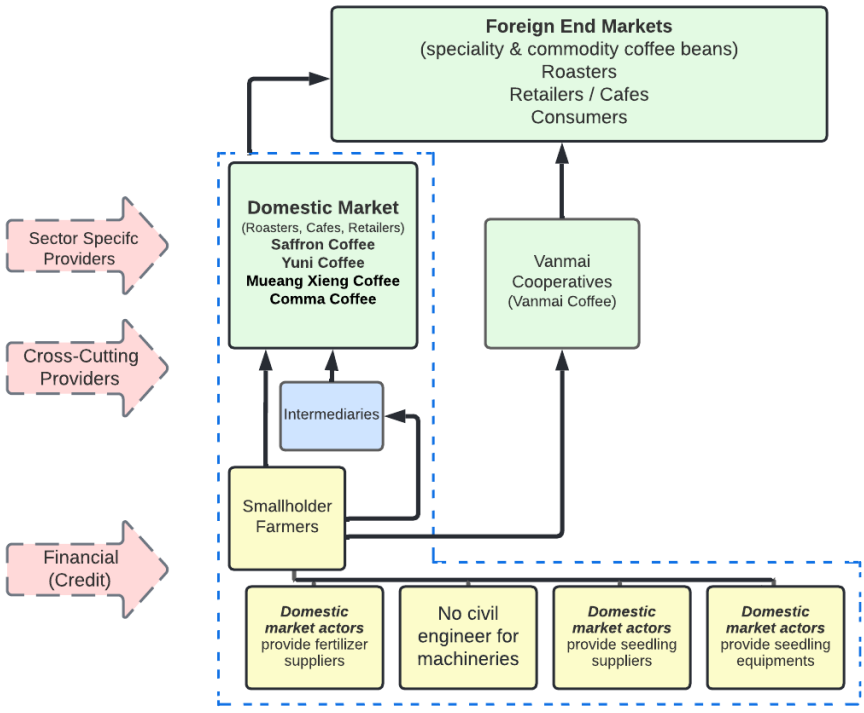
3.1.4 Market Structure

Figure 3.2: Value Chain in Southern Lao PDR



(Source: Report Team)

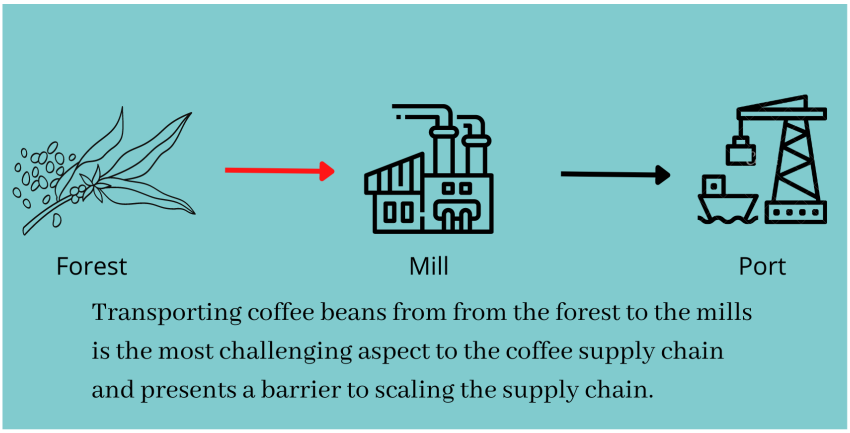
Figure 3.3: Value Chain in Northern Lao PDR



(Source: Report Team)

In this section, the coffee value chain in the south[21] (top) and the one in the north[22] (bottom) are provided for the comparison. Once ripe coffee cherries are collected by smallholder farmers, they are transported from their farms to processing facilities (mills). In mills, coffee cherries in Northern Lao PDR are often sorted by immersion in water; bad or unripe cherries float and the good ripe cherries sink. Then the ripe cherries are then cleaned by pressing the fruits in water through a screen. Next, the cherries are dried by the sun. Lasly, coffee green beans are produced after hulling, removing the silver skin from the beans. Unlike the coffee value chain in the south, the northern coffee value chain is decentralized, different from one region to another[23]. What is notable is that many coffee roasters, such as Saffron Coffee and Comma Coffee, support the entire value chain by providing agricultural inputs and training to farmers, processing coffee cherries, and even roasting. Thus, the coffee production in the north poses diverse dynamics depending on which coffee roasters or international development agencies the smallholder farmers have partnerships with.

3.1.5 Supporting Market Overview: Currently, the supporting market is almost non-existent in the coffee value chain in Northern Lao PDR. The coffee roasters and development agencies provide tracks to transport coffee cherries from farms to processing facilities and give credit to farmers. Transporting green coffee beans from mills to sea ports currently happens in an efficient manner. However, transporting coffee from the forest to mills is a major challenge to the coffee supply chain and presents a barrier to scaling the supply chain. Vanmai cooperative has a truck to collect coffee cherries or parchment from farms to address this, but there are no cross-sector companies providing solutions for transportation.[24]



3.1.6 Key Competitors: The biggest competitor in the region is **Vietnam**, which is the second best coffee producing country in the world, the largest producer of Robusta coffee[25]. Its Robusta is the least expensive widely-available coffee in the commodity market, which is often used in most soluble coffee blends[26]. In the south, cassava is replacing Robusta which is no longer a lucrative option for farmers, and the current Arabica production in the north is reasonable in this regard[27]. **China (Yunnan) and Myanmar** are the potential competitors or role models in the specialty coffee market. Coffee in Myanmar, for example, has gathered increasing attention in the past decade after nearly two hundred years of history

[21] UNCTAD (2020). *Lao People's democratic Republic: Sustainable Commercialisation in the Coffee Value Chain.* https://unctad.org/system/files/official-document/ditctabinf2020d2_en.pdf
[22] Interviews with Todd Moore, Kim Valakone, Andrew Bartlett, and Erlend Falch
[23] Interview with Erlend Falch
[24] Interview with Erlend Falch
[25] International Coffee Organization (2020). *Crop year production by country.* https://www.ico.org/prices/po-production.pdf
[26] Kaitlin Y. Cordes, Margaret Sagan & Solina Kennedy. (2021). *Responsible Coffee Sourcing: Towards a Living Income for Producers.* https://scholarship.law.columbia.edu/sustainable_investment_staffpubs/199
[27] Interview with Andrew Bartlett

hidden from the world. Coffee Quality Institute and USAID have been helping their coffee to make to the top shelf, and their average quality is mid- to upper-eighties on the 100-point Specialty Coffee Association (SCA) scale, where Northern Lao coffee has not reached yet[28]. However, in the specialty coffee market, the uniqueness in quality is a key for competitiveness, thus, as long as Northern Lao coffee can establish their unique position in the global market, it can be differentiated from these regional competitors.

3.2 Integrated Value Chain Analysis

3.2.1 End Market Analysis: Although the detailed data could not be collected, some amount of Northern Lao coffee is consumed in the region. Coffee tourism has been encouraged where visitors can walk through a coffee plantation in Paksong.[29] This could be further promoted to tourists entering the region through the China- Lao PDR railway especially after the COVID-19 restrictions are lifted. Depending on the geographical location of the production areas, other Northern Lao coffee is exported to Thailand and Vietnam. Within ASEAN, coffee trading is exempted from tariffs, which is favorable for Lao PDR given it is adjacent to the many member states.[30] Thailand is a particularly appealing market for the north as coffee consumption in Chiang Mai and Chaing Rai is growing fast.[31] Geographically, the sea ports in Vietnam is closer to Northern Lao PDR than Thailand, however, the customs clearance is often more cumbersome in Vietnam, which is challenging for the export.[32] Another export destination is the EU, such as France and Germany. Vanmai cooperative recently has acquired a certification, which is often a requirement for the European market. Among other export destinations, Japan and the US are worthy of attention. The market in the both countries are increasingly quality driven, and the stability in the quality is more prioritized than whether farms have certifications or not.

3.2.2 Business Enabling Environment: The Lao government has issued the Lao Coffee Sector Development Strategy by 2025, promoting the widespread planting of higher-value arabica varieties to meet the global demand for specialty coffee. To improve its business environment, the government has specified developing a credit mechanism for coffee farmers and reducing exporting costs.[33] The export cost is significant given the entire value chain process in Lao PDR has been handled manually as well as most of the other cash crops, which indicates high transaction time and costs at the borders of Lao and the neighboring countries as well as on the way to transit ports.[34]

3.2.3 Value Chain Governance

Vertical: While it is hard to categorize as one model, the structure of the coffee value chain in Northern Lao PDR is close to **relational** value chain governance.[35] In relational value chain governance, despite their mutual dependence, roasters can specify what they need, and control the highest valued activity in the chain, thus having the ability to exert more control over the supplier. Comma Coffee, for example, works closely with farmers providing technical support and quality control service. The farmers are under open contract with Comma, and they can sell coffee which is up to the standard given by Comma, but can find other buyers too. Many coffee roasters have similar models.

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[28] USAID. (2019). "Myanmar's specialty Coffee Makes It to the Top Shelf" https://winrock.org/document/myanmars-specialty-coffee-makes-it-to-the-top-shelf/

[29] ASEAN Briefing.(2018). *Investing in ASEAN's Coffee Industry.* https://www.aseanbriefing.com/news/investing-aseans-coffee-industry/

[30] Interview with Kazuo Sanbongi

[31] Interview with Kazuo Sanbongi

[32] Interview with Erlend Falch

[33] *Lao Coffee Sector Development Strategy by 2025* https://www.laocoffeeboard.org/

[34] Second Trade Development Facility. (2016) A Field Survey: Non-Tariff Measures (NTMs) Faced by Exports of Lao PDR. http://www.laotradeportal.gov.la/kcfinder/upload/files/Lao_NTM_survey9_2016%20(No%20Annex).pdf

[35] Marketlinks, USAID. *Types of Value Chain Governance*. https://www.marketlinks.org/good-practice-center/value-chain-wiki/types-value-chain-governance

Horizontal: There is only one cooperative (Vanmai) confirmed from the interviews we had. Horizontal cooperation is key for smallholder farmers to tackle their common constraints that require collective action, including high input costs and lack of market information.[36] Cooperatives are common in Southern Lao PDR, however, not in Northern Lao PDR at least for now. Here, the geographical challenge, the scattered production areas, is one of the barriers to promote cooperative formation.

3.2.4 Environmental and Social Inclusion concerns: Throughout this research, we could not have any interviews with farmers in the northern Lao PDR, who are put in the most vulnerable position affected by those situations. In general, coffee grown within agroforestry systems can reduce the landslide risk and helps provide natural habitats for increased or preserved biodiversity. Shade-grown coffee produced within agroforestry systems is generally regarded as a gold-standard for sustainable production globally.[37]

3.2.5 Barriers and Opportunities for Competitiveness

Quality and Price: The challenge of farmers in Northern Lao PDR is not finding an end market; rather it is producing high quality coffee in high volumes. Particularly, there is a challenge when it comes to coffee quality in Northern Lao PDR to compete on the upper-level commodity and specialty coffee in the international market. First, one of the obstacles that northern Lao PDR faces in improving quality is processing knowledge. In the present-day, Lao PDR farmers use wash processing instead of more advanced methods such as natural or other experimental processing. Second, not only do farmers not have the processing knowledge, but also it is challenging for them to invest their time and capacities in the production of coffee over other more profitable commodities such as bananas and cassava. This challenge is associated with the challenge of having Northern Lao coffee sold at lower prices than other competitive markets. This reflects an inconsistent quality of coffee. Moreover, the transportation and shipping cost cross-border is high in Northern Lao PDR. For instance, coffee is shipped from Northern Lao PDR to Bangkok in Thailand as the final destination. The high costs make the production of coffee scattered and low in Northern Lao PDR.

Lack of local initiatives: To assure high and stable quality there should be multiple experts who are able to assess coffee quality (such as Q-graders) and characteristics for producers, processors, and green bean buyers involved in the value chain. There are four Q-graders in Northern Lao PDR, yet none of them is Lao[38]. and most of the actions are directed by the coffee companies mentioned in the value chain map. There are four Coffee Quality Institute (CQI) certified coffee tasting professionals (Q-graders) in the northern Lao PDR, who are all from outside of the country. This shows the strong contrast comparing with the regional competitor such as Myanmar, where CQI and Myanmar Coffee Association (MCA) has trained 150 people on Q Grading and 67 people on Q Processing with the collaboration with USAID and Winrock International.[39]

Northern Lao PDR, has only four Q-graders and none of them are Lao. In contrast, regional competitor Myanmar has 150 certified Q-Graders.

Interviews with Local Farmers: While the team was unable to travel to Lao PDR because of COVID-19 restrictions, we were able to collect insights from local farmers in Northern Lao PDR with the assistance

[36] Marketlink, USAID. *Horizontal Linkages.* Link
[37] Interview with Todd Moore
[38] Interview with Andrew Bartlett
[39] Winrock International. (2019). *Myanmar's Specialty Coffee: Makes It to the Top Shelf* Link

of experts there. This step is critical for us to validate our findings. The insights collected from local farmers were found to be in line with those collected from interviews with coffee experts in Northern Lao PDR.

To begin with, the main crops that farmers in Northern Lao PDR intercrop with coffee are chili and rice. Also, the percentage of income that comes from coffee for those farmers ranges from 35 to 60%, with around 4000 to 5000 coffee trees on their lands. The main coffee company that farmers sell their coffee to is Mueang Xieng Coffee (a Lao company), and Catimor is the most popular variety. Tan Tai and Ban Pieng coffee groups are the two most prominent coffee organizations mentioned during the interviews. Insightfully, all interviewed farmers indicated a clear interest in joining associations in Northern Lao PDR.

With a view to analyzing the production and sale of coffee, labor costs range from 1,250,000kip to 1,500,000kip unless farmers utilize family members' labor. Furthermore, farmers indicated they use only compost instead of fertilizers. Farmers also indicated that prices are determined by market prices, which are likely based on processing techniques, quality, and grade of coffee, and contracts yearly. The following table gives details of the costs of producing coffee as indicated by the farmers.

Table 3.2. Cost of Production (2021-2022)

Harvest Season (2021-2022)						
	Farming costs (kip/kg cherry)	Primary processing (kip/kg parchment)	Secondary processing (kip/kg green bean)	Total cost	Selling price	Gross profit/loss (kip/kg)
Selling coffee cherries	5,000kip/kg	-	-	5,000kip/kg	5,000kip/kg	5,000kip/kg
Selling parchment	27,300kip/kg	2,000kip/kg	-	-	27,300kip/kg	25,300kip/kg
Selling green beans	45,000kip/kg	2,000kip/kg	2,000kip/kg	-	45,000kip/kg	41,000kip/kg

Moreover, all interviewed farmers indicated plans to expand their coffee production. However, a reliable market, fertilizers, seeds, and equipment are some of the things that farmers indicated they needed in order to maximize their coffee production. The biggest challenge for local farmers is acquiring the capital for investment. Interestingly, it is in the farmers' interest to increase the quantity produced, gain additional income, and have a market demand for coffee; all of which will enable them to produce more coffee. However, a lack of equipment, income, and low yields prevent coffee farmers from achieving their expansion plans. Coffee roasters and buyers mainly support farmers with equipment, but extension services and training on coffee production are also very useful for farmers. Local farmers, however, never received credit. Fortunately, they all indicated they had access to the internet. When it comes to climate change, it has affected their coffee production; on average every 1 to 5 years, frost reduces production.

3.3 Upgrading Opportunities

Quality and Price: positioning coffee as a market-driven commodity which leverages the motivation of farmers to produce coffee and increase its market price. This could be achieved through the following:

In the short run

- Given that the coffee production is still young, farmers should focus more on **adopting Good Agricultural Practices (GAPs)**. Land preparation, pruning for example. Adopting GAPs can not only boost productivity and quality but prolong the longevity of coffee trees.

In the medium-long run

- **Encouraging more advanced processing methods** such as natural processing is vital. The improvement of processing methods will bring coffee to international competition which will eventually boost the price of Northern coffee in the international market. This, however, has to be based on the farmers' adoption of GAPs. Advanced processing method can enhance the quality of coffee beans only if they are grown with care and picked at the right time[40].
- International organic certification. Even though certification does not make a significant difference for the domestic market, it does play a big role in the international markets (in Europe especially) for coffee produced in Northern Lao PDR where it has not positioned itself strongly yet in the international market.

In the long-run

- **Earn ICO membership**. Coffee from Northern Lao PDR is sold at discounted prices, unlike Vietnam and Thailand, as Lao PDR is not part of the International Coffee Organization (ICO). For Lao PDR to be a part of the organization, we recommend that it advances its data harmonization technique and centralizes data collection. This is because there are multiple organizations involved in the database collection such as the Ministry of Industry and Commerce, the Ministry of Agriculture and Lao Coffee Association, where each collects data different from the other.

Complementing approach

- A complementing approach to all the ones suggested above is to **encourage access to finance among smallholder farmers**. Private sector, non-profit organizations, and the Lao government should work collaboratively to provide investment and facilitate the access to credit for smallholder farmers. Our survey results suggest that smallholder farmers think access to finance is necessary for them to buy fertilizers. Both in the short-run and the long-run, the importance of financial inclusion cannot be more emphasized.

Ownership, Capacity Building and Collective Action: creating a local ownership of the production of coffee. This could be achieved through the following:

In the short run

- **Knowledge exchange and sharing** is key such as providing smallholder farmers with technical assistance from outside by professionals, or bring experience learning from other countries such

[40] Interview with Carl Cervone

as Vietnam, China, etc., or allow for knowledge sharing within the country i.e. southern parts of Lao PDR.

In the medium-long run

- **Collaborating with CQI and educating internationally certified coffee processors or tasters** to help farmers understand the potential value of the product and develop the sense of community and local ownership.
- **Promote the use of E-commerce**. Expanding the channels that Northern Lao coffee farmers can use to showcase their coffee to the international market. This is through decreasing their dependence on the coffee roasters, and allowing them to use non-conventional channels to sell their coffee; which in turn will reflect positively on their sense of local ownership.

In the long run

- **Develop cooperatives** through advancing the social and organizational structure in Northern Lao PDR on a macro and micro scale. By taking collective actions, farmers can gain stronger bargaining power and tackle some problems (lack of access to market and high input price, for example) which farmers cannot solve individually.
- **Empower women to be part of the decision making process**. Unlike women coffee farmers in Southern Lao, women in Northern Lao are neither taking leadership positions nor involved sufficiently in production and commercialization. This is explained by the fact that coffee in Northern Lao PDR is relatively new to that of Southern, which has been in the market for approximately 30 years. Hence, restructuring cultural norms and embedding gender empowerment ideas in the education system should be in place along with the creation of women associations that educate women coffee farmers and enrich their entrepreneurial knowledge.

"Advanced processing methods can enhance the quality of coffee beans only if they are grown with care and picked at the right time."

Carl Cervone, COO, Envertias

4. Rice Value Chain Analysis

4.1 Sector Profile

4.1.1 Overview and History: Rice is the most widely grown and consumed crop in the country, comprising over 80 percent of the country's farmed area. Most of the country's rice production occurs during the wet (rainfed) rice season, which spans from May to December and accounts for around 82 percent of total annual paddy production. The irrigated secondary dry period runs from December to April and is characterized by high temperatures. It is estimated that only roughly 13 percent of the wet season area is farmed during the dry season due to insufficient irrigation coverage. Rice is mostly farmed in lowland areas, with just around 5% of the crop being planted in higher elevations, primarily in the northern part of the country.[41]

(Image Source: International Rice Research Institute)

Most of the important rice-producing regions of Lao PDR are located all along the Mekong River, including Champasak, Khammouan, Saravan, Vientiane, and Bolikhamsai provinces. The great majority of rice is grown for home consumption, with less than ten percent of total annual output being sold for commercial purposes.

Rice harvesting areas have increased in both the wet and dry seasons during the past 30 years, with the latter increasing by 34 percent, mostly due to an increase in the amount of irrigated land available. Upland rice cultivation, on the other hand, has been declining due to the low profitability of the crop.[42]

4.1.2 Production and Export: The agricultural land area is estimated to have expanded from roughly 628,000 hectares in 2010 to over 770,000 hectares in 2016, before declining to around 670,000 hectares in 2019. In 2010, approximately 2.3 million tons of rice were produced per year, rising to a peak of 3.4 million tons in 2016 before falling to 2.9 million tons in 2019. The decline in later years is attributed to decline in demand.

According to data from the Ministry of Agriculture, the central and southern areas produce around 60 percent of lowland rice, with the northern region producing approximately 15 percent. Upland rice is mostly grown in the northern region, with the center region accounting for around 15 percent of overall production and the southern region accounting for approximately 5 percent. Finally, the central region

[41] FAO. (2019, April 9). 2019 FAO/WFP Crop and Food Security Assessment Mission(CFSAM)to the Lao People's Democratic Republic [Review of 2019 FAO/WFP Crop and Food Security Assessment Mission(CFSAM)to the Lao People's Democratic Republic]. https://www.fao.org/3/ca8392en/CA8392EN.pdf

[42] ibid

produces more than 70 percent of the country's dry season rice, followed by the southern region, which produces 20%, and the northern region, which produces around 10% of the rice.

Rice grown in the dry season yields around 5 tons of grain per hectare, whereas rice grown in lowland brings about 4.4 tons, and rice grown in the highland yields just 2 tons. A record level of national average yield of 4.45 tons per hectare was achieved in 2016, compared to 3.91 tons in 2010.[43]

Table 4.1: Rice's Harvest area and Production in Each Province

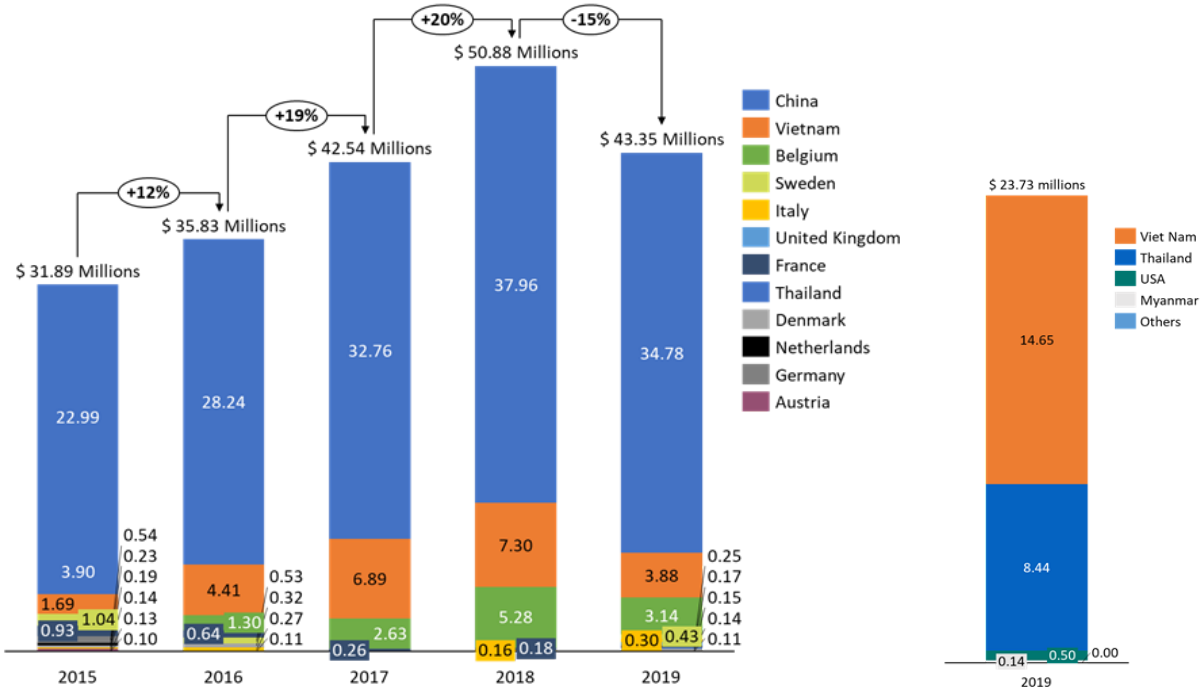
Region	Province	Harvest Area			Production		
		Low Land	Upland	Dry Season	Low Land	Upland	Dry Season
Northern Region	**Total**	**102,626**	**67,319**	**7,470**	**446,960**	**134,920**	**36,555**
	Phongsaly	8,178	9,400	1	34,350	17,715	5
	Luangnamtha	7,840	8,024	431	34,360	16,020	1,940
	Oudomxay	15,266	11,471	189	64,990	22,900	910
	Bokeo	12,614	3,802	1,432	54,700	7,350	6,765
	Luangprabang	13,141	18,897	1,606	57,590	38,070	7,880
	Huaphanh	12,880	4,540	1,598	57,540	9,365	7,990
	Xayaboury	32,707	11,185	2,213	143,430	23,500	11,065
Central Region	Total	**399,785**	**13,336**	**64,372**	**1,732,500**	**26,810**	**331,845**
	Vientiane Capital	52,066	-	14,232	231,750	-	74,005
	Xiengkhuang	18,803	7,600	40	86,960	15,750	140
	Vientiane	52,879	1,000	9,468	234,590	1,870	42,605
	Borikhamxay	37,662	1,813	1,357	157,805	3,365	6,710
	Khammuane	69,533	402	10,078	294,840	805	56,640
	Savannakhet	161,082	-	29,145	695,855	-	151,545
	Xaysomboon	7,760	2,521	52	30,700	5,020	200
Southern Region	Total	**167,545**	**3,931**	**17,140**	**731,240**	**7,270**	**86,400**
	Saravane	53,268	-	11,700	222,270	-	58,500
	Sekong	8,118	2,049	600	35,535	3,755	3,000
	Champasack	87,914	-	4,589	395,700	-	23,850
	Attapeu	18,245	1,882	251	77,735	3,515	1,050

(Source: Ministry of Agriculture and Forestry, Lao PDR, 2019)

Lao rice is mostly exported to China, Vietnam, and Belgium. From $31.8 million in 2015 to a high of $50.88 million in 2018, rice exports surged. There were $43.35 million in imports of Lao rice in 2019, the majority of which came from China ($34.78 million), Vietnam ($3.88 million), and Belgium ($3.24 million).

Figure 4.1: End Markets of Lao Rice

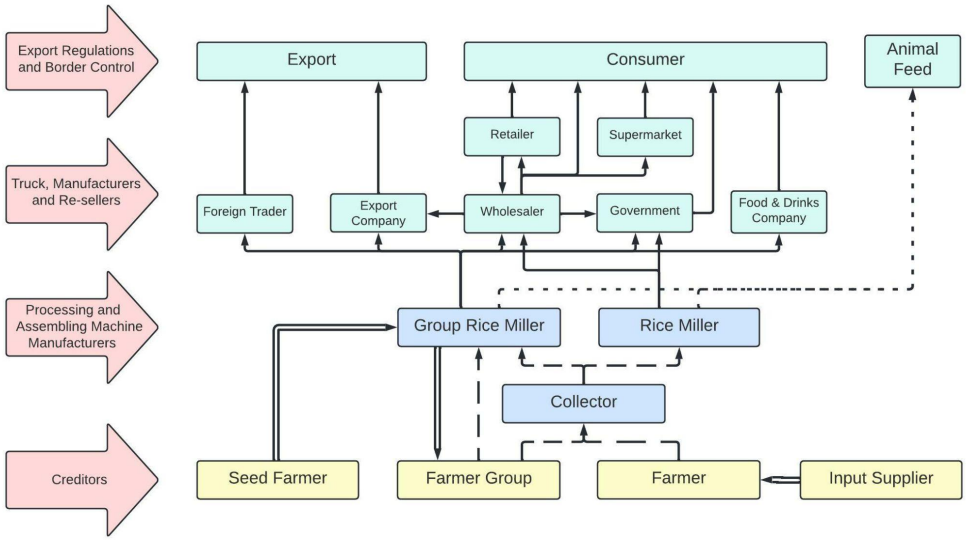
[43] Lao's Agricultural Statistics Year Book 2013-2019. (2019)
https://data.laos.opendevelopmentmekong.net/en/dataset/lao-s-agricultural-statistics-year-book-2013-2019



(Source: UN COMTRADE)

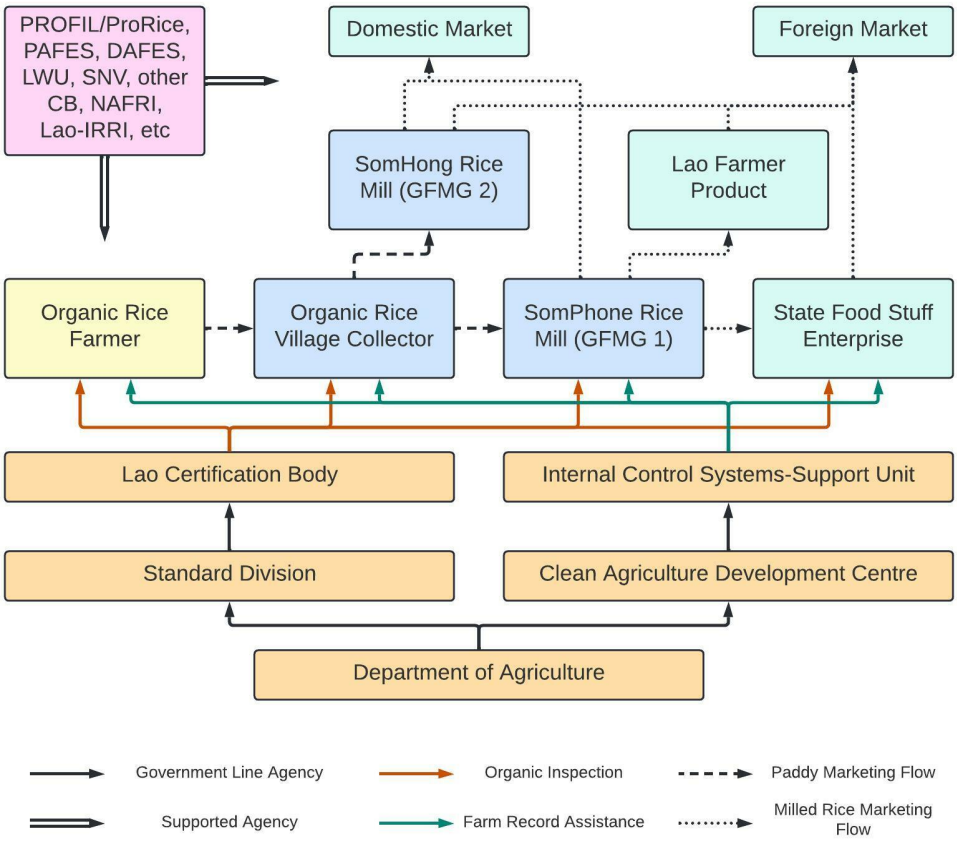
4.1.3 Market Structure

Figure 4.2: Conventional Rice Value Chain Map



(Source: Adapted from Rice VCA WFP 2017; Rice Value Chain in Lao PDR IFAD Report)

Figure 4.3: Organic Rice Value Chain Map



(Source: Extension Gaps in the Production)

Market structure: The rice market is partially vertically integrated. In the value chain, rice miller groups will provide seeds, fertilizers and sometimes mechanization services to contract farmers. Farmers will provide paddy rice to rice millers after harvest. Rice millers will also collect paddy rice from village collectors and non-contract farmers. They will then process rice and sell milled rice to big buyers and foreign traders.[44]

Rice millers are the main component in the value chain. They not only process paddy rice but also provide seeds to farmers. Then, farmers would promise to provide paddy rice after harvest. Farmers have difficulties to access finance so they have to obtain seeds or fertilizers from input suppliers or rice millers. Also, because of the high cost of collection from farms, many rice mills are located near the production areas. Thus, rice mills do not have foreign competition since rice milling has to be done domestically.[45]

In Lao PDR, the rice milling industry is very fragmented. According to the study Rice Landscape Analysis,[46]there are over 35,000 rice millers, but most of them are small processors at the village level."

[44] Synthesis Report on Rice policy for Smallholder and Vulnerability in Lao PDR. (n.d.). Retrieved April 20, 2022, from https://data.opendevelopmentmekong.net/dataset/9c45af21-7ef7-4ad0-86d6-56c5d28ac5ff/resource/a1eec7a6-e5c0-42a2-b89a-092dc327f322/download/004finalricepolicysynthesis2762016.pdf

[45] Integrated Value Chain Analysis of Selected Strategic Sectors in Lao People's Democratic Republic. (2005). http://lad.nafri.org.la/fulltext/LAD010320071390.pdf

[46] Rice Landscape Analysis - Feasibility of and opportunities for rice fortification in the Lao People's Democratic Republic | World Food Programme. (n.d.). Www.wfp.org. Retrieved April 20, 2022, from

They have very low capacities and lack quality control. Farmers and rice millers will also form farmers groups and rice millers groups accordingly to gain more bargaining power and have contracts with each other.

4.1.4 Supporting Market Overview: Transportation is an important service, which supports a variety of business operations for actors across a value chain.[47] In order to facilitate road connectivity between Lao PDR and China, the Lao-China railway is established to connect Vientiane and Shanghai in China. By taking advantage of the Lao-China railway, rice can reduce the estimated shipping time from 9 days to 4 days and distance decreased from 4.4 thousand km to 3.2 thousand km.[48] This railway can cut shipping time by about half of the maritime route through Thailand.[49] However, the transportation cost may increase from $70 to $100 per tonne.[50] In addition, financial institutions and input suppliers are important supporting actors for the rice value chain in Lao PDR.

4.1.5 Key Competitors: Thailand, Vietnam, Myanmar and Cambodia are the main competitors for Lao Rice. Lao PDR has higher rice yields as compared to Thailand, Myanmar and Cambodia, but lower than that of Vietnam. In terms of regional rice market competition, the total establishment cost per ton is lowest in Myanmar and Lao PDR, trailed by Vietnam. Crop establishment costs are similar in Cambodia, Myanmar and Lao PDR, but differ in the composition of cost. In Cambodia, seeds and herbicides are the major costs, whereas fertilizers cost is the major cost in case of Lao PDR and Myanmar. On the other hand, Thailand and Vietnam have higher crop establishment costs due to the high use of fertilizers as compared to other regional competitors.

Whether this cost advantage of Lao PDR translates into a competitive advantage in international rice markets largely depends on the quality, which affects pricing and profit. Moisture content of rice upon harvest, fungal diseases associated with harvesting and threshing time of year, and threshing practices all contribute to differences in quality.[51]

4.2 Integrated Value Chain Analysis

4.2.1 End Market Analysis: As worldwide average per capita rice consumption drops, world rice consumption will continue to be driven by population expansion over the next decade. Rising earnings in several Asian nations, such as China, Japan, Taiwan, and South Korea, are continuing to decrease per capita rice consumption. The changing demographics of Europe and Asia are also affecting rice demand, as the aging populations of many European and Asian nations, as well as growing health-consciousness, are leading to a move away from carbohydrate-based diets and more towards protein-based diets.[52]

The worldwide organic rice market was valued at $ 1.918 billion in 2020, and it is predicted to reach US$ 3.287 billion by the end of 2027, increasing at a compounded annual growth rate of 8 percent between 2021 and 2027.[53]

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https://www.wfp.org/publications/rice-landscape-analysis-feasibility-and-opportunities-rice-fortification-lao-peoples-democra#:~:text=In%20collaboration%20with%20the%20National%20Nutrition%20Committee%20Secretariat

[47] 1.3.5. Supporting Markets - Overview | Marketlinks. (n.d.). Retrieved May 11, 2022, from www.marketlinks.org website: https://www.marketlinks.org/good-practice-center/value-chain-wiki/supporting-markets-overview?msclkid=5f24fdf5d0c011ec8c5e9d82a2a0f63c

[48] Student Project. (2021). Exploring the Potential for Enhanced Agricultural Production & Exports via Lao-China Railway in Northern Lao PDR.

[49] ibid.

[50] ibid.

[51] Liese, B., Isvilanonda, S., Khiem, N., Tri, Luan, N., Ngoc, P., Pananurak, R., Pech, M., Shwe, K., Sombounkhanh, T., Möllmann, Y., & Zimmer. (2014). Economics of Southeast Asian Rice Production.http://www.agribenchmark.org/fileadmin/Dateiablage/B-Cash-Crop/Reports/Report-2014-1-rice-FAO.pdf

[52] USDA. (2022). Grain: World Markets and Trade [Review of Grain: World Markets and Trade]. Retrieved April 2022, from https://apps.fas.usda.gov/psdonline/circulars/grain.pdf

[53] Global Organic Rice Market – Industry Reports. (2021). www.360researchreports.com. Retrieved April 18, 2022, from https://www.360researchreports.com/global-organic-rice-market-17792218

Demand for broken rice is also experiencing a surge in China. While milled rice imports have slightly risen from 2020/21, the import of broken rice has doubled in the same year. Broken rice is most likely destined for use as animal feed, where it will partially replace maize in animal feed regimens. In addition, some broken rice is used in the production of processed foods and alcoholic beverages.[54]

Despite a slight reduction in average per capita consumption, population expansion continues to be the primary driver of worldwide rice consumption growth.

4.2.2 Business Enabling Environment: The government provides strong support for rice production and export. According to the Global Agricultural Information Network, the Lao's government has set the goal to increase "total paddy rice production to 5 million metric tons with 1 million metric tons of exports by 2025" (Bangkok, 2020). With government support, Lao PDR has more land area with irrigation than previous years and much rice research is done with International Rice Research Institute (IRRI) and the National Agricultural and Forestry Research Institute.[55]

4.2.3 Barriers and Opportunities for Competitiveness: Rice quality and processing costs are huge impediments to Lao PDR's ability to compete in the international market. Nevertheless, the country's cheap production costs and comparative advantage in growing glutinous rice could be enormous opportunities for the country.

Quality of rice: The inferior rice quality in Lao PDR, compared to Vietnam and Thailand, is most likely to be responsible for the low farm revenue. Because labor costs in Lao PDR are still very low, if rice quality could be improved while yields stayed unchanged, Lao rice would be highly competitive in the export market.

Post-Harvest and Logistics Costs: Despite its lower cost of production in Lao PDR, it is essential to mention that rice is seldom traded internationally in its paddy form, therefore maintaining a comparative advantage must extend beyond the farm level. Lao PDR lags in this area due to relatively higher processing, storage, and transportation costs as compared to Thailand and Vietnam.

Cost of Production at Farm Level: Because of the low cost of labor and land rent, the cost of production of rice is low in Lao PDR as compared to Thailand and Vietnam. On the farm level, Lao rice seems to be rather competitive even though yields and mechanization level are lower than that of Thailand and Vietnam.[56]

Glutinous rice: In Lao PDR, the price of non-glutinous rice is almost always greater than the price of glutinous rice at the retail level. It is noteworthy, however, that the inverse is true in terms of their relative costs on the worldwide market, where glutinous rice is invariably more expensive than non-glutinous rice.[57]

4.2.4 Environmental and Social Inclusion concerns: Organic rice farming can bring positive impacts to the environment. Research showed that organic rice farming can have significantly lower nitrate leaching, fewer GHG emissions and higher biodiversity compared to conventional rice farming. More specifically,

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[54] USDA. (2022). Grain: World Markets and Trade [Review of Grain: World Markets and Trade]. Retrieved April 2022, from https://apps.fas.usda.gov/psdonline/circulars/grain.pdf

[55] Integrated Value Chain Analysis of Selected Strategic Sectors in Lao People's Democratic Republic. (2005). http://lad.nafri.org.la/fulltext/LAD010320071390.pdf

[56] Liese, B., Isvilanonda, S., Khiem, N., Tri, Luan, N., Ngoc, P., Pananurak, R., Pech, M., Shwe, K., Sombounkhanh, T., Möllmann, Y., & Zimmer. (2014). Economics of Southeast Asian Rice Production.http://www.agribenchmark.org/fileadmin/Dateiablage/B-Cash-Crop/Reports/Report-2014-1-rice-FAO.pdf

[57] IFPRI. (2013, September 15). Rice Value Chains in China, India, Lao PDR, and Viet Nam: [Review of Rice Value Chains in China, India, Lao PDR, and Viet Nam:]. https://ebrary.ifpri.org/digital/collection/p15738coll2/id/128018

organic farming has, on average, 57% lower nitrate leaching, 14% lower CH4 emissions, and 30% more species than conventional farming. Therefore, organic rice farming can have benefits for the environment.[58]

4.3 Upgrading Opportunities

Yield and Cost of Production: Increasing the yield and decreasing the cost of production will place the already competitive Lao rice in a better position amongst regional competitors. This can be achieved as follows:

In short-medium run

- Farmers must embrace the implementation of Good Agricultural Practices (GAPs) in their fields. On their farms, the optimal utilization of seeds and fertilizers is seen to be lacking. Farmer Field Schools (FFS) can improve farmers' understanding of GAPs. According to the findings of an evaluation conducted by the FAO in the provinces of Champasack, Savannakhet, Xiengkhouang, and Xayabouly to evaluate the effectiveness of their FFS programs, the program was successful in increasing the rice yields of participants while simultaneously decreasing the cost of inputs when compared to the control group.[59] A similar program should be implemented on a larger scale throughout the country.

Quality and Market Price: The quality and low market price of Lao rice are important concerns. According to the safety ratings for human and animal usage, the four categories of clean agriculture in the country are categorized as: organic agriculture, pesticide-free agriculture, conventional agriculture and good agricultural practice.[60] Improvements in the quality and market price of Lao rice could be achieved through the following:

In the short run

- In conjunction with the government, in the short term, farmers should obtain certification for pesticide-free agriculture. This will enable them to obtain a slightly higher premium price than regular rice.

In the long run

- **Organic rice:** Rice producers in Laos should make efforts toward obtaining organic certification in the long run. This is easier in Lao PDR compared to its neighbors due to the fact that the country's rice is regarded as generally organic for three reasons. First and foremost, production conditions are marginal, responding little or not at all to increased inputs. Second, producers have little access to the market, and third, chemical inputs are prohibitively expensive or just not accessible in sufficient quantities.[61]

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[58] Mondelaers, K., Aertsens, J., & Van Huylenbroeck, G. (2009). A meta‐analysis of the differences in environmental impacts between organic and conventional farming. *British Food Journal*, *111*(10), 1098–1119. https://doi.org/10.1108/00070700910992925

[59] Phasouysaingam, A. (2017, January). Results Assessment for Farmers Field Schools (FFS) for Save & Grow (S&G)-based Sustainable Intensification of Crop Production (SIRP) [Review of Results Assessment for Farmers Field Schools (FFS) for Save & Grow (S&G)-based Sustainable Intensification of Crop Production (SIRP)]. FAO.

[60] Panyakul, V. (2012). *Lao's Organic Agriculture: 2012 Update* [Review of *Lao's Organic Agriculture: 2012 Update*]. United Nations Conference on Trade and Development (UNCTAD). https://unctad.org/system/files/official-document/Lao%20Organic%20Agriculture%202012%20Update.pdf

[61] Choulatida, P., Barzaga, R., Gummert, M., Medina, J., & Mercado, F. (n.d.). Extension Gaps in the Production, Postharvest and Marketing System of Organic Rice in Sangthong District, Vientiane Capital, Lao PDR [Review of Extension of Organic Rice in Sangthong District, Vientiane Capital, Lao PDR]. Retrieved May 2011, from http://lad.nafri.org.la/fulltext/2653-0.pdf

One approach for farmers to raise their income is to transition to "certified" organic agricultural production, particularly in the niche market of organic rice, where customers in developed nations are willing to pay a higher premium for organic products[62] and the demand for organic rice is expanding in the global market at the moment.[63] Producing organic rice for export may thus be a better choice for Lao farmers to gain access to the world market and enhance their profitability, rather than competing with already established players such as China and Vietnam in the conventional rice market. For the pursuit of shifting into organic, contract farming can be a feasible option.[64]

Cost-benefit analyses conducted in Thailand[65] and Nepal[66] have shown a higher cost-benefit ratio for organic rice cultivation as compared to conventional production systems.

- **Specialty rice:** In comparison to other glutinous rice varieties, Khao Kai Noi, a glutinous rice cultivated in Northern Lao PDR, is a Geographical Indication (GI) certified rice which has double the price as compared to other glutinous rice varieties. The Lao government should explore the possibility of obtaining similar kinds of certification for other native varieties.
- **Post-harvest Technological Upgrades:** Lao PDR is regionally competitive in terms of cost of production. Nevertheless, the milling and post harvest efficiency is low as compared to the regional competitors. At the moment, the Lao rice milling industry is unable to absorb the entire country's surplus paddy supply. The high price of Lao milled rice in relation to its quality hinders exports from the country. Private investment in large, sophisticated milling and polishing operations, whether local or foreign, is required to get around the milling constraints.

[62] Paull, John (2009), The Value of Eco-Labelling: Price Premiums & Consumer Valuations of Organic, Natural, and Place of Origin Food Labels, Saarbrücken, Germany: VDM Verlag

[63] Ellis, Wyn, Vitoon Panyakul, Daniel Vildozo, and Alexander Kasterine (2006), Strengthening the Export Capacity of Thailand's Organic Agriculture, Asia Trust Fund Project

[64] *Contract farming and organic rice production in Laos -a transformation analysis*. (2009). http://www.diva-portal.org/smash/get/diva2:505651/FULLTEXT01.pdf

[65] Suwanmaneepong, S., Kerdsriserm, C., Lepcha, N., Cavite, H. J., & Llones, C. A. (2020). Cost and return analysis of organic and conventional rice production in Chachoengsao Province, Thailand. Organic Agriculture. https://doi.org/10.1007/s13165-020-00280-9

[66] Adhikari, R. (2011, January). Economics of Organic Rice Production [Review of Economics of Organic Rice Production]. https://www.researchgate.net/publication/259535872_Economics_Of_Organic_Rice_Production

5. Maize Value Chain Analysis

5.1 Sector Profile

5.1.1 Overview and History: As the agricultural sector has become increasingly commercialized in Lao PDR, maize production has expanded, especially in the Northern Lao PDR highlands. Between 2005 to 2014, the area under maize in Lao PDR increased by 183% and the volume of maize production increased by 279%.[67] Maize is primarily produced for export to China, Vietnam and Thailand and primarily produced for the animal feed industry. According to the Lao Export Development Strategy the Lao PDR ministry of agriculture hopes to increase maize production to 1.4 million tonnes by 2030.[68]

(Image Source: UNCTAD Organization, Link**)**

5.1.2 Production and Export: Maize is the second largest crop produced in terms of area cultivated, behind rice production. In 2019 Lao PDR exported $47.7 mil USD in maize. Maize production in Lao PDR peaked in 2016 at 1.6 million tonnes and 260,000 hectares.[69] Since then, Maize production has been affected by drought, FAW infestation, and fluctuating demand from China primarily due to swine flu and Chinese policies aimed at reducing domestic inventory. However, with Chinese demand projected to rise greatly in the coming year, Lao maize production is expected to return to an upward trajectory Y/Y.

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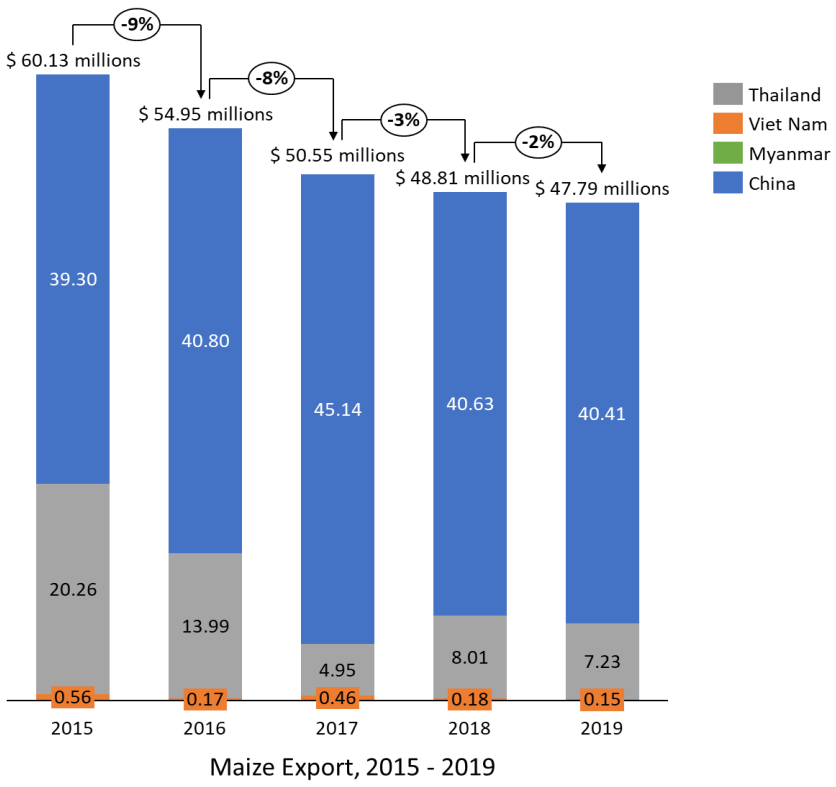
[67] Yap, Von Yi, et al. "Barriers to Agro-Ecological Intensification of Smallholder Upland Farming Systems in Lao PDR." Agronomy, vol. 9, no. 7, 13 July 2019, p. 375, 10.3390/agronomy9070375. Accessed 22 Aug. 2019.
[68] Government of Lao PDR, Ministry of Agriculture and Forestry. Agriculture Development Strategy to 2025 and Vision to the Year 2030. https://www.maf.gov.la/wp-content/uploads/2016/01/MDS-2025-and-Vision-to-2030-Eng.pdf.
[69] FAO. 2020. Special Report - 2019 FAO/WFP Crop and Food Security Assessment Mission to the Lao People's Democratic Republic. Rome. https://doi.org/10.4060/ca8392en

Figure 5.1: Maize Exports 2015 - 2019



(Source: UN COMTRADE)

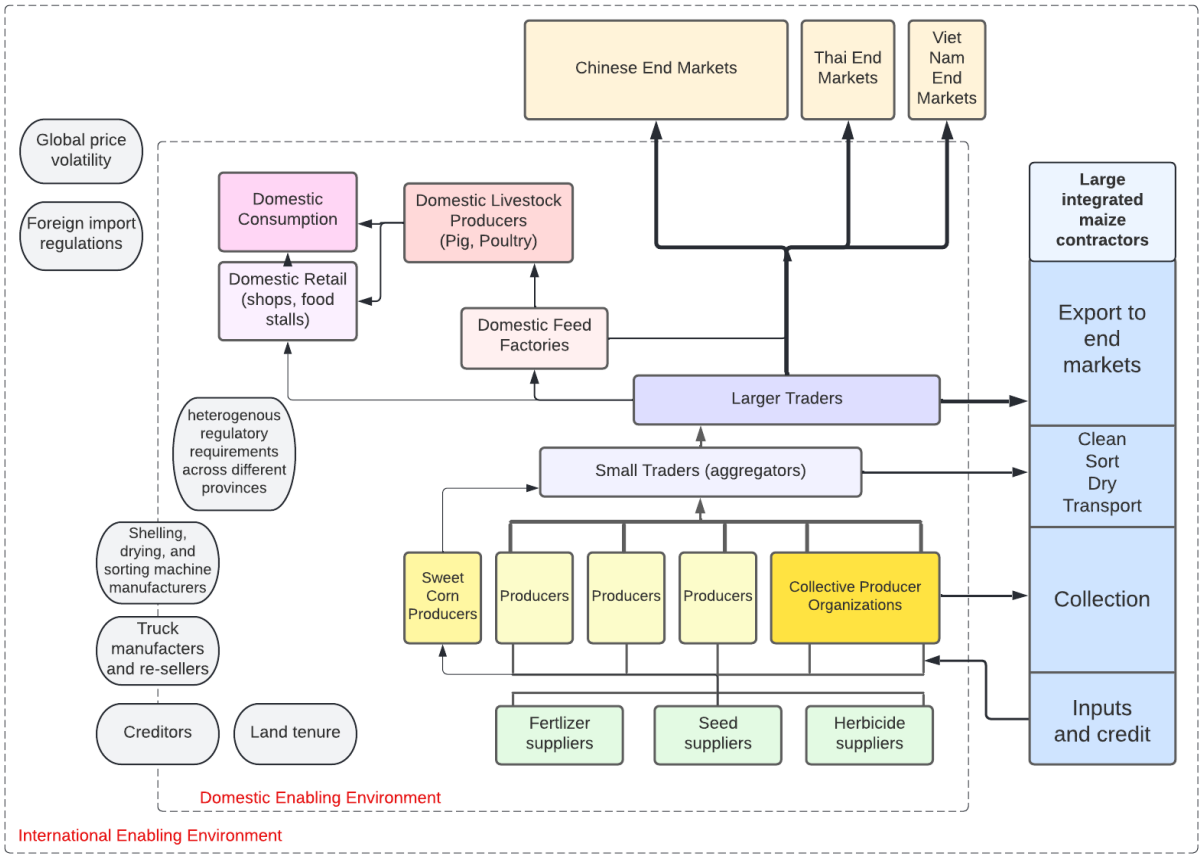
5.1.3 Value Chain Governance

Production: Maize production is grown primarily by smallholder producers. In a 2019 UNCTAD survey of three of the main maize producing districts (Oudomxay, Xiengkhuang, and Xayaboury) in Lao PDR, the average farm size was 3.7 hectares, with fewer 10 farms in the sample reaching over 10 hectares.[70] Most maize farmers grow maize in addition to other crops, The share of surveyed farmers indicating they had agricultural income other than maize was 42% (though this varied by province.) As such, value chain upgrading strategies should consider linkages between maize upgrades and other crops grown by smallholders such as rice, other cash crops like soy and cassava, and livestock.

The leading seed varieties planted by maize farmers are Advanta's Pacific 777 (Thailand), Charoen Pokphand Foods' (Thailand) CP varieties, especially CP 888, and Viet Nam's National Maize Research Institute's (notably, LVN 10).[71] According to the UNCTAD value chain analysis "the specific types of seeds used by each province depended on price differences among available choices, the associated characteristics of local input markets, as well as real or perceived suitability of the seed to local environmental conditions such as resistance to drought" (UNCTAD).

[70] United Nations Conference on Trade and Development. Analysing the Maize Value Chain for Export in Lao People's Democratic Republic. UNCTAD/DITC/COM/MISC/2020/2, 29 Sept. 2020.
https://unctad.org/webflyer/analyzing-maize-value-chain-export-lao-peoples-democratic-republic.
[71] ibid.

Figure 5.2: Maize Value Chain Map



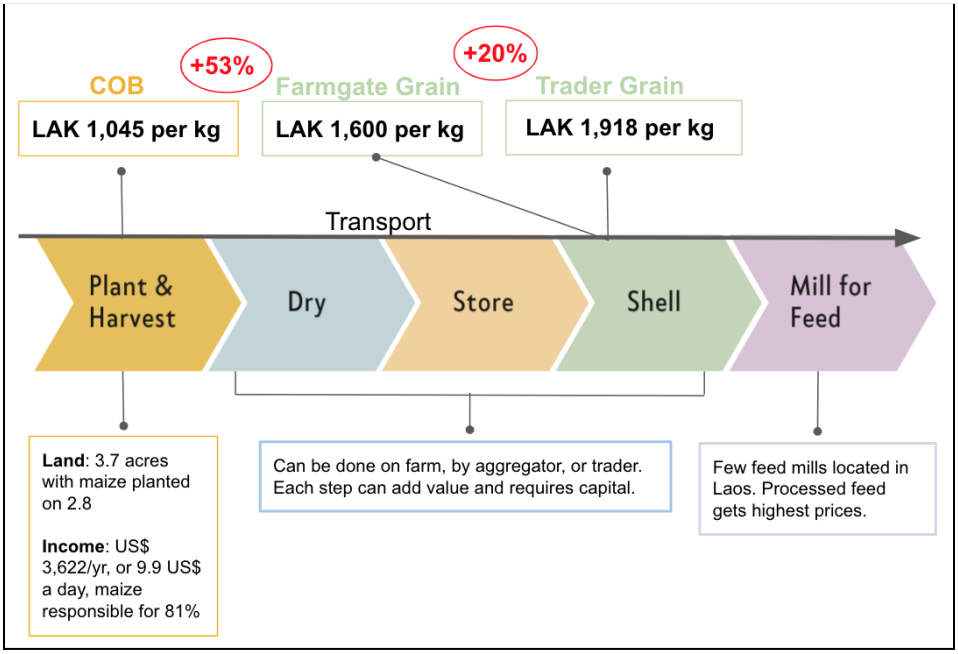
(Source: Report Team)

Contract farming plays a dominant role in the maize value chain. Large integrated maize contractors based in China, Vietnam, and Thailand often contract through a network of small traders, village associations, or directly with farmers to secure production for the year. Farmers often obtain inputs such as seeds, fertilizers, or pesticides directly from large maize contractors or obtain credit from contractors in order to purchase inputs from independent input providers. The credit is deducted from the amount paid to farmers at harvest. Large contractors work through a network of small and medium sized traders to aggregate and engage in some processing of the maize. They then export the maize to feed factories in neighboring countries. Therefore, these large contractors have a large level of control over the Lao maize market as they are the primary source of inputs, credit, and market information such as price information.

Once maize is harvested, it must be dried, shelled, and milled for animal feed. These steps can take place at a variety of points along the value chain, from the producer level up to the trader level. Dried and shelled maize obtains the highest prices. Farmers with the capacity for maize storage tend to obtain a price for their maize because this allows them to dry the maize as well as time their sales into the market for when prices are highest. Additionally, most shelling of maize happens at the trader level. However, farmers with capital to invest in small on-farm shelling machines often obtain a better price for maize. The highest quality maize is dried and shelled as close as possible to harvest time to avoid issues with pests or fungal growth. Most milling for animal feed happens abroad, closer to end markets. According to UNCTAD, the farmgate price for maize is on average 1,045 LAK/KG for maize in cob form that has not

been shelled. Maize that has been transported to large traders, dried, and shelled, is exported for almost double at LAK 1,918 per KG on average.[72]

Figure 5.3: Maize Processing steps and value addition



(Source: Report Team)

5.1.4 Supporting Market Overview: The key supporting markets for maize production are transport and trucking, agricultural machinery, and access to credit.

Credit: Access to credit in the maize value chain is limited, and supplied primarily by large maize purchasers. These credit arrangements are often informal, and Lao regulations on credit and interest rates are not typically enforced; leaving open opportunities for exploitation of farmers by lenders. Additionally, a lack of credit inhibits investment in on-farm investments for storage and processing. More data on farmer's current access to credit via contractors and demand for other sources of credit (such as micro credit) is needed. Microfinance institutions which gave less than 10 percent of all loans to the agriculture industry (and that 10 percent was almost exclusively given to large-scale agricultural enterprises) in 2014.

5.1.5 Key Competitors: China imports maize on the global commodities market. Lao PDR is the 4th largest exporter of corn to China. The top 5 exporters of maize to China are: Ukraine, the US, Bulgaria, Lao, and Myanmar. Regional competitors in the export of maize to China include Myanmar, the Philippines and Malaysia.

5.2 Integrated Value Chain Analysis

5.2.1 End Market Analysis: China, Thailand, and Vietnam are net importers of maize from abroad for supplying their animal feed industries, and the primary buyers of Lao maize. Demand for animal feed is rising in all of these countries year over year. Demand for maize has skyrocketed in China, the primary purchasers of maize from Lao PDR. In 2021, China's 2021 corn imports almost tripled in volume from the previous year, hitting a new record."[73] Additionally, turmoil caused by the current war in Ukraine may

[72] UNCTAD.
[73]Reuters. "China's Corn Imports Soar to New Record in 2021." Reuters, 18 Jan. 2022, www.reuters.com/markets/asia/chinas-grain-pork-sugar-imports-december-2022-01-18/. Accessed 22 Apr. 2022.

disrupt China's maize supply in the coming year(s). These unfortunate circumstances present an opportunity for Lao maize exports, as the price of maize is rising globally.

Lao PDR has ratified the protocol of Phytosanitary requirement for the export of maize from Lao to China, which means that all maize exported to China must be exported by a registered business entity and undergo inspection at the Lao PDR border before it can enter China.[74] The key qualities inspected for are dryness and mold. There is little information available on how much maize from Lao PDRs fails to meet SPS requirements; however, according to UNCTAD 36% of large traders have reported that they have had to reject maize due to quality issues. Ensuring proper drying and storage techniques along the maize value chain in Lao PDR will be critical to meeting growing demand for maize from China.

5.2.2 Business Enabling Environment: An ADB assessment of the agriculture sector in Lao PDR states that, "poorly defined and inconsistently applied policies, rules, and regulations" have created uncertainty in the market and constrain innovation and investment in the Lao agriculture Sector.[75] There are complex procedural barriers for small and medium enterprises along the maize VC to become formally registered, hindering the growth of the sector. A recent CSIS brief states that "convoluted government regulations have made it difficult to import and access new farming equipment and technologies that would improve practices."[76] And, in a report by the government of Lao PDR on barriers to export, researchers stated "it appears that transportation time and costs and documentation time are the major barriers to Lao's export of maize."[77] Standardizing and harmonizing the process for business registration, transport, and export of maize in the Lao value chain would have a large impact on Lao PDR's ability to increase maize exports.

5.2.3 Barriers and Opportunities for Competitiveness: UNCTAD reported that average yield per hectare of Lao maize reported was 6.32 MT per hectare, which is higher compared to maize yields in Thailand, Vietnam, Myanmar and the Philippines; however, below the yield per hectare in Malaysia and China. Additionally, UNCTAD reports that the export price of Lao maize is competitive with maize and feed prices in China, Thailand and Vietnam.

High prices and demand for food and animal feed as well as a growing domestic livestock market within Lao PDR present an opportunity for investment in animal feed processing and export of finished feed products rather than dry maize. There is potential for Lao PDR to capture more value from the maize chain by exporting feed. This would require investment in training and skills development. With the right financing mechanisms, this could be a good space for entrepreneurial SMEs to fill.

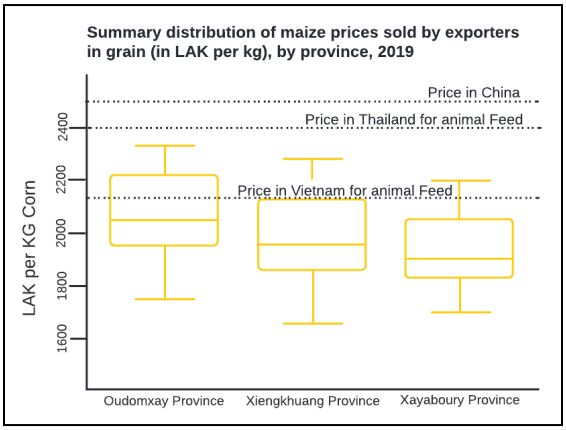


Figure 5.4: Maize Prices

[74]Second Trade Development Facility. A Field Survey: Non-Tariff Measures (NTMs) Faced by Exporters of Lao PDR. Package No. RFP/08/FY14. Government of Lao PDR., Sept. 2016. https://www.unescap.org/sites/default/files/2-5.Lao_NTM_survey9_2016.pdf.
[75]Asian Development Bank. Agriculture, Natural Resources, and Rural Development Sector Assessment, Strategy, and Road Map. Dec. 2018, www.adb.org/sites/default/files/institutional-document/480141/lao-pdr-agriculture-assessment-strategy-road-map.pdf, 10.22617/tcs189785-2. Accessed 22 Apr. 2022.
[76]Runde, Daniel, et al. "CSIS BRIEFS: Opportunities for Development Cooperation in Lao Strategic Sectors Renewable Energy, High-Value Agriculture, and SME Development." Mar. 2022. Link.
[77]Second Trade Development Facility. A Field Survey: Non-Tariff Measures (NTMs) Faced by Exporters of Lao PDR. Package No. RFP/08/FY14. Government of Lao PDR., Sept. 2016. https://www.unescap.org/sites/default/files/2-5.Lao_NTM_survey9_2016.pdf.

5.2.4 Environmental and Social Inclusion concerns: As farmers move from subsistence-based rice to production of maize for commodity markets, they are more exposed to price volatility in maize markets. In one 2019 study published in Land Use Policy authors reported that as some villages became more dependent on maize production as the primary source of income, without proper insurance or market information, some families' faced increased food insecurity and indebtedness to contractors during bad years.[78] Multiple authors over time have pointed out the decrease in soil quality and problems with erosion after multiple years of continuous maize production such as Cole (2022), Kallio Et al (2019)[79], and Fujisao et al (2020) in their paper *Impacts of the continuous maize cultivation on soil properties in Sainyabuli province*, *Laos* which found "total carbon (TC), total nitrogen (TN), available phosphorus, exchangeable potassium, and exchangeable calcium in the soil decreased with increasing duration of continuous cultivation in the sloped fields" where farmers practiced continuous maize cultivation.[80] While shifting from subsistence-based agriculture to maize mono-cropping is associated with a general increase in income of villagers, the adverse effect on soil quality and subsequent decreases in maize yields creates a long term risk of shifting to maize cultivation. Soil erosion control and nutrient replenishment should be strongly considered in any maize upgrading strategies or investments.

5.3 Upgrading Opportunities

Finance for producers: Producers in the maize value chain require access to finance to scale operations and invest in the efficiency and resilience of their operations. It is important to keep in mind that maize farmers also earn income from other crops as well as non-farm activities so increasing access to finance for farmers involved in maize production will have spillover effects in various other value chains considered in this report. Currently, maize producers obtain credit primarily from large maize traders or contractors; it should be a priority of the government to further examine these relationships to understand if the amount of credit currently available is sufficient, and if there is any exploitation occurring between producers and lenders. There are opportunities for the government to work with maize contractors to improve the relationships and nature of credit agreements between contractors and farmers through increased capacity building, transparency and formalization of contracts and/or credit agreements. These improvements would have positive spillover effects for other crops such as rice, soy, and cassava.

Training and access to machinery, equipment, and storage facilities for farmers: Expanded access to credit can only be impactful if farmers have access to training and information on the best maize production practices and upgrades. Increased access to storage facilities, understanding of proper drying techniques, and access to simple shelling machinery can all greatly improve income potential for the farmgate price fetched by producers. In a report published by the FAO the Chairperson of Lao Farmer Network is quoted stating:

> *"The importation process is complicated for importing new technologies for agricultural production. For example, if I want to import a solar dryer from abroad for drying agricultural products it takes too long to get the required papers completed. On the other hand, the funders may have a timeframe to pay. This makes the importation process very difficult as I have to get clearance from MAF, MOIC, MOF, etc."*
>
> *Source: FAO.*[81]

[78] Kallio, Maarit Helena, et al. "The Colour of Maize: Visions of Green Growth and Farmers Perceptions in Northern Laos." Land Use Policy, vol. 80, Jan. 2019, pp. 185–194, 10.1016/j.landusepol.2018.10.006. Accessed 14 Nov. 2020. https://www.sciencedirect.com/science/article/pii/S0264837718309979.

[79] ibid.

[80] Fujisao, Kazuhiko, et al. "Impacts of the Continuous Maize Cultivation on Soil Properties in Sainyabuli Province, Laos." Scientific Reports, vol. 10, no. 1, 8 July 2020, www.ncbi.nlm.nih.gov/pmc/articles/PMC7343792/, 10.1038/s41598-020-67830-9. Accessed 3 Jan. 2022.

[81] FAO. 2021. A way forward for supporting agricultural innovation in the Lao People's Democratic Republic – Key constraints and opportunities as identified by the agricultural innovation system assessment 2021. Vientiane. https://doi.org/10.4060/cb8057en

Facilitating access to and knowledge of the availability of this type of machinery and equipment for farmers in the maize value chain is critical.

Soil health: Long term soil health concerns are a threat to Lao maize production, specifically in the northern Lao upland areas. If farmers are going to reap long-term benefits from maize production, soil health should be directly addressed by the government through extension services as well as by the private sector maize contractors who supply inputs and purchase maize from farmers. Multiple studies and projects have addressed the potential benefits of intercropping legumes with maize.[82] It is worth further investigating legume export markets and methods for legume-maize intercropping. This could provide an extra source of income to farmers while addressing soil erosion, enhancing long term soil health, and improving overall sustainability of the maize value chain in northern Lao PDR.

[82] See: Barriers to Agro-Ecological Intensification of Smallholder Upland Farming Systems in Lao PDR (2019), Enhanced Legumes Production in Lao PDR Through Cross-Country Learning (2016), Opportunities and constraints for adoption of maize-legume mixed cropping systems in Laos (2020)

6. Pork Value Chain Analysis

6.1 Sector Profile

6.1.1 Overview and History: In 2015, livestock production contributed to 2.36% in GDP, and pork is currently the 3rd most consumed meat in Lao PDR. Historically, pork has been one of the most consumed meats in Lao PDR, and encounters strong demand from China and Vietnam. The Lao government has been consistently promoting meat production for import substitution and export. Pig production (heads) has been steadily increasing for a decade, and the pig population in Northern Lao takes up 1/3 of the total population in 2019, and 85% of pigs in Northern Lao are indigenous breeds. It is worth nothing that the upward trend is dominated by the increase in commercial pigs, and indigenous pigs are decreasing in production. Pigs and pig meat in Lao PDR is not as competitive in terms of price and popularity as that in Thailand, which is the number supplier for Lao PDR and its neighboring GMS (Greater Mekong Sub-region) countries. Domestic production has faced difficulties during the pandemic thus relying on imports more heavily than usual.[83] Since 2019, African Swine Fever has been prevalent in countries including China, Thailand, Vietnam and Lao PDR, affecting pig production to different extents. Due to lack of vaccination and sanitation among other problems unaddressed, the short-term goal is to enhance domestic production and substitute import.

(Image Source: Lao People's Democratic Republic)

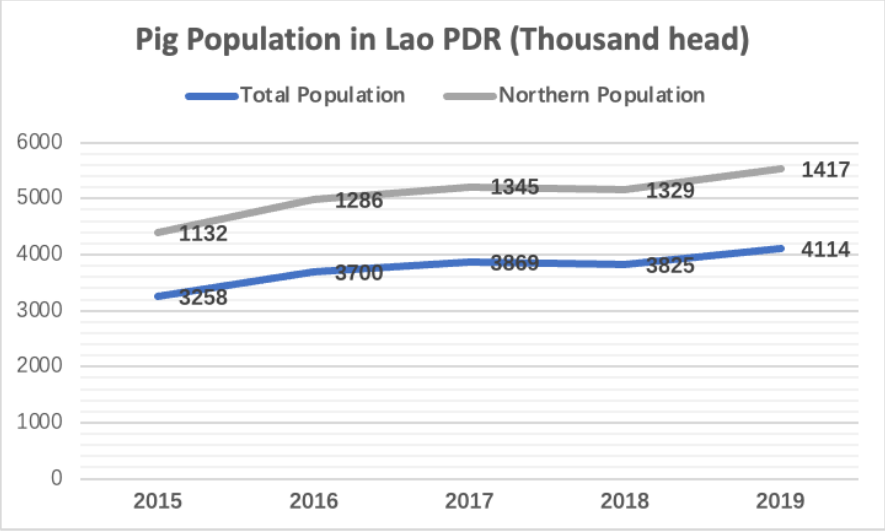
6.1.2 Production and Export

Production: As shown in Chart 6.1 and Table 6.2, in 2019 the pig population rose to 4.1 million, including 1.4 million in Northern Lao PDR. Combining the facts that Northern Lao is less populated and the pig population takes up one third of the national population indicates that pigs per household is higher in Northern Lao compared to national average. For example, Phongsaly is located at the north end of Lao PDR, and produces 2.6 times the national average per capita. Southern Lao has a higher level of commercial pig production. In contrast, the pigs in Northern Lao are populated by (more than 85% of Northern population) indigenous breeds raised by smallholder farmers.

[83] OEC. n.d. "Pig Meat in Laos | OEC." *OEC - The Observatory of Economic Complexity*. Retrieved April 18, 2022 (https://oec.world/en/profile/bilateral-product/pig-meat/reporter/lao).

What would be mentioned again in the value chain map section, the focus will be on indigenous pig production for it benefits smallholder farmers directly and to invest in long term competitiveness of the local breed.

Figure 6.1: Pig Population in Lao PDR



(Source: Department of Livestock and Fishery, Ministry of Agriculture and Forestry)

Table 6.2: Pig Population by Province

Region	Name of Province	Pig (Thousand Head)	
		2018	2019
Northern Region	Subtotal	1,329	1,417
	Phongsaly	272	290
	Luangnamtha	130	138
	Oudomxay	202	216
	Bokeo	88	93
	Luangprabang	272	291
	Huaphanh	190	203
	Xayaboury	175	186
Central Region	Subtotal	1,056	1,157
	Vientiane Capital	171	215
	Xiengkhuang	126	134

	Vientiane	138	147
	Borikhamxay	93	98
	Khammuane	121	128
	Savannakhet	376	403
	Xaysomboun	31	32
Southern Region	Subtotal	1,439	1,540
	Saravane	934	1,003
	Sekong	170	181
	Champasack	282	301
	Attapeu	53	55
	Total	3,825	4,114

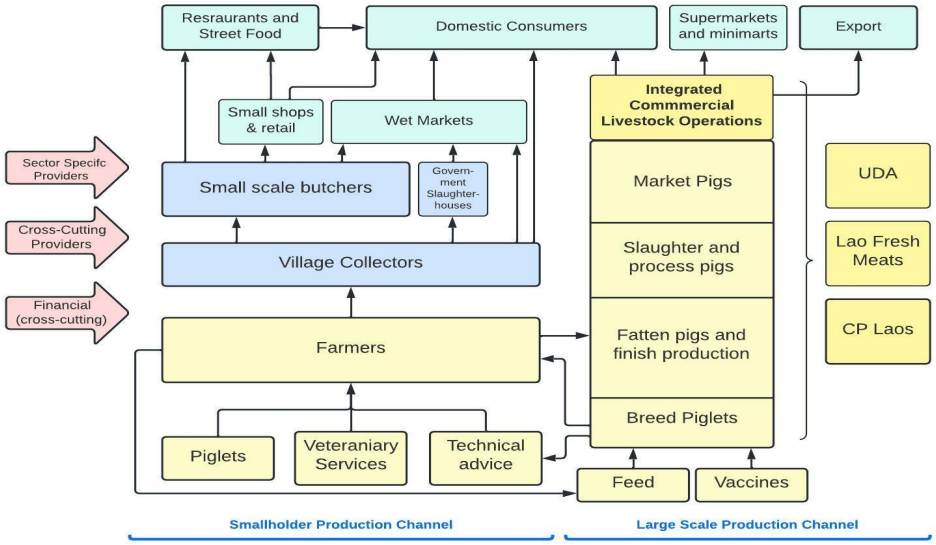
(Source: Department of Livestock and Fishery, Ministry of Agriculture and Forestry)

Export: Lao PDR has exported pigs and pig meat. In 2019, Lao PDR exported $74.4K in pigs to Vietnam, and $639K in pig meat to China. Compared to the same year import trade volume, which is $8.57M in pigs and $2.25M in pig meat for 2019.[84] In 2020, Lao PDR did not export due to pandemic shock to domestic production, relied heavily on imports, specifically $50.3M in pigs from Thailand, and $1.35M mainly from Thailand and Vietnam.[85]

6.1.3 VALUE CHAIN GOVERNANCE

Figure 6.3: Value Chain Map

[84] OEC. n.d. "Pig Meat in Laos | OEC." *OEC - The Observatory of Economic Complexity*. Retrieved April 18, 2022 (https://oec.world/en/profile/bilateral-product/pig-meat/reporter/lao).
[85] ibid



(Source: Report Team)

The value chain map for pigs contains two production channels. There are a few commercial farms that are involved in large scale production channels in the value chain map. They breed piglets for fattening themselves or selling to local farmers. Large commercial livestock farms in Vientiane Province can sell over 5,000 pigs per month[86]. There are a couple of foreign companies in the market taking advantage of lower costs of labor and land in Lao PDR including a Thai company, CP Laos [87]and a Chinese company, New Hope.

On the left-hand side, the smallholder production channel is mostly based on traditional systems such as simple confinement, free scavenging, and semi scavenging.[88] And smallholder farmers in Northern Lao mostly fed their pigs with locally produced feed like maize, cassava, and rice instead of commercial feed which is more nutritious but also more costly.

- **INPUT FOR PRODUCTION**:
  - **Feed**: Most smallholder farmers reported their feed for pigs are not commercial feeds but materials from nearby fields, including maize, rice bran and cassava. [89]
  - **Piglets:** Smallholders buy piglets from large scale farms but also in Northern Lao, there is a pattern between the ethnicity and piglet production. Traditionally, Mon-Khmer and Hmong-Mien farmers are the main producers of piglets, either for breeding or fattening. There is a rising number of Lao-tai ethnic groups growing piglets themselves because piglets purchase invites risk of bringing diseases from other villages.[90]

[86] Giz. 2017. "Sector Skills Study and Value Chain Analysis for Agriculture and Food Processing Sectors in Lao PDR." Retrieved April 18, 2022 (https://www.giz.de/en/worldwide/70634.html).
[87] Giz. 2017. "Sector Skills Study and Value Chain Analysis for Agriculture and Food Processing Sectors in Lao PDR." Retrieved April 18, 2022 (https://www.giz.de/en/worldwide/70634.html).
[88] Phengsavanh, Phonepaseuth, Brian Ogle, Werner Stür, Bodil E. Frankow-Lindberg, and Jan Erik Lindberg. 2010. "Feeding and Performance of Pigs in Smallholder Production Systems in Northern Lao PDR." *Tropical Animal Health and Production* 42(8):1627–33. doi: 10.1007/s11250-010-9612-4.
[89] Giz. 2017. "Sector Skills Study and Value Chain Analysis for Agriculture and Food Processing Sectors in Lao PDR." Retrieved April 18, 2022 (https://www.giz.de/en/worldwide/70634.html).
[90] P, Phengsavanh, Ogle B, Stur W, Frankow-Lindberg B.e, and Lindberg J.e. 2011. "Smallholder Pig Rearing Systems in Northern Lao PDR." *Asian-Australasian Journal of Animal Sciences* 24(6):867–74. doi: 10.5713/ajas.2011.10289.

    - **Veterinary Service:** Village Veterinary Workers (VVW) are trained by the District Departments of Agriculture to support smallholders with raising and looking after livestock.[91]
    - **Technical Service:** Large scale producers like CP Laos have contracts with smallholder farmers that buy piglets from the farm. The contracts cover feed, vaccines, and technical advice.[92]
- **Trade**: The value flows from smallholder farmers to village traders, who come 2-3 times a month to collect. While middle-scale and large scale farms sell their pigs through traders and butchers that they have long standing trust and trade relationships with.[93]
- **Slaughterhouses**: Most pig meat consumed in Lao PDR is processed in local slaughterhouses that are close to the smallholder farmers. There is at least one licensed slaughterhouse in each district. There is limited division of labor and non mechanized facilities.[94]
- **Marketing**: There is not enough availability of refrigeration in the transportation process. The degree of meat cut differentiation varies by retailers and slaughterhouses. The higher differentiation happens in some large butcher shops and wet markets.[95]
- **Consumption**: Most of the pork purchased by households is unprocessed and people in Lao PDR prefer to cook it at home, and sometimes buy a significant proportion of pork in forms of ready meals or soups. [96]

The horizontal linkage on the production level and trade level are both very weak. Farmers and traders in small scale rearing systems are very scattered in Northern Lao with growing rates of ownership. This means the lack of information between smallholder farmers is a disadvantage when it comes to negotiating prices with collectors and competitors.

The power dynamic in the smallholder farmers channel is very top down. And contract farming is the dominant force even in the smallholder production channel. Farmers have little power to negotiate prices despite much of the production being under some contracts with big farms.[97] Similarly, traders have little power in comparison to processors, who in turn have limited bargaining power with foreign buyers or foreign investors sometimes in the form of competitors (i.e.. CP laos)

6.1.4 Supporting Market Overview

The key supporting markets for pigs are as followings:

1. Production: Maize, rice, cassava
2. Trade: Transportation, IT industry

6.1.5 Key Competitors

The short-term goal for smallholder farmers rearing systems is to compete with local large scale farms like CP Laos, UDA and New Hope. Lao Fresh meats and CP Laos are emerging as large integrated firms with goals of exporting. These firms sometimes sell small piglets to farmers who raise pigs and sell them back to the firm, and also contract with farmers for food.[98]

In the long run, indigenous pigs in Lao PDR face challenges from foreign competitors from Thailand and Vietnam.

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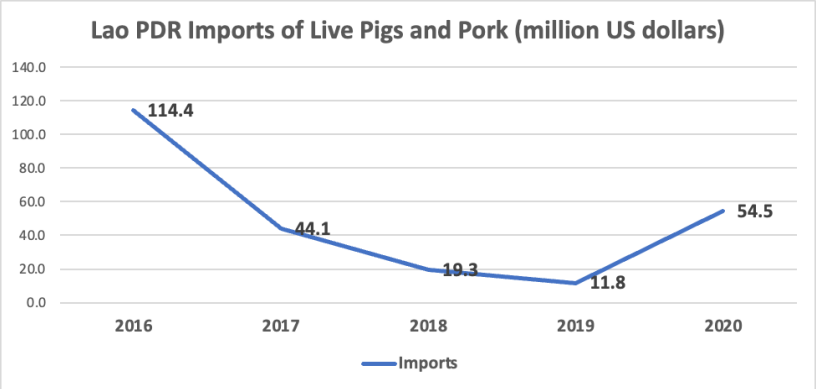
[91] Giz. 2017. "Sector Skills Study and Value Chain Analysis for Agriculture and Food Processing Sectors in Lao PDR." Retrieved April 18, 2022 (https://www.giz.de/en/worldwide/70634.html).
[92] ibid
[93] ibid
[94] ibid
[95] Giz. 2017. "Sector Skills Study and Value Chain Analysis for Agriculture and Food Processing Sectors in Lao PDR." Retrieved April 18, 2022 (https://www.giz.de/en/worldwide/70634.html).
[96] ibid
[97] ibid
[98] ibid

6.2 Integrated Value Chain Analysis

6.2.1 End Market Analysis: From different data sources, Lao PDR has not exhibited adequate export potential. For the past 5 years and further back, neighboring countries including China, Myanmar, Thailand, Cambodia, and Vietnam do not exhibit potential as end markets in near future.

From 2016 to 2020 specifically, Lao PDR only exported live pigs(swine, live) of trade value **$58K** to Vietnam in 2016, and pork(meat of swine; fresh,chilled, frozen) to Maldives of trade value **$240** in 2018, which are miniscule compared to its import volume in the same year, as indicated with the chart 6.4.

Figure 6.4: Lao PDR Imports of Live Pig and Pork



(Source: UN COMTRADE)

The import volume of live pigs and pig meat combined has been declining till 2020. We speculate that the the concurring African Swine Fever combined with Covid-19 accounted for most of the sudden increase in import volume in 2020.

For further analysis on the end markets, we analyzed the import trend of Lao PDR in the past 5 years. As shown in Table 6.5, Thailand has been the most stable import source of live pigs for Lao PDR, which is responsible for over 90% of the total import trade value. And as shown in Table 6.6, there is a noticeable change in the countries that Lao PDR has been importing pig meat from. Imports from European countries have been increasing in percentage, and there is a drastic decline in dependence on imported pig meat from Thailand.

Table 6.5: Live Pigs Import of Lao PDR 2016-2020

Year	Imports from	Commodity	Trade Value (US$)	Percentage
2016	Cambodia	Swine; live	2762187	2.4%
2016	Viet Nam	Swine; live	75168	0.1%
2016	Thailand	Swine; live	111521923	**97.5%**
2017	Cambodia	Swine; live	668876	1.5%
2017	Thailand	Swine; live	41854813	**95.6%**
2017	Viet Nam	Swine; live	1235265	2.8%

2018	Cambodia	Swine; live	412873	2.4%
2018	Viet Nam	Swine; live	209356	1.2%
2018	Thailand	Swine; live	16905512	**96.5%**
2019	Cambodia	Swine; live	49986	0.6%
2019	Viet Nam	Swine; live	27267	0.3%
2019	Thailand	Swine; live	8320966	**99.1%**
2020	Cambodia	Swine; live	132000	0.3%
2020	Thailand	Swine; live	50160362	**99.7%**

Table 6.6: Pig Meat Import of Lao PDR 2016-2020

Year	**Import From**	**Commodity**	Trade Value (US$)	Percentage
2016	Italy	Meat of swine; fresh, chilled or frozen	3836	4.5%
2016	Viet Nam	Meat of swine; fresh, chilled or frozen	19381	22.7%
2016	Thailand	Meat of swine; fresh, chilled or frozen	16381	19.2%
2016	Thailand	Meat of swine; fresh, chilled or frozen	45758	53.6%
2017	Italy	Meat of swine; fresh, chilled or frozen	6360	2.0%
2017	Thailand	Meat of swine; fresh, chilled or frozen	51840	16.4%
2017	Viet Nam	Meat of swine; fresh, chilled or frozen	258578	81.6%
2018	Rep. of Korea	Meat of swine; fresh, chilled or frozen	72440	4.0%
2018	VietNam	Meat of swine; fresh, chilled or frozen	228193	12.6%
2018	Thailand	Meat of swine; fresh, chilled or frozen	1504120	83.3%
2019	Belgium	Meat of swine; fresh, chilled or frozen	979495	29.1%
2019	Rep. of Korea	Meat of swine; fresh, chilled or frozen	1272934	37.8%
2019	Viet Nam	Meat of swine; fresh, chilled or frozen	1081081	32.1%
2019	Thailand	Meat of swine; fresh, chilled or frozen	34908	1.0%
2020	Canada	Meat of swine; fresh, chilled or frozen	211493	5.0%
2020	Germany	Meat of swine; fresh, chilled or frozen	377770	8.9%

2020	Viet Nam	Meat of swine; fresh, chilled or frozen	3572777	84.2%
2020	Thailand	Meat of swine; fresh, chilled or frozen	79103	1.9%

(Source: UN COMTRADE)

After analyzing the trade data of neighboring countries, we found that:

- China and Thailand have been only importing from Europe and North America in the past 5 years (China imported once from Vietnam in 2018).
- Myanmar and Vietnam predominately import from Thailand.
- Cambodia is the biggest pigs importer of Thailand, consisting of 61.4% of Thailand's total pig exports.[99]
- Lao PDR is among the top three pig markets, with Cambodia and Myanmar for Thailand.
- In conclusion, the practical and worthy goal for Lao PDR is to meet domestic demand and substitute imports.

6.2.2 Business Enabling Environment

- Lao PDR has been aggressively promoting pork production, encouraging farmers to move from conventional production to farming production which could both yield higher and standardized quality and higher production rates.
- In 2020 and 2025, Laos's government goals were pork production to meet the demand of around 97,500 tons and 116,200 tons.[100]
- Livestock Research Center (LRC) has been working on improving local breeds of pigs by enhancing their productive and reproductive performance.[101]
- In 2015, the National Agriculture and Forestry Research Institute (NAFRI) agreed to partner with Capacity Development for Agricultural Innovation Systems (CDAIS) to help farmers from Xanakham(Northern Lao) to advance their pig production system. This CDAIS project provides links to a microfinance association to help financial capacity development, and training programs that send farmers to Thailand to develop pig rearing skills.

6.2.3 Barriers and Opportunities for Competitiveness

Table 6.7: Pork's Barriers and Opportunities

	Barriers	Opportunities
Production	1. Outbreaks of diseases 2. High mortality of piglets 3. Slow growth rate of fattening pigs[102]	1. Researches on high nutrient, low cost, home-made feed alternative(Tiemann et al. 2017) 2. Piglet breeding and farrowing management training

[99] OEC. n.d. "Pig Meat in Laos | OEC." *OEC - The Observatory of Economic Complexity*. Retrieved April 18, 2022 (https://oec.world/en/profile/bilateral-product/pig-meat/reporter/lao).

[100] Xayalayath, Somsy, Gabriella Novotni Dankó, Peter Balogh, Klaus-Peter Brüssow, and Jozsef Rátky. 2021. "Reproductive Performance of Indigenous Lao Pigs Reared by Small-Scale Farmers in Northern Provinces of Laos." *Archives Animal Breeding* 64:365–73. doi: 10.5194/aab-64-365-2021.

[101] ibid

[102] Tiemann, Tassilo T., Ammaly Phengvilaysouk, Soukanh Keonouchanh, Tassilo T. Tiemann, Ammaly Phengvilaysouk, and Soukanh Keonouchanh. 2017. "Herd Dynamics Reflect Constraints for Pig Production and Farmer Attitudes in Smallholder Systems in Lao PDR." *Animal Production Science* 58(11):2158–66. doi: 10.1071/AN16730.

Marketing	1. Poor market access 2. Asymmetric information	1. Unions information facilitation 2. Digital technology transformation
Delivery	1. Poor road conditions 2. lack of cold chain supply system	1. National road maintenance and improvement projects 2. International railway projects that assisted by Thailand, Vietnam, and China

6.2.4 **Environmental and Social Inclusion concerns**Wastewater from pig farms has been a long-standing issue. From a research and follow-up project by UNDP, wastewater causes villagers near the farm to have difficulty breathing and ruin fertile land. [103]

6.4 Upgrading Opportunities

- Production:
    - Smallholder farmers should be encouraged to utilize available research results to increase pig production by experimenting with various feed alternatives. This requires investment and interventions from government and NGO like CDAIS.
    - Farrowing management training. Research has shown that the piglet's death rate could be decreased significantly by better monitoring and care from farmers during the first 3 days after farrowing.[104]
    - Disease prevention. Housing improvement that provides isolation of pigs in question avoids the spread of diseases. Health management including vaccination, deworming and provision of iron and vitamins are recommended. [105]
    - Sanitation improvement to eliminate negative spillover effects to agricultural products but also as a prevention measure for disease spread.

- Trade:
    - Unions or organizations for information sharing. The low negotiation power from smallholder farmers would be improved by organizations that facilitate information on markets.
    - IT infrastructure improvement at individual level would provide farmers with a diversity of finance and market information.

- Delivery:
    - The improvement project on National Road 13[106] supported by the World Bank and EIB is expected to create positive impacts including better travel conditions and road safety, reduced transportation costs and travel time.

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[103] UNDP. 2018. "From a Pig Farm to an Energy Bank with a Breath of Fresh Air | UNDP in Lao PDR." *UNDP*. Retrieved April 21, 2022 (https://www.la.undp.org/content/lao_pdr/en/home/presscenter/articles/2018/06/pigs--pipelines-and-a-breath-of-fresh-air.html).

[104] Xayalayath, Somsy, Gabriella Novotni Dankó, Peter Balogh, Klaus-Peter Brüssow, and Jozsef Rátky. 2021. "Reproductive Performance of Indigenous Lao Pigs Reared by Small-Scale Farmers in Northern Provinces of Laos." *Archives Animal Breeding* 64:365–73. doi: 10.5194/aab-64-365-2021.

[105] Tiemann, Tassilo T., Ammaly Phengvilaysouk, Soukanh Keonouchanh, Tassilo T. Tiemann, Ammaly Phengvilaysouk, and Soukanh Keonouchanh. 2017. "Herd Dynamics Reflect Constraints for Pig Production and Farmer Attitudes in Smallholder Systems in Lao PDR." *Animal Production Science* 58(11):2158–66. doi: 10.1071/AN16730.

[106] AIIB. 2020."Lao PDR: Climate Resilience Improvement of National Road 13 South Project (Section 3) - Projects - AIIB." Retrieved April 22, 2022 (https://www.aiib.org/en/projects/details/2020/approved/Lao-PDR-Climate-Resilience-Improvement-of-National-Road-13-South-Project.html).

- The ongoing projects including NR2[107] would create a demand pull for smallholder farmers in Northern Lao. For the benefits of transportation improvement to be precipitated at individual level, local transportation improvement including the cold chain logistics system requires investments.

[107] Gordon Feller. 2022. "A New Transportation Project for Northern Southeast Asia." World Highways. Retrieved May 10, 2022 (https://www.worldhighways.com/feature/new-transportation-project-northern-southeast-asia)

CROSS CUTTING ISSUES

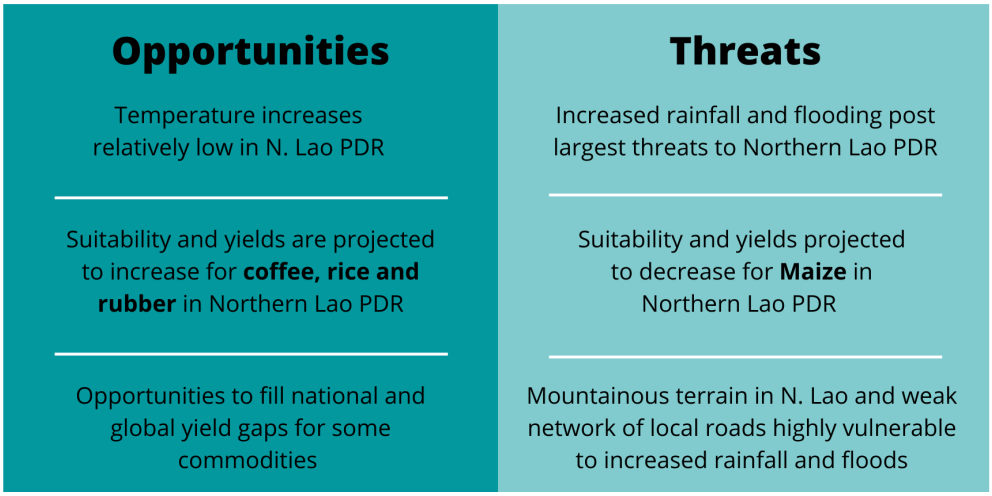
For Lao PDR to maximize the potential of the four markets it must also comprehensively address other areas of rural development which will impact all four value chains. In this section, we address six cross-cutting issues that are key to improving market access for farmers in Northern Lao PDR: resilience to climate change, e-commerce, finance for smallholder farmers, gender, global risks, and extension services.

7. Resilience to Climate Change

As Lao PDR becomes increasingly connected to regional transportation networks, ensuring that development strategies increase the abilities of producers in Northern Lao PDR to resist, recover, and reorient is critical to long term success of this region. Lao PDR's dependence on agriculture makes it extremely vulnerable to the effects of climate change. Additionally, as producers shift away from subsistence agriculture and seek to increase their income through increased production of cash crops and access to new markets (export and domestic), farmers' vulnerability to global economic shocks may increase.

USAID recently released a comprehensive study of projected impacts of climate change as they relate to climate variability, rainfall, flooding, and temperature increases for the entire Mekong Peninsula. Because of Northern Lao's elevation, the impact of climate change will be felt differently here than elsewhere in the region, presenting both opportunities and challenges.[108]

Figure 7.1: Opportunities and Threats from Climate Change



(Source: Report Team)

Transport: Severe weather events may be especially harmful in Northern Lao PDR where many roads are unpaved and vulnerable to landslides and floods. Many roads already become inoperable during the rainy season. As producers shift to export-based production (maize, coffee, and rice) or seek to market outputs in urban areas (pork), disruptions to transportation networks will pose an increased threat to livelihoods. Northern Lao's hilly terrain is especially challenging for roads. A CSIS report highlighted the **importance of investing in "roads with cross-drainage structures and water runoff designs."**[109] As noted above,

[108] ICEM. 2013. USAID Mekong ARCC Climate Change Impact and Adaptation Study for the Lower Mekong Basin: Main Report. Prepared for the United States Agency for International Development by ICEM – International Centre for Environmental Management. Bangkok: USAID Mekong ARCC Project. Available online at: www.mekongarcc.net/resource.

[109] Runde, Daniel, et al. "CSIS BRIEFS: Opportunities for Development Cooperation in Lao Strategic Sectors Renewable Energy, High-Value Agriculture, and SME Development." Mar. 2022. Link.

climate change could increase the productivity of certain crops such as rice and coffee in the Northern Provinces, and therefore investments in improved local transportation networks will be critical to making sure farmers in the North are well positioned to take advantage of these emerging opportunities.

Impact of Climate Change: Climate change will impact rainfall patterns, droughts, cyclones, and temperature. These changes will invariably affect Northern Lao PDR, but will have varying effects on each of the four crops covered in this report. While extreme weather is a threat to all crops, it is important to note that the uneven impacts of climate change may also benefit Northern Lao PDR in some ways. Northern Lao PDR sits at a higher elevation than the lower Mekong Basin. While regionally in the Mekong peninsula temperatures are projected to rise between 2 - 5 degrees in the coming decades, according to the USAID report: Mekong ARCC Climate Change Impact and Adaptation Study for the Lower Mekong Basin, temperatures are projected rise the least in Northern Lao PDR, which already experiences cooler temperatures compared to the rest of the region. They report that while many regions in the Mekong Peninsula will become less suitable to crop production, **higher elevation zones, such as Northern Lao PDR, will experience higher suitability and yields are projected to increase for certain crops, such as rice and coffee, and rubber.**

> **Rice**: Rice is Lao PDR's staple crop and the majority of farmers grow rice for home consumption. Rice production is highly vulnerable to climate change, with yields across Vietnam, Thailand, Cambodia, and Lao PDR projected to decline between 3% and 12% by 2050.[110] However, **yields are projected to increase in higher elevation Northern Lao PDR**.
>
> **Maize**: Climate change is projected to increase rainfall as well as rainfall variability and heavy rainfall events. This is a particular challenge for maize production in Northern Lao PDR where soil erosion has already become an issue. In Lao PDR, 8,000 km2 of land currently producing maize is projected to shift from moderate suitability to the not suitable category.[111]
>
> **Coffee**: According to USAID, "projected changes in temperature and rainfall will **increase suitability in areas of high elevation** such as in northern Lao PDR."[112] While further study is needed, this finding is promising for the potential of expanded Arabica coffee production in Northern Lao PDR.
>
> **Pork**: Subsistence and smallholder **pig production in Lao PDR is relatively resilient to climate change** because: "(i) it is not dependent on fodder, (ii) wild pigs are more resistant to disease outbreaks, and (iii) wild pigs are able to move to cooler habitat in heat wave conditions." Additionally, pigs can be kept inside shelters during monsoons or other extreme weather events. Pigs are also an important form of savings and an asset in times of emergency and a source of diversified income, increasing farmer resilience.

Implications and Recommendations: In order to increase the resilience of farmers in Northern Lao PDR subsistence based rice farmers must diversify production. The upgradings strategies presented throughout this report offer pathways for farmers to maximize incomes from expanding the production of maize, coffee, and pork and improve their production of rice. Along with the upgrades presented within each value chain it will be important for Lao PDR to increase farmer resilience through various mechanisms such as: **increased climate and weather information for farmers, improved extension services to**

[110] ICEM (2013) USAID Mekong ARCC Climate Change Impact and Adaptation Study on Agriculture. Prepared for the United States Agency for International Development by ICEM - International Centre for Environmental Management. https://www.usaid.gov/sites/default/files/documents/1861/USAID_Mekong_ARCC_Climate_Change_Impact_and_Adaption_Study_Agriculture_Report.pdf.
[111] ibid.
[112] ibid.

improve climate-resilient production, improved access to credit, and improved transportation networks to facilitate market access. Key strategies for guiding investments throughout these areas are presented in the following sections on ecommerce, finance, gender, and extension services. A holistic approach is needed to ensure the long term resilience of smallholder farmers in Northern Lao PDR.

8. E-commerce and Digital Marketplaces

E-commerce through online sales allows businesses to reach customers both at home and overseas, and vice versa. Small businesses in the form of smallholder farmers in Lao PDR can benefit from E-commerce for its lower costs in aspects of marketing, information sharing on a global scale. With e-commerce, both customers and businesses are no longer limited geographically and have an easier time finding each other. Cost reduction such as transaction fee and marketing, consolidating customer services, and enhancing market share of the business are reported to be one of the most prevalent benefits for SMEs in developing countries like Vietnam and Thailand. [113] Access to finance and information sharing for farmers in the forms of peer-to-peer lending, and farmer advisory services, are among the 5 key aspects that emerging markets like Indonesia are working on to develop a vibrant AgriTech ecosystem.[114] E-commerce booming combined with railway development cuts down costs and presents great opportunities for local trade as well as international trade.

Opportunities for Developing Countries

Unlike in developed regions where e-commerce giants like Amazon and Alibaba dominate the market, in developing countries there is greater space for competitors and new business models to emerge in the digital marketplace. These markets have potential to become as significant as those dominated by large global players, and there are opportunities for both entry of existing players and the rise of new locally owned technology companies.

In Lao PDR, like in other countries, the development of digital marketplaces has been hastened by the Covid-19 pandemic. While Lao PDR has moved in the right direction with enactment of legislation such as the Law on Electronic Transaction in 2012, the Law on Data Protection, and Law on Payment system in 2017, and the Law on Electronic Signature in 2018, Lao PDR is still behind in digital adoption compared to its neighboring countries. [115]

Table 8.1: Rate of Internet Penetration among Key Countries in SouthEast Asia

Vietnam (2020)	70.3%
Indonesia (2020)	53.7%
Philippines (2019)	46.9%
Lao PDR (2017)	**25.5%**

(Source: World Bank's, *Individuals using the Internet*[116])

The market value of e-commerce has grown exponentially during the pandemic:

1. Indonesia has the biggest internet economy within the Southeast Asian region, with a market of over USD 30 billion in gross market value (GMV) in 2020 and growing strong. And evidence[117] has shown that e-commerce has increased the resilience of small businesses during the

[113] Dai Nguyen, Huu Phuoc, and Thai Binh Dang. 2017. "The Impact of E-Commerce in Vietnamese SMEs." *European Journal of Business Science and Technology* 90–95. doi: 10.11118/ejobsat.v3i2.106.
[114] Goh, Lesly. 2022. "The Digital Transformation of Agriculture in Indonesia." *Brookings*. Retrieved April 23, 2022 (https://www.brookings.edu/blog/future-development/2022/01/21/the-digital-transformation-of-agriculture-in-indonesia/).
[115] Aristotle David and Cess Principe. 2021. "Fostering Laos' Digital Economy | ZICO Law." Retrieved April 26, 2022 (https://www.zicolaw.com/resources/alerts/fostering-laos-digital-economy/).
[116] World bank. (n.d). *Individuals using the Internet*. Retrieved April 20th, 2022. https://data.worldbank.org/indicator/IT.NET.USER.ZS?locations=LA
[117] Maria Monica Wihardja. 2021. "Why E-Commerce Is Essential to Indonesia's Small Businesses." *World Economic Forum*. Retrieved April 26, 2022 (https://www.weforum.org/agenda/2021/11/why-ecommerce-key-to-indonesias-small-businesses/).

post-pandemic era: Nearly 80% of the digital merchants in the survey kept their businesses throughout 2020, compared to the number of 40% for offline firms.

2. Vietnam's e-commerce is also expected to grow dramatically and reach 39 billion U.S. dollars by 2025[118], ranking second after indonesia. Besides strong competitors like Singapore's Shopee and Alibaba-owned Lazada from overseas, domestic online marketplaces have welcomed new players for the past decade. Overall, the business-to-customer revenue of the e-commerce sector between 2012-2020 has grown from under 1 billion dollars to 12 billion dollars. During the pandemic, increasing consumers are willing to shop online for fresh products. During the pandemic.[119]
3. Thailand came second after Indonesia in terms of internet economy size, and with retail and wholesale industries as the biggest contributors towards the sector's constant growth.[120]
4. The e-commerce is not as big as that in economies in other Southeast Asia but the growth rate is not negligible. Before the pandemic, e-commerce accounted for 8% of total card payments spent in the retail space, with 35% of the sector being made up by spending on travel and accommodation. At the end of 2021, e-commerce accounted for 14% of total card payments sales, with travel and accommodation only taking up 11%. Statistics from FNB[121] showed that total online sales in 2020 jumped by 55% and another 42% in 2021, driven by increased spending in less traditional e-commerce industries.

Infrastructure for E-commerce in Bigger Picture-Digital Agriculture

Data, digital platforms and connectivity are integral to transformation into digital agriculture. The realization of digital agriculture relies on the construction of infrastructure such as electricity supply, mobile network coverage and Internet connectivity. Electricity has been a major source of revenues for Lao PDR over the last decade, especially through exports to neighboring countries such as Thailand, Vietnam, Cambodia and Myanmar. Laos' electricity exports to neighboring countries and ASEAN states are expected to increase to about 20,000 MW between 2020 and 2030.[122]

According to the report from Lao-China Chamber of Commerce,[123]Lao PDR has weak Internet infrastructure connectivity, with the lowest connectivity ratio among ASEAN countries. Lao PDR ranks second to last in the ASEAN region in the number of mobile broadband subscribers per capita. This weak Internet infrastructure connectivity largely affects e-commerce participation because limited Internet providers make connectivity expensive and unstable, also with limited signal coverage. For Lao's farmers to get benefits from e-commerce, they need to have a bank account. However, in ASEAN, the Lao population ranks third from the bottom in terms of having a bank account, with less than a third of the population having an account with a financial institution, just ahead of Cambodia and Myanmar.[124]
In January 2021, the internet users in Lao PDR was 3.55 million, which is 15% increase since 2020. Its internet penetration reached 48.4%.[125] These numbers are great indicators to show that Lao PDR will have

[118] Dai Nguyen, Huu Phuoc, and Thai Binh Dang. 2017. "The Impact of E-Commerce in Vietnamese SMEs." *European Journal of Business Science and Technology* 90–95. doi: 10.11118/ejobsat.v3i2.106.
[119] cycles, This text provides general information Statista assumes no liability for the information given being complete or correct Due to varying update, and Statistics Can Display More up-to-Date Data Than Referenced in the Text. n.d. "Topic: E-Commerce in Vietnam." *Statista*. Retrieved April 26, 2022 (https://www.statista.com/topics/5321/e-commerce-in-vietnam/).
[120] Statista Research Department. n.d. "E-Commerce in Thailand - Statistics & Facts | Statista." Retrieved April 26, 2022 (https://www.statista.com/topics/6939/e-commerce-in-thailand/).
[121] Majola, Given. n.d. "E-Commerce Market in the Country Grows Rapidly." Retrieved April 26, 2022 (https://www.iol.co.za/business-report/economy/e-commerce-market-in-the-country-grows-rapidly-dcf56c94-a994-499b-bb29-2044b5b10a91).
[122] Anon. n.d. "Laos to Export 20,000 MW of Electricity by 2030 | Open Development Mekong." Retrieved April 26, 2022 (https://opendevelopmentmekong.net/news/laos-to-export-20000-mw-of-electricity-by-2030/).
[123]Lao-China Chamber of Commerce. 2022. "Laos' e-Commerce Growth Lags Other ASEAN Countries." Retrieved May 10, 2022 (http://www.liangjialijing.com/n_5459082.htm).

[124] ibid.
[125] Simon Kemp, 2021.. "Digital in Laos: All the Statistics You Need in 2021." *DataReportal – Global Digital Insights*. Retrieved May 9, 2022 (https://datareportal.com/reports/digital-2021-laos).

wider internet coverage in the future. Also, around 80% of the total population has mobile connections, which is 5.8 million. This number has increased 7.7% from 2020 to 2021.[126] In recent years, Lao people's utilization of e-commerce and electronic payment is rapidly growing.The increasing mobile connections provide a solid base for Lao farmers to take advantage of e-commerce and further increase their incomes.

What Is In Place

Lao PDR gained government support to promote e-commerce. The Lao Ministry of Posts and Telecommunications announced the development of e-commerce as one of its strategic goals for 2016-2025. The Lao government will complete the necessary information and communications technology (ICT) infrastructure and draft legal documents to support e-commerce by 2025. With increased support from the government, Lao farmers could enjoy better internet infrastructure connectivity and use digital platforms to have information sharing, get access to finance and sell commodities.

The Lao government has also conducted incentive programs in IT education and entrepreneurship. On August 25, 2021, the Trade and Economic Research Institute of Laos released a study on e-commerce development policies in Lao, analyzing four key factors for the development of e-commerce development in Lao. Also, at the same time, “China-Laos-Myanmar-Vietnam Cross-border E-Commerce Training" started in Yunnan Province, China, aiming to train specialized operational talents in the field of cross-border e-commerce for Lao PDR and other countries. This training program is expected to cultivate an IT talent pool for Lao PDR.

Regulatory Improvements Are Still Needed

1）A enabling business environment

As payment goes paperless for an increasing number of companies in Lao PDR, while most businesses and government authorities still require “wet ink” signature, this creates a conflicted narrative. And clear implementation and direction of existing legislation like Law on Electronic Signatures will create a stable business environment for existing businesses but also invites investors both at home and from overseas. Regulations on protection of intellectual property and recognition of electronic agreements will be paramount to creating an encouraging environment for entrepreneurs.

2）Information Communication Technology training

To eliminate exploitative foreign investors but also aim for a more sustainable, self-reliant transformation into the digital economy. Lao PDR has to look into incorporating Information Communication Training at all levels, from schools to the working force. It is a popular strategy to invite IT giants like Microsoft, Alibaba and Facebook in emerging markets but Laotians should be equipped not only to use but also to develop new technologies.

3）Consumer protection

Protection on data, privacy and consumer rights should be taken into account in regulation implementation even though digital transformation in Lao PDR is still at an early stage due to the irreversibility feature of data sharing. A widely shared awareness of rights of and obligations of both users and operators for these platforms would contribute to fast growing and sustainable platforms for all stakeholders.

[126] ibid.

9. Value Chain Finance for Smallholder Farmers

In Lao PDR, the relatively slow growth of its economy is attributed to the lack of access to working capital among micro, small and medium-sized enterprises (MSMEs). Only around 20 percent of them are able to access bank loans[127]. For smallholder farmers, access to financial services is even critical to get capital for farm investments in productivity, improve post harvest practices, smooth household cash flow, enable better access to markets and promote better climate adaptation. Access to an extensive range of financial services, however, poses a significant challenge for smallholder farmers, composed of heterogeneous groups, differing in their resource base and choice of crops and livestock, links to markets, and the relative importance of agricultural income[128]. For financial institutions as well, to enter the market entails diverse risks: dispersed market, cost of infrastructure and communication, seasonality, and limited collaterals among farmers[129]. Regarding transportation, the limited infrastructure not only increases households' costs of accessing financial service agents but also suggests there is less competition, which could allow agents to charge higher prices than the decent fees. The term "value chain finance" refers to the use of a value chain system so that the diverse actors within the system can benefit from tailored services and products to reduce the risk and cost of financing, which increase the overall efficiency of the value chain[130]. Finance actors range from state banks to community-based lenders, which typically offer various products such as grants, market-based loans, and equity (See Appendix 2 for the comprehensive list).

In Lao PDR, without formal access to banks, many smallholder farmers rely on two types of semi-formal microfinance institutions at the village level. First, village-level saving groups (SGs) are the institutions formed to collect savings from member villagers and lend them back to members in need with its interests which is distributed as dividend to the members. The number of SGs in the country reached up to 453 in 2009; however, the number has withered to 397 in 2020. Second, In 2009, village banks (VBs) were introduced by the German aid organization GIZ in collaboration with the Bank of the Lao PDR (BoL). The number of VBs has reached 825 in 2020[131]. Both institutions are good targets for the further interventions, however, they face a major challenge: the lack of operating skills to sustainably control their funds. At the national level, the Lao Microfinance Association (LMFA), a non-profit organization under regulation of the Ministry of Home Affairs, works as the national microfinance industry's umbrella organization. LMFA was established in 2007, went fully operational as it obtained the permanent license in 2018. Its mission is ranging from supporting and capacity building of VBs to microfinance customer protection and advocacy. LMFA's membership is expanding and it has 99 member MFIs in 2020, the coverage is pretty low given the number of VBs in the country for example.

The use of digital platforms is becoming increasingly common among ASEAN countries. In Indonesia, for example, TaniHub Group has peer-to-peer lending platforms for farmers who need working capital to find investors who want to invest. This type of business model is currently limited in Lao PDR because of the low rate of internet penetration (25.5% in 2017, see Appendix 2 for the comparison with the key regional countries).

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[127] World Wide Fund for Nature (2021). Unlocking Smallholder Finance for Sustainable Agriculture in Southeast Asia. https://sustainablefinanceasia.org/wp-content/uploads/2021/03/WWF-2021-Unlocking-Smallholder-Finance-for-Sustainable-Agriculture.pdf

[128] International Finance Corporation (2014). *Access to Finance for Smallholder Farmers.* https://www.ifc.org/wps/wcm/connect/536ed03b-82ef-4733-ac27-2282844cdf8e/A2F+for+Smallholder+Farmers-Final+English+Publication.pdf?MOD=AJPERES&CVID=kAQzrkq

[129] United States Agency International Development (2008). *FINANCE IN VALUE CHAIN ANALYSIS—A SYNTHESIS PAPER.* https://pdf.usaid.gov/pdf_docs/Pnadn417.pdf

[130] International Finance Corporation (2014). *Access to Finance for Smallholder Farmers.* https://www.ifc.org/wps/wcm/connect/536ed03b-82ef-4733-ac27-2282844cdf8e/A2F+for+Smallholder+Farmers-Final+English+Publication.pdf?MOD=AJPERES&CVID=kAQzrkq

[131] Chansathith Chaleunsinh and Koichi Fujita (2021). Yusof Ishak Institute. *Rural Finance in Lao PDR: Whither Village-Level Savings Groups?*. https://think-asia.org/bitstream/handle/11540/13877/ISEAS_Perspective_2021_88.pdf?sequence=1

Implications and Recommendations:
This section lays out a set of actions Lao PDR government and the other microfinance providers can take to aid the development and implementation of smallholder finance schemes.

1) Select LMFA as Lead Entity
In Lao PDR, like other developing countries, smallholder farmers often live in remote settings far from markets. To be inclusive enough to reach out to as many farmers as possible, paying cost for infrastructure and communication is indispensable. Also, authority has to be centralized to enable equal development among the rural communities. LMFA is a relatively new organization and has not earned enough members to have an influence as a lead entity on the national level. It should work with international organizations such as International Finance Corporation so that it can take advantage of its capital resource and the extensive network in the microfinance sector. This would also enable LMFA to collect objective data and let stakeholders get access to them, reassuring potential investors that there are benefits for them to enter the market.

2) Build the capacity of existing microfinance institutions
As the ISEAS study suggests, many managers of SGs and VBs do not have enough capacity to run their organizations for a long period of time. They have to be reliable agencies for smallholder farmers to flexibly adapt diverse needs of smallholder farmers. LMFA and its potential partners should provide the managers of those organizations with proper education and training on business skills and financial literacy. The fund for each SGs and VBs can be deposited or invested to be properly managed, or used for specific needs of their communities.

3) Tailor the services addressing the needs of smallholder farmers and financiers
In Indonesia, the Sustainable Cocoa Production Program (SCPP) was established for tackling the lack of access to finance among cocoa farmers and enhancing the competitiveness of its value chain addressing the declining yields at the same time. SCPP created an enabling environment for financial institutions to deliver diverse training on financial literacy, planning and saving, and sustainable agricultural practices[132]. This not only gives farmers an idea of how they can better use their working capital to show a path to increase productivity, but also lets financial institutions improve their understanding of the cocoa industry to develop better products. As this case shows, it is important to think about why smallholder farmers need access to finance and what kind of conditions financiers want when they decide to invest, not to set access to finance as the final objective.

[132]World Wide Fund for Nature (2021). Unlocking Smallholder Finance for Sustainable Agriculture in Southeast Asia. https://sustainablefinanceasia.org/wp-content/uploads/2021/03/WWF-2021-Unlocking-Smallholder-Finance-for-Sustainable-Agriculture.pdf

10. Gender

Gender empowerment in Northern Lao PDR could significantly echo with the impact of advancing transportation infrastructure. This is because the Lao PDR agricultural sector is dominated by women, who make up over half the agricultural workforce and contribute significantly to all aspects of agricultural production. While they are heavily involved in agricultural work, they face significant challenges in fully participating in it. Gender equality is a key element in achieving food security, increasing productivity of agricultural levels, managing natural resources; all of which makes the impact of the transportation infrastructure in Northern Lao PDR more prevalent. According to the FAO Policy on Gender Equality, "gender equality is not only a fundamental human right but also an essential means for FAO to deliver on its mandate". The Food and Agriculture Organization of the United Nations (FAO) conducted an analysis in the Phaxai district of Xieng Khouang province, in the northeast of the country, for measuring women's progression in agriculture as follows[133]:

1. **Gender and ethnicity are inextricably linked:** Particularly in agricultural villages, ethnic and traditions contribute highly in dividing labor between men and women. The work of women indeed varies across families, with some tasks falling into the men's category and others into the women's; however, their work is deemed to be 'lighter' than that of men. For instance, women's responsibilities include caring for children, cooking, cleaning, watering gardens, and weeding. As a general rule, men tend to perform physically demanding tasks, such as repairing household damage, cutting wood, plowing fields, caring for large livestock, or operating machinery. The rigid gender roles that prevail curtail women's ability to allocate time between work and household tasks, resulting in 'time poverty'.Rice season for example was a time when women worked longer hours than their husbands, which explains why men's schedules were more diverse: when men were sleeping, women were juggling household duties.

   For rice, the male and female were involved unevenly in Lao's rice farming. From a survey done by Moglia and other researchers (2020), they investigated 18 villages and found there are 39% women and 61% men in rice farming. Also, in smallholder farmers, women show better performance than men. There is a game-based approach to analyzing the gender difference of rice production of Lao's smallholder farmers. The results presented that women earned higher income by a higher level of cooperation and adopted new farming practices sooner than men[134]. Another institute also did a survey for Lao's rice farmers. By analyzing the data, women who used new practices were likely to use more practices and report its usefulness than men[135]. Therefore, there is a bound to argue that organic rice farming should get more women involved.

   Ethnicity also contributes greatly to gender dynamics, especially when it comes to the leadership of villages. Often, in ethnic minority communities, women face a disproportionate workload and lack access to leadership positions due to cultural perceptions that favor men.

2. **In leadership roles outside the national sphere, women are significantly underrepresented:** There is a significant underrepresentation of women in leadership positions at the province and district level as well as in village administration. A common issue in agriculture is the unequal access to leadership opportunities for women and the low representation of women in

[133] NAFRI. (2020.). *Country Gender Assessment of Agriculture and The rural sector in Lao People's Democratic Republic*, from https://www.phakhaolao.la/en/publications/country-gender-assessment-agriculture-and-rural-sector-lao-peoples-democratic-republic#:~:text=Women%20are%20an%20integral%20part

[134] Larson, S., Giger)-Dray, A., Cornioley, T., Thephavanh, M., Thammavong, P., Vorlasan, S., Connell, J. G., Moglia, M., Case, P., Alexander, K. S., & Perez, P. (2020). A Game-Based Approach to Exploring Gender Differences in Smallholder Decisions to Change Farming Practices: White Rice Production in Laos. Sustainability, 12(16), 6594. https://doi.org/10.3390/su12166594

[135] Moglia, M., Alexander, K. S., Larson, S., Giger)-Dray, A., Greenhalgh, G., Thammavong, P., Thephavanh, M., & Case, P. (2020). Gendered Roles in Agrarian Transition: A Study of Lowland Rice Farming in Lao PDR. Sustainability, 12(13), 5403. https://doi.org/10.3390/su12135403

decision-making bodies. The CGA team conducted a study on the role of gender in agriculture in the Xieng Houage Province which is located in northeast Lao PDR from November 27th to December 1st. There is a significant lack of representation for women in leadership and administration in the province's villages. The quota for women in leadership positions was once in place but was abolished after villagers voiced their dissatisfaction with this model. Furthermore, agricultural investment projects often undervalue women. So, unless women are specifically involved and asked for feedback during project launch processes, their voices will be underrepresented, and potential investments may not benefit them.

For instance, women are generally the main caretakers of pigs, but men do possess most of the management positions and role of community leaders in Lao PDR. Despite the national gender strategy calling for women to hold at least 20% of decision-making positions by 2020, women in Lao PDR often feel marginalized and silenced and their potential stifled.

3. **Women do not have equal access to information and rights:** Meetings, training, and information sessions in villages are usually attended by men since women are usually spent with housework. Occasionally, women receive information from their husbands. The problem is that women feel too timid to ask questions or speak during meetings and training, so they cannot fully participate. Women in rural areas often have low educational and literacy levels, which may explain this. Due to the education and literacy gap between men and women, men and women both hold the perception that women are less capable.

   Additionally, while women have access to banking and credit systems, they often experience obstacles to obtaining them. In general, women have a harder time accessing financing mechanisms than men since banks often require title deeds, assets, high-interest rates, and the signature of the primary breadwinner of the household.

Implications and Recommendations: In light of the above insights, the following areas should be addressed to ensure the better integration of women in agriculture in Northern Lao PDR.

1. Building women's capabilities, including women who belong to minority ethnic groups, is crucial to improving the confidence level of women farmers through the following recommendations.

   - Foster the exchange of skills and information between women's farmer groups.
   - In order to improve women's participation in advanced agricultural training and extension, women farmers need better technical training.
   - Enable gender-focused teaching at the university level in Lao PDR to change cultural perceptions.
   - Revisions of national laws and regulations, such as the National Land Laws and the Agriculture Law, must take gender concerns into account.
   - Provide civil society with space for participation in national policy formulation and implementation, especially when it comes to CEDAW reporting to the United Nations.

2. Facilitate the involvement of women in agricultural investment decisions. They gain negotiation skills by being equipped with the necessary tools. Agricultural investors should also be provided with knowledge regarding their responsibilities such as the free, prior, and informed consents (FPIC) and their impact on women in rural communities.

3. Access to finance and credit for women should be improved. It can be done by developing a credit system that is readily accessible to women.

11. Global Risks AND COVID-19 Pandemic

Considering Lao PDR in the context of global political risks, two major crises have occurred recently; the COVID-19 pandemic and the Russia-Ukraine conflict; which have to be addressed to ensure an advancement in the impact of Lao PDR transportation system.. In Lao PDR, most of the workforce is employed in agriculture (80%). During times of economic crisis, when income loss could affect food security, subsistence farming serves as an important safety net for many households[136]. World Food Programme (WFP) data shows that neither agricultural activities nor access to agricultural inputs declined significantly in Lao PDR[137]. However, there were disparities across provinces; in Luangnamtha, respondents perceived negative consequences. Bokeo, Bolikhamxai, Savannakhet, and Bolikhamxai have also been adversely affected.

The mitigation measures have had an impact on cash crops and horticulture in Northern Lao PDR such as Luangnamtha and Bokeo, which in turn has affected overall household incomes in northern provinces of the country. Furthermore, the agricultural sector of Lao PDR is highly susceptible to extreme weather events, pest attacks and other shocks that threaten the livelihoods of farmers. Even though the agricultural sector played a more resilient role than many other sectors globally during the pandemic, in Lao PDR the industry is still working its way back from flooding and droughts that devastated the country in 2019 and has not been able to absorb the effects of the pandemic.

In spite of Lao PDR's distance from Ukraine and Russia, the suffering as a result of the Russia-Ukraine conflict goes far beyond Ukraine's borders. Despite Lao PDR's focus on recovering from COVID-19, Russia's escalating aggression will have a ripple effect on Lao PDR's economic attempts to recover from the COVID-19 pandemic[138]. This was reflected in how the Lao PDR foreign ministry responded to the Russia-Ukraine conflict. They avoided criticizing Moscow in order to safeguard their friendship. In the wake of the outbreak of hostilities in Ukraine, the Lao Foreign Ministry merely stated it was closely monitoring the situation, urged the parties involved to de-escalate tensions, and encouraged diplomatic settlements[139].

Implications and Recommendations: War in Russia may further escalate the already high prices of fuel, food, and other commodities (including fertilizer) in the aftermath of the conflict between Ukraine and Russia. Supply chain disruptions will affect food affordability, especially for food that makes up a healthy diet, as prices will increase and remain volatile. Most poorer segments spend most of their income on food, so they tend to have a high food expenditure. If food prices increase or incomes fall, Lao PDR is likely to face the challenge of unaffordability[140]. Nevertheless, the Russia-Ukraine conflict could bring an opportunity to Lao PDR to position itself as an exporter of maize to countries that depend on this commodity. However, the fact that there is a higher cost of fertilizers, which is also associated with this war, imposes a challenge.

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[136] IMPACT OF COVID-19 ON CHILDREN, ADOLESCENTS AND THEIR FAMILIES IN LAO PDR. (n.d.). Retrieved April 21, 2022, from https://www.unicef.org/laos/media/4936/file/IMPACT%20OF%20COVID-19%20ON%20CHILDREN

[137] COVID-19 Rapid Assessment of Food Security and Agriculture in Lao PDR | World Food Programme. (n.d.). Www.wfp.org. https://www.wfp.org/publications/covid-19-rapid-assessment-food-security-and-agriculture-lao-pdr

[138] All Nations Will Suffer Costs of Russia's Aggression Against Ukraine. (2022, March 3). U.S. Embassy in Laos. https://la.usembassy.gov/all-nations-will-suffer-costs-of-russias-aggression-against-ukraine/

[139] 2022/24 "Russia's Invasion of Ukraine: Southeast Asian Responses and Why the Conflict Matters to the Region" by Ian Storey and William Choong. (2022, March 9). ISEAS-Yusof Ishak Institute. https://www.iseas.edu.sg/articles-commentaries/iseas-perspective/2022-24-russias-invasion-of-ukraine-southeast-asian-responses-and-why-the-conflict-matters-to-the-region-by-ian-storey-and-william-choong/

[140]

12. Extension services

Despite the fact that public extension is the primary source of agricultural extension for smallholder farmers in developing countries, it has remained underdeveloped due to a range of complex structural issues. It is considered as under-resourced, expensive, and frequently plagued by bureaucratic processes.[141] Currently, rice producers in Laos continue to struggle to get a competitive market price when compared to their counterparts in Thailand and Vietnam due to poor quality. Maize farmers still lack awareness about suitable storage methods. In a similar vein, coffee farmers are lacking in their understanding of modern post-harvest practices. Finally, pig producers continue to experience outbreaks of swine illnesses as well as slow growth of the piglets. As a result, there is still tremendous room for improvement in the methods used to convey information to farmers about Good Agricultural Practices (GAPs), which can be advantageous in increasing yields, lowering costs, and preventing infection and illness.

Implications and Recommendations:

1. FFS has proven to be an effective approach for increasing yields, adoption rates, and profitability in many countries of the world, including Lao PDR .[142] FAO has tried and succeeded with the FFS approach for rice in Lao PDR. This can be replicated for other crops as well. To address this, the government, in collaboration with donor initiatives, should expand the frequency of FFS throughout the country.
2. In the wake of increasing numbers of mobile and internet users in Lao PDR, the government should encourage digital extension services by forming partnerships with the private sectors. Use of Information and Communication Technology (ICT) to enhance agriculture extension has been effective in many developing countries with some notable examples being e-Krishok in Bangladesh, Digital Green in India, Cojeno in Kenya, Ethiopia, Uganda and Tanzania and Senekela Orange in Mali.[143] ICT in agriculture should be viewed not as a direct substitute to the conventional extension but as a complementary intervention.
3. Farmer-to-Farmer (F2F) extension is the dissemination of information and knowledge by farmers to their fellow farmers, typically through the use of lead farmers and farm instructor volunteers. According to this technique, farmers who are nominated to be primary farmers are typically referred to as lead farmers, and they are chosen based on their agricultural competence and influence over the community. It has been demonstrated that this methodology is more effective in providing extension services when compared to the traditional method of delivery.[144] This method can be effective in northern Lao PDR where conventional methods are expensive and less sustainable.

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[141] Mapiye, O., Makombe, G., Molotsi, A., Dzama, K., & Mapiye, C. (2021). Towards a Revolutionized Agricultural Extension System for the Sustainability of Smallholder Livestock Production in Developing Countries: The Potential Role of ICTs. *Sustainability*, *13*(11), 5868. https://doi.org/10.3390/su13115868

[142] Waddington, H., Snilstveit, B., Hombrados, J., Vojtkova, M., Phillips, D., Davies, P., & White, H. (2014). Farmer Field Schools for Improving Farming Practices and Farmer Outcomes: A Systematic Review. *Campbell Systematic Reviews*, *10*(1). https://doi.org/10.4073/csr.2014.6

[143] Olagunju, O., Adetarami, O., Shehu Nabara, I., Koledoye, G. F., & Olumoyegun, A. T. (2021, October). Digitization of Agricultural Extension Sys [Review of Digitization of Agricultural Extension Sys]. https://www.researchgate.net/publication/355653039_Digitization_of_Agricultural_Extension_System_for_Effective_Management_of_Emergency_in_Nigeria

[144] Ragasa, C. (2014). Improving gender responsiveness of agricultural extension. In A. R. Quisumbing, R. Meinzen-Dick, T. Raney, A. Croppenstedt, J. A. Behrman, & A. Peterman (Eds.), Gender in agri
culture: Closing the knowledge gap (pp. 411–430). FAO, Springer.

13. Conclusion

As a predominantly agricultural country where the majority of the population are smallholder farmers, smart and productive investment in Lao PDR's farmers will be critical to its development and economic growth. Lao PDR's dependence on agricultural production makes it vulnerable to climate change and other shocks, and the full impact that COVID has had on the country over the last two years is still unclear. However, recent investments in Lao's transportation infrastructure mean that market access and regional connectivity is expanding. In order for Lao PDR's agricultural outputs to scale and reach new export opportunities, smallholder farmers must be linked to new markets through improved rural transport networks, increased access to capital, and accelerated digital transformation to enable market access.

None of the upgrades presented in this report can be successfully implemented on their own. While this report presents specific recommendations and upgrading strategies for each commodity, it is important to note that smallholder farmers in Northern Lao PDR face a common set of constraints: poor linkages to larger transportation networks, poor access to credit, little access to quality extension, and increasing threats from climate change. Investments in Lao's agricultural system must integrate crop-specific investments and wider regional investments in transportation and financial infrastructure in order to maximize market access for the four commodities covered. Lao PDR will need to focus on sustainable production and building environmental resilience as climate change becomes an increasingly imminent threat. The country should pursue opportunities that maximize the synergies between resilience and sustainable intensification. Sustainable production of key commodities like rice, maize and coffee could present export premiums and help brand Lao PDR as a source of "clean green" exports.

Connectivity will increase access to markets for outputs and enable sales through better output prices and reduced input costs. Improvements in road infrastructure can play a significant role in encouraging agricultural diversification and better value addition through more commercialized agriculture. Even though value-added services are increasingly growing in ASEAN countries, most of those services are not available or only to a limited extent in Northern Lao PDR. While partial cold chain services and packaging services exist for food produce, many other value-added logistics services are not available, including vendor managed inventory and inventory and supplier management services, for example[145]. This demand is expected to grow as Lao PDR is getting connected to the neighboring countries as land-linked countries, especially with the aforementioned Lao-China railway.

Current rising demand for animal products in neighboring countries as well as increased commodity prices for feed crops like corn and soy present potential opportunities for export-led growth. Additionally, climate change may present new opportunities in Northern Lao PDR for certain crops like coffee and rice. A comprehensive investment strategy that integrates all of these interconnected facets of the agricultural system can position Lao PDR for growth as it becomes increasingly physically and digitally connected to the rest of the world.

[145] World Bank. (2020)."FROM LANDLOCKED TO LAND-LINKED UNLOCKING THE POTENTIAL OF LAO-CHINA RAIL CONNECTIVITY".

APPENDIX

Appendix 1. List of Interviews Conducted

Name	Organization	Date	Team members who attended
Senthil Nathan	Enveritas	2/14	Kohei Kawabata
Todd Moore	Saffron Coffee	2/21	Yomna Gaafar & Kohei Kawabata
Yoko Matsushima	The Little House Coffee, Vientiane	2/22	Kohei Kawabata
Kazuo Sambongi	Nippon Biodiesel Fuel Co., LTd	2/22	Kohei Kawabata
Kim Valakone	Agence Française de Développement	2/23	Yomna Gaafar & Kohei Kawabata
PhengKhouane Manivong	Agence Française de Développement	2/24	Yomna Gaafar & Kohei Kawabata
Carl Cervone	Enveritas	3/1	Kohei Kawabata & Erin Leonard
Andrew Bartlett	Helvetas	3/7	Yomna Gaafar & Kohei Kawabata
Yin Hang	Comma Coffee	3/24	Yomna Gaafar & Kohei Kawabata
Elrend Falch	United Nations Office on Drugs and Crime	4/11	Yomna Gaafar & Kohei Kawabata
Yifan Gu	Guangzhou Yuexiu Foods	2/13	Sirui Ye

Appendix 2. Value Chain Finance Actors and the Type of Finance

	Grants	Concessional loans	Market-based loans	Equity
State banks	●	●		
Non-governmental institutions	●	●		
Community-based lenders		●	●	
Microfinance institutions		●	●	
Social lenders		●	●	
Commercial banks			●	
Development banks	●	●	●	●

Impact investors			●	●
Corporations (CSR/commercial)	●	●	●	●
Fintech companies		●	●	

(Authors edited. Cited from WWF, Unlocking Smallholder Finance for Sustainable Agriculture in Southeast Asia. [146])

Appendix 3: Interviews with Local Farmers of Coffee in Northern Lao PDR

Questionnaire for Coffee Agricultural Value Chain Upgrading in Northern Lao PDR

We are a team of students at School of International and Public Affairs, Columbia University in New York, and we're working with the World Bank as consultants for a research project on improving the value chains of coffee, maize, pig/pork, and organic rice in Northern Laos. The objective of the study is to identify opportunities to improve market access and competitiveness for smallholder farmers and local agribusiness enterprises in northern Lao PDR and policies and actions to realize these opportunities.

By answering questions about the commodity market(s) you participate in, you will help us identify stakeholders, understand their roles and responsibilities in value chains for each commodity, and eventually contribute to our goal of upgrading those value chains for Lao PDR.

And if you think there is anyone we should talk to for a particular question, please let us know. Thank you so much for your time.

Interview 1

Section A: Qualitative Questions

1. What are the main crops are you growing?
   Coffee, Rice, chili, vegetable
2. Why are you growing coffee?

Like planting coffee and can earn additional income for family

3. Based on answer of question 1,

a. Rank each crop in: income, work done, farming system/land space, etc.

Coffee, rice i

b. What percentage of your income comes from coffee?

50% per year

4. How many coffee trees do you have?

4,000 trees

5. Who do you sell your coffee to?

Meuangxieng and Comma

6. What coffee varieties do you grow? Rank them by priority/volume.

Cartimor, Arabica, Java

7. Is there any farmer organization that you are part of?

Tan Tai coffee group

a. If yes, What does the organization do?

[146]World Wide Fund for Nature (2021). Unlocking Smallholder Finance for Sustainable Agriculture in Southeast Asia. https://sustainablefinanceasia.org/wp-content/uploads/2021/03/WWF-2021-Unlocking-Smallholder-Finance-for-Sustainable-Agriculture.pdf

Plant coffee, produce green bean
b. If there is an association in Northern Lao , would you be interested to work with them? Interested
8. Which crops are you intercropping coffee with?
Nothing
9. Walk us through the costs from production to sales including the below questions….
a. How much does it cost you to hire labor (approximately)?
1,200,000
b. Do you use fertilizers and/or pesticides?
no fertilizers, use only compost
c. If you use fertilizers, do you pay for fertilizers?
10. How is the price of coffee determined? According to market price

11. Does the price vary according to the quality of coffee? OR Do you get a higher price for a better quality coffee?
According to market price and grade of coffee
12. Is coffee production done by male or females or both?
Both male and female
13. What are your plans for coffee production? Expanding, maintaining or decreasing? Plan to expand
14. What support do you need to increase coffee production? Fertilizers, seeds, reliable markets, etc. Reliable market and equipments
15. What are your main constraints as a farmer?
16.What would make you farm more coffee? OR what would you like to see that will make you grow more coffee?
Want to increase quantity produced and gain additional income
17. Why are you interested in making these changes?
Do not have enough equipment for production
18. What forms of help or assistance do you receive from your buyers? Some equipment
19. Have you used the government extension service? Was it helpful? yes, and very useful
20. Have you obtained credit or received finance for production?
Never
21. Do you have access to internet and/or mobile coverage?
Have access to internet
22. Have you ever been trained in coffee production?
Yes
a. If yes, was it useful?
Very useful
b. If not, would you be interested in attending training?
23. Have you seen any effects of climate change recently?
have seen changes
24. How often do you get affected by these changes? (e.g. drought, frost, and flood)? Frost every year

Section B: Questions about costs and profits
Please fill in the blanks of the table below according to the final products you sell to the buyers.
(Farming costs include costs regarding seeds, fertilizers, and pesticides for example, but not labor costs.)

Harvest Season (2021-2022)

	Farming costs (kip/kg cherry)	Primary processing (kip/kg parchment)	Secondary processing (kip/kg green bean)	Total cost	Selling price	Gross profit/loss (kip/kg)
Selling coffee cherries						
Selling parchment						
Selling green beans	45,000kip/kg	2,000kip/kg	2,000kip/kg		45,000kip/kg	41,000kip/kg

Harvest Season (2020-2021, if the record is available)						
	Farming costs (kip/kg cherry)	Primary processing (kip/kg parchment)	Secondary processing (kip/kg green bean)	Total cost	Selling price	Gross profit/loss (kip/kg)
Selling coffee cherries						
Selling parchment						
Selling green beans						

Interview 2

Section A: Qualitative Questions

1. What are the main crops are you growing?
   Coffee, chili, rice
2. Why are you growing coffee?

Household have increased income and good market

3. Based on answer of question 1,

a. Rank each crop in: income, work done, farming system/land space, etc.

Rice, coffee, chili

b. What percentage of your income comes from coffee?

35%

4. How many coffee trees do you have?

4,620 trees

5. Who do you sell your coffee to?

Meuangxieng coffee company

6. What coffee varieties do you grow? Rank them by priority/volume.
Cartimor, Typica
7. Is there any farmer organization that you are part of?
Pieng Coffee production group
a. If yes, What does the organization do?
Produce coffee together and sale collectively
b. If there is an association in Northern Lao , would you be interested to work with them? Interested
8. Which crops are you intercropping coffee with?
Did not plant any another crops in the forest besides coffee (planting coffee under natural forest trees)
9. Walk us through the costs from production to sales including the below questions….
a. How much does it cost you to hire labor (approximately)?
Own labor or use family member's labor
b. Do you use fertilizers and/or pesticides?
Did not use fertilizers, use compost only
c. If you use fertilizers, do you pay for fertilizers?
X
10. How is the price of coffee determined?
No answer
11. Does the price vary according to the quality of coffee? OR
Do you get a higher price for a better quality coffee?
Price is based on quality of coffee and based on the yearly contract
12. Is coffee production done by male or females or both?
Production done by both male and female
13. What are your plans for coffee production? Expanding, maintaining or decreasing? I will be expanding
14. What support do you need to increase coffee production? Fertilizers, seeds, reliable markets, etc. Fertilizer and reliable market
15. What are your main constraints as a farmer? Main constraint is capital for investment
16. What would make you farm more coffee? OR what would you like to see that will make you grow more coffee?
Because of market demand
17. Why are you interested in making these changes?
Because quantity produced is not enough
18. What forms of help or assistance do you receive from your buyers? Production equipment
19. Have you used the government extension service? Was it helpful?
Received training on production techniques and some advice
20. Have you obtained credit or received finance for production?
No, never received or obtained credit
21. Do you have access to internet and/or mobile coverage?
I have access to internet
22. Have you ever been trained in coffee production? Yes
a. If yes, was it useful? Very useful
b. If not, would you be interested in attending training?
23. Have you seen any effects of climate change recently?
Yes, I have seen changes in the climate
24. How often do you get affected by these changes? (e.g. drought, frost, and flood)?
I get affected by climate change every 3-4 years (frost) and extreme cold weather
Section B: Questions about costs and profits
Please fill in the blanks of the table below according to the final products you sell to the buyers.
(Farming costs include costs regarding seeds, fertilizers, and pesticides for example, but not labor costs.)

Harvest Season (2021-2022)						
	Farming costs (kip/kg cherry)	Primary processing (kip/kg parchment)	Secondary processing (kip/kg green bean)	Total cost	Selling price	Gross profit/loss (kip/kg)
Selling coffee cherries	5,000kip/kg			5,000kip/kg	5,000kip/kg	5,000kip/kg
Selling parchment	27,300kip/kg	2,000kip/kg			27,300kip/kg	25,300kip/kg
Selling green beans						

Harvest Season (2020-2021, if the record is available)						
	Farming costs (kip/kg cherry)	Primary processing (kip/kg parchment)	Secondary processing (kip/kg green bean)	Total cost	Selling price	Gross profit/loss (kip/kg)
Selling coffee cherries						
Selling parchment						
Selling green beans						

Interview 3

1. What are the main crops are you growing?
   Rice, coffee chili, garlic
2. Why are you growing coffee? Can raise additional income for family because there is market for it
3. Based on answer of question 1,

a. Rank each crop in: income, work done, farming system/land space, etc. Rice, coffee, chili
b. What percentage of your income comes from coffee?

Coffee about 40%

4. How many coffee trees do you have?

4,000 trees

5. Who do you sell your coffee to?

Mueangxieng coffee company

6. What coffee varieties do you grow? Rank them by priority/volume.
Cartimor, Typica
7. Is there any farmer organization that you are part of? Ban Pieng coffee group
a. If yes, What does the organization do?
Processing in group, collective sale and work together
b. If there is an association in Northern Lao , would you be interested to work with them? Interested
8. Which crops are you intercropping coffee with?
Teak tree (ໄມ ້ ຫອງ), banana
9. Walk us through the costs from production to sales including the below questions….
a. How much does it cost you to hire labor (approximately)?
About 1,500,000kip/year
b. Do you use fertilizers and/or pesticides?
Use self made compost
c. If you use fertilizers, do you pay for fertilizers?
10. How is the price of coffee determined?
According to processing (parchment coffee 27,000kip/kg)
11. Does the price vary according to the quality of coffee? OR Do you get a higher price for a better quality coffee?
Price is based on coffee quality and according to agreed price on annual basis.
12. Is coffee production done by male or females or both?
Production done by both male and female
13. What are your plans for coffee production? Expanding, maintaining or decreasing?
Have plan to expand
14. What support do you need to increase coffee production? Fertilizers, seeds, reliable markets, etc.
Need bio compost, seeds, and reliable market
15. What are your main constraints as a farmer? investment capital
16. What would make you farm more coffee? OR what would you like to see that will make you grow more coffee?
Product is not enough to meet market demand
17. Why are you interested in making these changes?
Not enough income
18. What forms of help or assistance do you receive from your buyers? Some equipment and production technique
19. Have you used the government extension service? Was it helpful? Receive training on coffee production
20. Have you obtained credit or received finance for production?
No
21. Do you have access to internet and/or mobile coverage?
Have access
22. Have you ever been trained in coffee production? Yes
a. If yes, was it useful? Useful
b. If not, would you be interested in attending training?
23. Have you seen any effects of climate change recently?
Cold weather, frost
24. How often do you get affected by these changes? (e.g. drought, frost, and flood)?
Every 4-5 years, frost makes production go down
Section B: Questions about costs and profits
Please fill in the blanks of the table below according to the final products you sell to the buyers.
(Farming costs include costs regarding seeds, fertilizers, and pesticides for example, but not labor costs)

Harvest Season (2021-2022)						
	Farming costs (kip/kg cherry)	Primary processing (kip/kg parchment)	Secondary processing (kip/kg green bean)	Total cost	Selling price	Gross profit/loss (kip/kg)
Selling coffee cherries	5,000kip/kg			5,000kip/kg	5,000kip/kg	5,000kip/kg
Selling parchment	27,300kip/kg	2,000kip/kg			27,300kip/kg	25,300kip/kg
Selling green beans						

Harvest Season (2020-2021, if the record is available)						
	Farming costs (kip/kg cherry)	Primary processing (kip/kg parchment)	Secondary processing (kip/kg green bean)	Total cost	Selling price	Gross profit/loss (kip/kg)
Selling coffee cherries						
Selling parchment						
Selling green beans						

Interview 4

Section A: Qualitative Questions

1. What are the main crops are you growing?
   Rice, coffee chili, garlic

2. Why are you growing coffee? Can raise additional income for family because there is market for it
3. Based on answer of question 1,
a. Rank each crop in: income, work done, farming system/land space, etc. Rice, coffee, chili
b. What percentage of your income comes from coffee?
Coffee about 40%
4. How many coffee trees do you have?
4,000 trees
5. Who do you sell your coffee to?
Mueangxieng coffee company
6. What coffee varieties do you grow? Rank them by priority/volume.
Cartimor, Typica
7. Is there any farmer organization that you are part of? Ban Pieng coffee group
a. If yes, What does the organization do?
Processing in group, collective sale and work together
b. If there is an association in Northern Lao , would you be interested to work with them? Interested
8. Which crops are you intercropping coffee with?
Teak tree (ໄມ ້ ຫອງ), banana
9. Walk us through the costs from production to sales including the below questions….
a. How much does it cost you to hire labor (approximately)?
About 1,500,000kip/year
b. Do you use fertilizers and/or pesticides?
Use self made compost
c. If you use fertilizers, do you pay for fertilizers?
10. How is the price of coffee determined?
According to processing (parchment coffee 27,000kip/kg)
11. Does the price vary according to the quality of coffee? OR Do you get a higher price for a better quality coffee? Price is based on coffee quality and according to agreed price on annual basis.
12. Is coffee production done by male or females or both?
Production done by both male and female
13. What are your plans for coffee production? Expanding, maintaining or decreasing? Have plan to expand
14. What support do you need to increase coffee production? Fertilizers, seeds, reliable markets, etc.? Need bio compost, seeds, and reliable market
15. What are your main constraints as a farmer? investment capital
16. What would make you farm more coffee? OR what would you like to see that will make you grow more coffee? Product is not enough to meet market demand
17. Why are you interested in making these changes? Not enough income
18. What forms of help or assistance do you receive from your buyers? Some equipment and production technique
19. Have you used the government extension service? Was it helpful? Receive training on coffee production
20. Have you obtained credit or received finance for production? No
21. Do you have access to internet and/or mobile coverage? Have access
22. Have you ever been trained in coffee production? Yes
a. If yes, was it useful? Useful
b. If not, would you be interested in attending training?
23. Have you seen any effects of climate change recently? Cold weather, frost
24. How often do you get affected by these changes? (e.g. drought, frost, and flood)? Every 4-5 years, frost makes production go down
Section B: Questions about costs and profits

Please fill in the blanks of the table below according to the final products you sell to the buyers.
(Farming costs include costs regarding seeds, fertilizers, and pesticides for example, but not labor costs.)

Harvest Season (2021-2022)						
	Farming costs (kip/kg cherry)	Primary processing (kip/kg parchment)	Secondary processing (kip/kg green bean)	Total cost	Selling price	Gross profit/loss (kip/kg)
Selling coffee cherries	5,000kip/kg			5,000kip/kg	5,000kip/kg	5,000kip/kg
Selling parchment	27,300kip/kg	2,000kip/kg			27,300kip/kg	25,300kip/kg
Selling green beans						

Harvest Season (2020-2021, if the record is available)						
	Farming costs (kip/kg cherry)	Primary processing (kip/kg parchment)	Secondary processing (kip/kg green bean)	Total cost	Selling price	Gross profit/loss (kip/kg)
Selling coffee cherries						
Selling parchment						
Selling green beans						

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