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The Fresh Mango Value Chain of Son La Province, Vietnam

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Abstract

Mangoes are one of the key cash crops in Son La province, Vietnam and makes a significant contribution to smallholder farmers' incomes. However, the challenges and constraints in production, marketing, consumption, and exporting are major impediments to these vulnerable actors in the mango value chain. Overproduction combined with the limited adoption of advanced techniques and a lack of market integration poses risks for the main mango suppliers in the chain. This study analyzes the mango value chain in Son La, determines the challenges and opportunities encountered by value chain actors, and provides some options to improve mango value chain performance and efficiency and open better market opportunities for farmers.

Keywords: mangoes, value chain, Vietnam, cross-border trade, cooperatives, policy

Introduction

Son La province is the largest fruit production area in northern Vietnam, and mangoes are now one of the most important cash crops contributing to economic development and poverty reduction in the region. The total mango growing area currently is over 18,000ha, which accounts for 16 per cent of the country's mango production area. Areas are expected to increase to over 21,000ha in the coming years (Son La DARD, 2021). Giap and Dung (2019) have estimated the 2019 production outcome in the region at around 31,276 tonnes, valued at around VND 680 billion (or 20,000 VND/kg)[1]. The estimated production of fresh mangoes then increased to 56,000 tonnes in 2020 and to over 61,000 tonnes in 2021, with production values of around VND 784 billion (14,000 VND/kg) and VND 183 billion (3,000 VND/kg), respectively. The significant reduction in price has been caused by the substantial increases in supply coupled with logistics problems and interruption to the cross-border trade with China due to disruptions linked to the COVID-19 pandemic (see later discussion). Total output is projected to increase further to 78,310 tonnes in 2025 (Son La DARD, 2020), with an estimated production value of either VND 235, VND 822, or VND 1,409 billion based on three different price scenarios (low (3,000 VND/kg), medium (10,500 VND/kg), and high (18,000 VND/kg)) (Dyer et al., 2021).

In 2021, Son La province exported around 8,600 tonnes of mangoes through official trade channels, of which over 7,800 tonnes were exported to China, with the rest going to other countries such as the United States, Canada, and Australia (Son La DARD, 2021). Official export volumes accounted for 12 per cent of the total production output in the province.

[1] On average, $AUD 1 = 16,000 VND

The recent involvement of many new chain actors has significantly promoted the offtake, processing, and exporting of mangoes in Son La. However, the linkages and collaboration between different chain actors and farmers is fragmented and makes it difficult for farmers to access markets. The high dependence on Chinese markets, combined with the unprecedented impact of the COVID-19 pandemic, has also put enormous pressure on prices and growers. In addition, increasingly stringent Chinese import, and biosecurity requirements have significantly impacted export volumes of mangoes. These impacts have significantly adversely affected mango prices, resulting in very low or negative profit margins to farmers, and a major disincentive for innovation and investment in small farms.

The main purpose of this study is to analyze the Son La province mango value chain. The different value chain drivers and actors within the mango sector will be studied and alternative policy options to improve the mango value chain in Son La province will be provided. In addition, the production, information, and revenue flows in the value chain will be mapped, and the performance of the logistical and cross-functional drivers of the chain will be analyzed. Finally, appropriate intervention strategies will be suggested to improve the performance of the value chain.

Overall Sector Analysis

The Vietnamese mango sector

The agricultural sector has been the backbone of Vietnam's economy and has transformed food production to feed the population and export surplus food products to the global market. In 2021, the total contribution of the agriculture, forestry, and fishing sectors accounted for 12.56 per cent of the country's gross domestic product (GDP) (Statista, 2022). The export turnover of agricultural and aquatic products reached $US28.04 billion, accounting for 8.3 per cent of the total export turnover in 2021, of which, the export of fruit and vegetables provided $US3.55 billion (MOIT, 2022).

Mangoes are one of the top five fruits exported from Vietnam. The production area has been continuously increasing and as indicated in Table 1, the consequent production output has risen, by over 7 per cent (to over 959,000 tonnes) from 2020 to 2021 (MOIT, 2022).

Table 1. Output of some Vietnamese fruits in the period of 2017 – 2021 (thousand tonnes)

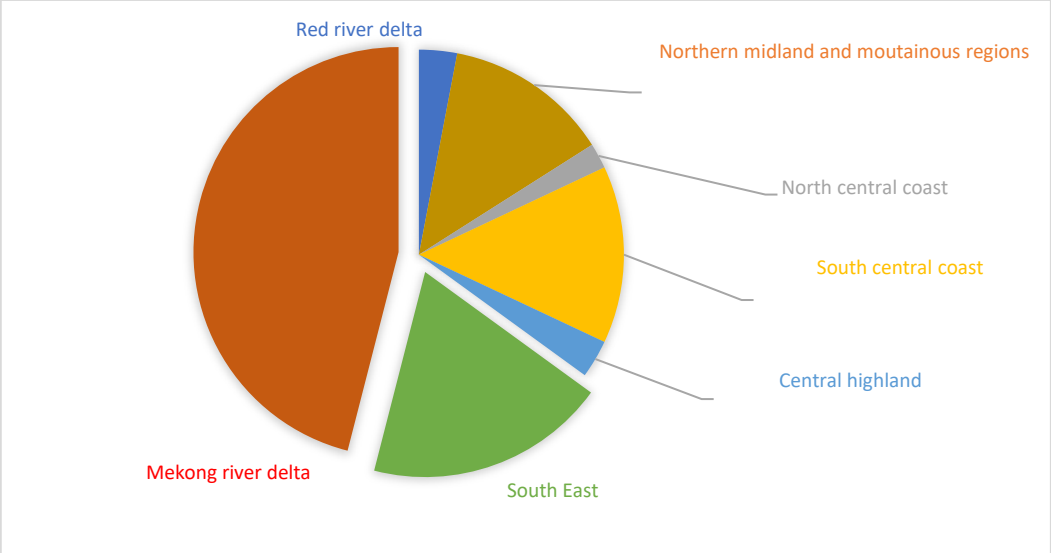
Fruits	2017	2018	2019	2020	2021 (Estimated)	2021 increase compared to 2020 (%)
Dragon fruit	952.8	1,074.2	1,242.5	1,363.8	1,418.4	4.10
Longan	492	541.4	507.9	589.2	635.2	7.80
Grapefruit	571.3	525	779.3	903.2	959.2	6.20
Citrus	947	976	960.9	1,070.6	1,113.4	4.30
Mango	788.2	788.5	814.8	893.2	958.4	7.30
Pineapple	567.1	674	679.9	723.7	759.9	5.00

Source: (MOIT, 2022, p.23)

In 2017, the Mekong River delta was the largest mango production area, with around 46 per cent of the nation's production area, followed by the South-East region, at around 19 per cent. The next-

largest regions were the South-Central Coast, and the Northern Midland and Mountainous regions, which accounted for 14 and 13 per cent respectively. Son La province is situated in the Northern Mountainous region (Figure 1) (SOFRI, 2017).

Figure 1. Vietnamese mango production by region in 2017



Source: (SOFRI, 2017)

The main mango harvesting season in Vietnam is commonly during the summer from April to June, although mangoes can be produced year-round in the Mekong. However, high mango volumes during the peak harvest season often exceed domestic consumption demand, resulting in oversupplies and low prices. Farmers in the South often apply technical interventions (e.g., Paclobutrazol) to manipulate and prolong the flowering and harvesting seasons to spread the harvest to periods when prices are higher (Table 2). The Southern Vietnamese mangoes are always available in the off-season for Chinese markets with a large supply beginning in October and lasting up until April of the following year (Chen, Zou & Qi, 2019, p. 10). According to the Southern Horticultural Research Institute, there are over 40 different mango varieties in Vietnam (SOFRI, 2017).

Table 2. Mango harvesting season in Vietnam by regions

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
The North, Central, Highland areas												
South-East provinces												
Mekong River Delta (main season)												
Mekong River Delta (off season)												

Source: (SOFRI, 2017)

Over 80 per cent of Vietnamese mangoes are exported to China, and the Chinese market continues to be the country's largest total fruit and vegetable consumption market with a share of 53.7 per cent in 2021, equivalent to an export turnover of $US1.91 billion. This was up by 3.7 per cent on the previous year (MOIT, 2022). As indicated in Table 3, the United States market ranked second with $US222.9

million, up 32 per cent on 2020 and accounting for 6.3 per cent of the market share. Other major markets were Korea with an export turnover of $US157.4 million (up 10.1 per cent); Japan with $US153.2 million (up 20 per cent); and Thailand at $US147.3 million (down 6.3 per cent). In addition, many other markets including Taiwan, Australia, United Arab Emirates, Hong Kong, and Singapore have recently expanded, in an attempt to reduce the dependency on the Chinese market (MOIT, 2022).

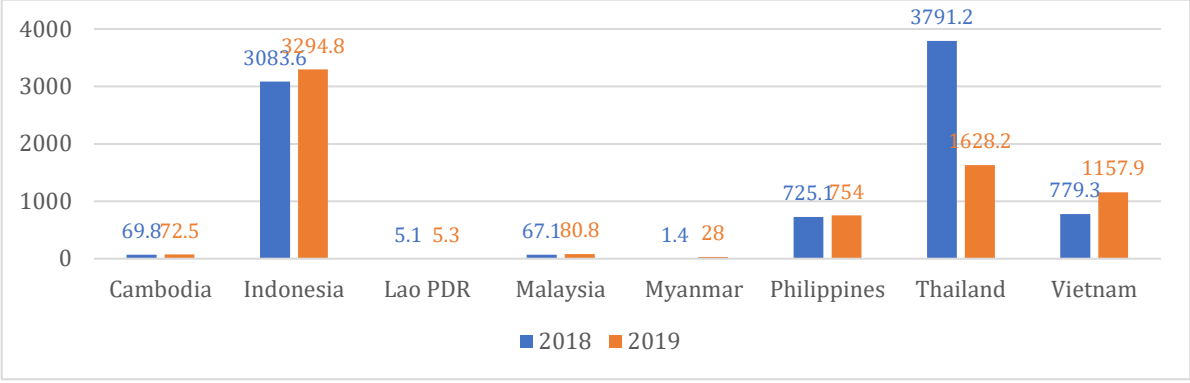
Table 3. Turnover of the top ten Vietnamese fruit and vegetable export markets in 2020 and 2021

Markets	2020		2021		Growth rate (%)
	Turnover ($US million)	Proportion (%)	Turnover ($US million)	Proportion (%)	
	3,269		**3,551**		**8.6**
China	1,840	56.3	1,907	53.7	3.7
United States	169	5.2	223	6.3	32.0
Korea	143	4.4	157	4.4	10.1
Japan	128	3.9	153	4.3	20.0
Thailand	157	4.8	147	4.1	-6.3
Taiwan	94	2.9	127	3.6	34.1
Australia	64	2.0	82	2.3	28.2
United Arab Emirates	42	1.3	47	1.3	12.6
Hongkong	59	1.8	79	2.2	32.9
Singapore	36	1.1	38	1.1	6.8

Source: (MOIT, 2022, p.24)

Vietnam is the 13th largest mango producer in the world (MARD, 2021) and ranked the third-largest in the Association of Southeast Asian Nations (ASEAN), behind Indonesia and Thailand (ASEAN, 2021). As observed in Figure 2, there has also been an increase in mango production in many of these other ASEAN countries. The production volume of mangoes in Vietnam was projected to increase about 37 per cent from 728.1 to 999.6 thousand tonnes in the 5-year period from 2015 to 2020 (Nguyen M.N., 2022). While the ASEAN Statistic Yearbook showed that Vietnam increased mango output by over 48 per cent from 2018 to 2019 (ASEAN, 2021), in contrast, output from Thailand plummeted by 57 per cent from 2018 to 2019 (ASEAN, 2021). This loss in production in Thailand can be a new opportunity for other countries in the ASEAN region (Figure 2).

Figure 2. Mango production in ASEAN, 2018 – 2019 (thousand tonnes)



Source: ASEAN (2021, p. 198-199)

Son La mango subsector analysis

Son La province is in the Northwest of Vietnam. The livelihoods of numerous ethnic minority groups there are heavily dependent on agricultural production, which is also a foundation of other sources of income. The total land area of the province is 1412.3 thousand hectares, of which the agricultural land is 367.9 thousand hectares, some 26.2 per cent of the total land area. Almost all the rest is for forestry which accounts for over 55.8 per cent of the total land area (GSO, 2022, p. 42).

Agricultural production recently has undergone a remarkable transformation from low-net-income food crops to higher-value cash crops. Production areas of corn and rice have reduced significantly, replaced by vegetables and varied fruit varieties such as longan, mangoes, plum, banana, pineapple, and H'mong apple (Table 4).

Table 4. Current and forecast production area (ha) and output (tonnes) for fruits in Son La province

Fruit	Area 2020 (ha)	Area 2021 (ha)	Est. Area 2025 (ha)	Output 2020 (tonnes)	Output 2021 (tonnes)	Est. Output 2025 (tonnes)
Mango	18,918	19,235	21,170	54,274	56,370	78,310
Longan	18,702	19,210	21,410	89,379	98,950	108,720
H'mong apple	12,640	12,840	13,710	16,006	33,310	36,600
Plum	11,507	12,230	13,350	62,418	66,100	70,850
Banana	5,350	5,500	6,920	47,795	54,750	68,310
Pomelo	2,513	2,460	2,770	8,666	8,510	12,930
Orange	1,968	2,110	2,450	6,955	7,660	9,630
Passion fruit	1,894	3,150	4,260	18,003	28,190	38,740
Avocado	1,254	1,250	1,360	5,492	6,500	6,850
Lychee	259			838		
Other fruit	3,845	10,590	18,550	11,297	88,200	168,910

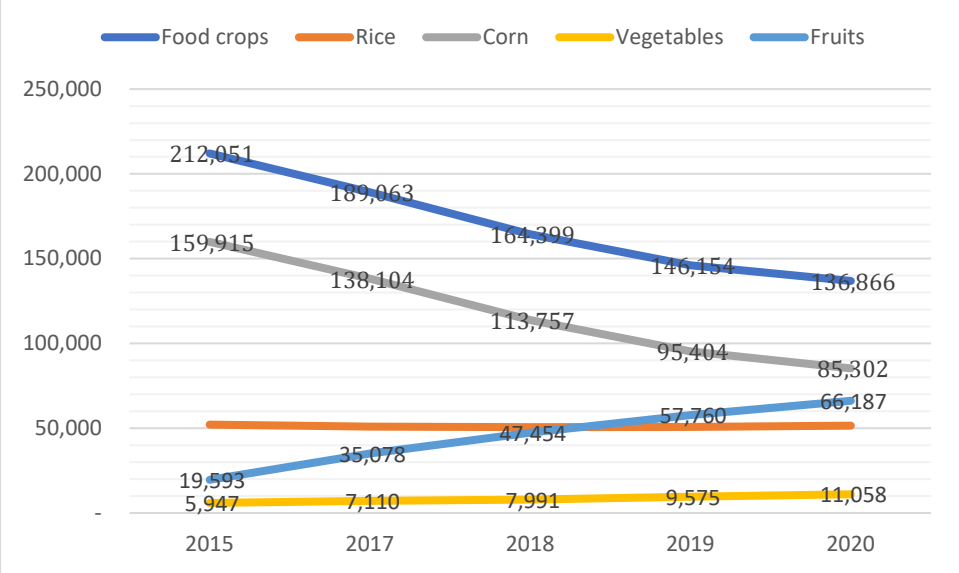
Note: 'Other fruit' includes dragon fruit, persimmon, pineapple, lime, peach, macadamia, custard apple, mandarin, apple. *Source*: Son La DARD (2020)

Between 2015 and 2020, the total food crop area including rice and corn reduced by 35 per cent. Specifically, corn's growing area declined by 46 per cent, whilst rice areas slightly decreased by 1 per cent (Son La Statistic, 2020). The reduction of corn production area was due to increasing input costs, especially fertilizers. Maize yields are also declining due to soil erosion and soil fertility loss. The national and provincial Governments also encouraged more sustainable and higher value crops to reduce maize production on sloping lands. Combined with variable and often low maize prices, maize revenue is often lower than production costs, so local farmers have increasingly been adopting alternative crops with higher income. At the same time production areas of higher-value crops such as vegetables and fruit trees have increased by 85 and 237 per cent respectively (Figure 3) (Son La Statistic, 2020). The increase in vegetable and fruit production areas is partly driven by market demand for varied agricultural food-quality products, along with very active Government policies and support programs. Farmers also see the potential benefits of less labor-intensive fruit trees compared to annual crops.

Up until 2015, mangoes were one of the least popular crops in Son La. The local population considered mangoes as a "home-grown fruit" and mostly for home consumption. They only sold mangoes in local

markets when they had a good harvest. The local native varieties were the most dominant in the region, and without technical interventions, native varieties had low yields and are susceptible to pest attacks. However, these varieties are established and grow quickly, meaning farmers can harvest after just two to three years of planting. While the yield is low and the fruit size is small, the smell and taste are delicious and high-quality.

Figure 3: The crop conversion in Son La province from 2015 to 2020 (hectares)



Source: Son La Statistic (2020)

In mid-2015, the local government in Son La province identified that growing corn was no longer effective in generating a sustainable income for its population. A scheme "Growing fruit trees on sloping land" was established to convert the areas of corn and other low-efficient crops to climate-appropriate fruit trees like mangoes (Nhandan.vn, 2019). The area for mangoes rose from 3,695ha in 2015 to 19,235 ha in 2021 and production reached 61,045 tonnes (Son La Statistic, 2021). In 2021 mango production had doubled in two years compared to the 31,276 tonnes in 2019 (Giap & Dung, 2019).

Son La is becoming a major fruit production region in Northern Vietnam. Mangoes and a variety of other fruits are now a major land use and have promise for export development in the long-term (Table 4). Son La has favorable climatic and soil conditions for mango production. Mangoes are grown in almost all 12 districts and the Son La city region; however, it is mainly focused in three districts, Mai Son (3,637ha), Yen Chau (2,905ha), and Muong La (2,373ha) (Son La Statistic, 2020) (Figure 4). In these districts over 90 per cent of the population are ethnic groups such as Thai, Muong, Kho Mu, Dao, and H'Mong. It is estimated that at least 30,000 smallholder households are involved in growing mangoes in Son La province, with 12,000 mango growing households concentrated in the three main districts. Each household has on average 0.5 - 0.6ha of land for growing mangoes (Dyer et al., 2021).

Part of the Government scheme introduced in 2015 was the provision of a new mango variety - the Taiwan (GL4) variety. This GL4 variety is also grown in Hainan and other provinces of China. It is known in China as "big green mango" and in Vietnam, it is known as "Taiwanese" and "elephant" mangoes (Dyer et al., 2021). The fruit is very big in size and has a weight of more than 1 kilogram per fruit. Most importantly, the Taiwanese mango variety is suitable for domestic fresh consumption, Chinese market exports, and processing for juice. In addition, there are now other varieties grown such as VRQ-XX1 (Thailand variety), R2E2 (Australia variety), and Van Du (Phu Tho province). These varieties have moved to Son La province from the Mekong River Delta and Northeast regions but were grown only

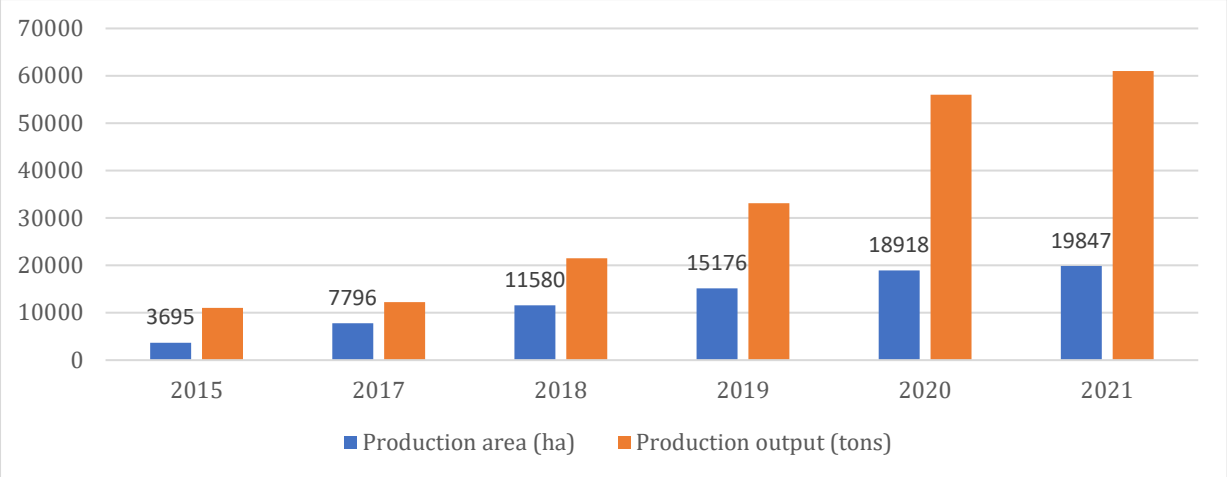
in small volumes. Other varieties grown in small quantities in the Yen Chau and some other districts (including Xoai Tron and Xoai Hoi varieties) are locally well-known (Nguyen et al., 2021, p.68), have high quality and are suitable for high-end domestic markets (Dyer et al., 2021).

Figure 4. Mango production in Son La is mainly in Mai Son, Yen Chau and Muong La districts

Source: Dyer et al. (2021)

The main market for Son La mango is domestic consumption, and only a small volume is exported formally to international markets. In 2021, the total mango production output was around 61,045 tonnes, of which 8,600 tonnes were exported, and around 5,000 tonnes were sold to the DOVECO Dong Giao processing company, which mainly processes dried mango products (Figure 5) (Son La DARD, 2021).

Figure 5. Son La mango production areas and output, 2015 – 2021



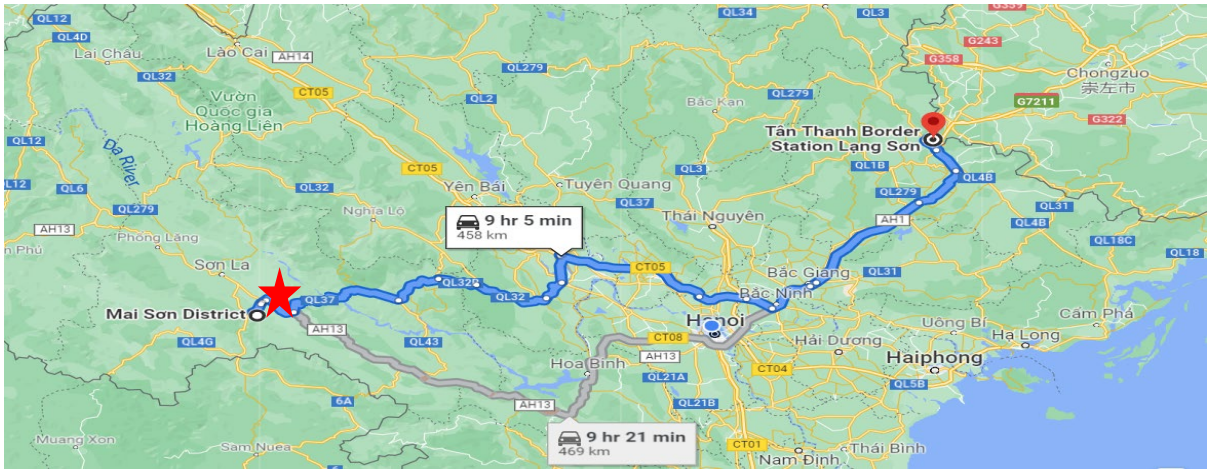
Source: Son La Statistics (2020), Son La DARD (2021)

As mentioned earlier, between 2020 and 2021, estimated mango production value reduced significantly from VND 784 billion to VND 183 billion (Dyer et al., 2021). This represents a value loss of over VND 600 billion ($US 25.8 million), which is a severe reduction of income to mango growers. The reduction in production value resulted from a rapid increase in production areas, combined with

sudden and large price reductions during this period. While provincial mango output continues to increase as new planting areas come into full production, the capacity of farmers and many traders to identify, develop and access new markets is limited. In addition, the lockdowns and disruptions of transportation systems and logistics due to the COVID19 pandemic negatively impacted supply chains and domestic mango consumption in the region. Further, China recently imposed strict regulations for the formalization of cross-border trade procedures which created further challenges and constraints for semi-formal cross-border trade with China (Tien et al., 2020). Informal exports to China have been restricted (including mangoes) and while official exports are allowed through quarantine channels and protocols this has resulted in local oversupply and a significant reduction in mango prices. Although there are no official reports on the impact of these events on this mango value chain, the production surplus has been identified by farmer groups. Combined with the recent significant rise in the price of fertilizer, mango farmer profits have been drastically curtailed.

The Tan Thanh border gate in Lang Son Province is the main border gate to export Vietnamese agricultural products across to China. Almost all Son La mangoes for export to China is collected from mango production areas and then transported through direct road transport routes heading to China through this gate. Mangoes from Southern Vietnam and from Cambodia are also transported via the Tan Thanh border gate and the Puzhai border gate at Pingxiang in the Southern Guangxi (Figure 6) (Dyer et al., 2021). In 2019, more than 95 per cent of mango exported to China was via these channels (Wandschneider et al., 2019). The distribution parks in Pingxiang then rapidly transport mangoes throughout mainland China. In addition, a small volume of mangoes was also exported to China across the Vietnamese Northeast border (Roberts et al., 2019, p. 6).

Figure 6. Son La mango road trade route to China



Source: Dyer et al. (2021)

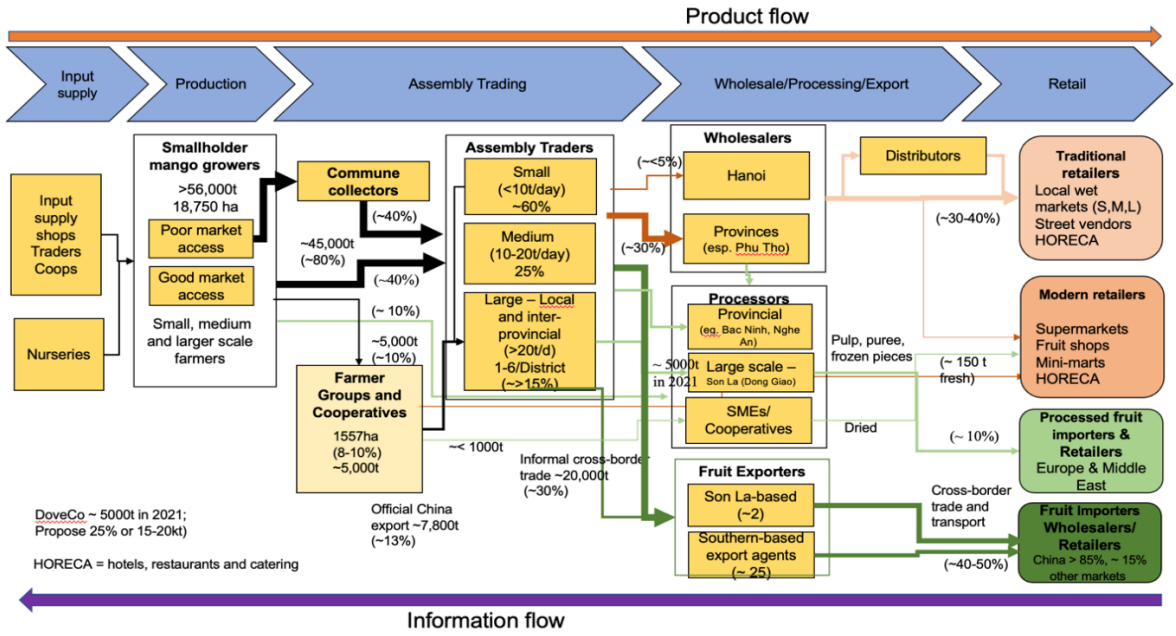
Son La Mango Value Chain

Product flow

Son La mango's existing value chain starts with input suppliers, then farmers' output flows through many different intermediaries and finally ends up with retailers and customers. These value chain operators provide significant inputs into the chain. As indicated in Figure 7, smallholder farmers are the major suppliers of mangoes and can be classified into three categories: small-scale farmers (<300 trees/~<1ha), medium-scale farmers (300 – 500 trees/~1 – 2 ha), and large-scale farmers (>500 trees/~2 – 5 ha) (Dyer et al., 2021).

However, there are many challenges in accessing local traders and buyers. The market price of mangoes offered by local traders to farmers sometimes impacts their choices. Consequently, many farmers have limited options or no alternative market sources to sell their mangoes. It is estimated that over 80 per cent of mangoes are assembled and traded by local collectors and traders, while 10 per cent is sold directly to local processors and the other 10 per cent provided through farmer groups or cooperatives.

Figure 7. Product flow, processes and actors in the Son La mango value chain



Source: Dyer et al. (2021)

Farmers who participate in farmer groups or cooperatives may have more options to sell their mangoes. Some sell a portion of their mangoes to local traders and processors and the majority to cooperative suppliers to provide to supermarkets or safe-food stores. The traders in this mango value chain in Son La comprise collectors and traders operating in the local market, who can purchase mangoes from farmers for a reasonable markup price and sell them to processors for profit. The larger assembly traders supply about 30 per cent of the mangoes to wholesale markets in Northern provinces, about 30 per cent to fruit exporters, who are based in Son La province, and the remainder to inter-provincial traders who travel to Son La during the harvesting season (Dyer et al., 2021).

Fruit exporters are the main actors who are directly involved in cross-border markets and provide mangoes to overseas markets. The traders play a critical role in connecting processors, wholesalers and exporters to the local farmers and are critical drivers in the mango value chain. About 30-40 per cent of mangoes from wholesalers reach the retail shops and domestic wet markets for domestic consumption. Some large processing companies further process and value-add by drying and freezing, which are later exported to Europe and the Middle East. In addition, fruit exporters in the value chain export about 40–50 per cent of the mangoes to China via both official and informal cross-border trade channels (Dyer et al., 2021).

As indicated in Figure 7, the information flows in a different direction from the product. Other relevant information related to the market and products are disseminated and transferred from retailers, wholesalers, exporters, processors, assembly traders, and finally to farmers.

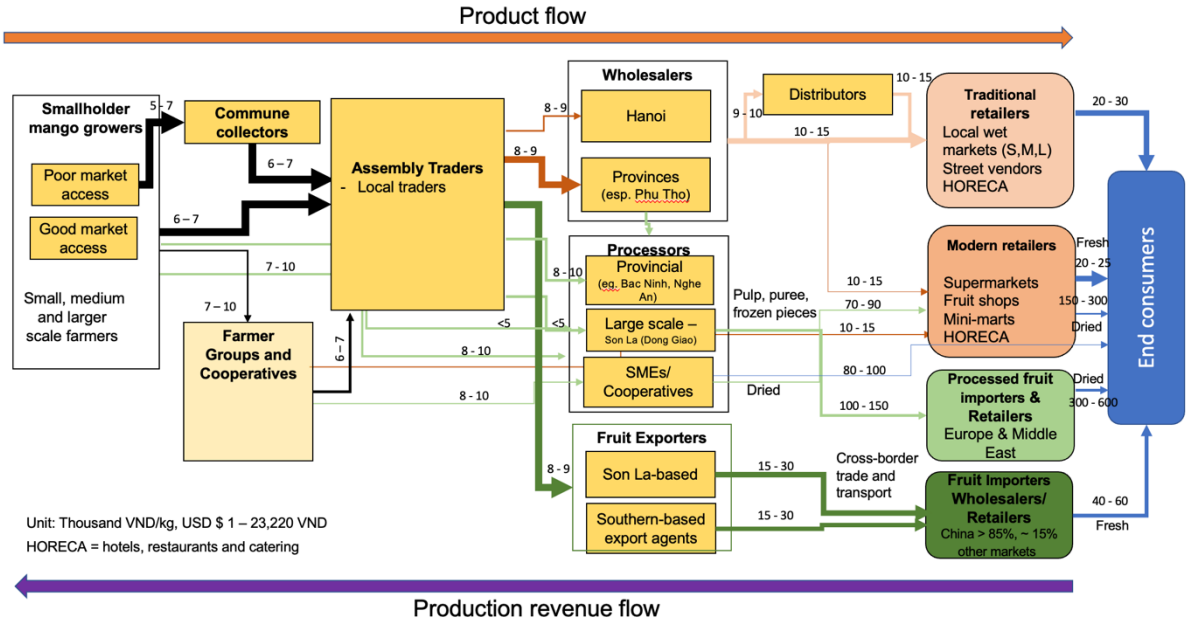
Overall, the product flow of mangoes in Son La, Vietnam is dominantly by local farmers, who are involved in growing and harvesting, after which mangoes are then sold to domestic and local markets. The mangoes are purchased by collectors and traders in the next stage of the value chain process. The traders buy in bulk from the farmers and cooperatives and sell to wholesalers, processors, and fruit exporters. Finally, the wholesalers supply to the domestic markets for local consumption, while processors and fruit exporters sell to overseas markets and to cross border trade.

Revenue flow process

According to the revenue flow shown in Figure 8, local farmers in 2021 sell mangoes for 5,000-7,000 VND per kilogram of mangoes if they have poor market access. At this time markets were volatile and prices fluctuated due to product availability, quality, market requirement, and most importantly, buyers' willingness to pay. In most cases, market conditions influence farmers' revenue from mangoes if they have the poor capability to access market information. Farmers with better quality fruit, can access higher value domestic or export markets and receive an extra 1,000 – 3,000 VND/kg.

Farmers who participated in groups or cooperatives selling higher quality, certified VietGap mangoes can receive higher prices and profits. Farmers in cooperatives producing mangoes under VietGAP standards must follow strict regulations and requirements for quality, safety and traceability. These high-quality products are sold directly to modern retail markets or importers from cooperatives without the intervention of local traders or middlemen. However, the farmer groups and cooperatives have specific market quotas because of contractual agreements with the retailers, that is, they need to provide mangoes frequently with a given volume. Farmers in cooperatives still sell mangoes to local traders during the peak harvesting season when supplies are large.

Figure 8. Production revenue flow in the Son La mango value chain



Note: The revenues in the map above were calculated by the authors based on short interviews with local farmers, traders, collectors, cooperative leaders, Son la DARD's staff, Hanoi consumers and retailers, and interviewers involved in the survey with Dyer's team in 2021. The mango price through the value chain is estimated only for the 2021 mango harvest season in Son La province.
Figure 8 should be read in conjunction with Figure 7.

The assembly traders receive a margin of 2,000 VND/kg from the wholesalers and a further margin of around 2,000 – 3,000 VND/kg when they sell to local processors and fruit exporters, but these margins include all logistics and transportation costs. Wholesalers only increase their price by 1,000 VND/kg when selling to the distributors, but they can get around 2,000 – 6,000 VND/kg if they sell higher quality fruit directly to modern retailers.

Meanwhile, local mango processors can add value by producing products such a pulps, juices, and frozen fruit with selling prices between 70,000 – 150,000 VND/kg depending on the kind of processed output. However, capital investment and operating costs are often very high. Modern retailers and exporters can add value and revenue by selling dried mangoes at prices between 80,000 – 150,000 VND/kg.

Local processors normally only buy low-quality mangoes at the cheapest price for efficient input optimization, as they do not require strict specifications about the appearance or size of the mangoes. On the other hand, modern retailers (for example, AEON, BigC, MM Mega Market, Massan) can set a margin of between 5,000 – 10,000 VND/kg of fresh mangoes when it reaches the end consumers. It is estimated that fruit importers can receive a margin of about 15,000 – 30,000 VND/kg from Chinese importers, particularly, the exported mangoes which has the highest quality and is classified as Grade A. Exporters selling dried mangoes to Europe and the Middle East can make a significant profit. The average export price of Vietnamese dried mangoes ranges from USD20 – 30$ per kg, equivalent to about 450,000 - 600,000 VND/kg (Vietnam trades, 2020). However, the dried mangoes exported to these markets are in small portions.

Overall, the revenue flow through the value chain indicates that local traders are the key distributors to supply mangoes to the next stage and they have the most powerful influence on mango price in the production region. Traditional retailers and fruit exporters are key actors providing fresh mangoes to domestic and international consumers. Most of the gains from the mango value chain accrue to the high-value-added exporters. There is limited distribution of these gains from the wholesalers down to traders and eventually to the farmers.

Current Government Policy Intervention in the Mango Value Chain in Son La Province

As previously discussed, there have been significant government interventions to support the mango value chain in Son La and other parts of Vietnam. The policies introduced also encountered difficult challenges and have seen slow progress in implementation. According to Truong and Sidique (2022), there were several policies adopted and proposed by the provincial and national levels to support the supply of fresh mangoes across the value chain. The improvement of market linkages and quality have been the two main focusses to improve the chain performance.

Quality improvement to meet export market standards

The local government has introduced a policy of establishing farm cooperatives and farmer groups to help mobilise resources and combine small farmers to increase their capacity to engage in large-scale sustainable farming systems. In recent years, the Son La government has issued certifications such as VietGAP (Vietnamese Good Agricultural Practices), Organic, or Safety certificates, where farmers are required to adhere to traceability standards. The VietGAP certificate is the most popular and compulsory certificate applied for mango production. This regulation provides standards, requirements, and principles that guide growers in the right practices of mango cultivation, harvest, and post-harvest management. The application of VietGAP standards has many advantages and generates more market opportunities for farmers domestically. The certification can prove the quality of the products and build trust for consumers about their products' origin, traceability, high quality

for hygiene and safety, friendly cultivation with the environment, and consumers' health benefits (Cao, 2020). Simultaneously, farmer QR-code and Production Unit Codes (PUCs) are also applied to meet domestic and international market requirements. As of 2021, Son La province has been granted 125 PUCs for growing fruit trees exported to the Chinese market covering 4,007 hectares; 47 PUCs for growing fruit trees covering 412 hectares for exporting to the United States; and 48 PUCs for growing fruit trees covering 386 hectares for exporting to Australia and New Zealand (Son La DARD, 2021).

The purpose of these policies is to improve the value chain by facilitating connections between mango farmers to domestic and international market standards. Further, the local government through extension services also supports farmers to increase their capacity for accessing training support, in post-harvest, market information, and farm business management. The policy also encourages collaboration to share quality information between farmers, processors, wholesalers, and exporters about producing high-quality farm mangoes.

The actors in the mango value chain need to fully understand the quality segmentation issues to satisfy the importer's requirements (Peter, 2020, p.21). If quality management is conducted properly by the value chain actors, the export volume of mangoes can increase thus generating more revenue for the economy.

Market access improvement

The Son La government has actively taken part in promoting mango production, distribution, and marketing. Domestic Trade-Fairs and online marketing have been organized and conducted frequently by the local government to help farmers connect to value chain actors such as supermarkets and wholesalers. Moreover, the transportation system has been improved and upgraded significantly (Huynh et al., 2021, p.11) that has facilitated traders, businesses, and mango buyers' easy access to remote areas.

Furthermore, the national government has also embarked on improving and negotiating more Free Trade Agreements (FTAs) among countries in the ASEAN region to boost cross-border trade facilitation. The Vietnamese government is actively involved in bilateral and multilateral FTAs and as of March 2021, Viet Nam has been participating in 14 FTAs (WTO, 2021). This paves the way for Vietnamese agricultural exporters to participate in global value chains and attract foreign capital to this field. There are four FTAs that influence mango trade: the ASEAN Economic Community (AEC), the Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CPTPP), the Europe-Vietnam Free Trade Agreement (EVFTA), and the United Kingdom-Vietnam Free Trade Agreement (UKVFTA) (Truong and Sidique, 2022).

Value Chain Drivers

Value chain drivers are extremely important in the overall profitability and sustainability of the mango value chain in Son La. These factors drive the flows of product, value, and information throughout the value chain. Different actors within the chain rely on these factors to assess their performance, production output, and most importantly the revenue they get from their interactions in the value chain. In addition, value chain drivers not only help the actors in daily activities, but many managers and business leaders can also use these drivers to improve business planning and upgrade processes within the chain. To measure the performance of the supply chain in terms of design, planning, and operation of the chain, it is important to consider two key major groups of drivers in terms of value chain performance – logistical drivers and cross functional drivers (Chopra and Meindl, 2013). These drivers play a critical role in the Son La mango value chain.

Logistical drivers

As mentioned previously, the main incentive behind the expansion of mango production in the region was the increase in prices and market demand in China since 2010 combined with the local government program for "Growing fruit trees on sloping land". These factors have prompted farmers to invest in mango production to increase their household incomes. It is observed however that smallholder farmers may lack the capability to produce high-quality products due to inefficient input use, limited technical knowledge, limited capital, and poor market linkages.

Over 90 per cent of mango growers are small to medium-scale smallholder growers and over 50 per cent of mango planted areas are less than three years old (Dyer et al., 2021). This means production output will continue to increase in the coming years as young trees come into full production. There are also major differences in the mango quality, productivity, returns, technical capability and market access between growers in different locations. As production output increases, it will be essential to support remote farmers and connect them to new markets and improve their mobility, and transport systems as production increases.

Transportation

Efficient and effective transport networks are vital for smooth flows of products and vital information. Transportation plays a vital role in moving products throughout different stages of the supply chain and impacts responsiveness and efficiency (Chopra and Meindl, 2013). The Son La mango value chain is a relatively low-cost value chain because mangoes do not require long-term refrigeration or storage and traders usually use conventional non-refrigerated trucks to reduce the cost of transportation.

Farmers dispatch mangoes to collection agents in the villages and communes using motorbikes, wheelbarrows, or small trucks, depending on the access, distance, harvesting volume and road condition. Almost all collecting points are located along main commune or district roads which larger trucks can access and load mangoes. These trucks then move to main roads leading to the Noi Bai-Lao Cai expressway to transport product to the Chinese border, and the Tan Thanh border gate, Lang Son province. These large trucks have a capacity of around 30 to 40 tonnes per shipment. Son La mango exporters have a significant advantage over the southern provinces as the Vietnam-China border gates are much closer.

Mangoes can reach wholesale markets in Hanoi and other northern wholesale markets in Phu Tho, Hung Yen, Thai Binh, Nam Dinh provinces within 4 – 6 hours. Moreover, there are plans for a new Hanoi – Moc Chau expressway to be completed in the next few years, which will reduce the traveling time between Son La and Hanoi by 2 hours (VietnamNet, 2018).

Facilities

In the mango value chain, production sites and storage sites are the two main types of facilities (Chopra and Meindl, 2013). Making any decision relating to facilities has a significant impact on the performance of supply chain, such as decisions referring to capacity, location, or investing in technologies.

In general, there is limited investment in facilities and infrastructure throughout the mango value chains in Son La province. Mango collectors are often local farmers, who also have small orchards and help to collect mangoes from other farmers. The collecting points and packing sheds are built from a part of the collectors' houses and are mostly close to the production areas. Normally, fresh mangoes

are transported from collecting points to the wholesale markets during the night without the need for warehouses for storing.

Mango collection points located close to growing areas significantly reduce the risks and cost to farmers and increase the efficiency of the supply chain. Given mangoes are highly perishable, significant damage to fruit is caused by long-distance transportation, rough roads and poor transport, and unsuitable packaging.

Normally, mangoes are delivered to Hanoi wholesale markets, however, there are no chilling or packing facilities at these locations. Mangoes are distributed immediately to smaller retail merchants, smaller stores, or street vendors nearby. Packing areas with cool rooms are usually available at modern retailers such as supermarkets, mini-marts, and modern fruit shops, which often have their own distribution centers. Generally, fresh mangoes are sold within a week either at stores or traditional markets to provide the best quality for the end consumers.

Proper storage facilities are vital for the continued development of the Son La mango value chain. Facilities such as cold rooms can greatly improve mango shelf life, quality and freshness reaching the customers. Most often, the quality deteriorates significantly before the product reaches the markets and farmers lose revenue as buying points are not accessible to farmers in remote areas of Son La. The challenges in post-harvest management create significant effects on the value chain performance, production, cost, and other associated risks and implications. Often, farmers must travel long distances to access the nearest available markets to sell their mangoes or mangoes are sold to traders who travel to the remote villages to collect directly from small farmers. Mangoes are susceptible to humidity and temperature and can be easily affected if not stored and transported under reasonable temperatures. Cool room storage built at the farm level by cooperatives, private processing companies, and even large-scale household farmers can greatly support local mango growers. However, most farmers in remote parts of the province have little to no access to proper storage facilities, which is a major impediment.

Inventory and warehousing

The strategic fit of the value chain can be improved significantly when there are appropriate inventory policies (Chopra and Meindl, 2013). For example, storage facilities such as cool rooms can prolong the mango's freshness and shelf life, both increasing mango's value and contributing to the flexibility of delivery. The majority of mangoes in Son La are sold fresh to traders for wholesale and retail fruit sales. Fruit sold to local processors is stored before processing, then exported or sold within the domestic market. The facilities are mostly owned by private sector companies and cooperatives. However, the cost of maintaining these facilities remains a significant challenge. Most international mango buyers require advanced processing and high-quality mango products from Vietnam. The demand for quality mangoes has shifted the government, farmers, and traders to critically improve the inventory and warehousing challenges to enhance product quality and efficiency within the mango value chain. According to the value chain diagram, processors, traders, and exporters do have effective warehousing and inventory management systems. However, these need to be improved at the farm level, where farmers should have access to such facilities to effectively participate in the mango value chain.

Cross-functional drivers

Sourcing

Sourcing is a series of business operations that are required for purchasing goods and services. Sourcing decisions can impact significantly on supply chain performance and sourcing from low-cost countries allows firms to provide a basic product at low cost (Chopra and Meindl, 2013). More importantly, sourcing decisions also affect the level of achievement of responsiveness and efficiency in the supply chain. As such, the increase in the cost of fertilizers in the international market can impact and reduce the income of mango producers, but consumers in importing countries such as China, Europe, Middle East, and Australia, benefit as they can access more product at a reasonable price. Chen, Zou & Qi (2019, p. 16) indicated that Vietnamese mangoes are the cheapest varieties in China's imported mango market.

Mangoes can be sourced from many different actors within the Son La value chain. However, procurement and distribution of large supplies of mango occurs between the collectors, traders, wholesalers, and processors. Outsourcing transportation and storage services is often an option for some collectors, wholesalers, and processors. Farmers and cooperatives generally have a limited quantity of mango supply and thus may also use transport services to shift mangoes to the market.

In general, it is often cheaper for farmers to use transport services rather than operate their own trucks. This is because they may only use the truck during the short harvest period, which can increase the cost. Therefore, outsourcing some activities often makes good sense. If farm labour is in short supply in specific important periods, activities such as pruning, spraying, and harvesting could all be outsourced.

Information

Good information can be considered as a key driver that can help to improve the use of supply chain resources, coordinating the supply chain flows, increase responsiveness, and reduce unnecessary costs. However, interactions and exchange of information between actors in the Son La mango value chain is generally very fragmented. Smallholder mango growers appear to source most of their technical and market information from other farmers, local input suppliers or product sellers, collectors, and traders. Some growers may get information via their cooperative membership when cooperatives receive technical support from local extension staff and other research and development programs. Growers in remote locations with poor access to the main roads generally have less access to technical and market information.

Information flow between stakeholders at the local level and some key research and development organizations to mango growers may also be limited. There are also limitations in the flow of technical information between district and commune extension officers and growers. More interestingly, there appears to be strong linkages and exchange of information between processors and fruit exporters and their customers which is crucial to the Son La mango value chain. However, it appears little information is exchanged back upstream to traders and growers. A small number of more innovative traders and exporters may work closely with their grower cooperatives to communicate, improve practices, product quality requirements, and standards, however, this appears to be limited. In addition, there is also limited information flow from traditional wholesalers, retailers, and large processors back through traders to growers, besides mango pricing information. Improved transfer and dissemination of key information throughout the entire value chain is essential.

Major Constraints of the Son La Mango Value Chain

Production system

In the mango production system, there are still limitations to the adoption of good farming practices, such as fruit bagging, pruning, VietGAP, fertilization, floral manipulation, and grading to increase mango production and quality to comply with market standards and specifications. Compliance with food safety and biosecurity standards are also low. For example, there is limited management of fruit flies and other pests and diseases, nor adoption of biosecurity protocols for export (Dyer et al., 2021).

Access to training and extension services

Small and fragmented production areas, and difficult access to technical support and farmer training and market information, are the main challenges to the adoption of advanced techniques by growers and cooperatives. Significant amounts of low-quality mango are produced from low-income grower households who have limited knowledge and experience in mango production. These households often have financial strains with limited ability to invest in or adopt new practices or technologies, particularly when prices and income are so low.

Technical manuals and instructions on post-harvest practices are mainly provided by local extension officers but in limited quantities. This challenge requires farmers to learn farming techniques by themselves through interaction with neighbours, working for larger farms, or accessing information on the internet.

Access to markets

There is often weak linkages, cooperation, and coordination both between growers, and between growers and traders, exporters, processors, and wholesalers. Effective feedback and information exchange often only occur between a few close actors in the chain. There is usually little communication about processor and retailer product requirements or standards back to growers through the traders. Farmers have limited access to markets and market information, and therefore depend heavily on local collectors and traders. Consequently, traders are important and influential actors in the value chain.

The recent investment of smallholder farmers in new orchards combined with a lack of new market development has led to local oversupply. Son La mangoes also have to compete with mangoes from the Mekong and other regions in Vietnam, as well as imports from Cambodia, both in Hanoi and in Chinese markets.

Value-adding system

Although several large processing companies and factories have established in Son La, they are either not fully in operation, or operating below capacity due to volatility of markets, poor fruit quality, and difficulty in attracting raw material. Since the mango prices have decreased significantly since 2020, the volume of low-quality mangoes has increased as farmers are less inclined to apply inputs or good management practices. In response some cooperatives have switched to processing dried mangoes to try and add value.

Transportation system

For more densely populated central districts with better roads, larger trucks are available which translates into lower transport costs for linking farmers to the nearest trading hubs (Lancon et al., 2014, p.16). In remote villages however, the costs for shipping agricultural products out of their fields are higher, due to the poor rural road conditions and the smaller vehicles used (công nông) (Lancon et al., 2014, p. 16). Farmers located in remote areas must bear the expense of hiring motorized trailers

for the transportation of their mangoes. Overall, transportation costs are a huge burden to most cooperatives and farmers.

Access to finance

Many mango producers have limited access to finance and loans as they usually need to register their land use certificate for their land to local banks to get loans. This is a big constraint for farmers or newly established families who do not have land use certificates to show their ownership of subdivided inherited family land. This presents challenges to many mango growers needing to take out loans to expand, intensify or improve their production and market systems to meet quality and food safety standards.

Suggested Interventions

Intervention by Government agencies

Increasing market access and development of the mango sector is one of the highest priorities of the Son La Provincial Government, particularly the Department of Agriculture and Rural Development (DARD). Son La DARD has issued new policy interventions in 2021 to provide funding support for growers, groups, or cooperatives to invest in storage, preservation, or processing technologies (Son La DARD, 2021). These policies support processing and improved value adding which provides new markets for farmers to sell their mangoes. Also, these government interventions and initiatives can indirectly benefit farmers because the other chain actors can offer more market options. As estimated in Figure 8, exporters can receive a higher price because they provide only A grade mangoes that meet the strict specifications of buyers in importing countries, even though the higher margin also includes storage, packaging, transport, and cross-border trade costs. In addition, the increase in export channels also leads to new technology and improved management such as using fruit bagging to meet the higher quality standards of export markets.

To achieve a sustainable supply chain, it is essential to increase the transparency throughout the chain through product identification and traceability (Loemhof & Nunen, 2005, p. 1). The local government has introduced VietGAP standards, certifications, and traceability (production area and processing facility codes) to provide opportunities for small farmers to access the higher value markets. According to a survey conducted in 2021, mangoes containing a QR code in Hanoi markets received a price premium of VND 10,550/kg compared with those mangoes with 'no indication of the place of origin'. VietGAP certified mangoes could obtain a higher premium price of VND 20,200/kg compared to products without certification (Loc, Dieu, & Zou, 2021, p.17). However, the increased cost of VietGap compliance must also be considered by farmers. Son La branding and trademarks combined with higher quality also have potential to add value for growers and actors in the chain.

However, many farmers may find it difficult to access training services, or adopt and comply with strict certification processes. In order to achieve the certification requirements, farmers have to complete training in safe-chemical use, record-keeping, and follow good agricultural practices. Many farmers, particularly with limited literacy in the Vietnamese language, may find certification processes complicated and time consuming, and not worth the added investment. As a result, addressing these challenges, and improving mango quality remains a priority to access these higher value domestic and export markets. In addition, the role of local government to enhance mango quality and biosecurity controls in these markets is crucial.

Capacity building for cooperatives

There are around 1,700 members and over 800ha of mangoes grown in over 60 farmer cooperatives in Mai Son and 35 in Yen Chau districts. There are also two cooperatives in Yen Chau that process mangoes (and other fruit) with a combined processing capacity of 800 tonnes/year (Son La DARD, 2021). Cooperative leaders and farmer members need support to improve cooperative governance, management, and operational capacity, financial management, negotiation and marketing, and planning skills to strengthen their resilience to future shocks or risks. Supporting market linkages from cooperatives also benefits farmers. Therefore the government also needs to support cooperatives and farmer groups to connect with local processors and exporters.

Interventions by private firms

The private sector plays a crucial role in the function and development of the mango value chain. The availability and willingness of market actors and investors can significantly contribute to creating income for farmers and other stakeholders involved in the chain. The presence of several large fruit processing companies, wholesalers, exporters, and retailers are key drivers for Son La mango farmers. DOVECO-Dong Giao, TH group, and Nafoods are the main fruit processor companies in Son La province. DOVECO-Dong Giao is one of Vietnam's largest processing companies and is aiming to produce 50,000 tonnes of processed fruit products annually. They have established export markets in Europe and other countries. Dong Giao will start operation from their new processing facility in 2022 and plan to absorb up to 25 per cent of total mango production (GL4 variety) (Son La DARD, 2021). However, these firms are still not in full operation. Based on experience, a key priority for success will be for these firms to invest in strengthening the collaboration and technical support with smallholder mango grower suppliers.

Conclusion

Mangoes are one of the key cash crops in Son La province, Vietnam and the industry makes a significant contribution to household incomes for thousands of smallholders. Closer engagement of market actors in the mango value chain such as traders, processors, wholesalers, fruit exporters, and modern retailers is critical to promoting mango sector and market development for the province. Moreover, the increasing availability of local processing, both large-scale and commune-level facilities should provide local farmers with alternative markets and value adding options. However, overproduction combined with poor quality, low prices, weak market linkages and failure to develop new markets will result in ongoing challenges unless urgently addressed. This will directly affect incomes, particularly for small-scale farmers, and particularly ethnic minority mango growers. As such, the collaboration and linkages of all stakeholders in the chain need to be strengthened. Mechanisms to improve transparent communication and exchange of technical and market information between exporters and farmers will help farmers improve their production and marketing systems. In addition, delivery of training and capacity building to farmer groups and cooperatives is needed to improve production efficiency, fruit quality, compliance with standards and ability to link to the higher-value markets.

Further analysis is required to identify priority development initiatives to create new markets and improve the production efficiency, fruit quality and profitability of the farmers, traders, and wholesalers throughout the Son La mango value chain. Given the current challenging context the national and provincial governments have an important role to play. Key areas include policies for improving local transport and logistics infrastructure and facilities, strengthening cooperatives, and promoting community-scale processing and value adding, provision of market information, and support to identify and develop new markets for fresh and processed fruit, technical support to cooperatives, traders, and exporters to meet more stringent quality, biosecurity and food safety standards and specifications in export and domestic markets. In addition, the local government needs

specific policies that support quality improvement and improved governance and compliance with cross-border trade protocol requirements.

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