Lao People's Democratic Republic
Department of Irrigation
Ministry of Agriculture and Forestry

MARKET ASSESSMENT

OP05-CS01

LOAN IMPLEMENTATION CONSULTANT - DOI

SUSTAINABLE RURAL INFRASTRUCTURE AND WATERSHED MANAGEMENT SECTOR PROJECT

SAFE VEGETABLE MARKET ASSESSMENT NAM TONG REPRESENTATIVE SUBPROJECT

INACON

joint venture with

TETIRA

sub consultants

BMEC ENGINEERING & CONSULTING

MIRA Consulting

SAFE VEG ETABLE MARKET ASSESSMENT – NAM TONG REPRESENTATIVE SUBPROJECT

IN XIENGKHOUANG PROVINCE, LAO PEOPLE'S DEMOCRATIC REPUBLIC

27 MARCH 2022

Sustainable Rural Infrastructure and Watershed Management Sector Project (ADB-funded SRIWMS – Loan No. 3817 - LAO)

Prepared by Dr. Kenneth E. Neils and

Mr. Inphong Soommart

of the Loan Implementation Consultant – DOI (OP05-CS01)

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ABBREVIATIONS

CIF	Cost, Insurance, and Freight
DAFO	District Agriculture and Forestry Office
Ha	Hectare
HPN	Houaphan province
HVC	High Value Crop
K	Kip
Kg	Kilogram
LIC-DOI	Loan Implementation Consultant – Department of Irrigation
LIC-Province	Loan Implementation Consultant of a Project Province
LPB	Luang Prabang province
Mt	Metric Ton
PAFO	Provincial Agriculture and Forestry Office
PICSA	Partnerships for Irrigation and Commercialization of Smallholder Agriculture Project
RSP	Representative Subproject
SRIWSM	Sustainable Rural Infrastructure and Watershed Management Project
VTE	Vientiane
WUG	Water User Group
XBL	Xayabouly province
XK	Xiengkhouang province

1. INTRODUCTION

The safe vegetables Nam Tong market assessment report is a deliverable under Output 1. The emphasis in the assessment was on collecting and analyzing high value agricultural product market information from markets at the local, provincial, national, and export levels. The focus was on assessing the current market for selected high value crops that could be produced and marketed by the producers of the Nam Tong Representative Subproject (RSP) in Xiengkhouang Province. The market assessment includes seven priority, high value crops that can be produced during the dry season at the Nam Tong RSP and marketed with relatively high marketing margins at the different levels of the value chains.

To carry out this assessment, the LIC-DOI Agricultural Market Linkages Specialist and Expert and the LIC-DOI Team Leader/Project Management Expert collected market information on potential high value crops that have been produced or could be produced in Xiengkhouang province and marketed profitably at various levels of the value chain. At the producer level, the LIC-DOI Agribusiness Team visited and conducted workshops with the Nam Tong RSP and its producers, together with the PAFOs, DAFOs, PICSA, and LIC-Provinces in order to collect high value crop production preferences, cost of production, farmgate price, buyer linkages, and producer margins. The cost of collection of the local collectors and the destination for the collected agricultural crops were determined and the buyers, wholesalers or retailers at local, provincial, and national levels, were surveyed to collect prices and calculate margins at all levels. The market potential for exporting the products from these HVCs was determined based on historical global and regional export data and trends, recent export demand and supply information, Lao export information, and Lao competitiveness in the export market.

2. VALUE CHAIN DESCRIPTION

For the purposes of this market assessment, the value chains for the priority HVCs are described, initially, generically since there is little variation across HVCs. The general value chain for vegetables and herbs involves the producer at the Nam Tong Representative Subproject producing the crop during the dry season, selling at the farmgate to the local or provincial collector who owns or hires a large truck (up to 5 ton capacity) to transport the vegetables and herbs to the wholesaler or retailer in Vientiane or other provincial marketplace.

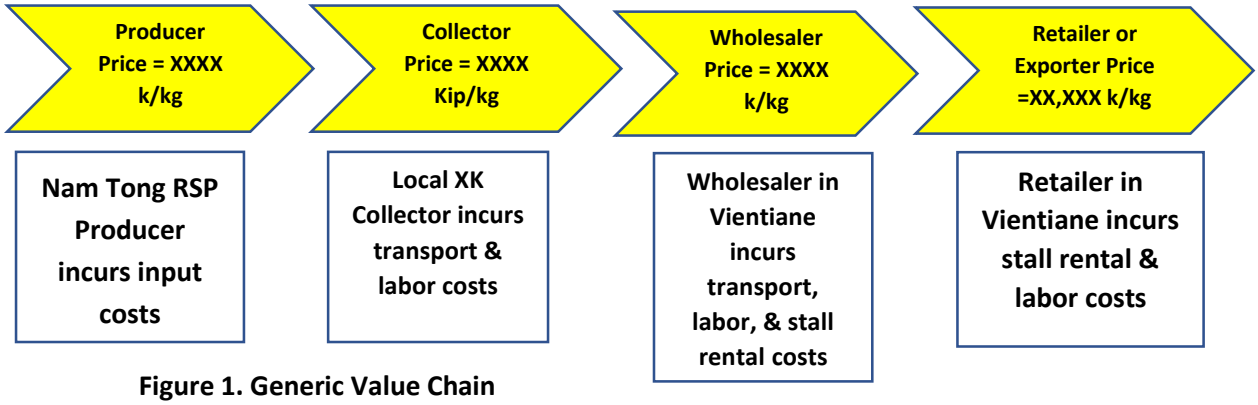

Figure 1. Generic Value Chain

The diagram above of the generic value chain does not cover the dynamics, that is, the linkages at the various levels in the value chains. The diagram that does this is the following marketing flow chart diagram.

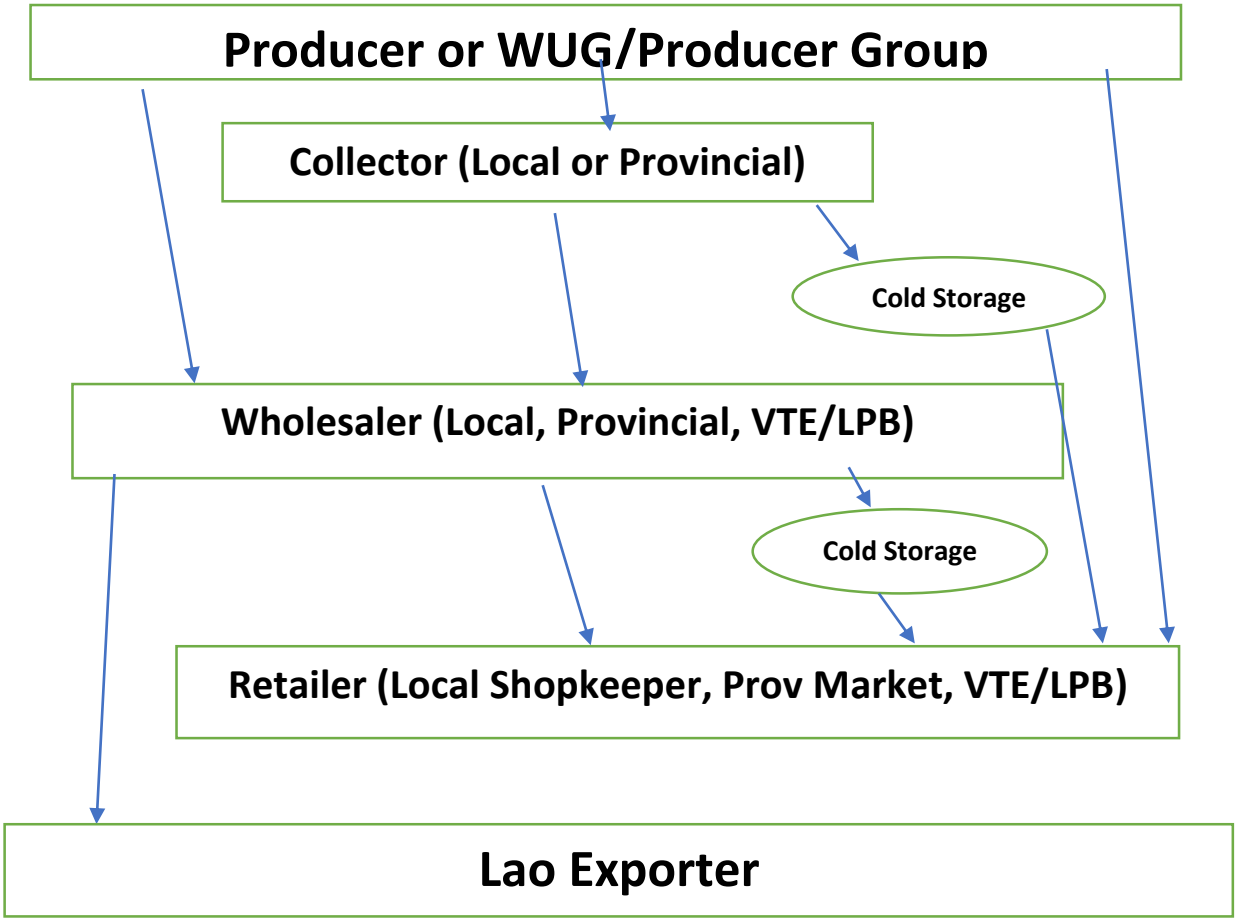

Figure 2. Marketing Flow Chart

This diagram shows that the margins can vary depending on how agricultural products are marketed. Garlic is a good example. If a producer group or collector transports a truckload of garlic plus other vegetables, such as, onions, leeks, etc. to a retailer in the Vientiane Capital Market, that producer group or collector will receive a higher margin than if the sale was made to the wholesale market.

There are many margins along the value chain, including producer, collector, wholesaler, retailer, and exporter:

- Producer margin equals farmgate price minus cost of production.
- Collector margin equals price of product sold to wholesaler – cost of collection (product cost, transport, driver/labor)
- Wholesaler margin equals price of product sold to retailer – cost of wholesaling (product cost, transport, labor, rent on market stall)
- Retailer margin equals price of product sold to customer – cost of retailing (product cost, labor, rent on market stall)
- Exporter margin equals CIF price of product sold to importer – cost of exporting (product cost, transport, warehousing, handling, shipping, insurance)

For the seven priority crops, the various margins along with the costs and prices associated with each margin are given in Table 1.

Table 1. Prices and Margins of the Recommended High Value Crops in the Value Chains

High Value Crop	Producer				Collector			Wholesaler			Retailer			Exporter		
	Yield	COP	PP	PM	COC	CP	CM	COW	WP	WM	COR	RP	RM	COE	EP	EM
	1000 Kg/HA	1000 K/KG	1000 K/KG	1000 K/KG	1000 K/KG	1000 K/KG	1000 K/KG	1000 K/KG	1000 K/KG	1000 K/KG	1000 K/KG	1000 K/KG	1000 K/KG	1000 K/KG	1000 K/KG	1000 K/KG
Garlic	3.5	6.8	10	3.2	10.5	13	2.5	13.5	15	1.5	15.1	20	4.86	25.7	29	3.3
Leafy Vegetables (Cabbage)	1.59	2.15	6	3.85	6.18	6.5	0.32	7.04	8	0.96	6.65	10	3.35	-	-	-
Herbs (Cilantro)	1.5	2.08	6	3.92	6.18	6.5	0.32	7.04	8	0.96	6.64	13	6.36	-	-	-
Yard Long Beans	4.5	4.41	5	2.38	5.400	6	0.6	6.145	6.5	0.355	6.645	8	1.355	-	-	-
Cucumbers	11.6	4.24	4	1.028	4.400	4.75	0.35	4.895	5.417	0.522	0.145	7	2.1057	5.81	7	1.19
Maize	6	0.938	1.8	0.863	1.897	2.3	0.403	-	-	-	-	-	-	3.021	3.358	0.337
Forage Crops (Napier Grass)	25	1228	??	0.047	-	-	-	-	-	-	-	-	-	-	-	-

From this point on in this Market Assessment, each of the seven priority HVCs are described separately. The seven HVCs are garlic, leafy vegetables, herbs, yard long beans, cucumber, maize, and forage crops.

3. TARGETED HIGH VALUE CROPS

3.1 GARLIC

3.1.1 Demand and Supply

Demand - Global consumption of garlic was 26.5 million metric tons (mt) in 2016, including,

- fresh and cold-stored garlic (89.2% of total)
- dried garlic (10.1% of total)
- other – frozen, pickled, etc. (0.7%)

From 2004 to 2018, China's position as a global leader in garlic production gradually trended upward. China commands an 80% share of the global garlic exports, with the bigger clove garlic with lesser number of cloves the global preference. At present, Indonesia, Vietnam and the USA are the largest export destinations, with Southeast Asia, Brazil, the Middle East and Europe also serving as important markets.

National demand - In 2019 Lao (Laos) sold 322 metric tons of garlic (Ref: Selina Wamucii). In 2019 alone, the demand for Lao (Laos) garlic (herbs and spices category) increased by 2.8 percent compared to the year 2018. Between 2017 and 2019, garlic's exports grew by 71 percent bringing the country US$ 498,000, US$ 736,000, US$800,000 for the years 2017, 2018, and 2019, respectively. In 2020, there were no exports of garlic. Lao garlic exports are classified as garlic, fresh or chilled (HS code 070320).

Provincial demand - Xiengkhouang province is a major producer of garlic in Laos, producing over 3600 mt in 2017 and supplying neighboring provinces. Other Project provinces also produce garlic during the dry season but the quantities are such that only local markets are being supplied. However, with the penetration of 322 mt of Lao garlic to the export market in Thailand in 2020, the value chains of garlic in various provinces have reached the wet markets in Vientiane and are likely to continue to broaden into the export markets. Thailand's garlic imports reached the peak in 2020 and are likely to continue growth in the immediate term.

Supply - From 2004 to 2018, China's position as a global leader in garlic production gradually trended upward. In 2018, global production of garlic was 28,494,130 mt, with China producing 22,273,802 (more than 78%). India 1,721,000 mt, Bangladesh 461,970 mt, 331,741 mt, and Egypt 286,213 mt. Now, with its relatively stable export market, China is the most critical country in the international garlic supply chain, accounting for 80% of global garlic exports. The 5 biggest exporters of garlic are China, Spain, Argentina, Netherlands and Italy. Collectively, those 5 countries represent 90.8% of revenues earned for garlic sold on the international market during 2020. That percentage indicates a very concentrated cohort of garlic suppliers.

Regional Supply (Asian countries) - Asian countries sold over two-thirds (67.7%) of the world's exported garlic during 2020 with shipments valued at $2.1 billion. China was the largest supplier. Laos purchased 609 metric tons of garlic (from Vietnam or China) in 2019.

Provincial Supply - The farmers in Xiengkhouang (XK) province have been producing garlic, peanuts, leafy vegetables, and other vegetables and have supplied about 12% and 5% of the total vegetables produced in XK and sold into the Vientiane and the Luang Prabang wet markets, respectively, during the dry season (Ref: PAM Market Assessment, 2017). Xiengkhouang traders supply about 10% of the total vegetables sold in the Vientiane market. That supply includes 10 5-mt truckloads of vegetables each day to the main wholesale market in Vientiane. Xiengkhouang agricultural products are sold locally in local markets and in neighboring districts within the province, in outside provincial markets, especially Vientiane[1] and Luang Prabang wet markets, and export markets (China, Vietnam, and Thailand). The vegetable and garlic from Xiengkhouang province have good reputation for low-chemical inputs, and for their taste due to the climate, soils and farming practice.

3.1.2 Margins

Producer Margin = Farmgate (producer) price – cost of production
The cost of production in Xiengkhouang province averages about 6800 Kip/kg (including labor) with a yield of about 3500 kg per hectare during the dry season in irrigated areas. The farmgate price during the dry season averages about 10,000 Kip/kg, giving a gross margin of 3,200 Kip/kg. At a yield of 3500 kg, the gross margin is 11,200,000 Kip/ha or $957/ha. The farmers know local collectors (with a transport truck) who they contact by cell phone and sell their dried garlic to.

[1] The main markets of Vientiane are Tong Kan Kham, That Luang and Kua Din. Their main function is retail selling of crops, meat and fish. Wholesale operations take place early in the morning (3-4 a.m.) at the transport terminal, the vehicle loads the products quickly, it is then bought up by market retailers shortly after and it is replaced by retailing or loaded on to smaller vehicles to other markets.

Table 2. Prices and Margins of the Garlic Value Chain

High Value Crop	Producer				Collector			Wholesaler			Retailer			Exporter		
	Yield	COP	PP	PM	COC	CP	CM	COW	WP	WM	COR	RP	RM	COE	EP	EM
	1000 Kg/HA	1000 K/KG	1000 K/KG	1000 K/KG	1000 K/KG	1000 K/KG	1000 K/KG	1000 K/KG	1000 K/KG	1000 K/KG	1000 K/KG	1000 K/KG	1000 K/KG	1000 K/KG	1000 K/KG	1000 K/KG
Garlic	3.5	6.8	10	3.2	10.5	13	2.5	13.5	15	1.5	15.1	20	4.86	25.7	29	3.3

Garlic Margins	Margin (1000 kip/kg)
Producer Margin	3.2
Collect Margin	2.460
W/sale Margin	1.5
Retail Margin	4.855
Exporter Margin	3.300

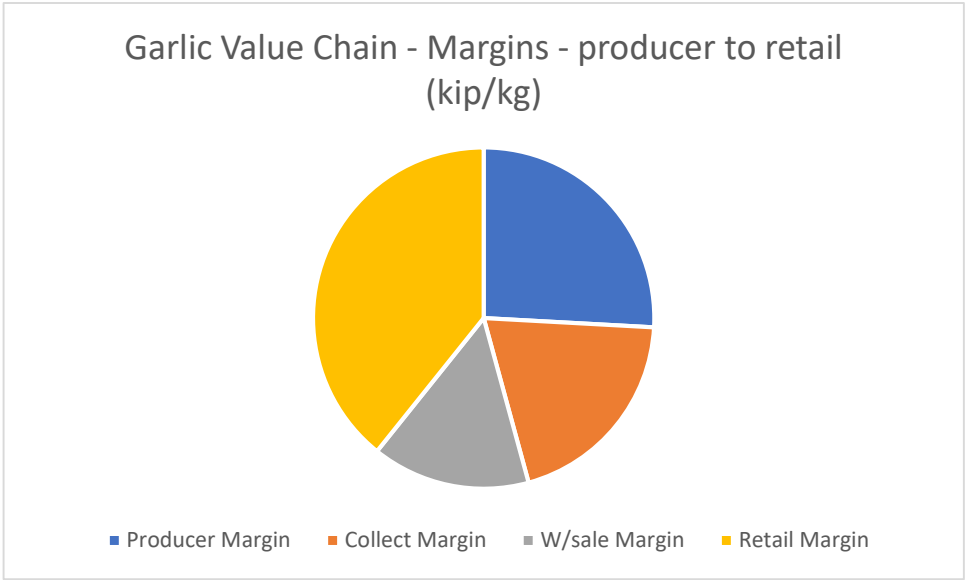

Figure 3. Comparative Margins of Producer to Retailer Levels of the Garlic Value Chain

Collector Margin = Collector price – producer price – cost of transport (includes labor)
In this margin estimation, it is assumed that a 5-ton capacity truck is hired (for 400,000 Kip/mt produce) by a local collector who transports the garlic to Vientiane markets after being contacted by wholesalers and retailers in Vientiane markets. The local collectors (as well as other provincial collectors) also transport the Xiengkhouang garlic to other distant provincial markets, notably Luang Prabang. The collector typically arrives in the early morning (4-5 am) to the Vientiane wholesale market and other city markets where the wholesalers/retailers are met. The collector margin for relatively large volumes of garlic delivered to the Vientiane market is about the same or lower than the margin obtained when selling small quantities of garlic to local retail shops, where demand is limited.

Wholesaler Margin = Wholesale price – collector price – cost of market stall rent – cost of labor
Based on market information from the wholesalers/retailers at the Lao-Aussie wet market, the Non Kho New Market, the Vientiane Capital Market, and the TTL International Agriculture Products Wholesale Market in Vientiane, the wholesalers/retailers make their orders to the collectors in Xiengkhouang province (and other provinces) and the collectors deliver the garlic (and other produce) to the market place where they meet the wholesalers/retailers. The costs incurred by the wholesalers includes the rent (about 2 million Kip per year) on the market stall and the cost of labor for handling and selling the garlic. Twelve kg bags of garlic are sold at the wholesale price and 1 kg loose or tied bundles of garlic are sold at the retail price.

Retailer Margin = Retail price – wholesale price – cost of transport – cost of market stall rent – cost of labor
As discussed above, many wholesaler/retailers in Vientiane marketplaces sell their garlic at a lower (wholesale) price for larger volumes while maintaining a higher retail price for direct consumers.

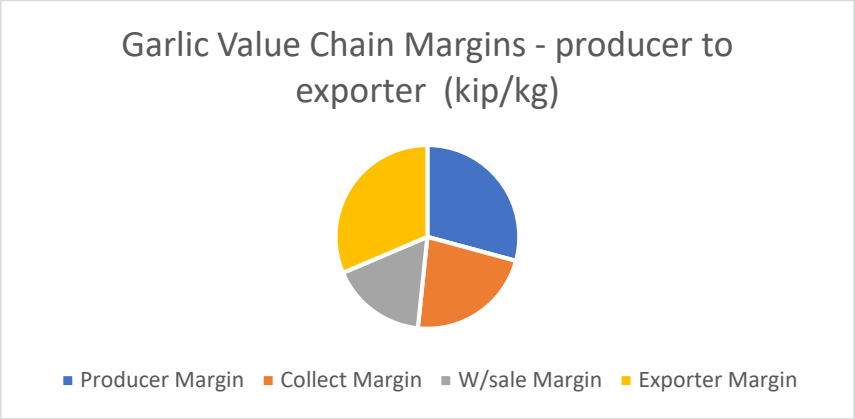

Figure 4. Comparative Margins of Producer to Exporter Levels of the Garlic Value Chain

Exporter Margin = Export price – wholesale price – cost of shipping – cost of transport, warehousing, and packing
Some of the high value crops, such as, garlic, have a history, in some cases relatively short,of being exported by Lao exporters. The pre-shipping costs (about $300/40 foot container) include the cost of transporting from the wholesale marketplace in Vientiane to a bonded warehouse, the cost of warehousing for up to a week, the cost of packing and handling. The cost of freight forwarding[2] to Thailand is relatively expensive because the amount of cargo transported from Thailand to Lao PDR is nine times greater than that transported from Lao PDR to Thailand[3]. In some cases, the trucks return to Laos empty. Empirical information from the exporting of dry goods to Thailand in 2015 included the scenario whereby the cost of two containers (totaling 40-feet) transported to Bangkok Thailand was $1700.

3.1.3 Seasonality, Product Quality, Value Added, and Competition

Seasonality - Garlic prices are influenced by the seasons, with minimal producer prices (5-10,000 Kip/kg) during and just after the harvest months, that is, starting in mid-February and carrying through to May, followed by a steep increase in the price of garlic (up to 40,000 Kip/kg) starting in late May when garlic is planted in the wet season, peaking in June, and dropping back to moderate prices (about 15,000 Kip/kg) by August and September then a gradual increase in price (to 20,000 Kip/kg) in October and November (when garlic is planted during the dry season) continuing through January and part of February. Agroecological features in Xiangkhouang province also influence the timing of crop production and supply of garlic to the market, but these agroecological features are beyond the scope of this assessment.

[2] Includes cross-border costs (bridge toll, a temporary import charge on vehicles into Lao PDR, and immigration fees for crossing a border) charged at a border gate
[3] Ref: Logistics Costs in Lao People's Democratic Republic Development Studies Center, Institute of Developing Economies, Japan External Trade Organization

Product Quality – There are different types of garlic being produced in Xiengkhouang province. There are both the single-clove (relatively small) less abundant type and the much more abundant, multi-clove (moderate) type (with its producer margins presented earlier in Section III) being produced in Xiengkhouang. The garlic from Xiengkhouang province has a good reputation for low-chemical inputs, and good taste due to the climate, soils and farming practice.

Value Added – Various garlic value-added products are processed and marketed widely in Laos, including pickled garlic. Dried garlic represents a sizeable percentage (~10%) of world trade and could be a profitable product for export.

Competition – The principal competition for the Lao multi-clove type of garlic is the large white multi-clove garlic imported from China. The large Chinese garlic sells at the wholesale and retail levels for about the same price per kg as the Lao garlic. However, Lao consumers prefer the Lao garlic because of its better taste. This competitive feature (good taste) of the Lao garlic makes the Lao garlic competitive on both the domestic and the international market.

3.2 LEAFY VEGETABLES – CABBAGE

3.2.1 Demand and Supply

Demand - The global cabbage market revenue amounted to $39.4B in 2018, dropping by -3% against the previous year. This figure reflects the total revenues of producers and importers (excluding logistics costs, retail marketing costs, and retailers' margins). The market value increased at an average annual rate of +3.1% from 2007 to 2018; the trend pattern indicated some noticeable fluctuations being recorded throughout the analyzed period. The most prominent rate of growth was recorded in 2010 when the market value increased by 14% year-to-year. Global cabbage consumption peaked at $43.7B in 2016; however, from 2017 to 2018, consumption failed to regain its momentum. The country with the largest volume of cabbage consumption was China (33M mt), comprising approx. 45% of total consumption. Moreover, cabbage consumption in China exceeded the figures recorded by the world's second-largest consumer, India (9.2M mt), fourfold. The third position in this ranking was occupied by Russia (3.7M mt), with a 5.2% share. The countries with the highest levels of cabbage per capita consumption in 2018 were Romania (57 kg per person), South Korea (46 kg per person) and Ukraine (39 kg per person). Driven by increasing demand for cabbage worldwide, the market is expected to continue an upward consumption trend through 2025. Market performance is forecast to retain its current trend pattern, expanding with an anticipated CAGR of +1.4% for the seven-year period from 2018 to 2025, which is projected to bring the market volume to 80M mt by the end of 2025.

In 2018, the global exports of cabbage and other brassicas totaled 2.5M mt, surging by 7.2% against the previous year. The total export volume increased at an average annual rate of +3.4% over the period from 2007 to 2018; however, the trend pattern indicated some noticeable fluctuations being recorded over the period under review. The most prominent rate of growth was recorded in 2011 when exports increased by 16% year-over-year. Over the period under review, global cabbage exports reached their maximum in 2018 and are likely to see steady growth in the near future. In value terms, cabbage exports amounted to $1.7B in 2018. Over the period under review, the total exports indicated a resilient expansion from 2007 to 2018: its value increased at an average annual rate of +3.4% over the last eleven years. Global cabbage exports attained their peak figure in 2018

and are expected to retain its growth in the near future. China was the largest exporter of cabbage and other brassicas in the world, with the volume of exports reaching 990K tonnes, which was near 39% of total exports in 2018. The U.S. (220K tonnes) ranks second in terms of the total exports with a 8.7% share, followed by the Netherlands (8.3%), Spain (6.2%) and Mexico (5.7%). Canada (85K tonnes), Poland (84K tonnes), Italy (72K tonnes), Germany (66K tonnes) and Macedonia (57K tonnes) followed a long way behind the leaders.[4] Exports from China increased at an average annual rate of +7.0% from 2007 to 2018. At the same time, Macedonia (+11.5%), Spain (+9.3%), Mexico (+6.1%), Canada (+5.6%) and the Netherlands (+3.1%) displayed positive paces of growth. Moreover, Macedonia emerged as the fastest growing exporter in the world, with a CAGR of +11.5% from 2007-2018. The U.S. and Italy experienced a relatively flat trend pattern. By contrast, Germany (-2.2%) and Poland (-3.7%) illustrated a downward trend over the same period. While the share of China (+21 p.p.), Spain (+3.9 p.p.), Mexico (+2.7 p.p.), the Netherlands (+2.4 p.p.), Macedonia (+1.6 p.p.) and Canada (+1.5 p.p.) increased significantly in terms of the global exports from 2007-2018, the share of Poland (-1.7 p.p.) displayed negative dynamics. The shares of the other countries remained relatively stable throughout the analyzed period. In value terms, the largest cabbage markets worldwide were China ($398M), the U.S. ($344M) and the Netherlands ($194M), with a combined 54% share of global exports. Spain, Mexico, Italy, Canada, Poland, Germany and Macedonia lagged somewhat behind, together accounting for a further 32%.

Supply - In 2018, the amount of cabbage and other brassicas (a genus that includes cabbage, swede, rape, and mustard) produced worldwide stood at 73M mt, picking up by 1.7% against the previous year. The total output volume increased at an average annual rate of +1.4% over the period from 2007 to 2018; the trend pattern remained relatively stable, with only minor fluctuations being observed in certain years. The pace of growth was the most pronounced in 2011 with an increase of 6.8% against the previous year. Global cabbage production peaked in 2018 and is expected to retain its growth in the near future. The general positive trend in terms of cabbage output was largely conditioned by slight growth of the harvested area and a relatively flat trend pattern in yield figures. In value terms, cabbage production totaled $40.5B in 2018 estimated in export prices. In general, the total output indicated prominent growth from 2007 to 2018: its value increased at an average annual rate of +1.4% over the last eleven years. The trend pattern, however, indicated some noticeable fluctuations being recorded throughout the analyzed period. Based on 2018 figures, cabbage production decreased by -11% against 2016 indices. The pace of growth appeared the most rapid in 2010 when production volume increased by 26% year-to-year. Global cabbage production peaked at $45.5B in 2016; however, from 2017 to 2018, production failed to regain its momentum. In 2018, approx. 2.5M ha of cabbage and other brassicas were harvested worldwide; therefore, remained relatively stable against the previous year. The harvested area increased at an average annual rate of +1.3% over the period from 2007 to 2018. In 2018, the global average cabbage yield totaled 29 mt per ha, approximately reflecting the previous year. Overall, the cabbage yield continues to indicate a relatively flat trend pattern.

In 2018, approximately 2.3M mt of cabbage and other brassicas were imported worldwide; dropping by -10.3% against the previous year. The total import volume increased at an average annual rate of +2.4% over the period from 2007 to 2018; however, the trend pattern indicated some noticeable fluctuations being recorded over the period under review. The pace of growth appeared the most rapid in 2015 with an increase of 24% y-o-y. Over the period under review, global cabbage imports reached their peak figure at 2.6M mt in 2016; however, from 2017 to 2018, imports stood at a somewhat lower figure. In value terms, cabbage imports totaled $1.5B in 2018. Overall, the total

[4] Transport Costs and Prices in Lao PDR Unlocking the Potential of an Idle Fleet (2018 World Bank pub)

imports indicated a conspicuous increase from 2007 to 2018: its value increased at an average annual rate of +2.4% over the last eleven years. The trend pattern, however, indicated some noticeable fluctuations being recorded throughout the analyzed period. Based on 2018 figures, cabbage imports decreased by -12.2% against 2016 indices. The most prominent rate of growth was recorded in 2011 with an increase of 16% against the previous year. Global imports peaked at $1.7B in 2016; however, from 2017 to 2018, imports failed to regain their momentum. n 2018, China, Hong Kong SAR (546K tonnes), distantly followed by the U.S. (225K tonnes), Canada (189K tonnes), Malaysia (176K tonnes), Russia (113K tonnes), Germany (112K tonnes) and Thailand (105K tonnes) represented the main importers of cabbage and other brassicas, together mixing up 64% of total imports. Singapore (64K tonnes), Japan (60K tonnes), the Czech Republic (53K tonnes), France (50K tonnes) and the UK (42K tonnes) occupied a minor share of total imports. Imports into China, Hong Kong SAR increased at an average annual rate of +6.3% from 2007 to 2018. At the same time, Thailand (+32.5%), Malaysia (+9.8%), France (+2.5%), the U.S. (+2.2%), Canada (+2.0%) and the Czech Republic (+1.2%) displayed positive paces of growth. Moreover, Thailand emerged as the fastest growing importer in the world, with a CAGR of +32.5% from 2007-2018. Singapore experienced a relatively flat trend pattern. Among the main importing countries, Thailand experienced the highest rates of growth with regard to imports, over the last eleven-year period, while the other global leaders experienced more modest paces of growth. The average cabbage import price stood at $641 per tonne in 2018, approximately reflecting the previous year. Over the period from 2007 to 2018, it increased at an average annual rate of +1.1%. The growth pace was the most rapid in 2013 when the average import price increased by 18% year over year. Over the period under review, the average import prices for cabbage and other brassicas attained their maximum at $692 per tonne in 2014; however, from 2015 to 2018, import prices failed to regain their momentum. There were significant differences in the average prices amongst the major importing countries. In 2018, the country with the highest price was Canada ($1,597 per tonne), while Russia ($315 per tonne) was amongst the lowest.

3.2.2 Margins

Table 3. Prices and Margins of the Cabbage Value Chain

High Value Crop	Producer				Collector			Wholesaler			Retailer		
	Yield	COP	PP	PM	COC	CP	CM	COW	WP	WM	COR	RP	RM
	1000 Kg/HA	1000 K/KG	1000 K/KG	1000 K/KG	1000 K/KG	1000 K/KG	1000 K/KG	1000 K/KG	1000 K/KG	1000 K/KG	1000 K/KG	1000 K/KG	1000 K/KG
Cabbage	1.59	2.15	6	3.85	6.18	6.5	0.32	7.04	8	0.96	6.65	10	3.35

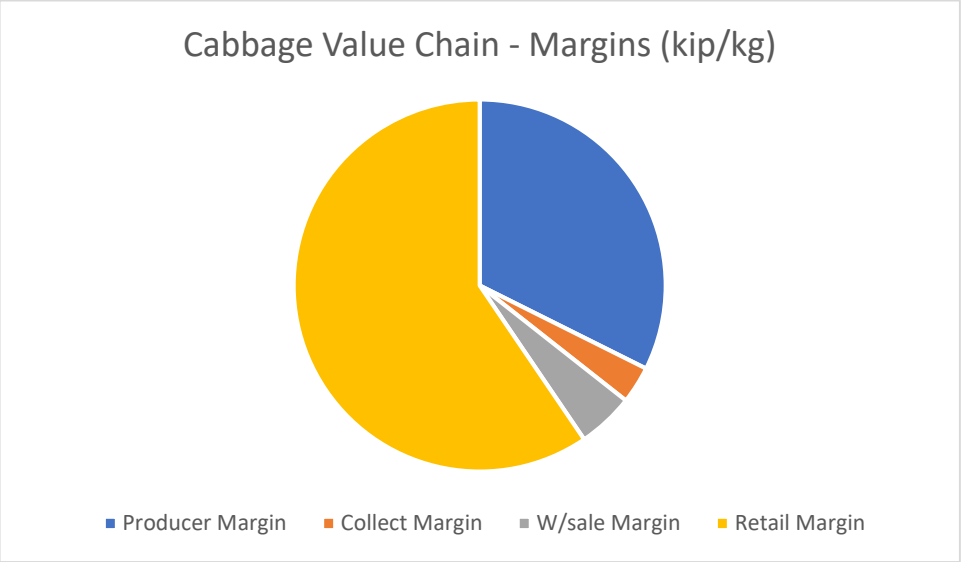

Figure 5. Comparative Margins of Cabbage Value Chain

Cabbage Margins*	Margin (kip/kg)
Producer Margin	3.850
Collect Margin	0.32
W/sale Margin	0.318
Retail Margin *Export Margin probably negative	3.35

Producer Margin

Farmgate Price = 6000 Kip/kg – 2150 Kip/kg

Margin = 3850 Kip/kg ($329/ha)

Collector Margin

Price = 6500 Kip/kg

Margin = 320 Kip/kg

Wholesaler Margin

Price = 8000 Kip/kg

Margin = 960 Kip/kg

Retailer Margin

Price = 10,000 Kip/kg (VTE retail price at Vientiane Capital Organic market on 5 March)

Margin = 3350 Kip/kg

Exporter Margin

The average global cabbage export price amounted to $682 per mt in 2018, coming down by -5.4% against the previous year. If the export price (cif by tandem truck to Bangkok) paid by the international buyer was the same ($682/mt) as in 2018, and the wholesale price in Laos (Vientiane wholesale market) of cabbage paid by the exporter was 6000 Kip/kg, the cost of reefer services (as per, e.g., the Thai Reefer Service Company) would need to be about 2000 Kip/kg (2 million Kip/mt or $4718/27600 mt tandem truck capacity) in order to breakeven.

Intra-regional and intra-country transport costs - The average annual distance driven by Lao transport trucks is 55,000 kilometers. In comparison with other developing countries, Lao PDR is in the lower mid-range and is comparable to other developing, landlocked countries (i.e. Niger, Malawi, Ethiopia, Hungary, Czech Republic, etc.). The low annual mileage together with the high costs of capital and low profit margins prevent companies from investing in more expensive, yet more cost-efficient vehicles. This in turn increases variable operating costs and prevents them from competing with transport service providers from neighboring countries. This is exacerbated by the grim outlook for the transport industry. In recent years, declining transport demand together with new market entrants have led to significant overcapacity in the sector. As a result, many trucks remain idle for long periods of time.[5] Note that consolidation services (which are usually much higher than full truckload shipments). Transport prices vary greatly by the direction of transport (both in (1) and (2)). Lowest transport prices are observed on southern routes with an average of LAK 1,925 / LAK 622 per ton-km, followed by northern routes with an average of LAK 3,321 / LAK 869. The highest prices per ton/km are observed on central routes with an average of 5,057 / LAK 1,548. There are a number of explanations for this: The higher price of northern routes is likely due to the more mountainous topography and worse road condition (compared to southern routes)

3.2.3 Seasonality

Seasonality

The wet season is considered the highest price time of the year for fresh vegetables.

[5] Transport Costs and Prices in Lao PDR Unlocking the Potential of an Idle Fleet (2018 World Bank pub)

Product Quality

The shelf life of cabbage can be extended significantly if proper cold storage conditions are facilitated. However, the pre-feasibility of cold storage needs to be done.

Value added

Potential market premium price for organic cabbage in major Lao markets (Vientiane and Luang Prabang).

3.3 HERBS (Cilantro)

3.3.1 Demand and Supply

Demand - As the herbs are highly perishable, there is little/no opportunity for exporting from Laos. The markets demanding the herbs are limited to national, provincial, and local. The demand across these various markets is steady as these herbs are consumed on a daily basis.

Supply – Cilantro leaves can be produced in 30 days, multi-cropping is very possible during the dry season. Coriander, the seeds from the cilantro plant, take about 90 days before being harvested.

3.3.2 Margins

Table 4. Prices and Margins of the Cilantro Value Chain

High Value Crop	Producer				Collector			Wholesaler			Retailer		
	Yield	COP	PP	PM	COC	CP	CM	COW	WP	WM	COR	RP	RM
	1000 Kg/HA	1000 K/KG	1000 K/KG	1000 K/KG	1000 K/KG	1000 K/KG	1000 K/KG	1000 K/KG	1000 K/KG	1000 K/KG	1000 K/KG	1000 K/KG	1000 K/KG
Cilantro	1.5	2.08	6	3.92	6.18	6.5	0.32	7.04	8.33	1.29	8.478	13	4.52

Cilantro Margins	Margin (1000 kip/kg)
Producer Margin	3.92
Collect Margin	0.32
W/sale Margin	1.29
Retail Margin	4.522

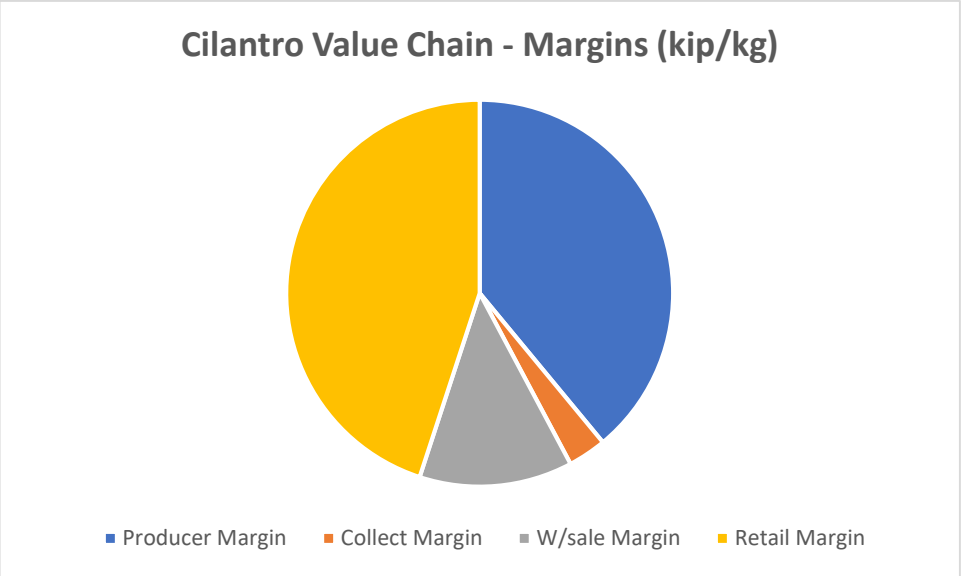

Figure 6. Comparative Margins of Cilantro Value Chain

Producer Margin

Producer Price = 6000 Kip/kg (cilantro bunches – 7 bundles per kg)

Producer Margin = 6000 Kip/kg – 2080 Kip/kg = 3920 Kip/kg (5,883,000 Kip/ha or $503/ha)

Collector Margin

Local Collector Price = 6500 Kip/kg

Local Collector Margin = 6500 Kip/kg - 6180 Kip/kg = 320 Kip/kg (sells to shopkeeper located within 10 kilometers from farm)

Wholesale Margin

Vientiane Wholesaler Price = 8000 Kip/kg

Wholesaler Margin = 8333 Kip/kg – 7040 Kip/kg (hires 5 mt truck to bring to Vientiane produce) = 1293 Kip/kg

Retailer Margin

Vientiane Retailer Price = 13,000 Kip/kg

Retailer Margin = 13000 Kip/kg – 8478 Kip/kg = 4522 Kip/kg

3.3.3 Seasonality and Product Quality

Seasonality

Cilantro (and other herbs) are produced and available from Laos suppliers all year. During the wet season, the herbs can be multi-cropped under shade to protect from the extreme rainfall.

Product Quality

To maintain product quality and shelf life, cold storage is available at the Loa Aussie market in Vientiane. Cilantro and dill can be stored for about 7 days in cold storage with very little deterioration. The herbs can also be frozen for a number of months or kept frozen in ice cubes with no deterioration.

3.4 CUCUMBERS

3.4.1 Demand and Supply

Demand – The cucumber and gherkins market is poised to grow by USD 1.07 billion during 2020-2024, progressing at a compounded annual growth rate of almost 4% during the forecast period (Ref: Technavio, 22 June 2021). The market is fragmented with several exporting countries occupying the market. The 5 biggest exporters of cucumbers by value are Spain, Mexico, Netherlands, Canada and the USA. Combined, these major cucumber suppliers accounted for 81.9% of all cucumbers exported in 2020. So high a percentage indicates a highly concentrated set of cucumber exporters.

The total export values for Laos cucumber were US$ 212,000 (for 202 mt of cucumbers), US$ 523,000 (455 mt), and US$ 358,000 (377) in 2017, 2018, and 2019, respectively. Vietnam exported 80,000+ mt of cucumbers in 2019 to Malaysia and Singapore.

Supply – China produces 75% of the cucumbers in the world, followed by Iran, Turkey, Russia, Mexico, and Ukraine. Only Indonesia and Japan are among the top 20 producing countries.
Top producing countries:

	Country	Mt of cucumbers produced
1	China	56,240,428
2	Iran	2,283,750
3	Turkey	1,848,273
4	Russia	1,604,346
5	Mexico	1,072,048
6	Ukraine	985,120
7	Uzbekistan	857,076
8	United States	700,819
9	Spain	643,661
10	Japan	550,000
11	Poland	538,676
12	Kazakhstan	460,110
13	Egypt	457,795
14	Indonesia	433,931
15	Netherlands	410,000
16	South Korea	333,233

17	Germany	267,589
18	Cameroon	257,211
19	Sudan	240,405
20	Belarus	226,443

Top importing countries include
USA
Germany
UK
Russia
Netherland

3.4.2 Margins

Table 5. Prices and Margins of the Cucumber Value Chain

High Value Crop	Producer					Collector			Wholesaler			Retailer			Exporter		
	Yield	COP	PP	PM	PM	COC	CP	CM	COW	WP	WM	COR	RP	RM	COE	EP	EM
	1000 Kg/HA	1000 K/KG	1000 K/KG	1000 K/KG	1000 K/HA	1000 K/KG	1000 K/KG	1000 K/KG	1000 K/KG	1000 K/KG	1000 K/KG	1000 K/KG	1000 K/KG	1000 K/KG	1000 K/KG	1000 K/KG	1000 K/KG
Cucumber	11.6	4.24	5.5	1.03	1458	5.900	4.75	0.35	4.895	5.417	0.522	4.895	7	2.105	5.81	7	1.19

Cucumber Margins	Margin (1000 kip/kg)
Producer Margin	1.028
Collect Margin	0.350
W/sale Margin	0.522
Retail Margin	2.105
Export Margin	1.190

Figure 7. Comparative Margins of Producer to Retailer Levels of the Cucumber Value Chain

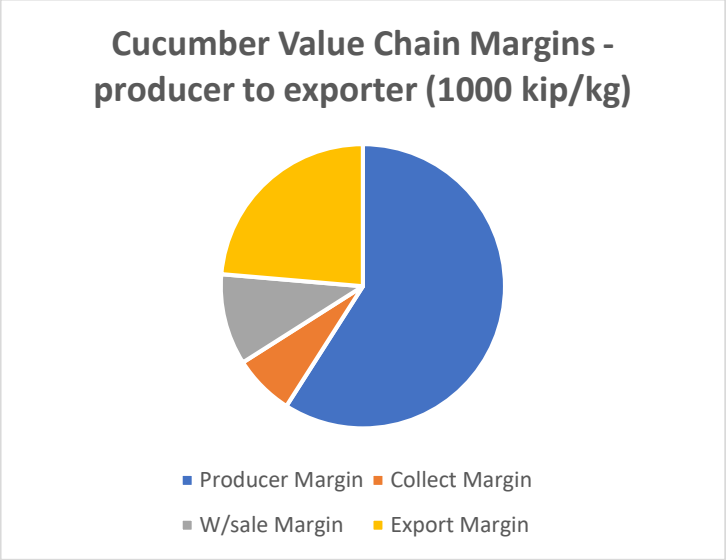

Figure 8. Comparative Margins of Producer to Exporter Levels of the Cucumber Value Chain

Producer Margin

Farmgate Price: 4000 Kip/kg

Producer Margin: 1028 Kip/kg ($966/ha)

Collector Margin

Collector Price: 4750 Kip/kg

Collector Margin: 350 Kip/kg

Wholesaler Margin

Wholesale Price: 5417 Kip/kg

Wholesale Margin: 522 Kip/kg

Retailer Margin

Retailer Price: 7000 Kip/kg

Retailer Margin: 2105 Kip/kg

Exporter Margin

Exporter Price: 7000 Kip/kg ($0.60/kg)

Exporter Margin: 1190 Kip/kg

The export prices for one kg of Lao cucumber were US$1.05 in 2017, US$1.15 in 2018, and $0.95 in 2019. In 2022, the approximate price range for Vietnam cucumber is between US$ 1.01 and US$ 1.11 per kilogram. In Laos, the price range is between US$ 0.95 and US$ 1.15. Vietnam's import price for cucumber in 2019 was US$0.86 per kg.

3.4.3 Added Value

Improvements in post-harvest technology (grading and packaging) will be an option to create value for the vegetables. Cool store facilities are lacking and limit the opportunity for the traders to aggregate their products, assemble larger loads, and be more efficient with their logistics and timing of delivery to markets. Small cool storage may enable the traders to better target higher value markets especially if combined with a market connection cool chain transport network.

3.5 YARD LONG BEAN

3.5.1 Demand and Supply

Demand – The local, provincial, and national demand for long yard beans is all year, as the yard long bean is a mainstay in the diet of the Lao people.

Supply - The supply is less during the wet season as, with most vegetables, the yard long bean cannot tolerate too much water. Shaded cultivation of vegetables is a way of preventing excess water from inhibiting the growth and survival of the vegetables.

3.5.2 Margins

Table 6. Prices and Margins of the Yard Long Bean Value Chain

High Value Crop	Producer					Collector			Wholesaler			Retailer		
	Yield	COP	PP	PM	PM	COC	CP	CM	COW	WP	WM	COR	RP	RM
	1000 Kg/HA	1000 K/KG	1000 K/KG	1000 K/KG	million K/HA	1000 K/KG	1000 K/KG	1000 K/KG	1000 K/KG	1000 K/KG	1000 K/KG	1000 K/KG	1000 K/KG	1000 K/KG
Yard Long Beans	4.5	2.62	5	2.38	10.71	0.400	6	0.6	0.145	6.5	0.355	0.145	8	1.355

Yard Long Bean Margins	Margin (1000 kip/kg)
Producer Margin	2.380
Collect Margin	0.600
W/sale Margin	0.355
Retail Margin	1.355

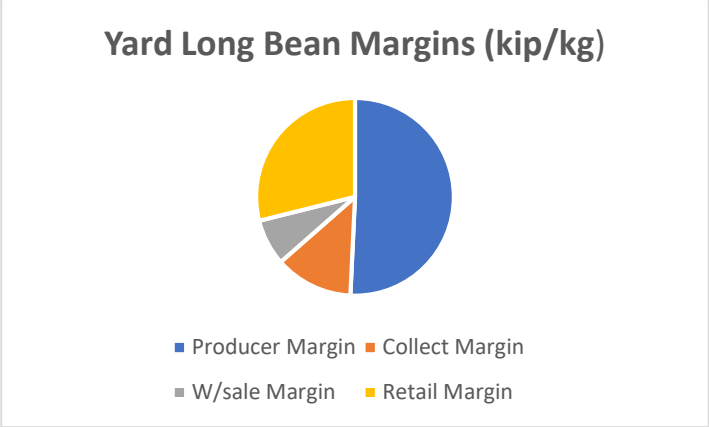

Figure 9. Comparative Margins of Yard Long Beans Value Chain

Producer Margin

Producer Price = 5000 Kip/kg
Producer Margin = 5000 Kip/kg – 2620 Kip/kg = 2380 Kip/kg ($915/ha)

Collector Margin

Collector Price = 6000 Kip/kg
Collector Margin = 6000 Kip/kg – 5000 Kip/kg – 400 Kip/kg = 600 Kip/kg

Wholesale Margin

Wholesale Price = 6500 Kip/kg
Wholesale Margin = 6500 Kip/kg – 6000 Kip/kg – 145 Kip/kg = 355 Kip/kg

Retail Margin

Retail Price =7000 Kip/kg
Retail Margin = 7000 Kip/kg - 6500 Kip/kg – 145 Kip/kg = 1355 Kip/kg

3.5.3 Seasonality, Product Quality

Seasonality – Yard long beans, and other beans, such as, the common bean, can be produced all year using appropriate and viable production technologies.

Product quality - Quality of the yard long beans is maintained by using appropriate and viable storage and handling technologies.

3.6 MAIZE

3.6.1 DEMAND AND SUPPLY

Demand – Maize is an important component of animal feed fed to swine and poultry. The # head of swine and poultry has nearly doubled (as measured by head per capita) in Laos in the recent past 20 years from 1998-2018. In China, Vietnam, and Thailand the # head per capita has, generally, increased but at a much lesser rate over the same time period. The average increase in the # head of poultry per capita in the four countries was 78% versus 28% for # head of swine per capita during the 20 years. The demand for feed is directly proportionate to the # head (chicken and swine)/capita in each of the countries.

Table 7. Regional countries' Per capita Swine and Chicken

Country	Swine			Poultry		
	1998	2018	% Increase	1998	2018	% Increase
	# Head/Capita			# Head/Capita		
Laos	0.28	0.53	89	2.3	5.6	143
China	0.32	0.3	-6	2.3	3.7	61
Vietnam	0.23	0.3	30	1.7	3.2	88
Thailand	0.11	0.11	0	3.3	4	21
Average Increase			28			78

Laos produces more maize than it consumes, exporting surplus maize to neighboring countries, China, Thailand and Viet Nam. These neighboring countries are net importers of maize from abroad for supplying their animal feed industries. 72.3% of the maize used by Viet Nam's animal feed industry was imported, while in Thailand the need for imported maize in 2020 to supply feed demand was estimated at around 29-41 per cent of the total demand.

Table 8. Laos Maize Export Values

Value of Maize Exports from Laos to	**2015**	**2016**	**2017**	**2018**
	Million USD			
China	28			
Thailand	11	11	4	7
Vietnam	13	17		

Supply - The importance of maize as a cash crop in the country came to prominence during the 2000's, as between 2002 and 2008 the yearly growth rate of maize production averaged 40.9 per cent, with a peak in 2005 of 83.1 per cent yearly growth and no year falling below 11 per cent growth. During this period, the amount of land dedicated to maize production also increased substantially, growing at an average rate of 27.4 per cent per year. In Xiengkhuang province, hybrid maize expanded due to increasing demand from Viet Nam, being introduced by Vietnamese buyers with support from local traders and district extension agents. Maize production in the country reached a peak of 1.55 million tons in 2016 and then fell to 1.19 and 0.77 million tons in 2017 and 2018, respectively. The yield of maize, after growing consistently from the second half of the 90's, has stayed relatively stable in 2012-2017 at an average of 5.83 tons per hectare and then falling in 2018 to 5.18 tons per hectare.

Combined, Xayaboury, Xiengkhouang, Houaphan, and Luang Prabang provinces in 2018 produced 55.6 per cent of all the maize produced in Lao People's Democratic Republic and accounted for 82.1 per cent of the total production area with maize.

Table 9. Maize Production Area in Project Provinces

Province	**2018 – Production Area (ha)**	**2018 – Production (mt)**	**2018 - Yield (mt/ha)**
Total	**148.2**	**768**	**6**
Xayabouly	**43.1**	**232.5**	**5.6**
Xiengkhouang	**20.7**	**105**	**5.9**
Houaphan	**9.6**	**56.2**	**5.6**
Luang Prabang	**8.7**	**33.1**	**6.3**

3.6.2 Margins

Table 10. Prices and Margins of the Maize Value Chain

High Value Crop	Producer				Collector			Wholesaler			Retailer			Exporter		
	Yield	COP	PP	PM	COC	CP	CM	COW	WP	WM	COR	RP	RM	COE	EP	EM
	1000 Kg/HA	1000 K/KG	1000 K/KG	1000 K/KG	1000 K/KG	1000 K/KG	1000 K/KG	1000 K/KG	1000 K/KG	1000 K/KG	1000 K/KG	1000 K/KG	1000 K/KG	1000 K/KG	1000 K/KG	1000 K/KG
Maize	6	0.938	1.8	0.863	0.097	2.3	0.402	-	-	-	-	-	-	0.721	3.358	0.337

Maize Margins	Margin (1000 kip/kg)
Producer Margin	0.863
Collect Margin	0.402
Exporter Margin	0.337

Figure 10. Comparative Margins of Producer to Exporter Levels of the Maize Value Chain

Producer Margins

Producer Price – current price (as of March 2022) 1800 Kip/kg (in grain form)

Maize in cob form can be seen as an input, to be converted into dry maize in grain form, which is then exported or consumed by domestic users of maize. Farmers sell most frequently to small traders, known as "village collectors", who trade yearly volumes of maize of 1,000 tons or less. Additionally, 21 per cent of farmers sell to district traders from the same district either exclusively (15 per cent of farmers) or partially (6 per cent), while a small number of farmers sell to traders from another village. Village collectors act largely like aggregators, buying from farmers and selling (as agents) to larger traders. Farmers usually face few choices (in terms of number of potential buyers) selling their maize at the farmgate. 29 per cent of surveyed farmers reported having an agreement with a trader (mostly of an oral nature), with important differences among provinces. Median and mean prices of maize in grain were LAK 1,600 per kg and LAK 1,602 per kg respectively. There are many farmer characteristics associated with maize sales prices received by farmers, such as: Geographic factors, whether farmers are members of a producer group (i.e. a "cooperative"), whether farmers have dedicated storage facilities to store their maize, whether farmers store maize, and for how long, whether farmers receive inputs from traders, and the wealth of the farmer.

Producer Margin – 863 Kip/kg ($442/ha)

Collector Margin

Collector Price – 2300 Kip/kg

Collector Margin – In 2018, maize in grain form was bought for an average of LAK 1,635 per kg (median LAK 1,650 per kg), but there were differences among provinces. Traders who bought maize only in cob form, as expected, had significantly higher margins than those buying maize in grain form. Shelling often takes place at the "village collector" (small trader) level or other traders that buy maize directly from farmers. After deducting transport and labor costs, the estimated margin for the local collector is 402 Kip/kg of maize grain.

Exporter Margin

Exporter Price – Reference prices are (i) United States (prices for no.2 yellow maize in United States Gulf ports) and (ii) Thai maize prices (source: Thai Feed Mill Association). Maize farmers in Laos are very vulnerable to the occurrence of negative shocks to the price of maize. Current price (18 March 2022) of #2 yellow maize in US ports is $7.4175/bushel (or $0.292/kg or 3358 Kip/kg)

Exporter Margin – 3358 Kip/kg (exporter price = current #2 yellow corn price) – 2300 Kip/kg (Collector price) – 721 kip/kg (exporter costs) = 337 Kip/kg

3.6.3 Seasonality, Product Quality, and Issues

Seasonality – The mean number of months that traders store maize was 3.6 months, while the median was 3 months.

Product Quality - Traders indicated that drying and sorting maize are necessary to improve the quality of maize, in line with the importance of reducing humidity and avoiding contamination by fungi or pests. The first quality check of maize is carried out by the trader (often, a "village collector") when he/she checks the maize that a farmer has for sale for moisture content and contamination (for example, by weevils). The price offered by traders to farmers for maize is conditional on its observed quality. The degree of humidity is an important determinant of the quality of maize sold and we would expect a priori that those farmers storing and selling dry maize fetch higher prices. Adequate storage can reduce the incidence of problems like insects, rodents and fungi damaging stored maize, and which can also negatively affect the sales price of maize. Furthermore, the capacity to store maize also tends to improve a farmer's bargaining position, as they can in principle decline an immediate sale opportunity in expectation of improved prices in the future.

Issues - existence of heterogenous regulatory requirements across different provinces. These include export fees charged in Xiengkhuang and Xayaboury provinces, the registration requirements for exporters, different regimes for the import of seeds, among others. To our knowledge, there is no centralized repository of the existing regulatory information for the maize value chain in the country.

3.7 FORAGE CROPS (Napier grass)

3.7.1 Demand and Supply

Demand

Animal fattening is clearly related to market access and meat demand. Rural areas of Laos have traditionally struggled to find markets for products because of low population density and poor transport links. However, Xieng Khouang province has had a high commercial rate of cattle export to Vietnam and more recently has experienced increasing commercial opportunities in places where smallholders are growing forage for cattle feeding. The farmers that farm the Nam Tong irrigation scheme area have about 1,200 head of cattle, with an average of 5.8 head per household. Cattle are an important export and the main source of monetary income for most farmers in Xiengkhouang province. At present, the model of cattle raising is a traditional method, that is, free grazing on the paddy fields eating the rice straw over the dry season and keeping the cattle in a shelter during the wet season.

Increasing income, population and urbanization, as well as the export of beef and buffalos to neighboring countries, have all contributed to the short supply of beef in the domestic market. In 2016, about 15% (20,281 head) of the province's cattle were for domestic consumption, and approximately 6% (8,113 head) were for sale as live animals. MAF estimated that about 100,000 cattle were slaughtered annually. This is equal to 10,000 tons of beef (valued at about 70 million USD) annually consumed in Laos. As the demand for livestock and livestock products continues to increase on a per capita basis (from 8 kg/person/year in 2015 to 8.4 kg/person/year) in Laos, the derived demand for forage crops by cattle farmers, generally, in Laos, and the cattle fattening industry, specifically, increases. Markets, however, for forage crops produced in Xiengkhouang province are usually localized because of the weight and bulky physical characteristics of the forage crops. Ruzzi grass is a preferred forage crop during the wet season, while Napier grass and elephant grass, are examples of dry season forage crops. This market assessment relates the market potential for HVCs and livestock that are produced in the dry season. **The Napier grass is the forage crop example that is described here. This assessment does not include the demand (domestic or international) and supply for fattened cattle nor the demand (domestic, international) for meat or other cattle products. For the cattle market assessment please contact the Cattle Specialist of the LIC-Xiengkhouang province.**

Supply

Lao-native beef cattle are primarily *Bos indicus*, and most ruminant production in Laos is still dominated by small-scale or backyard producers that use traditional practices, resulting in low productivity. The cattle herd size in Laos has grown by an average of 5 percent per year from 1.52 million in 2010/11 to 1.81 million in 2014/15. In 2016, the Laos cattle population was 1.88 million head, with smallholder farmers representing 98% of production despite efforts by the Laos government to develop commercial-scale farms. There were 170 commercial cattle farms in 2016, with 56 percent in the Central region of Laos.

For Nam Tong farmers alone, the dry season production of forage crops will compete for irrigated cultivated land with other HVCs. Napier grass, mainly used to feed livestock in cut and carry feeding systems, has a relatively high level of total digestible nutrient content and crude protein of about 17%, thereby a relatively efficient forage crop for fattening livestock. Napier grass can be produced during the dry season with irrigation on the Nam Tong irrigation scheme at about 75 mt (wet weight)/ha (or about 12 mt (dry weight)/ha over six months, with monthly harvesting possible. It takes about 1 hectare of forage crop (Napier grass) to feed 2 cattle for 6 months (360 cow-days). Within the six months, the cattle increase their weight by

3.7.2 Prices and Margins

The producer margin for production of Napier grass is estimated by valuing the dry matter weight of the Napier grass fed to cattle over a given time period minus the costs of the production of the Napier grass over that same time period. It takes approximately 15 kg of dry matter of Napier grass fed to cattle to get 1 kg weight gain of the cattle. The producer prices of live cattle in Laos per mt for the years 2016, 2017, 2018 were US$ 2,700, US$ 2,748, US$ 3,012, respectively.

Producer Price: Not Available.
Producer Margin – In Thailand, the revenues of Napier grass farmers production year 2021 found that all size of Napier grass cultivation areas has the average income was $205.16/hectares, the average cost was $105/hectares and **net profit (gross margin) was $100.16/hectare** (see detail on the study in the paragraph below).

> "An example of producing and feeding Napier Grass to cattle in Thailand is referenced here. In Thailand, Napier grass is the newest economics crop of the farmers in Nong Wua So district, Udon Thani Province. returns of Napier grass farmers in Nong Wua So District Udon Thani Province and 3) to analyze problems and obstacles of Napier planting and find a solution to solve the problem by choosing to study in the farmers who are Napier planting in Nong Wua So district, Udon Thani Province. Sampling by using a specific method (Purposive Samplings) for 54 cases, the production results in 2021 were analyzed as follows from the study of the average cost per hectares of Napier grass farmers in Nong Wua So district, Udon Thani Province for the production year 2021 found that the average total cost all sizes of cultivated areas equal to $105/hectares which are divided into average variable cost was $97.4/ hectares and the average fixed cost was $7.63/hectares. when considering by the size of the cultivated area it was found that small planting areas (1-3 hectares) had average total costs of $126.53 /hectares, which consisted of average variable costs are equal to $116.76/hectares and the average fixed cost is $9.76/ hectares. The medium-sized planting area (3.1-5 hectares) has an average total cost of $93.97/hectares consisting of an average variable cost was $84.22 / hectares while the average fixed cost was $9.76/hectares. For large planting areas (more than 5 hectares) the average total cost is $83.23/hectares which consists of the average variable cost of $79.0 /hectares and the average fixed cost is $4.19/hectares. The revenues of Napier grass farmers production year 2021 from the study found that all size of Napier grass cultivation areas has the average income was $205.16/hectares, the average cost was $105/hectares and net profits was $100.16/hectares. When the researchers considering by the size of the cultivated area it was found that small planting areas (1-3 hectares) had an average income of $229.35/hectares, an average cost of $126.53/ hectares, and an average net profit of 102.82/hectares." (Ref: COSTS AND RETURNS OF NAPIER GRASS PRODUCTION IN NONG WUA SO DISTRICT, by Krisdakorn Wongwai, UDON THANI, THAILAND, September, 2021).