

**CREATING LINKAGES FOR EXPANDED AGRICULTURAL NETWORKS
(CLEAN) PROJECT IN LAOS PDR**

BASELINE REPORT

SUBMITTED TO WINROCK INTERNATIONAL BY:



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Front page picture: Chinese cabbage unloading and packaging at a collection point

LIST OF ACRONYMS

ACMES	Ayeyawady-Chao Phraya-Mekong Economic Cooperation Strategy
BBS	Beneficiary Based Survey
CES	Community and Environmental Services Co. Ltd
CI	Custom Indicator
CLEAN	Creating Linkages for Expanded Agricultural Networks
DoA	Department of Agriculture of MAF
DTEAP	Department of Technical Extension and Agro Processing of MAF
DAFO	District Agriculture and Forestry Office
EDC	Enterprise and Development Consultants Co., Ltd
FAIS	Food Aid Information System
FAO	Food and Agriculture Organization of the United Nations
FFPr	Food for Progress
FGD	Focus Group Discussion
FO	Farmer Organizations
GAP	Good Agricultural Practices
GMP	Good Manufacturing Practices
GMS	Greater Mekong Subregion
Ha	Hectare
HH	Household
Kg	Kilograms
KII	Key Informant Interview
LEA	Lao Extension Approach
LAO PDR	Lao People's Democratic Republic
LOP	Life of Project (Target)
LMS	Learning Management System
MAF	Ministry of Agriculture and Forestry
M&E	Monitoring and Evaluation
MT	Metric Tons
NAFES	National Agriculture and Forestry Extension Services
O&M	Operations and Maintenance
OCA	Organizational Capacity Assessment
PAFO	Provincial Agriculture and Forestry Department
PMP	Performance Management Plan
RFP	Request for Proposal
ROM	Results Oriented Management
SMEs	Small and Medium-sized Enterprises
SPS	Sanitary and Phytosanitary Measures
SI	Standard Indicator
SO	Strategic Objectives
SOW	Scope of Work
TOR	Terms of Reference
USD	United States Dollars
USDA	United States Department of Agriculture
VC	Value Chain

1. EXECUTIVE SUMMARY

Overview of the Baseline Study

In FY 2017, the United States Department of Agriculture (USDA) under the Food for Progress (FFPr) initiative awarded funding to Winrock International (Winrock) to design and implement a four-year project with the focus of increasing agricultural productivity and expanding trade of agricultural products in Laos PDR. Winrock started implementation of the Creating Linkages for Expanded Agricultural Networks (CLEAN) project in September 2017, with an end date of September 2021. The project is being implemented in five provinces of Laos, including Champasak, Sekong and Salavan Provinces in the southern region and Vientiane Capital and Vientiane Province in the central region of Laos.

The CLEAN project has seven principal activities and their respective outputs and outcomes contribute to the following USDA Food for Progress Strategic Objectives (SO):

FFPr SO1: Increased agricultural productivity by building the capacity of producers in improved productivity and profitability; training producers in improved production techniques; post-harvest handling, marketing, sanitary and phytosanitary practices; and providing grants and loans for equipment and agriculture inputs.

FFPr SO2: Expanded trade of agriculture products by developing both domestic and export market linkages; facilitating trade relationships, researching exports opportunities; promoting a coordinated and strategic approach to building market share by associations and promoting food safety issues and requirements.

The project will be evaluated against 21 performance indicators (see Table 1 below). For the majority of CLEAN performance indicators, the baseline will be zero at the project start. However, the baseline values for indicators such as yield per hectare per target commodity type, volume of commodities (metric tons) sold by project beneficiaries, value of sales by project beneficiaries had to be determined through the baseline survey. Therefore, in line with the USDA evaluation policy, Winrock contracted Enterprise and Development Consultants Co., Ltd. (EDC), a local consulting firm based in Vientiane, Laos, to undertake the baseline study for the project. The primary goal of the baseline survey was to collect an in-depth situational analysis in the project target areas and use the results from the baseline study for the following purposes:

- Establish a baseline as points of comparison to support measurement of program impacts as part of future project evaluation activities;
- Guide realistic and feasible target setting for performance indicators;
- Support program design;
- Identify and recommend responses to risks and constraints that may pose challenges to planned project implementation.

The baseline survey took place between June 27th and July 29th, 2018 in nine districts of the five project target provinces. The beneficiary-based survey included a quantitative approach/representative beneficiary-based survey to collect data for the CLEAN performance indicators and a qualitative study to gather additional information to add context, richness, and in-depth insights to the findings from the population-based household survey. The beneficiary-based household survey sample was designed to be statistically representative of the villages selected in all five project target areas. The two-stage clustered sampling design yielded a household sample size of 867 households in 51 randomly selected villages, about 10% of the total number of villages in the project target areas.

Village Sample Size

	Source	# of villages
Total number of villages in the 9 districts	National Population census 2015	515
Number of villages producing at least one of the 5 commodities	DAFOs	222
Village level sample size (villages actually surveyed)	Sampling guide method	51

The CLEAN project aims to reach 14,877 beneficiaries throughout the life of project. The sample size was calculated using the following formula (utilizing a similar methodology recommended by USAID¹):

- $n = N^2 * z^2 * s^2 * MoE^2$.
- Considering a 95% Confidence level and 5% Level of Precision, the calculated sample size against 14,877 farmers stands equal to 856. However, to minimize the risk of farmer household's dropout during the survey a total of 1,020 households were interviewed (20 households per village) for the study.

The Table Below Summarizes the Household Sample Size:

	Number of HH in the sample	HH per village
Calculated sample size (after formula above)	856	16.78
Adjusted sample to obtain a round number of HH per village	867	17.00
Actual number of HH interviewed	1,020	20.00

The qualitative study was conducted during the same timeframe in parallel with the population-based household survey. In all, 32 focus group discussions were held with a total of 239 individuals, with an average size of seven people in each group to gather information about selected crops, use of production techniques and practices, access to services and extension support, access to inputs and equipment, major market constraints, risks farmers face, and potential solutions. The focus group discussion (FGD) participants included community leaders, women's union representatives and representatives from farmer groups. The participants in the FGDs and household surveys are different persons. Key informant interviews were held with a total of 78 value chain actors including 22 district government officers, 16 producers, 27 traders, nine input suppliers, and four wholesalers.

Summary of the Participants to the Baseline Survey:

	Number of villages	Number of participants
Household surveys	51	1,020
Focal Groups Discussions	32	239
Key Informant Interviews	n/a	78

Limitations and challenges experienced during the study included:

- the process of obtaining clearance for fieldwork from the Department of Agriculture (DoA),
- difficulty in obtaining current household counts at the village level from existing government data sources,
- difficulty mobilizing individuals for the focus group discussions,
- difficulty accessing some villages due to heavy rainy season,
- seasonality of data collection,
- limitations of self-reported data (e.g., inaccurate estimate of land size, recollection of amount inputs used, yield, volume of sales etc.),
- lack of information on input suppliers and wholesalers at district line agencies

Key Findings

The following is a summary of the main findings of the baseline survey, as well as key points specific to theme. However, it must be noted that the quantitative analysis at the household level, specifically on land holding, production, and sales are based on farmer recall; they must be treated as only indicative rather than definitive at this stage. The survey was conducted in July 2018 and covered crop harvests of 2017, involving farmers' recall of 6 to 12 months.

Theme 1: Household and Farmer Characteristics

Household characteristics. The average household size in the sample is 5.94 people/HH higher than in the National Census (5.20 people/HH). In the survey sample, 3.4 people/HH on average are involved in agricultural production. This includes adults and children of age to assist in farm work (14 years old and above).

¹ USAID/ Feed the Future, Sampling Guide for Beneficiary-Based Surveys, February 2016.

The respondents rely mainly on farming for their source of income, but about 16% combine farming with another occupation. Respondent education level is low and there is a high ethno-linguistic diversity across the target districts. The CLEAN project approach to targeting of farmers' households will be a key element conditioning farmers' participation in the project.

Record keeping. The survey confirmed that farmers generally do not keep records of farm operations, expenses related to production, or harvested figures and sales. The number of farmers keeping records of agricultural operations is 40 or 3.9% of the sample of 1020 farmers. There are 70 farmers in the sample who mentioned keeping record of agricultural expenses (7% of the sample). There are 125 farmers out of 1,020 interviewed who have kept records of harvested quantities and sales, or 12% of the sample.

Training profile. Overall, only 279/1,020 respondents (27%) have received some training: 17% formal training, 7% on-the-spot training, and 3% both. Training needs show that selling agricultural products remains a priority issue for the farmers, with 29% requesting training on market linkages. Other training topics ranked by importance were: organic fertilizers (10%), pest control (9%), seeds (7%) and chemical fertilizers (6%). About 6% of the respondents said that they do not need any training.

Farmer groups. In the project area, only 12% (127/1020) of the respondents mentioned that there is a production group in their village, out of which less than half are members of the group (51/127 respondents).

Access to finance. Only 12% of the respondents mentioned that they have borrowed funds in 2017 for agricultural production. The main sources of credit are loans from public banks (52%) and loans from Village Development Funds (25%) and from a private bank (12%). On average, respondents borrowed 11 MLAK, mainly to buy agricultural inputs (87% of the cases), agricultural equipment (50%), and to hire labor (54%).

Access to technical information and advice. Access to technical information is a critical element in improving production practices and product quality. Technical information useful to farmers includes production techniques such as use of chemical fertilizers (types, doses, application schedule) and pesticides (adequacy to control specific crop pests, doses, application protocol, users' safety, etc.). There are few options for farmers to receive support and technical advice when needed. Most of the respondents (82%) said they receive no support or advice from their input supplier. Although all farmers have access to inputs through mobile suppliers or input shops, only 6% of the respondents said they can buy inputs on credit from the supplier, 12% receive some technical advice from the supplier when buying inputs, and 12% receive advice on marketing of agricultural products. Mobile phones are another alternative to access information (used by 80% of the respondents), in particular if connected to the internet. However, less than 10% of the respondents use a smart phone with connection capacity.

Awareness about good agricultural practices (GAP)/sanitary and phytosanitary measures (SPS). The enumerators provided the survey respondents with a short definition of both acronyms. Overall, awareness about SPS is higher than GAP: 18% vs. 14% of all respondents in the survey.

- About one out of four respondents has heard about GAP (251/1020).
- Information was provided by the District Agriculture and Forestry Office (DAFO) for half of them (126/251). Many other channels are mentioned such as agribusiness, media, relatives, etc.
- More than one third has heard about SPS, mainly through DAFO.

Theme 2: Land

Access to productive land. The household survey revealed that average landholding in the sample is 3.16 ha. Almost two thirds of the respondents have land-use rights for paddy land² and gardens, and one third have plots of the slash-and-burn land-use type. Households in Paksong District (Champasak Province) and Sangthong District (Vientiane Capital) have land-use right for relatively larger landholdings

² Used mainly for rice production in rainy season (one paddy crop per year). In Kasi and Vangvieng Districts (Vientiane Province) other crops are grown in dry season including cabbage

approaching 4 ha, while in Viengkham and Vangvieng, areas are less than 2 ha. Only about 11% of the surveyed households rent agricultural land.

Soil preparation. Soil preparation (ploughing) is only required for annual field crops such as white cabbage produced on dedicated land. In Paksong one or two till operations are required before transplanting the cabbage seedlings in the field: two thirds of the farmers till their fields with hand-tractors. In Kasi, cabbage is produced in paddy fields after the rice harvest. In this case, ploughing is not always required. For perennial or multi-annual crops³ (citrus, pepper, sacha inchi and cardamom) soil preparation (ploughing) is not required. Crop establishment is done manually by digging holes to plant seedlings (citrus, cardamom). In the case of vine crops (pepper and sacha inchi) crop establishment involves the use of poles to support the vines' growth. The poles can either be live trees, wooden poles, or concrete poles.

Water management. In both main producing districts (Paksong and Kasi), white cabbage is generally irrigated (respectively 86% and 93% of the cases), and the most common irrigation water sources are irrigation canal or a river. Advanced irrigation techniques (furrow, sprinkler, drip line) are more common in Paksong District than in Kasi, where flood irrigation is practiced by 40% of the respondents. For perennial crops, use of irrigation is much less common: 16% of the respondents use irrigation for sacha inchi and pepper production and 34% for citrus production. Cardamom, a forest product, does not require irrigation and benefits from forest understory moisture.

Soil management. Soil cover practices differ greatly between the two main producing districts: 91% of the respondents apply no soil cover in Paksong, while in Kasi more than half of the farmers apply an organic soil cover made of crop residues (rice straw) and green mulching or both. This is because in Kasi District, cabbage is produced after the paddy crop and straw is available on the field. For perennial crop production, soil management issues are less pressing than for cabbage due to the absence of top soil disturbance and reasonable year-round soil cover by tree canopy or natural vegetation.

Theme 3: Importance of Selected Crops

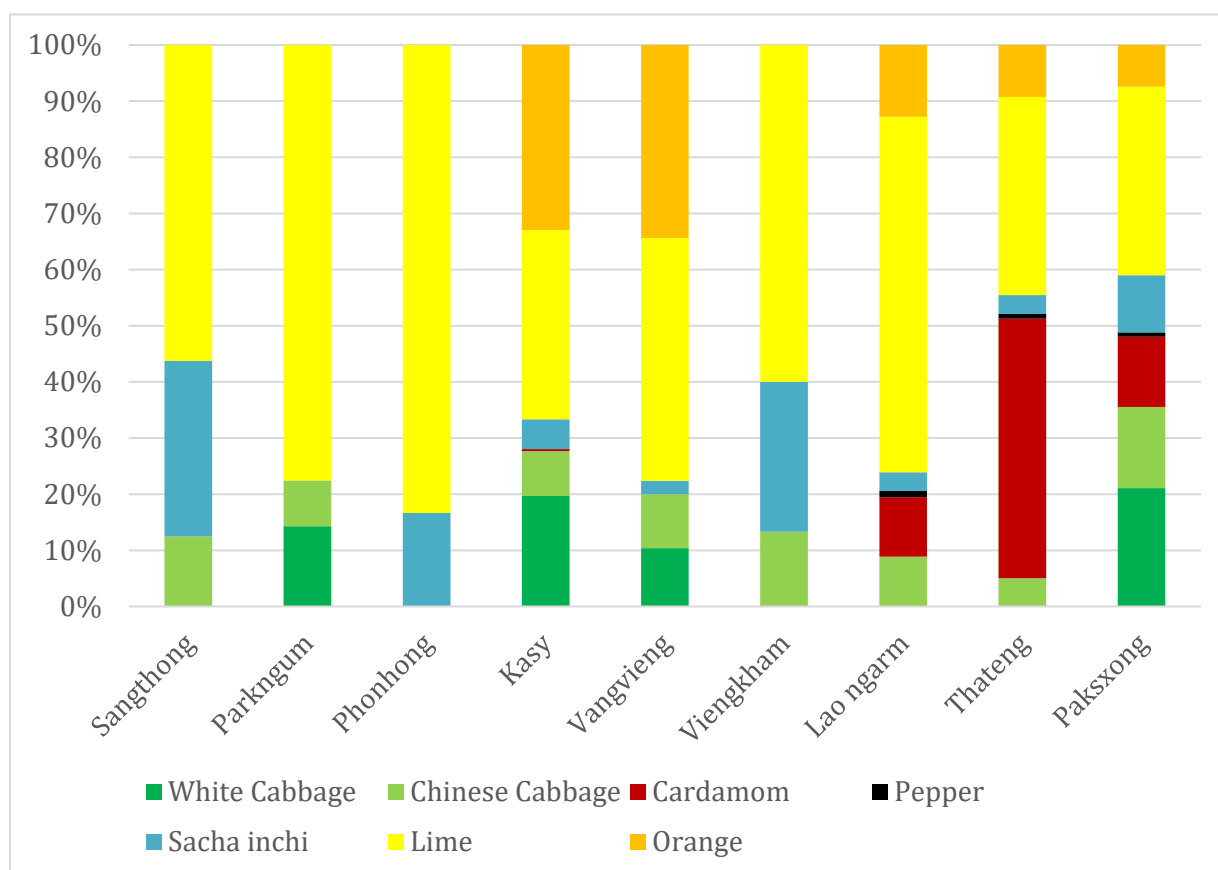
Crop Characteristics. The selected crops⁴ are secondary cash crops. They cover a relatively small part of the district areas. For example, on the Bolaven Plateau, coffee covers 14% of the total districts' area while cabbage and cardamom production cover 2.3% and 0.6% respectively. Similarly, paddy fields cover most of the arable land in Kasi and Vangvieng in Vientiane Province and citrus represent only 2.4% and 6.1% respectively (Source: *DAFO communication and reports*).

The household survey provided valuable information on where the selected crops are produced across the nine target districts. The result shows that some of the crops are produced in almost all districts: this is the case of lime, sacha inchi and Chinese cabbage. On the other hand, white cabbage, orange, cardamom, and pepper are produced in specific areas. The graph below shows the distribution of crops produced by the 1,020 surveyed households. When the combined percentage is higher than 100%, it means that households produce more than one crop.

³ Perennial: Any plant that persists for several years, usually with new herbaceous growth from a part that survives from season to season. Trees and shrubs are perennial, as are some herbaceous flowers and vegetative ground covers. Citrus (lime and orange) are perennial trees, cardamom and pepper are perennial vines and cardamom is a perennial vegetative ground cover plant. Cabbage is an annual crop.

⁴ Cabbage (white cabbage and Chinese cabbage), pepper, sacha inchi, citrus (lime and oranges) and cardamom

Figure 1: Crop occurrence in the household survey sample (distribution by district)



Paksong and Kasi are leading districts for white cabbage production. Cardamom is produced by more than half (55%) the households surveyed in Thateng District, more than in Paksong (20%) and Lao Ngam (7%) districts; orange is produced mainly Kasi and Vangvieng districts. Pepper is produced by less than 1% of the respondents, all on the Bolaven Plateau (Lao Ngam, Thateng and Paksong districts). On the other hand, sacha inchi and lime are ubiquitous crops and occur in several of the target districts: sacha inchi is present in almost all districts (produced by less than 6% of the surveyed HH), while lime is very common in all target districts.

At the farm level, farmers who produce white cabbage, lime or orange allocated about one fifth (20%) of their total cropped area to these crops in 2017. The three other selected crops cover a smaller percentage of the farm cropped area: 9% for sacha inchi, 6% for Chinese cabbage and 1% for pepper. Farming systems are rice-based in Vientiane Province and Vientiane Capital, while coffee is the main crop on the Bolaven Plateau.

Theme 4: Agricultural Inputs

Service from input sellers. 82% of the respondents said that they receive no services from input providers and only 6% can buy inputs on credit with only 12% reporting that they receive technical advice from input providers. However, most respondents (80%) expressed satisfaction with the quality of inputs received. This tends to indicate that farmers and input suppliers have strong commercial relationships, but input suppliers may not have adequate knowledge to provide technical advice to farmers. There is potential to support input suppliers so that they provide technical advice to farmers. This is particularly relevant for Chinese and white cabbage producers.

As a general finding, cabbage production is much more input intensive than that of the four other commodities. This implies that seeds (improved hybrid seeds), other commercially available inputs (chemical fertilizers and pesticides), as well as irrigation are commonly used for both white and Chinese cabbage production. This is because commercial cabbage production generates significant income and

farmers are willing to invest in commercial inputs. All other crops (pepper, sacha inchi, citrus -lime and orange- and cardamom) are a complementary source of income and farmers rely much less on commercial inputs as they can reuse home-saved seeds from one season to another and they tend to use relatively little chemical fertilizers and pesticides.

Use of seeds. For white cabbage and Chinese cabbage, farmers use only hybrid seeds that are bought each new cropping cycle. Hybrid cabbage plants do not produce viable home-saved cabbage seeds. Farmers generally use only one variety of white cabbage seeds that are readily available at local markets. Some farmers buy the seeds sold by mobile Vietnamese traders: 21% of the respondents in Kasi and 6% in Paksong. For other crops that are perennials or multi-annuals, seeds (open pollinating) or seedlings can generally be produced on-farm or at local level or obtained from various sources: DAFO, buyers of agricultural products, investors/promoters/relatives, etc.

Chemical fertilizers. Chemical fertilizers are used by all cabbage producers interviewed in Paksong and Kasi districts. They generally use more than one type of granular fertilizer available locally or through mobile input sellers. For perennial and multi-annual crops (pepper, sacha inchi, citrus and cardamom), use of chemical fertilizers is much less common. Chemical fertilizers are used by 14% of the citrus producers interviewed in the household survey. None of the household survey respondents use any chemical fertilizer for production of pepper, sacha inchi, and cardamom

Organic fertilizers. These are commonly used on cabbage production in Kasi (75% of respondents) but much less in Paksong (29%). For perennial and multi-annual crops (pepper, sacha inchi, citrus and cardamom), use of organic fertilizers is not very common. Organic fertilizers are used by 27% of the citrus producers and 21% of the sacha inchi producers. For pepper, two producers out of five mentioned they use organic fertilizers. Respondents do not use any organic fertilizer for production of cardamom. The term “organic fertilizer” is sometimes used by informal traders to encourage farmers to buy their products, such as foliar fertilizers in liquid form for citrus trees.

Chemical insecticides. These are used by 77% of the cabbage farmers in Paksong and 27% in Kasi. For perennial crops, use of chemical pesticides remains exceptional. Insect pests are reported as common by farmers producing sacha inchi (37%) and citrus (80% of the producers). The main pest issue for cardamom is related to damage by rodents, as mentioned by 83% of the producers.

Use of hired labor. Part-time hired labor for white cabbage production is widely practiced in Paksong District (51% of the respondents) and in a lesser extent in Kasi District (27%). Labor wage is 48,600 kips (~\$5.65) per day on average in both districts. For perennial crops, hired labor is used by 7% of the sacha inchi producers, 15% of the citrus producers and 10% of the cardamom producers.

Theme 5: Post Harvest

Post-harvest losses. Losses at harvesting time are significantly high, ranging between 9% and 14% of the gross harvested quantity for cabbage, orange, and cardamom. In the case of lime, losses of almost one third are reported, due to fruit falling at or before harvest. This is due to absence of irrigation and inadequate fertilization and tree maintenance techniques. Post-harvest losses are also important for cabbage and sacha inchi (6-9%) but less problematic for cardamom (0-2%). Loss during transport from the field to the selling point is relatively limited.

Post-harvest operations. Analyzing post-harvest operations can prove difficult as respondents tend to have different interpretations of cleaning, sorting, and trimming operations. In most cases, producers intend to sell their product as quickly as possible. This indicates that farmers receive no or little guidance from buyers on what the required operations are after harvest. Cardamom is dried using fire heat or under shade, while sacha inchi is left to dry on the plant or sun dried in the village.

Storage capacity. Most of the respondents don't have storage capacity for perishable and bulky products such as cabbage and citrus. A few producers of sacha inchi and cardamom are able to store their product

after drying, mainly in wooden stores on stilts (traditionally used to store paddy) or in spare rooms inside the house.

Theme 6: Sales

Buying and selling. Only four out of a sample size of 258 farmers that produce cabbage had any formal contractual arrangement with buyers. Instead they sold to informal traders without any form of written agreement. Interest in formal marketing arrangement depends on the value chain: two thirds of respondents in cabbage value chains but less than half in the citrus value chain.

Access to markets. Key marketing related issues mentioned by the respondents vary depending on the crop: for white cabbage and cardamom, unsold production was mentioned by more than 70% of the respondents. A major issue mentioned by orange producers (70% of respondents) is that production is limited and cannot meet market demand. Price fluctuation was mentioned as an issue more often by farmers producing white cabbage (21%) and sacha inchi (28%) than other crops.

Producers of cabbage and citrus have reported that quality grades generally apply only in peak production season. At time of production shortage, buyers tend to maximize aggregated volume to supply the market demand further downstream on the value chain.

Volume of sales by survey respondents. The household survey collected data on volume of sales by respondents. Figures are based on farmers' recall as most of the producers do not keep written records of sales. The data shows that the total combined volume of sales by the 1,020 surveyed households is 2,834 metric tons for the 2017 crop harvest. White cabbage contributes to two thirds of the total volume of sales by survey respondents. Citrus contributes to 7% of the total volume and cardamom to 2%. Pepper and sacha inchi do not have significant contribution to the current volume of sales. Data from the surveyed beneficiaries provides an estimate of the total volume of sales for the entire population of beneficiaries. The baseline data for indicator S-14 "volume of commodities sold by project beneficiaries" is estimated at 109,890 metric tons. The proposed baseline values are disaggregated by commodity and the Life of Project target (LOP) will be revised to aim at an increase of 30% of the baseline volume of commodities sold.

Value of sales by survey respondents. The combined value of sales by the 1,020 survey respondents amounts to almost 5 billion Kip (USD 615,371) for the 2017 crop harvest. The value of sales of white cabbage and orange amounts to about 1.5 billion Kip each. Chinese cabbage and lime contribute about 635 million Kip each, while value of sales of sacha inchi amounts to 73 million. There was no recorded sale of pepper among the five interviewed pepper producers. Data from the surveyed beneficiaries provides an estimate of the total value of sales for the entire population of beneficiaries. The baseline data for indicator S-13 "value of sales by project beneficiaries" is estimated at USD 18,919,065. The proposed baseline values are disaggregated by commodity and the Life of Project target (LOP) will be revised to aim at an increase of 30% of the baseline value of commodities sold.

Table 1 Summary of Indicators

#	Outcome and Output Indicators	Life of Project Target	Baseline	Baseline Status
SI-1	Number of hectares under improved techniques or technologies as a result of USDA assistance	43,165	0	None of the hectares surveyed follow all the elements of production packages
SI-2	Number of individuals who have applied new techniques or technologies as a result of USDA assistance	8,926	0	None of the individuals surveyed follow all the elements of production packages
SI-3	Number of individuals who have applied improved farm management practices (i.e. governance, administration, or financial management) as a result of USDA assistance	10,414	0	None of the individuals surveyed apply all of the improved farm management practices
SI-7	Number of private enterprises, producers' organizations, water users' associations, women's groups, trade & business associations, & community-based organizations (CBO) that applied improved techniques and technologies as a result of USDA assistance	178	0	None of the private enterprises and farmers' organizations surveyed apply all of the improved techniques and technologies
SI-8	Number of public-private partnerships formed as a result of USDA assistance	12	0	
SI-9	Value of new public and private sector investment leveraged as a result of USDA assistance	\$2,640,000	0	
SI-11	Total increase in installed storage capacity (dry or cold storage) as a result of USDA assistance	1,250	0	There was no dry/cold storage identified in the baseline survey. Baseline is set at zero.
SI-12	Number of policies, regulations and/or administrative procedures in each of the following stages of development as a result of USDA assistance (Stage1, Stage 2)	3	0	
SI-13	Value of sales by project beneficiaries	\$24,594,785	\$18,919,065	Baseline data estimate based on weighted household survey sample (disaggregated by commodity)
SI-14	Volume of commodities (metric tons) sold by project beneficiaries	142,857 MT	109,890 MT	Baseline data estimate based on weighted household survey sample (disaggregated by commodity)
SI-16	Number of individuals who have received short-term agricultural sector productivity or food security training as a result of USDA assistance	14,877	0	
SI-17	Total number of individuals benefiting directly as a result of USDA assistance	14,877	0	
SI-18	Total number of individuals benefiting indirectly as a result of USDA assistance	178,524	0	
CI-1	Yield per hectare per target commodity type	TBD	See below	
CI-2	Number of agricultural input supplies/firms that sell improved inputs as a result of USDA assistance	TBD	0	
CI-3	Number of agreements signed (contracts, MOU, etc.) between buyers / sellers through trade promotion events (e.g. missions, fairs, etc.)	115	0	
CI-4	Number of government officers and auditors trained in internationally recognized quality standards and food safety	177	0	
CI-5	Number of grants disbursed to individuals or firms/cooperatives/producer groups/businesses as a result of USDA assistance	15	0	
CI-6	Value of grants disbursed to individual or firms/cooperatives/business as a result of USDA assistance	\$498,900	0	
CI-7	Number of farmer organizations meeting GAP and SPS requirements	100	0	
CI-8	Number of consumers receiving messaging on food safety and "clean" and "safe" Lao products through awareness campaign	450,000	0	

There are no yield statistics available for these crops, neither at the national level (Ministry of Agriculture and Forestry (MAF)), nor at the district level. The proposed baseline data is based on the results of the household survey and proposed baseline data for indicator CI-1 with yield per hectare per target commodity type is below:

Selected crops	Proposed baseline yields (in metric ton /Ha)
White cabbage	29.93
Chinese cabbage	22.57
Pepper*	0.7
Sacha inchi	0.65
Lime	5.00
Orange	3.45
Cardamom	1.07

(*) Note: Yield for pepper is a conservative estimate. There are only five respondents with a few pepper plants in the household survey.

2. INTRODUCTION

Project Background

The CLEAN project will use a value chain approach to increase the production and reduce post-harvest losses of clean horticulture to improve quality compliance and certification systems and to develop linkages and increase demand in domestic, Greater Mekong Subregion (GMS), and global markets for clean produce from Laos PDR.

Baseline Study Aim and Objectives

The CLEAN baseline study objectives are to:

1. Establish a baseline as points of comparison to support measurement of program impacts as part of future project evaluation activities;
2. Guide realistic and feasible target setting for performance indicators;
3. Support program design through situational analysis;
4. Identify and recommend responses to risks and constraints.

The study delivered four main outputs:

1. The baseline per se, consisting of the population-based household level quantitative study and the qualitative information and analysis collected during field work;
2. The Situational Analysis reports including Value Chain (VC) mapping of the five selected commodities;
3. CLEAN key evaluation questions (Relevance, Efficiency, Effectiveness, Impact, Sustainability);
4. Recommendations to the project, including Risk and Constraints Analysis and suggestions to address the key evaluation questions.

3. BACKGROUND

Agricultural Context

Agriculture employs more than 60% of the labor force but arable land only covers 6.6% of the total country area and arable land per capita is about 0.2 ha (The World Bank⁵, 2017). Laos remains an agrarian society that is undergoing a sharp transition from subsistence to commercial production. Laos is now considered a lower middle-income country with a per capita income⁶ of 2,270 USD in 2017. The latest Lao Expenditure and Consumption Survey in 2012 estimated that 23.2% of the population lives under the poverty line; poverty incidence is even more acute in remote areas and tackling food and

⁵ <https://data.worldbank.org/indicator/NV.AGR.TOTL.ZS?end=2017&locations=LA&start=1960&view=chart>

⁶ The World Bank, GNI per capita, Atlas method

nutrition insecurity are difficult challenges to overcome. In particular, access to land for food production or commercial farming is a key constraint for smallholders, operating on 3 ha or less⁷.

The Lao PDR's Government Strategies

The Agriculture Development Strategy of 2015 and vision for 2030 (MAF ADS, 2015), aims at “Ensuring food security, producing comparative and competitive agricultural commodities, developing clean, safe and sustainable agriculture and shift gradually to the modernization of a resilient and productive agriculture economy linking with rural development contributing to the national economic basis” (MAF, 2015). The most recent Five-Year National Socio-Economic Development Plan (NSED 2016–2020) has set the following strategies for agriculture:

1. promote clean and organic agriculture in each local area in order to meet the domestic market demand and export to foreign markets,
2. promote production along with marketing and processing,
3. improve and upgrade irrigation to permanent and robust systems with effective management,
4. upgrade the existing agriculture extension and development centers, among others.

In this transition context, providing support for the Lao farmers to undergo the current transition is critical. Extension service delivery through public agencies follows the Lao Extension Agriculture (LEA) approach, designed and promoted by the National Agriculture and Forestry Extension Service over 15 years (1999-2014) with support from the Swiss Development Corporation (SDC). The LEA promotes the establishment of agricultural production groups as the basis to encourage a learning process and deliver training and demonstrations.

Public extension services outreach capacity is limited by technical personnel posted at District Agriculture and Forestry Offices (DAFOs have around 4,200 staff nationwide including technical and administrative staff). Technical Service Centers at local level are of particular importance to provide information, inputs, and technical advice to farmers in their vicinity. Shortcomings are acknowledged in performing key functions such as “promotion, support and extension activities, as well as monitoring”. Other channels of extension, through private sector for instance, remain limited to the occasional situation where investors provide technical guidance on specific production they intend to buy from the farmers.

Priority crops are defined in the Agriculture Development Strategy with paddy rice as the main focus for the primary goal of food production (Program 1). The target is to produce 4.7 million tons of paddy rice by 2020, while national output in 2017 is estimated at around 4.2 million tons by the Food and Agriculture Organization of the United Nations (FAO) Country Brief issued in July 2018. Significant surplus has been produced due to massive investments in irrigation infrastructure over the last 20 years. However, paddy produced under irrigated conditions in dry seasons represents only 13% of the national output. Under the second goal of Agricultural Commodity Production (Program 2), production of commercial commodities, agricultural diversification, development of Agriculture Production Group/Agriculture Cooperatives, private sector investment, and market linkages are promoted.

Besides paddy rice surplus target of 1.5 million tons by 2015, priorities are also set for major tradable commodities (namely animal feed corn, coffee, sugar cane, cassava, and rubber), as well as crops referred to as “other potential cash crops that are special and unique in the local areas” with existing production, including: Job’s tears, sesame, tea, tobacco, legume / beans, and fruit trees.

⁷ There is no legal definition of smallholder farmers but the article 17 of the Land Law (2003) defines the area that the Government allows households to use (expressed in Ha per unit of family labor): for paddy or livestock: not more than 1ha, for industrial or annual crops: not more than 1 ha, fruit trees: not more than 3 ha, forage grass on degraded land: not more than 15 ha

Finally, the strategy also mentions crops “which have production potential for export to neighboring countries such as sacha inchi (*Mak Nam Manh*, *Plukenetia volubilis*), Mak Kao (Tung fruit) and some non-timber forest products (NTFPs) such as cardamom”.

Production of Paksong Cardamom on the Bolaven Plateau is becoming a less popular crop and replaced by commercial crops that offer quicker returns such as cassava or sweet potato. The district agriculture officer said that: “Farmers shift from one crop to another following market demand, following the flow.” In Kasi and Vangvieng, the Guandong variety of cardamom has been introduced by traders selling seedlings collected from Northern Lao (Phongsaly, Oudomxay provinces) where this type of cardamom fetches a much higher price than the local wild variety. As reported by the Chinese trader traveling from Northern Laos: “Guandong cardamom seedlings can be sold at LAK 5,000 per one seedling. Farmers can get much higher price from Guandong variety dried fruits (LAK 250,000 – 400,000 per Kg) than local varieties (LAK 75,000 – 85,000 per Kg).”



Guandong cardamom seedlings sold by itinerant Chinese trader in Kasi and Vangvieng districts

Priority Value Chains

The CLEAN project selected the value chains to be supported in Lao PDR using the following criteria⁸:

- Proofed market potential and potential comparative advantages;
- Opportunities and comparative advantages for smallholder households to graduate from traditional markets into high-end, export-quality value chains or higher value local markets (including internal value chain opportunities and external forces such as an enabling environment and support services);
- Risk associated with selection of a specific value chain (e.g. potential to achieve volumes, buyer willingness to work with farmer associations, and investment readiness of firms within the chain);
- Potential impact on farmer employment, return on investment, and short- and long-term profitability;
- and environmental impacts, including water and natural resource management, land stewardship, and reduced fertilizer and pesticide use.

The CLEAN project selected five commodities for this study including cabbage (white cabbage and Chinese cabbage), pepper, sacha inchi, citrus (lime and orange), and cardamom. Cabbage and citrus fall under the category of “other potential cash crops”. Sacha inchi and cardamom are clearly identified as potential crops for export, but while sacha inchi is an agricultural product, cardamom is considered a forest product and therefore has a different status in regard with production quotas and tax regime. Pepper is not mentioned in the national agriculture development strategy.

4. STUDY METHODOLOGY

The study methodology, described in detail in the baseline design plan, was organized in three phases:

1. The preparation phase included the sampling design, the preparation and testing of the survey tools, the training of the enumerators and obtaining an official authorization from the Department of Agriculture, Ministry of Agriculture and Forestry to conduct the study. Prior to administering the baseline survey, the EDC team conducted a pre-assessment during May 22nd – June 2nd, 2018

⁸ Request for Proposal for CLEAN baseline study (page 3)

- to gather information on the selected value chain commodities and obtain a roster of villages where the households produce these crops for sampling design purposes.
2. The field survey phase took place between June 27th and July 28th, 2018. To cover the study areas in a reasonable timeframe, two teams comprised of ten enumerators each were organized with one supervisor for each team. Two value chain consultants were also mobilized in parallel to conduct key informant interviews with other value chain actors (e.g., traders, wholesalers, inputs dealers and district government officials).
 3. The third phase involved data cleaning, analysis and drafting of the study report carried out from July the 30th to August the 24th.

Study Instruments

Three main study instruments were developed to collect both qualitative and quantitative information and inform the baseline indicators and the situational analysis on the five commodities:

1. The household questionnaires were developed to collect quantitative information, include a general section on the respondent and the farm management aspects and five specific crop sections (thereafter referred to as “crop questionnaires”)
2. The Focus Group Discussion guidelines designed to collect additional information to add context, richness, and in-depth insights to the findings from the population-based household survey, facilitated by the team supervisors.
3. The Key Informant Interview guidelines and value chain analysis report formats were prepared to guide the Value Chain consultants during the investigations in the target districts. The study instruments are provided in Annex 3.

Training and Survey Administration

The training of enumerators was conducted intermittently over a period of two weeks (8th -21st of June), with support from the project’s short-term international and local Monitoring, Evaluation and Learning Specialists (MEL). The enumerators were trained on how to carry out the interviews, including explanation and interpretation of the questions and variables included in the questionnaires, the flow and skip-patterns, definitions, and explanations of how to handle unusual cases and when to contact the supervisors for assistance. The questionnaires were tested on June 9th, 2018 in Phonhong District, one of the target districts. The field survey was conducted from June 27th to July 29th of as per the detailed schedule provided in Annex 5.

Data Entry and Cleaning

Household questionnaires were administered by the enumerators using paper forms. Data was then typed into electronic tablets using pre-loaded forms matching the questionnaire template and numbering. Double entry procedure was performed by enumerators immediately after completion of the household survey in each village. The EDC Data Management Specialist reviewed the datasets and identified mistyped data and inconsistencies by comparing both data entry forms. Paper forms were used as a source to correct the master dataset, stored on the central server at the EDC office. Additionally, SPSS and Excel were used to do the data cleaning, and statistical analysis was completed using Excel.

Data Quality Control

Data quality control measures were applied at each stage of the process:

- on-the-spot control in the target village by the team supervisors
- double data entry procedure in electronic tablets
- double storage of data on the tablet memory and uploaded daily on the EDC server
- cross checks between data in the form and in the tablet by the Data Management Specialist

Study Limitations and Constraints

Several factors have affected the study:

- delays to obtain clearance for fieldwork;
- difficult conditions accessing target villages (2 villages replaced in the sample);
- outdated list of households at village level;

- farmers availability to participate in the focal group discussions (32 sessions conducted over 51 villages) and household study (22% of the randomly selected households were replaced);
- lack of information on input suppliers and wholesalers at district line agencies;
- relative validity and reliability of self-reported data (e.g. land size, amount inputs used, yields, etc.)

Ethical considerations

The EDC team ensured ethical considerations were adequately addressed throughout the survey process. Enumerators requested prior consent from respondents before each household interview. A letter explaining the objective of the survey was read and explained and respondents signed to confirm their consent to participate in the study. In addition, the survey teams have applied a Do-No-Harm principle throughout the village-level survey process in order to avoid raising expectations or introduce messages that can be confusing for farmers. The study team also ensured that all participants and stakeholders had an equal access to information and equal opportunity to express their concerns and ideas.

Sampling Design

The CLEAN target area covers five provinces, nine districts with a total of 515 villages. Based on the National Housing and Population Census conducted in 2015, the total population was about 434,000 persons in 86,000 households. As the national statistics on the production of the five selected commodities by districts was outdated, a pre-assessment was conducted in all nine districts to gather information on selected value chain crops and identify the villages with households producing the selected crops during May 22- June 2, 2018. Meetings were held with the District Agriculture and Forestry Offices (DAFO) managers, village chiefs, and farmers in each district. The pre-assessment concluded that 222 villages produce or have produced at least one of the five commodities in CLEAN target areas. The table below provides details on number of villages where farmers producing at least one of five value chains commodities.

Table 2: Number of villages producing one or more the five commodities

Province	District Name	Number of Villages	Number of Households	Population (2015 Census)	Village Producing at Least 1 of 5 VC
Vientiane Capital	Sangthong	36	6,411	28,916	9
	Pak Ngum	53	10,090	48,003	23
Vientiane	Phonhong	59	13,004	62,245	2
	Kasi	51	7,001	35,993	43
	Vangvieng	63	10,579	53,488	28
	Viengkham	17	3,982	16,948	4
Salavan	Lao Ngam	97	13,040	70,941	56
Sekong	Thateng	51	6,597	38,315	21
Champasak	Paksong	88	15,304	78,792	36
5 provinces	9 districts	515	86,008	433,641	222

Source: After National Housing and Population Census (LSB, 2015)

For the beneficiary-based survey, the sample size of households was determined based on the Sampling Guide for Beneficiary-Based Surveys (USDA, Feb 2016), following a two-stage cluster sampling design. The first stage was the random selection of 51 villages, about 10% of the total number of villages from the Lao RDR's Population Census (2015).

In the second stage, households were selected randomly in each target village, based on listing available within the village administration committee. The CLEAN project aims to reach 14,877 direct beneficiaries over life of project in target areas. The sample size was calculated using the following formula (utilizing a similar methodology recommended by USAID⁹): $n = N^2 * z^2 * s^2 * MoE^2$ considering a 95% Confidence level and 5% Level of Precision, the sample size against 14,877 farmers stands equaled to 856. However, to minimize the risk of farmer household's dropout during the survey a total of 1,020 households were interviewed (20 households per village) for the study.

⁹ USAID/ Feed the Future, Sampling Guide for Beneficiary-Based Surveys, February 2016

Table 3: Village and Household sample design

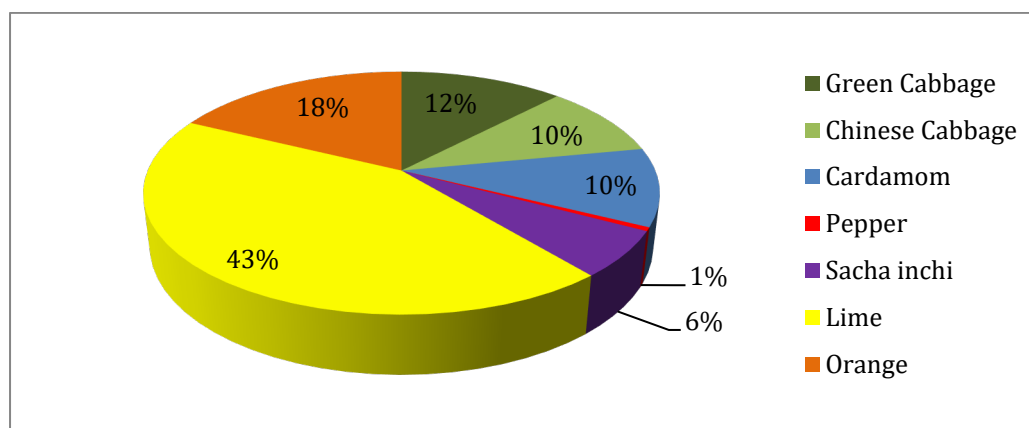
Province	District Name	Village producing at least 1 of 5 VC	Village sample	Household sample as calculated	Households sample actually surveyed
Vientiane Capital	Sangthong	9	2	34	40
	Pak Ngum	23	5	85	100
Vientiane	Phonhong	2	1	17	20
	Kasi	43	10	170	200
	Vangvieng	28	6	102	120
	Viengkham	4	1	17	20
Salavan	Lao Ngam	56	13	221	260
Sekong	Thateng	21	5	85	100
Champasak	Paksong	36	8	136	160
5 provinces	9 districts	222	51	867	1,020

The complete list of sample villages is in Annex 5.

Out of the 1,020 surveyed households, a total of 373 households do not produce any of the five selected crops (36% of the sample), 365 households produce one of the selected crops (36% of the sample) and 282 households produce more than one of the selected crops (28% of the sample). In the case where a household produces more than one of the selected crops, the farmers were asked questions related to these crops using the corresponding crop questionnaire ¹⁰. Therefore, the number of crop questionnaires used during the survey does not directly correspond to the number of households interviewed. The survey administered a total of 1,030 crop questionnaires from interviews with 1,020 households. The chart below presents the distribution of the administrated crop questionnaires over the selected commodities:

Secondary data show that farming systems on the Bolaven Plateau are predominantly coffee production systems: coffee plantations cover 14% of the total area, while cabbage cover only 2.3% and cardamom 0.6% of the area. In Kasi and Vangvieng districts as well as in Vientiane capital, farmers are predominantly rice producers and Citrus plantations cover a small percentage of the arable land area (2.4% in Kasi and 6.1% in Vangvieng). In the districts of Vientiane Capital (Sangthong, Pak Ngum) as well as Phonhong and Viengkham districts, farmers are paddy rice producers and paddy define the farming systems.

Figure 2: Distribution of crop questionnaires over the selected commodities



5. BASELINE DETAILED FINDINGS PER INDICATOR AND HOUSEHOLD CHARACTERISTICS

SI-1 Area under improved techniques or technologies as a result of USDA assistance

This indicator measures the area (in hectares) of land under improved technique(s) or technology (ies). The term 'improved techniques' is defined in the handbook: "Food for Progress and McGovern-Dole

¹⁰ See section "study instruments" above for details on what the term crop questionnaires is for. Questionnaires are available in Annex 3

Indicators and Definitions” (USDA, 2014). The handbook indicates on page 10 examples of relevant techniques or technologies: crop genetics (e.g. improved/certified seed), pest and disease management, soil-related fertility and conservation, irrigation, water management.

For this study, the selected improved techniques taken into account are: improved certified seeds, soil fertility (soil cover: crop residues, green mulching, plastic mulching and application of organic fertilizer), soil conservation measure (terrace, contour, bunds), improved irrigation technology (sprinkler, drip, pipe). The results for white cabbage are shown below:

Table 4: Areas under improved techniques (white cabbage, in hectare)

White cabbage	Pak Ngum	Kasi	Vangvieng	Paksong	Grand Total	In % of cropped area
Improved seeds	1.3	13.8	0.7	94.3	110.1	97%
Soil cover	0.9	8.8	0.6	8.6	18.9	17%
Organic fertilizer application	1.2	11.5	0.9	14.7	28.2	25%
Soil conservation measures	1.2	0.6	0.1	11.7	13.6	12%
Improved irrigation	1.3	1.0		29.6	31.9	28%

For white cabbage, over a total cropped area of 112.9 ha, improved seeds are used on 110.1 ha or 97% of the cropped area. Cabbage is produced as a commercial crop for the domestic and Thai markets. The use of uniform improved seeds is a direct reflection of the market demand for standard product. The seeds sold in tin cans are widely available from input sellers, either shops in district and provincial town markets or from mobile resellers. Other improved techniques are applied but over relatively smaller areas.

Table 5: Areas under improved techniques (Chinese cabbage, in hectare)

Chinese cabbage	Kasi	Paksong	Grand Total	In % of cropped area
Improved seeds	2.0	21.4	23.4	94%
Soil cover	1.2	1.6	2.8	11%
Organic fertilizer application	1.1	2.2	3.3	13%
Soil conservation measures	0.2	2.1	2.2	9%
Improved irrigation	-	-	-	

For Chinese cabbage, the main improved technology is the use of improved / certified seeds currently applied on most of the total cropping area: 23.4 over 24.8 ha. Other technologies are applied marginally, on around 10% of the cropped areas.

For citrus plantations, the same improved production technologies have been selected except improved/certified seeds that are not available in Lao PDR. Results are shown for Vangvieng and Kasi districts where the planted areas are the most significant.

Table 6: Areas under improved techniques (Citrus)

Citrus	Kasi	Vangvieng	Grand Total	In % of cropped area
Soil cover	5.77	1.26	7.03	6.8%
Organic fertilizer application	15.25	4.05	19.30	18.7%
Soil conservation measures	0.16		0.16	-
Improved irrigation	4.70	0.48	5.19	5%

Over a total area of 103 ha citrus production, organic fertilizers are applied on 18.7%. This shows potential to introduce improved techniques and technologies in the citrus gardens of Kasi and Vangvieng. Elsewhere, citrus trees are individual trees and small groups of trees around settlements and there might be less rationale for introduction of improved techniques on measurable areas. Farmers do not use improved techniques such as adequate fertilization management (both organic and chemical) or integrated pest management, indicating a need to provide technical advice to promote improved fertilization and pest management techniques.

Even if lime can be harvested every month in a year, the market price of dry-season lime is much higher than in wet-season. Productivity is hampered by inadequate techniques (pruning, fertilization) and absence of irrigation in dry season.

Picture on the right shows how limes are packaged in net bags by traders who transport the lime to the capital city markets in a 6-wheel truck with 2-metric-ton capacity (in Vangvieng district during the peak lime harvesting season, July 2018).



For the three other commodities (pepper, sacha inchi and cardamom), none of the above improved techniques are used. Producers use home-saved, non-certified seeds and reuse seeds from one crop cycle to the other. For both vine crops (sacha inchi and pepper) soil conservation practices such as contours, bunds, and terraces are not used. These crops are not irrigated. Finally, cardamom is grown in a forest environment and no improved technique is used.

SI-2 Number of farmers applying new techniques or technologies

Number of individuals who are currently applying new techniques or technologies is measured by selecting the same technologies as for SI-1, namely: improved certified seeds, soil fertility (soil cover: crop residues, green mulching, plastic mulching, and application of organic fertilizer), soil conservation measures (terrace, contour, bunds), and improved irrigation technology (sprinkler, drip, pipe).

For white cabbage, all farmers use improved seeds and 95% use soil conservation measures. The soil conservation measures are bunds that have a beneficial effect on run-off erosion. Organic fertilizers (animal manure mixed with straw or other vegetal biomass) are also applied by almost half of the farmers in the sample. Soil cover techniques (mulching) are also applied by 34% of the farmers. There is a visible potential to introduce and promote improved irrigation techniques, currently used by only 9% of the survey respondents.

Table 7: Number of farmers applying improved techniques (White cabbage)

White cabbage	Total number of farmers	In % of farmers
Improved seeds	160	100%
Soil cover	55	34%
Organic fertilizer application	77	48%
Soil conservation measures	152	95%
Improved irrigation	14	9%

Table 8: Number of farmers applying improved techniques (Chinese cabbage)

Chinese cabbage	Total number of farmers	In % of farmers
Improved seeds	125	100%
Soil cover	45	36%
Organic fertilizer application	73	58%
Soil conservation measures	47	38%
Improved irrigation	6	5%

Table 9: Number of farmers applying improved techniques (Citrus)

Citrus	Total of citrus producers	In % of farmers
Soil cover	37	14%
Organic fertilizer application	82	30%
Soil conservation measures	23	8%
Improved irrigation	-	-

No improved techniques	129	48%
Total	273	100%

As shown in the short table above, over 273 farmers producing citrus, 82 (or 30%) are applying organic fertilizers and 37 (14%) applying other soil fertility technologies (soil cover). As mentioned in the section above, these technologies are applied on rather small areas, mainly due to the scattered nature of the citrus trees population. There is potential to promote improved irrigation techniques for citrus production.

Technology/Technique: Soil preparation for cabbage

This operation is critical for annual field crops such as white cabbage. Details provided below compare the soil preparation techniques in both leading cabbage producing districts: Paksong and Kasi. In Kasi, white cabbage is cropped after paddy rice, therefore tilling is not required: only 6% of the producers plough their field because cabbage is transplanted in crop residues, paddy straw in this case. In Paksong however, one or two till operations are required before transplanting the cabbage seedling in the field: two thirds of the farmers plough their field before transplanting the cabbage seedlings. More than one third of the farmers weed the field and dig holes manually to transplant the seedlings.

Table 10: Soil preparation techniques for white cabbage

Soil Preparation	Paksong	Kasi
No till	31%	82%
One pass tilling	27%	4%
Two pass tilling	4%	2%
Three pass tilling	0%	0%
Other technique	38%	12%

In Kasi, as ploughing is not practiced, soil preparation does not require hiring equipment or machinery. As explained above, cabbage is generally sown directly after paddy harvest. In Paksong, 70% of the farmers use their own equipment (hand-tractor) for soil preparation and 30% hire a tractor. Costs of soil preparation (ploughing) are of 590,000 Kip/ha on average. This cost is affordable for farmers producing cabbage for commercial purpose.

Crop establishment practices for perennial crops

There is no soil preparation operation such as tilling or ploughing for the other commodities. For perennial or multi-annual crops (citrus, pepper, sachu inchi and cardamom) soil preparation is mainly done manually, once at the time of crop establishment. Nonetheless, information is provided below on practices and conditions for crop establishment.

For vine crops (pepper and sachu inchi), various kind of support are used: living and dead trees are the most common support for pepper while wooden poles are commonly used for sachu inchi.

Table 11: Type of support for vine crops (pepper and sachu inchi)

Type of support for vine crops	Living tree	Dead tree	Wooden pole	other	Total respondents
Sachu inchi	13%	25%	45%	17%	100%
Pepper	40%	40%	20%	-	100%

For cardamom, 89% of the producers establish cardamom seedlings under existing natural forest using traditional methods. While 6% use a mix of natural and planted trees as shade, and another 6% use planted trees only. A possible project intervention will be to increase the amount of land under the latter two techniques.

When citrus trees are grown in gardens (as opposed to scattered individual trees close to habitations), about one third of the respondents introduce another crop in the inter-row in association with citrus trees. The associated crop is generally another fruit tree species (80% of the respondents) or an annual crop (20% of the respondents).

Technique/Technology: Use of Seeds

Farmers use only hybrid seeds that are bought each new cropping cycle. Hybrid cabbage plants do not produce viable seeds. Farmers generally use only one variety of white cabbage seeds. Only 16% of farmers in Kasi use two varieties and 7% in Paksong, indicating a strong market demand for a uniform product. Most of the farmers buy the seeds from the district market, but some farmers buy the seeds sold by mobile Vietnamese traders: 21% of the respondents in Kasi and 6% in Paksong.

For other crops that are perennials or multi-annuals, seeds or seedlings can generally be produced on-farm or at local level or obtained from various sources as detailed in the table below.

Table 12: Origin of seeds for perennial crops

Perennial Crops	N=	DAFO	Trader / Buyer	Investor	Relatives	Produced own seedlings from seeds	Bought from market	Collected from the wild	Don't know
Pepper	5	40%	40%	20%					
Sacha inchi	83	13%	25%	45%	17%				
Citrus	168	1%			52%	36%	10%		1%
Cardamom	107		1%		65%	6%	5%	16%	7%

N= number of respondents

Pepper seeds or seedlings were obtained from DAFO (2 farmers), a trader (2 farmers), and an investor (1 farmer). An investor is a buyer providing seeds to promote production of the commodity in his/her value chain.

Sacha inchi seeds were provided to farmers by investor / promoter of the crop in 45% of the cases. However, farmers also mentioned that they obtained sacha inchi seeds from informal traders (25%) and relatives (17%) DAFO also provided seeds to 13% of the respondents, generally as a support to a private sector investment to promote production. For instance, the DAFO director in Kasi District (Vientiane Province) assisted a Chinese investor (name unknown) in distributing inputs to farmers in Ban Thongmeuak in 2013.

For citrus, information collected from the 168 respondents who produce citrus commercially or semi-commercially show that seeds or seedlings are obtained from various sources: relatives (49% of respondents), seedling produced from eaten fruits seeds (36%), seedling bought from the market (10%), etc. Only a minority of respondents mentioned that they know how to graft citrus trees (24%) or to prune (23%), indicating that horticulture technical skills are still relatively unknown to farmers. This is an important element, demonstrating that more extension services are needed to enhance farmers capacity to produce quality seedlings and maintain productive trees.

The origin of cardamom seeds is also diversified: obtained from relative in two third of the cases and also collected from the forest in 16%, highlighting the dual nature of cardamom: agricultural product and Non-Timber Forest Product.

Technique/Technology: Chemical fertilizers

For cabbage production, all respondents use chemical fertilizers. About half of the respondents in Kasi use only one type of fertilizers, probably because cabbage benefit from remaining fertility in the soil after the rice crop. In Paksong about two thirds of the respondents use two or three types of fertilizers.

Table 13: Number of types of chemical fertilizers used for white cabbage

Chemical Fertilizers	Paksong	Kasi
Not used	0%	0%
1 type	35%	54%
2 types	53%	46%
3 types	12%	0%

There are stark differences in types of chemical fertilizers used in the two main cabbage producing districts: In Kasi, farmers use mainly urea (46-0-0) and composed triple-15 formula, while in Paksong, Ammonium Phosphate (16-20-0) is the most commonly used formula. This reflects the different types of soils and cropping patterns found in both areas: the soils of volcanic origin in Paksong have better agronomic characteristics than the alluvial soils found in the valley floor in Kasi District. In addition, the cropping pattern is different: in Kasi, cabbage is grown after paddy rice, while in Paksong cabbage is grown on dedicated gardens.

Table 14: Type of fertilizers used for white cabbage

	Kasi		Paksong		
Type of chemical	Type 1	Type 2	Type 1	Type 2	Type 3
15-15-15	25%	23%	5%	5%	0%
16-20-00	7%	8%	84%	89%	60%
46-00-00	64%	69%	0%	0%	0%
Other formula	5%	0%	11%	5%	40%

For perennial and multi-annual crops (the four other commodities), use of chemical fertilizers is much less common. Chemical fertilizers are used by 14% of the citrus producers. Respondents do not use any chemical fertilizer for production of pepper, sacha inchi and cardamom.

Table 15: Use of chemical fertilizers on perennial crops

Perennial Crops	N=	1 type	2 types	Not used
Pepper	5			100%
Sacha inchi	83			100%
Citrus	168	11%	3%	86%
Cardamom	107			100%

On citrus chemical fertilizers used are: 15-15-15 (33% of respondents who use fertilizers), 16-20-00 (21% of respondents), urea (33%) and other types of fertilizers (13%, mostly foliar fertilizers). Reported fertilizer doses are of 69kg or liter per ha on average.

Technique/Technology: Organic fertilizers

Organic fertilizers are defined as opposed to chemical fertilizers. Organic fertilizers are either animal manure, vegetal biomass and liquid compost. These are generally produced on-farm using available manure and biomass. Organic fertilizers also include granular organic fertilizers available in the market.

Vangvieng orange is a symbolic fruit and popular commodity of Vangvieng and Kasi districts, Vientiane Province. It's a main source of income for many local farmers to better their household livelihood. Vangvieng orange is sold to markets from November to January, the total products could not meet the high annual demand in local markets, Vientiane Capital and other provinces.

The orange variety is well adapted to local conditions and does not suffer pest or disease damage. Little chemical inputs are required. The visual aspect of the orange is not perfect but well appreciated on the local market (Kasi and Vangvieng district towns) as well as in Vientiane capital markets.



A great majority of white cabbage producers in Paksong do not use any organic fertilizer (81% of the respondents). In Kasi District 73% of the white cabbage producers use animal manure, (310 kg/ Ha on average) while in Paksong, they are only 13% and at lower dose (285 kg / ha).

Table 16: Percentage of cabbage producers using organic fertilizers

	Kasi	Paksong
Animal manure (Kg)	73%	13%
Vegetal (Kg)	0%	4%
Liquid compost (liter)	0%	2%
Granular	2%	0%
None	25%	81%

Cabbage producers also use organic fertilizers under organic production requirements, such as in the organic Chinese cabbage producers group in Phonhong District, Vientiane province.

For perennial and multi-annual crops (the four other commodities pepper, sacha inchi, citrus and cardamom), use of organic fertilizers is not very common. Organic fertilizers are used by 27% of the citrus producers and 21% of the sacha inchi producers. For pepper, 2 producers out of 5 mentioned they use organic fertilizers. Respondents do not use any organic fertilizer for production cardamom.

Table 17: Use of organic fertilizers on perennial crops

Perennial Crops	N=	1 type	2 types	Not used
Pepper	5	40%		60%
Sacha inchi	83	19%	2%	78%
Citrus	168	26%	1%	73%
Cardamom	107			100%

The term “organic fertilizer” is sometimes used by informal traders to encourage farmers to buy their products, such as foliar fertilizers in liquid form for citrus trees.

Technique/Technology: Chemical pesticides (weed, pests and diseases control) and cabbage

Weeding practices for white cabbage differ also between both districts: in Paksong 80% of the farmers use a hoe and 16% use herbicide combined with manual or hoe methods. In Kasi, 9% of the farmers do no weeding at all and no respondent use herbicide. This constitutes a minority of farmers who consider that weed infestation does not affect the yield. This can be the case when efficient mulching is applied and can control weed growth. In most of the cases however, weeding is conducted, using a hoe in combination with other methods. The interesting observation is that weeding is mainly a non-chemical, non-mechanical operation, and requires on-farm labor.

Table 18: Weeding practices for white cabbage

Weeding method	Kasi	Paksong
No weeding	9%	0%
Manual weeding only	13%	0%
Manual & Hoe	18%	4%
Manual, Hoe & brush cutter	2%	0%
Manual, Hoe & herbicide	0%	6%
Hoe only	48%	80%
Hoe & brush cutter	5%	0%
Hoe and herbicide	0%	6%
Brush cutter	5%	2%
Weed killer (herbicide)	0%	2%

The main issue on the white cabbage mentioned by the respondents is insect attacks and insect combined with crop disease.

Table 19: Insect pest on cabbage

Main pest	Kasi	Paksong	Grand Total
Insect	80%	94%	89%
Insect, rodent and disease	7%	0%	3%
Insect and disease	11%	6%	8%
Don't know	2%	0%	1%

The main pest control techniques are: use of pesticide in Paksong and manual control of insect pest in Kasi (caterpillar). In both districts some farmers do not control pest: 16% in Kasi and 11% in Paksong.

Table 20: Pest control for cabbage

Pest control	Kasi	Paksong	Grand Total
No control	16%	11%	13%

On farm tool / manual control	5%	0%	2%
Manual only	44%	8%	22%
Manual and trap	2%	0%	1%
Manual and pesticide	5%	4%	4%
Pesticide only	27%	77%	58%

There is a stark contrast in use of pesticide: 77% of the farmers use only pesticides to control pests, against 27% in Kasi. Cabbage in Paksong is produced in rotation with lowland paddy rice, The rotation with a cereal and the inundated conditions in wet season provide unfavorable conditions for cabbage pests. However, in Paksong, crop cycles of cabbage are in succession. Monocropping generally faces more pest load, requiring control measures (pesticide in this case or IPM and other methods)

Technique/Technology: Chemical pesticides (weed, pests and diseases control) and other value chains

For perennial crops, use of chemical pesticides remains exceptional. Interestingly, there is no weeding operation for sacha inchi and cardamom in more than one fifth of the cases. The most common weed control techniques involve manually removing the weeds, using the tool (hoe), or a mechanical brush cutter (the most common in citrus gardens). Use of chemical weed killer is mentioned by 2% of sacha inchi producers, in combination with manual or weeding with a hoe.

Table 21: Weed control of perennial crops

	No weeding	Manual weeding	Manual & tool	Manual, tool and brush cutter	Manual and chemical weed killer	Tool (hoe)	Tool and brush cutter	Tool and weed killer	Brush cutter
Pepper	40%	20%				20%			20%
Sacha inchi	22%	10%	5%	1%	1%	31%	6%	1%	23%
Citrus	1%	1%	1%	1%		10%	2%		81%
Cardamom	24%	5%				71%			1%

Focal group discussions confirmed that all villages do acquire equipment such as small farm implements and inputs from district center and nearby markets, as well as informal input sellers that circulate from village to village.

Insect pests are reported as common by farmers producing sacha inchi (37%) and citrus (80% of the producers). The main pest issue for cardamom is related to damage by rodents, as mentioned by 83% of the producers. Pepper and sacha inchi crops, however, are relatively pest free (80% and 49% respectively).

Table 22: Types of pest on perennial crops

	Insect pests	Rodent	Disease	Two or more pest types	No pest	Don't know
Pepper					80%	20%
Sacha inchi	37%	2%	1%	3%	49%	6%
Citrus	80%	-	-	12%	8%	1%
Cardamom	2%	83%	1%	8%	7%	

Chemical pesticides are used by 57% of the commercial or semi-commercial citrus producers and by 10% of the sacha inchi producers. Respondents do not use any chemical pesticide for production of pepper, and cardamom.

Table 23: Use of chemical pesticide on perennial crops

Perennial Crops	N=	1 type	2 types	Not used
Pepper	5			100%
Sacha inchi	83	10%		90%
Citrus	168	55%	2%	42%
Cardamom	107			100%

Technique/Technology: Use of hired labor and cabbage

Hired labor for white cabbage production is widely practiced in Paksong District (51% of the respondents) and in a lesser extent in Kasi District (27%). Labor is hired for 7 man-days for a crop cycle on average in Paksong, and 4 man-days in Kasi, indicating family labor shortage at peak production operations: transplanting, harvesting. Labor wage is 48,600 kips/ day on average in both districts.

Technique/Technology: Use of hired labor and other value chains

Contrary to cabbage production, respondents have generally not hired external labor to produce perennial and multi-annual crops. Only 15% of the citrus producers have hired limited labor (about 5 man-day per year) at an average daily rate of 65,000 kips/day. For cardamom production, farmers who hired labor did so for an average of 15 man-days a year at a daily rate of 43,000 kips/day.

Table 24: Hired labor for perennial crops production

Perennial Crops	N=	Hired labor	Did not hire labor
Pepper	5	-	10%
Sacha inchi	83	7%	93%
Citrus	168	15%	85%
Cardamom	107	10%	90%

Technique/Technology: Water management and cabbage

In both main producing districts (Paksong and Kasi), white cabbage is generally irrigated (respectively 86% and 93% of the cases), and the most common irrigation water sources are irrigation canal or a river. Bore well are also used in Paksong by 27% of the respondents.

Table 25: Irrigation water source for white cabbage

Water Source	Paksong	Kasi
Irrigation canal	26%	68%
River	24%	18%
Bore well	27%	
Well	4%	
Pond	4%	7%
Reservoir	1%	
No irrigation	14%	7%

Advanced Irrigation techniques (furrow, sprinkler, drip line) are more common in Paksong District than in Kasi, where flood irrigation is practiced by 40% of the respondents who get water from a canal or a river.

Table 26: Irrigation technique for white cabbage

Irrigation technique	Paksong	Kasi
"Flood" irrigation	10%	40%
Furrow	35%	10%
Sprinkler	24%	21%
Drip line	29%	19%
Combination of 2 techniques	3%	10%

Average cost of irrigation is of 160,000 Kips / ha in Paksong and 91,000 Kips / ha in Kasi, reflecting the different level of irrigation technology used. Farmers expressed high level of satisfaction with the current irrigation system they use (94% in Paksong and 88% in Kasi)

Technique/Technology: Water management and other value chains

For perennial crops, use of irrigation is much less common: 16% of the respondents use irrigation for sacha inchi and pepper production and 34% for citrus production. None of the respondents use irrigation for cardamom production. Contrary to cabbage production, irrigation techniques for perennials are low-

technology: PVC pipe, water hose and water can. Drip irrigation for citrus production has yet to be introduced.

Table 27: Use of irrigation for perennial crops

	"Flood" irrigation	Furrow	Sprinkler	Drip line	PVC pipe	Water hose	Water can	Combination of 2 techniques	Not used
Sacha inchi			8%		8%	15%	62%	8%	
Citrus	2%	2%				26%	21%	14%	24%

During group discussions, participants mentioned irrigation systems built with public funds as owned by the District Agriculture and Forestry Department, while in reality most of the infrastructures have been transferred to water user groups to operate and maintain. There is still a widely accepted perception that maintenance and repair of public infrastructure remains the role of the state. Other public investments mentioned were supported by donor's funded project (SUFORD, Oxfam, etc.) This is an indication that transferring responsibility of public or common infrastructure to village or farmers' organizations may not be a realistic option to ensure sustainability. Opting for promoting individual irrigation systems at plot level may be more relevant, in particular for perennial crops such as citrus plantations.

Technique/Technology: Soil cover and soil conservation practices and cabbage

Soil cover practices differ greatly between the two main producing districts: 91% of the respondents apply no soil cover in Paksong, while in Kasi more than half of the farmers apply an organic soil cover made of crop residues (rice straw) and green mulching or both.

Table 28: Soil cover practices for white cabbage

Soil cover	Paksong	Kasi
Crop residues	2%	16%
Green mulching	7%	36%
Both above	0%	4%
No soil cover	91%	45%

Soil conservation practices are quite similar in both districts: The vast majority of farmers do not apply any soil conservation practice. Contour and bunds are used in few cases only. More than 95% of the farmers mentioned that no soil erosion occurs on their field.

Table 29: Soil conservation practices for white cabbage

Soil conservation	Paksong	Kasi
Contour	6%	4%
No conservation practice	86%	95%
Bund	8%	0%
Don't know	0%	2%

Half of the farmers producing white cabbage in Paksong perceive soil fertility increase, and the other half say it is stable. The agronomic quality of the soils on the Bolaven Plateau explain farmers' positive perception but nutrients balance and restitution to the soil in the long run has yet to be confirmed. In Kasi however, 68% of the farmers said the soil fertility stays stable and 9% reported that soil fertility decreases.

Table 30: Farmers perception of soil fertility change

Soil fertility perception	Paksong	Kasi
Increase	50%	14%
Decrease	1%	9%
Stable	49%	68%

Don't know	0%	9%
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Technique/Technology: Soil Management and other value chains

For perennial crops production, soil management issues are less pressing than for cabbage due to absence of top soil disturbance (no tilling required) and reasonable year-round soil cover by tree canopy or natural vegetation. Perennial crops can also form the basis to establish agroforestry systems that promote crop diversification and provide multiple ecological benefits.

SI-3 Number of individuals who have applied improved farm management practices

Three elements are measured to assess whether farmers are applying the basics of improved farm management namely: record keeping of agricultural operations (Questionnaire item 5.1.1), bookkeeping of production-related expenses (Questionnaire item 5.1.2), and record keeping of the harvested production and value of sales (Questionnaire item 5.1.3).

Table 31: Number of farmers recording of agricultural operations

Districts	No record	Recorded	Recorded in detail	Grand Total
Sangthong	38	1	1	40
Pak Ngum	89	6	5	100
Phonhong	17	3		20
Kasi	195	4	1	200
Vangvieng	119	1		120
Viengkham	20			20
Lao Ngam	253	4	3	260
Thateng	97	3		100
Paksong	152	5	3	160
Grand Total	980	27	13	1020

The number of farmers keeping record of agricultural operations is 40 persons or 3.9% over the sample of 1,020 farmers

Table 32: Number of farmers recording of agricultural expenses

Districts	No record	Recorded	Recorded in detail	Grand Total
Sangthong	39	1		40
Pak Ngum	85	11	4	100
Phonhong	15	5		20
Kasi	189	10	1	200
Vangvieng	115	5		120
Viengkham	18	2		20
Lao Ngam	246	12	2	260
Thateng	98	2		100
Paksong	145	9	6	160
Grand Total	950	57	13	1020

There are 70 farmers in the sample who mentioned keeping record of agricultural expenses (6.9% of the sample)

Table 33: Number of farmers recording of harvest figures and sales

Districts	No record	Recorded	Recorded in detail	Grand Total
Sangthong	34	6		40
Pak Ngum	81	16	3	100
Phonhong	17	3		20
Kasi	186	14		200

Vangvieng	108	11	1	120
Viengkham	18	2		20
Lao Ngam	226	27	7	260
Thateng	90	8	2	100
Paksong	135	18	7	160
Grand Total	895	105	20	1020

As shown in the table above, there are 125 farmers out of 1,020 interviewed who have kept record of harvested quantities and sales, or 12.2% of the sample.

The survey confirmed that farmers generally do not keep record of farm operations, expenses related to production or harvested figures and sales.

Table 34: Farmers' records keeping

Record Keeping of	No record	Recorded	Recorded in Detail	Total sample
Farm operations	980	27	13	1,020
Farm Expenses	950	57	13	1,020
Harvest and sales	895	105	20	1,020

The results above indicate that record keeping at farm level is still the exception. The efficiency of efforts to introduce basic business/farm management literacy to smallholder farmers in rural areas has to take in account social parameters such as the low level of education and specificities of each ethno-linguistic group. In rural communities, decisions related to commercial production and market linkages may not always be based on rational factors such as economic calculations (production costs, expected profits).

SI-7 Number of organizations that applied improved techniques and technologies as a results of USDA assistance

Farmers' organizations (production groups, water user groups, etc.) are a key feature of the national extension approach for agriculture. Establishing farmers' groups is a common approach to deliver public extension services (promotion of model farmers, demonstrations and training) and provide support through donor's funded projects. Production groups that have demonstrated capacity to produce commercial crops and have adequate management capacity are to be further supported to be registered as agricultural cooperatives. However, there are very few examples of agricultural cooperatives being established.

In the project area, only 12% (127/1020) of the respondents mentioned that there is a production group in their village out of which less than half is a member of the group (51/127 respondents).

The focal group discussion confirmed the relatively low occurrence of farmers groups (26%): among the 23 villages, only 6 have at least one group organization for various purpose (water users' groups for irrigation, women weaving groups, etc.).

SI-11 Total Increase in installed storage capacity as a result of USDA assistance

Most of the respondents don't have storage capacity for perishable and bulky products such as cabbage and citrus. Only one respondent in Viengkham District has a cold tank to store Chinese cabbage. A few producers of sacha inchi and cardamom can store their product after drying, mainly in wooden store on stilts (traditionally used to store paddy) or in spare rooms inside the house. The focal group discussion confirmed the lack of storage at village level in all cases.

Table 35: Storage capacity at farm level

Selected crops	Respondent with Storage	Wooden store	In the house
White Cabbage	-		
Chinese cabbage	1%		
Pepper			
Sacha inchi*	6%*	3 (100%)	-
Lime*	1%		
Orange*	-		

Cardamom	11%	9 (75%)	3 (25%)
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(*) Data for sachu inchi, lime and orange from commercial and semi-commercial farmers only. Production for self-consumption is excluded

Because of the absence of appropriate storage capacity, farmers sell their products soon after harvest to avoid further loss of quality. Developing smallholders' storage capacity seems like an obvious improvement. Such investment however is beyond the farmers' investment and management capacity and would prove ultimately unprofitable. Storage facility established at farmers' group level would be difficult to operate and maintain efficiently without intensive training and capacity building. The private stakeholders further downstream the value chain (buyers, traders, wholesalers), are best positioned to engage in such investment, providing that they can access value chain financing or can access affordable credit facilities.

Half the producers of cardamom dry the fruit by exposing to fire heat (50% of the respondents) and 34% of the respondents sold the fresh cardamom pods without drying. The remaining 15% did not have any production in 2017. The cardamom producers reported a ratio dried fruit / fresh fruit of about 80% on average.

Sun drying sachu inchi fruits after harvest is the most common practice (65% of respondents). Other respondents dried the fruit in the shade (4%), while 18% of the respondents did not dry the fruit (although some mentioned the fruits dried on the vine before harvest) and the remaining did not have any production in 2017. Weight ratio (dried/fresh fruits and nut/fruit) reported by respondents are not consistent. This may be because the farmers are not familiar with this production yet.

Lack of storage capacity remains a key constraint for value adding of the selected commodities. The focal group discussion confirmed that there is no storage capacity at village or farmers' group levels. The products are kept in the house or sold immediately after harvest. Traders can take advantage of the lack of storage capacity by applying arbitrary quality criteria when supply exceeds demand. However, promoting the increase of storage facilities at village or group level is conditioned by the level of commitment and capacity of the village or group committee to manage, operate and maintain such infrastructure.

SI-13 Value of sales by project beneficiaries

The value of sales per household in the sample for each commodity was determined based on item 14 in each crop questionnaire. The results are presented for each commodity and per district.

Table 36: Average value of sales per respondent in the HH survey sample (in Kips / HH)

Districts	White cabbage	Chinese Cabbage	Sachu inchi	Lime	Orange	Cardamom
Sangthong		250,000	2,527,176	75,556		
Pak Ngum	3,850,000	1,360,000		17,949		
Phonhong			-	-		
Kasi	6,210,000	732,375	778,667	3,340,180	4,249,655	
Vangvieng	285,385	279,333	333,333	6,042,037	25,909,302	
Viengkham		537,500	-	44,444		
Lao Ngam		91,176	161,429	49,105		2,200,500
Thateng		36,000	432,000	37,000		8,066,250
Paksong	14,380,214	11,210,407	464,839	34,884	239,474	10,403,750
Average	9,914,738	5,100,344	883,639	1,421,651	8,133,169	7,326,296

Table 37: Average value of sales per respondent in the HH survey sample (in USD* / HH)

Districts	White cabbage	Chinese Cabbage	Sachu inchi	Lime	Orange	Cardamom
Sangthong		\$31	\$312	\$9		
Pak Ngum	\$475	\$168	\$-	\$2		
Phonhong						
Kasi	\$767	\$90	\$96	\$412	\$525	
Vangvieng	\$35	\$34	\$41	\$746	\$3,199	

Viengkham		\$66		\$5		
Lao Ngam		\$11	\$20	\$6		\$272
Thateng		\$4	\$53	\$5		\$996
Paksong	\$1,775	\$1,384	\$57	\$4	\$30	\$1,284
Average	\$1,224	\$630	\$109	\$176	\$1,004	\$904

(*) 1USD = 8100 Kips

The pepper producers interviewed during the survey did not have any sale yet.

The combined value of sales by all respondents includes all types of farmers: commercial, semi-commercial farmers as well as farmers who produce primarily for household consumption. The results are summarized below.

Table 38: Combined value of sales by survey respondents

Selected crops	Nb. of respondents	Value in Kips	Value in USD
White cabbage	160 HH	LAK 1,586,358,000	\$ 195,847
Chinese Cabbage	125 HH	LAK 637,543,000	\$ 78,709
Pepper	5 HH	-	-
Sacha inchi	83 HH	LAK 73,342,000	\$ 9,055
Lime	447 HH	LAK 635,478,060	\$ 78,454
Orange	183 HH	LAK 1,488,370,000	\$183,742
Cardamom	106 HH	LAK 563,470,000	\$69,564
Grand Total	1,109 HH	LAK 4,984,561,060	\$ 615,371

The combined value of sales by survey respondents amount to almost 5 billion Kips (USD 615,371). The value of sales of white cabbage and orange amounts to about 1.5 billion Kip each. Chinese cabbage and lime contribute about 635 million Kip each, while value of sales of sacha inchi amounts to 73 million. There was no recorded sale of pepper among the 5 interviewed pepper producers.

The estimate for this indicator was computed based on the Sampling Guide for Beneficiary-Based Surveys (USDA, Feb 2016) and in accordance with guidelines for the two-stage cluster sampling design option. As for the previous indicator, the sampling weight is calculated as follow for each one of the crops.

Overall sample weight: $w_{ij} = 1 / f_{ij} = 1 / f_{1i} * f_2 = (m/M) * (b_i / B_i)$

Where: m: number of villages to be selected (51)

M: number of villages in the sample frame (222)

b_i : Total number of farmers selected for sampling in a given village i (=20 farmers)

B_i : Total number of farmers in village i

Table 39: Indicator estimate (value of sales, in USD)

Selected crops	Nb. of respondents	Value of sales in USD	Calculated Indicator estimate in USD
White cabbage	160 HH	\$ 195,847	\$8,047,652
Chinese Cabbage	125 HH	\$ 78,709	\$3,451,081
Pepper	5 HH	-	-
Sacha inchi	83 HH	\$ 9,055	\$295,878
Lime	447 HH	\$ 78,454	\$1,095,429
Orange	183 HH	\$183,742	\$2,806,104
Cardamom	106 HH	\$69,564	\$2,494,921
Grand Total	1,109 HH	\$ 615,371	\$18,191,065

The proposed baseline value of sales is USD 18,919,065 and when disaggregated by commodity, the proposed baseline values for each selected crop are:

- White cabbage - USD 8,000,000
- Chinese cabbage - USD 3,450,000
- Sacha inchi - USD 300,000
- Lime - USD 1,100,000
- Orange - USD 2,800,000

- Cardamom - USD 2,500,000

Therefore, Life of Project (LOP) targets should be defined for each individual commodity. It is proposed to envisage an increase of 30% in the value of sales achieved through a combination of key project interventions: (i) improved production and post-harvest practices including innovative approaches such as climate smart agriculture and renewable energies; (ii) quality compliance and certification of agricultural products; (iii) improved plant protection practices (iv) better access to regional and high-value domestic markets; (v) encourage investment in the target value chains.

The above figure is based on farmers' recall as most of the farmers do not keep written records of value of sales.

The focal group discussion provided an interesting insight into how the value of sales are recorded at village level. In most of the time the record will be related to the main commercial crop such as paddy or coffee. The selected crops are mostly considered as secondary commercial crops provided complementary income. The following information was mentioned in the discussion:

In Ban Namon Niya, Kasi District the value of paddy sold in 2017 reached almost 700 million kips (USD 80,000) in 2017 for the whole village, while value of other crops sold amounted to 443 million kips (USD52,000).

Producers of cabbage and citrus have reported that quality grades generally apply only in peak production season. At time of production shortage, buyers tend to maximize aggregated volume to supply the market demand further downstream the value chain.

Grades are generally applied arbitrarily by the buyer and no clear quality grade specifications are available to the farmer. Information on quality requirements is provided orally by the buyers and may differ from one buyer to another and from one season to another.

Information on price received by producer for each quality grade is summarized below.

Table 40: Reported prices for each quality grade at aggregation stage (in Kips / Kg)

Selected crops	Grade 1- Av. Price	Grade 2- Av. Price	Grade 3- Av. Price
White Cabbage	1,381	914	-
Chinese cabbage	2,337	1,500	-
Sacha inchi	No grades applied		
Lime	4,169	1,921	700
Orange	7,177	5,649	4,470
Cardamom	29,483	19,667	-

Prices vary greatly from grade to grade. Generally, only two grades apply: first and second level grades. Prices for grade 3 above were reported by a few producers only. Citrus farmers tend to complain more than producers of other commodities about how quality grades are applied.

The participants in focal group discussions mentioned the typical price for the selected commodities:

Paksong cardamom: 40,000 – 60,000 kips/kg for dried cardamom and 2,000-6,000 kips / kg for fresh cardamom

Chinese cabbage: 250 -1000 kips / kg in the southern region, 1000-2000 kips / kg in Vangvieng (Phonexay Village)

White cabbage: 250 – 1000 kips / kg in the southern region, 2,000-3,000 kips / kg in Vangvieng (Phonexay Village)

Orange: 4,000 – 8000 kips / kg in Kasi and Vangvieng

Lime: up to 4,000 kips / kg for fruits with good aspect, but only 1,000 – 2,000 kips / kg for fruits with average visual quality

Sacha inchi: 6,000 and up to 12,000 kips / kg (shelled, nuts) but 0 kips/kg was mentioned as a reference to buyers not showing up at harvest. In Ban Phathao, Vangvieng District, production is restarting after a request from local traders for this product, confirming the volatility of the local demand and therefore price uncertainties.

As shown above, price reported by participants to group discussion can vary widely and there is a tendency to over-report prices.

The prices and grades mentioned above also provide a basis to explain the value of sales. For instance, there are noteworthy prices differences between white cabbage and Chinese cabbage, as well as between lime and orange.

SI-14 Volume of commodities sold by project beneficiaries

The table below shows the average volume of sales per HH, for each crop disaggregated by district.

Table 41: Average volume of sales per survey respondent (in Metric Ton)

Districts	White cabbage	Chinese Cabbage	Sacha inchi	Lime	Orange	Cardamom
Sangthong	1.13	0.04	0.12	0.06		
Pak Ngum		0.33				
Phonhong						
Kasi	3.26	0.33	0.06	1.07	0.69	
Vangvieng	0.11	0.10	0.03	2.07	3.50	
Viengkham		0.05		0.02		
Lao Ngam		0.03	0.02	0.01		0.08
Thateng		0.01	0.02			0.44
Paksong	19.75	9.27	0.05	0.01	0.02	0.60
Average	11.57	4.10	0.06	0.47	1.15	0.43

The information above confirms that cabbage producers in Paksong District are able to sell higher volumes than in other districts: close 20 metric tons of white cabbage and more than 9 tons of chinese cabbage. Volume of sales is much smaller in other districts. For citrus, producers in Kasi and Vang Vieng District are the districts where farmers are able to sell higher volumes than in other districts. Volume of sales of cardamom are highest in Paksong and Thateng districts and rather small in Lao Ngam.

Typical quantities of commodities produced by households were mentioned during focal groups discussions provide an idea of the farmers' perception on crop production. The following figures were mentioned in some of the group discussions:

Cardamom: few hundred kg and up to 2 metric tons / family / year

White Cabbage: up to 12 metric ton / year / family

Chinese cabbage: 300 kg and up to 1 metric ton / family / year

Orange in the south: 1-2 ton / family / year

Lime: 150 – 500 kg / family / year

Sacha inchi: 120-500 kg dry / family / year

In villages where farmers are engaged in cabbage production as the main source of income, production per family can be much higher: the group discussion in Ban Sepian, Paksong District mentioned that white cabbage production can reach 120 metric ton / year (2 crop cycles or more) and Chinese cabbage 20 metric ton / year (2 crop cycles or more). Whether these are realistic numbers is questionable, but it provides an idea of the village committee perception on production capacity for crops produced for commercial purpose, while quantities produced for local consumption are not mentioned but far from negligible.

ing districts are also able to produce much higher commercial surpluses than in other districts. Volumes of sacha inchi sold are relatively limited in all districts except in Sangthong (more than 100 kg). Volume of cardamom sold is of 0.43 tons on average in the three southern districts.

The data in the table below combines volume of commodities sold by all types of households: commercial, semi-commercial farmers as well as farmers who produce primarily for household consumption.

Table 42: Combined volume of sales by survey respondents (in Metric Ton)

Selected crops	Nb. of respondents	Volume of sale in MT	In % of total
White cabbage	160 HH	1,852	65%
Chinese Cabbage	125 HH	512	18%
Pepper	5 HH	-	-
Sacha inchi	83 HH	5	-
Lime	447 HH	210	7%
Orange	183 HH	210	7%
Cardamom	106 HH	45	2%
Grand Total	1,109 HH	2,834 MT	100%

The total combined volume of sales is of 2,834 metric tons. White cabbage contributes to two third of the total volume of sales by survey respondents. Citrus (lime and orange) contribute to 7% of the total volume and cardamom to 2%. Pepper and sacha inchi do not have significant contribution to the current volume of sales.

The estimate for this indicator was computed based on the Sampling Guide for Beneficiary-Based Surveys (USDA, Feb 2016) and in accordance with guidelines for the two-stage cluster sampling design option. The sampling weight is calculated as follow for each one of the crops.

Overall sample weight: $w_{ij} = 1 / f_{ij} = 1 / f_{1i} * f_2 = (m/M) * (b_i / B_i)$

Where:

- m: number of villages to be selected (51)
- M: number of villages in the sample frame (222)
- b_i : Total number of farmers selected for sampling in a given village i (=20 farmers)
- B_i : Total number of farmers in village i

Table 43: Indicator estimate (volume of commodity sold, in MT)

Selected crops	Nb. of respondents	Volume of sale in MT	Calculated Indicator estimate in MT
White cabbage	160 HH	1,852	79,060
Chinese Cabbage	125 HH	512	22,623
Pepper	5 HH	-	-
Sacha inchi	83 HH	5	171
Lime	447 HH	210	2,866
Orange	183 HH	210	3,410
Cardamom	106 HH	45	1,760
Grand Total	1,109 HH	2,834 MT	109,890 MT

The proposed baseline volume of commodity sold is 109,890 metric tons. When disaggregated by commodity, the proposed baseline values for each selected crop are rounded as follows:

- White cabbage - 79,000 metric tons
- Chinese cabbage - 23,600 metric tons
- Sacha inchi - 170 metric tons
- Lime - 2,900 metric tons
- Orange - 3,400 metric tons
- Cardamom - 1,800 metric tons

To reach the target volume of sales, the CLEAN project will aim at a 30% increase of volume sold achieved through a combination of key project interventions: (i) improved production and post-harvest practices including innovative approaches such as climate smart agriculture and renewable energies; (ii) quality compliance and certification of agricultural products; (iii) improved plant protection practices (iv) better access to regional and high-value domestic markets; (v) encourage investment in the target value chains

Losses at harvesting time are significantly high, ranging between 9% and 14% of the gross harvested quantity for cabbage, orange and cardamom. In the case of lime, losses of almost one third are reported: lime trees produce year-round but outside the peak production time (January / March) a large part of the fruits do not meet market quality (small fruit, premature fall, insect damage, etc.)

Table 44: Post-harvest loss and self-reported gross yields

Selected crops	Harvest Loss (kg)	Loss in %	Av. harvested quantity (kg / HH)	Gross yield (Kg / ha)	Post-harvest loss (Kg)	In %	Loss during transport (Kg)	Distance to selling point (km)
White Cabbage	1,211	9%	13,159	55,431	1,138	9%	80	35
Ch. cabbage	628	14%	4,524	38,642	316	7%	24	15
Sacha inchi*	10	2%	453	1,182	29	6%	0	1
Lime*	962	32%	2,988	7,409	53	2%	1	1
Orange*	288	13%	2,195	3,262	22	1%	1	14
Cardamom	130	12%	1,094	1,074	2	0%	-	2

(*) Data for sachu inchi, lime and orange from commercial and semi-commercial farmers only. Production for self-consumption is excluded/

Post-harvest losses are also important for cabbage and sachu inchi (6-9%) but less problematic for citrus and cardamom (0-2%). Loss during transport from the field to the selling point is relatively limited.

SI-16 Number of individuals who have received short-term agricultural productivity or food security training as a result of USDA assistance

The conclusions hereunder are derived from data collected through the General Section items 5.1.4 – 5.1.10 of the HH questionnaire. Overall, only 279/1,020 respondents (27%) have received some training: 17% formal training, 7% on-the-spot training and 3% both.

Table 45: Farmer's attendance to training

Districts	Never attended a training	Formal training	Formal training and On -the -job training	On the job training	Don't know	Grand Total
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Sangthong	15	15	4	5	1	40
Pak Ngum	45	27	11	14	3	100
Phonhong	11	6	1	2		20
Kasi	139	35	2	23	1	200
Vangvieng	97	14	1	8		120
Viengkham	16	1		3		20
Lao Ngam	198	38	7	14	3	260
Thateng	79	12	4	2	3	100
Paksong	130	21	4	5		160
Grand Total	730	169	34	76	11	1020

The focal group discussions confirmed that trainings are provided to a limited audience: only 26% of the villages mentioned that training related to production, post-harvest or market linkages were provided to farmers. This percentage is in line with the household survey finding summarized above (27% of respondents). On average, farmers attended 4 training sessions. Farmers in Pak Ngum received an average of 6 trainings while in Viengkham they attended only 2 sessions. Trainings were generally conducted within the past 4 years.

Table 46: Average number of training farmers attended and year

Districts	Average # of attended training sessions	Year attended training (Av.)
Sangthong	3.2	2015
Pak Ngum	6.2	2017
Phonhong	3.0	2015
Kasi	3.4	2015
Vangvieng	3.9	2011
Viengkham	2.0	2017
Lao Ngam	3.8	2011
Thateng	2.2	2013
Paksong	4.7	2015
Grand Total	4.1	2014

Trainings were conducted by: DAFO (58%), Project staff (35%), Agribusinesses (12%), Farmers (5%), Trader/buyer (1%), Input supplier (1%). Small traders and input suppliers have had a limited role in providing training to farmers. However, they have regular interactions with producers and therefore may have in-depth understanding of farmers' constraints and aspirations.

Training needs show that selling agricultural products remains a priority issue for the farmers, with 29% requesting training on marketing. Other training topics ranked by importance were: organic fertilizers (10%), Pest control (9%), Seeds (7%) and Chemical fertilizers (6%). About 6% of the respondents said that they do not need any training.

CI-1 Yield per hectare (kg/ha) per target commodity type

Data from the Household Survey was used to compute crop productivity expressed in Kg / ha. The cumulated cropped area (in ha) and production (in Kg) were used to determine an average yield, as summarized below. The computed average yields are compared with self-reported gross yields.

Table 47: Estimated crop productivity

Selected crops	Self-reported Gross yield (Kg per Hectare)	Combined production (in Kg)	Cumulated area (Ha)	Computed yields (Ton /Ha)
White Cabbage	55,431	2,105,413	70.35	29.93
Chinese cabbage	38,642	565,506	25.05	22.57
Sacha inchi*	1,182	22,165	34.22	0.65
Lime*	7,409	212,156	42.46	5.00
Orange*	3,262	212,874	61.66	3.45
Cardamom	1,074	78,622	73.2	1.07

(*) Productivity average for commercial production, excluding individual citrus trees or sacha inchi plants maintained mainly for self-consumption

Data above represent average over very different situations and cropping conditions. There are subject to caution as they rely on information provided by producers for last year crop cycle.

Differences between self-reported yields and computed yields are explained by unreliable data reported by producers (areas in particular). However, computed yields might provide a more realistic estimate of crop productivity. It is to be noted that there are no yield statistics available for these crops, neither a national level (MAF) nor at district level.

CI-2 Number of agricultural input suppliers/firms that sell or supply improved inputs as result of USDA assistance

There are little alternative options for farmers to receive support and technical advice when needed. Most of the respondents (82%) said they receive no support or advice from their input supplier. Only 6% of the respondents said they can buy inputs on credit from the supplier, 12% receive some technical advice from the supplier when buying inputs and 12% receive advice on marketing of agricultural products.

Farmers engaged in commercial production of annual crops such as cabbage have relatively frequent interaction with their input supplier for seeds (hybrid seeds produced in Thailand and Vietnam and bought in tin cans), chemical fertilizers and pesticides. The suppliers are generally established at district or provincial town centers. For other crops where home-saved seeds are used, the farmers generally avoid using inputs and therefore have little relation with input suppliers and retailers shop owners. During focal group discussions, it was confirmed that farmers would go and buy inputs if necessary, and that they trust the quality of seeds or fertilizers is acceptable. There is generally little choice in the product offered by input retailers. In other cases, farmers would buy inputs from mobile suppliers that offer a more diverse range of product but provide no advice on application protocol. These informal retailers are not well identified, and sometime sell prohibited or expired products.

In regard to access to information, 36% of the respondents said they had received information related to agricultural production from various sources other farmers (13%), relatives (5%), DAFO (6%), Farmers Group (4%), TV/radio (2%), internet (0.4%). Information received was related to production (22%), crop pest and disease (15%), weed control (10%), market prices (10%).

Mobile phones are another alternative to access information (used by 80% of the respondents), in particular if connected to the internet. However, less than 10% of the respondents use a smart phone with connection capacity.

In order to increase service delivery to farmers, involving input suppliers and small traders as partners in the project could prove beneficial to disseminate technical advice on good practices, improved techniques and market information. Identification of reliable well identified and formally registered businesses might prove challenging. Some of the input suppliers and traders are informal businesses looking for short-term opportunities, discouraging potential investors who wish to engage in more long-term business partnerships with producers.

CI-3 Number of agreements signed between buyers and sellers

The key finding drawn from the household survey is that relatively few farmers are engaged in formal contract farming (4 /285 farmers in Cabbage VC). Interest in formal marketing arrangement depends on VC: two thirds of respondent in Cabbage VC but less than half in Citrus VCs.

Table 48: Contract farming status for the selected crops

Selected crops	% of Respondents engaged in contract farming	% of Respondents interested in entering in formal contract farming arrangement
White Cabbage	1%	42%
Chinese cabbage	-	57%
Sacha inchi	11%	64%
Lime	1%	52%
Orange	-	42%
Cardamom	4%	68%

Information above confirms that very few farmers are engaged in formal contract farming. Such commercial arrangements have been formalized for sachu inchi production in the past, but this has not prevented both parties to breach contract terms: side-selling on the producers' side have been reported as well as investors who failed to buy the production from farmers. These reports indicate that informal arrangements are the norm in the upstream of the selected value chains, hampering efforts to establish a reliable production base and preventing potential private investments to materialize in these value chains.

During focal group discussions, it appeared that producers and village authorities generally sell their products to informal traders. Farmers and village committee members don't have the names and contact details of the traders. This tends to indicate opportunistic behavior on the side of traders who avoid being committed by buy product from farmers. Interestingly, in the case of Ban Thongkalong, Paksong District, where most of the households are engaged in cabbage, the village committee know the names and phone number of two traders for cabbage, but not for other commodities (sachu inchi, citrus).

The percentage of farmers expressing their interest in entering into formal production agreements (ranging from 42% to 68% in the table above), indicates that securing market access remains an important condition to further specialize or increase production of a specific crop. In that respect, producers of sachu inchi and cardamom may be the ones facing the most pressing marketing issues.

Table 49: Problems faced by farmers in marketing of the crops (in % of respondents)

Selected crops	Unsold production	Quality grades	Selling price drop	Other issue
White Cabbage	72%	9%	21%	23%
Chinese cabbage	34%	2%	13%	38%
Sachu inchi	28%	2%	28%	54%
Lime	52%	17%	18%	45%
Orange	26%	13%	5%	70%
Cardamom	79%	6%	0%	26%

Key issues mentioned by the respondents vary depending on the crop: for white cabbage and cardamom, unsold production was mentioned by more than 70% of the respondents. Overproduction remains a key problem in both value chains, as well as in the lime value chain. Quality grades seem to be more problematic for producers of citrus than for other crops. Traders tend to apply more stringent quality grades for citrus at time of peak production.

A major issue mentioned by orange producers (70% of respondents) is that production is limited and cannot meet market demand. Production areas are expanding. Price fluctuation was mentioned as an issue more often by farmers producing white cabbage (21%) and sachu inchi (28%) than other crops. Reliability was mentioned repeatedly when respondents were prompted to make suggestions on how to improve marketing of their product: stable price and secured selling of the product are farmers' priorities.

CI-4 Number of government officers and auditors trained in internationally recognized quality standards and food safety

As part of the current agriculture sector development strategy, the Ministry of Agriculture and Forestry promote Good Agricultural Practices and Sanitary and Phytosanitary measures. The current Good Agriculture Practices on Food and Safety Management currently used are based on ASEAN GAP standard as stated in the Decision of the Minister on Good Agriculture Practices for Food Safety Standard ref 115 dated 27/01/ 2011 and related decisions. The Lao Certification Body (LCB) under the Standard Division of the Department of Agriculture of MAF is responsible for Clean Agriculture Certification (GAP and organic) in accordance with the ISO/IEC 17065 standard. The human resources for evaluation and inspection are regular staff of the Standard Division, personnel of the Clean Agricultural Development Center, and Provincial Agriculture Section. In addition, the LCB can hire contractual staff to support the inspection and certification functions. As the Quality Management Manual for clean agriculture certification is very recent (dated April 2016), it is proposed to set the baseline as zero for the indicator:

CI-4 Number of government officer and auditors trained in internationally recognized quality standards and food safety.

CI-7 Number of farmer organizations meeting GAP and SPS requirements

Information derived from the section 5.5 of the household questionnaire show that farmers' awareness on GAP and SPS is limited and vary from one direct to another.

Table 50: Farmers' awareness of GAP and SPS requirements

Districts	Familiar with GAP	Familiar with SPS
Sangthong	3%	3%
Pak Ngum	9%	8%
Phonhong	2%	2%
Kasi	19%	18%
Vangvieng	11%	10%
Viengkham	2%	2%
Lao Ngam	27%	29%
Thateng	10%	11%
Paksong	16%	17%

Overall, awareness about SPS is higher than GAP: 18% vs. 14% of all respondents in the survey. The enumerators team provided the respondent with a short definition of both acronyms, but the above results are to be considered as indicative, as they seem somewhat counterintuitive.

The focal group discussions confirmed low exposure of farmers and village authorities to GAP and SPS standards requirements. Only 4 villages over 23 (17%) have received information in GAP and SPS, mainly through DAFO and project-funded interventions.

The CLEAN project result framework does not include any indicator on farmers' access to credit. However, at questionnaire design stage the CLEAN project Monitoring, Evaluation and Learning consultant required that a section on this aspect to be included in the questionnaire. As per analysis of item 5.2 of the HH questionnaire related to credit, only 12% of the respondents mentioned that they have borrowed funds in 2017 for agricultural production. The main sources of credit are: loan from a Public Bank (52%), loan from the Village Development Fund (25%) and from a Private Bank (12%). On average respondents borrowed 11 MLAK, mainly to buy agricultural inputs (87% of the cases), agricultural equipment (50%) and to hire labor (54%). Regarding solvency perceptions, 73% of respondents who borrowed funds felt they would be able to repay their loan. Average interest rate at which respondents borrowed is of 1.18% per month or 2.16% p.a. Family debt remains a sensitive topic in rural communities and answers above are subject to due caution.

The focal group discussion also confirmed that access to finance remains a constraint. Almost 80% of the villages where focal group discussions were conducted (or 18/23 villages) mentioned that finance can be accessed from Village Development Funds, but available lending capital is limited and insufficient. Amounts of loans taken by farmers are too small to invest in productive activities, in particular to acquire production and post-harvest equipment (machinery, irrigation equipment, storage, etc).

Detailed Findings Related to Household Characteristics

Household Characteristics

The 1,020 surveyed households have an average size of 5.94 members out of which 3.4 persons on average are directly involved in agricultural production. The average household size in the sample is higher than in National Census (5.20 people / HH).

Table 51: Average household size, members involved in agricultural production

Province	District Name	Average HH size	Average HH size	HH member involved in agriculture
		National population census (2015)	CLEAN baseline survey (2018)	CLEAN baseline survey (2018)
Vientiane Capital	Sangthong	4.67	5.58	3.43
	Pak Ngum	4.81	5.40	3.19
Vientiane	Phonhong	4.09	5.30	3.05
	Kasi	5.05	5.84	3.08
	Vangvieng	5.31	6.48	3.57
	Viengkham	4.26	5.85	3.10
Salavan	Lao Ngam	5.76	6.04	3.65
Sekong	Thateng	5.73	6.85	3.90
Champasak	Paksong	5.17	5.43	2.94
5 provinces	9 districts	5.20	5.94	3.36

In three districts (Vangvieng, Lao Ngam and Thateng), there are more than 6 members per household on average and agricultural production involves more than 3.5 people per household on average.

Occupation

Respondents are in majority farmers (97%). Farming is the only occupation for 81% of the respondents while 16% of the respondents combine farming with another occupation: small commerce (7%), civil servant (6%), worker / wage laborer (2%) and police or army (1%).

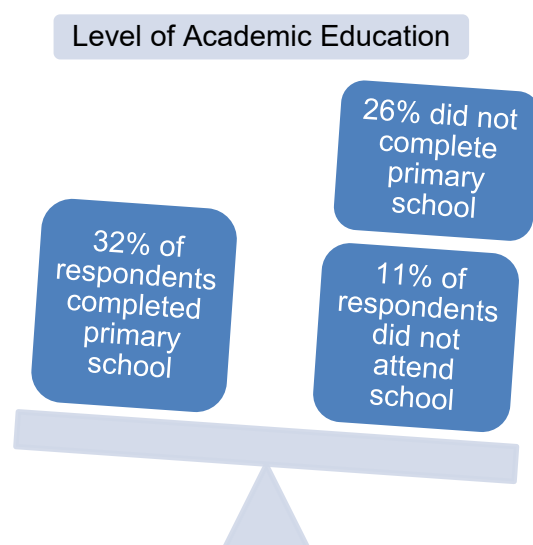
Table 52: Respondents' occupation

Occupations	In % of total respondents	Number of survey respondents	Respondent's spouse
Civil servant	-	4	3
Farmer	81%	828	749
Farmer and civil servant	6%	65	63
Farmer and commerce	7%	69	64
Farmer and police/army	1%	6	6
Farmer and business	-	4	3
Farmer and worker	2%	21	20
Farmer and student	-	3	-
Commerce	-	4	3
Police/army	-	1	1
Worker	-	1	1
Student	-	1	-
No occupation / n.a.	1%	13	6
Grand Total	100%	1020	919

Education level

Farmers' education level is an important aspect to be taken in account by the project when attempting to introduce improved farm management practices (record keeping for instance) or production standards (Good Agricultural Practices requirements). Low education level represents a constraint for farmers to understand and record structured information. About a third of the respondents had completed primary school and on the other hand, 11% did not attend school. The chart below summarizes the average education level of respondents.

Figure 3: Household survey respondents' education level



Ethno-linguistic Groups

Although the CLEAN project does not report in ethno-linguistic groups in its indicators, the baseline survey team was requested to collect such information and it was included in the questionnaire. This information may be useful to adopt adequate measures when providing support to farmers members of the Mon-Khmer and Hmong-Eiw Mien groups. The survey found out a great diversity of ethnic groups: 47% of the respondents are Lao, 13% are Yrou, 11% are Kmmu, 7% are Suay and the remaining 22% of respondents belong to 9 other ethnic groups (less than 5% of the respondents in each group). The table below shows the ethnic diversity among the survey respondents, as per the official ethno-linguistic classification.

Table 53: Respondents' ethno-linguistic group

Districts	Lao – Tay	Mon-Khmer	Hmong-Eiw Mien	Total
Sangthong	37	3	0	40
Pak Ngum	100	0	0	100
Phonhong	20	0	0	20
Kasi	86	92	22	200
Vangvieng	65	13	42	120
Viengkham	18	1	1	20
Lao Ngam	111	149	0	260
Thateng	18	82	0	100
Paksong	47	113	0	160
Grand Total	502	453	65	1020
In % of all respondents	49%	44%	6%	100%

In four target districts (Kasi, Lao Ngam, Thateng and Paksong) most of the respondents are Mon-Khmer. These districts are already well connected to the market and commercial production of cabbage, citrus and cardamom is well established. The project intends to provide support to Mon-Khmer farmers and therefore adequate measures should be taken to ensure that these farmers are involved in planning and implementation of project activities.

Access to Productive Land

Information about landholding size has been collected following the official classification that is based on the land-use type. The classification includes the following land-use categories: paddy field, garden, pasture, slash and burn land. The land-use category is indicated on temporary land use right documents, the most common form of land title in rural areas. Farmers generally do not hold full property right in the form of permanent land title. They have temporary land-use rights and they pay land tax based on the land-use category and estimated area indicated on the temporary land-use right document. Table

below describes the pattern of owned land distribution among the sample baseline survey households. The survey revealed that the average landholding in the HH sample is of 3.16 ha.

Table 54: Land holding size (in Ha)

Districts	Total land holding	Paddy field	Slash & burn plot	Garden	Pasture	Other land type
Sangthong	4.88	1.01	1.56	1.10	0.80	0.42
Pak Ngum	3.23	1.69	0.07	0.88	0.40	0.18
Phonhong	4.54	2.32	0.00	0.13	1.95	0.14
Kasi	2.40	0.92	0.13	0.83	0.44	0.09
Vangvieng	1.98	0.82	0.02	0.86	0.15	0.14
Viengkham	1.56	0.62	0.00	0.22	0.36	0.35
Lao Ngam	2.54	0.52	0.95	0.91	0.03	0.13
Thateng	4.32	0.75	0.89	2.20	0.32	0.16
Paksong	4.85	0.06	1.17	3.13	0.29	0.20
Average land size	3.16	0.75	0.61	1.34	0.30	0.16

Almost two thirds of respondents have land-use right for paddy land (61%) and one third for slash-and-burn land use type. Two thirds have land use right for gardens and 13% for pasture. Pasture and other land types have been included in the study because they are often converted and used to produce commercial crops or tree crops.

Households in Paksong and Sangthong have land-use right over relatively larger landholdings approaching 4 ha, while in Viengkham and Vangvieng, areas are of less than 2 ha. Sangthong, Pak Ngum and Phonhong districts, located in the Vientiane plain, have access to comparatively larger areas of paddy fields, a determining factor in the farming system. Also, households in Paksong have access to relatively large area of the garden land type with over 3 ha.

Only about 11% of the surveyed households rent agricultural land. They are mainly in Pak Ngum Kasi, Lao Ngam and Thateng districts. In 38% of the cases, farmers “rent” or borrow land for no fee. When a rental fee is paid, it amounts at about 2 MLAK/year on average. Land is rented for rice production in half the cases and vegetables in one third of the cases.

Importance of Selected Commodities in Survey Area

At national level, agricultural statistics such areas, production, number of producers are not available for the selected crops. At district level, agricultural statistics such as cropping areas are not systematically recorded at district level for these five crops at a few exceptions as shown below. There are no data recorded/available for pepper and sacha inchi in any of the surveyed districts.

Table 55: Partial data on cropping areas for the 5 commodities in target districts

Districts*	total area	arable land	paddy	other crops	gardens	coffee	White Cabbage	Chinese Cabbage	Lime	Orange	Cardamom
Kasi	206,238	7,399	4,198	2,812	360				68	107	
Vangvieng	167,928	9,539	6,186	2,714	639				361	224	
Lao Ngam	94,000				4,450	15,835					647
Thateng	64,260					5,798	242	122			1,822
Paksong	344,186					48,751	9,504	1,920	5	260	623
	876,612	16,938	10,384	5,526	5,449	70,384	9,746	2,042	434	591	3,092

*Source: DAFO reports 2017, (For Districts not shown above: No annual report is available)

The statistics above confirm that farming systems on the Bolaven Plateau are predominantly coffee production systems: coffee plantations cover 14% of the total area, while cabbage cover only 2.3% and cardamom 0.6% of the area. In Kasi and Vangvieng districts, farmers are predominantly rice producers and Citrus plantations cover a small percentage of the arable land area (2.4% in Kasi and 6.1% in Vangvieng). These statistics provide an overview of the agricultural land use at district level and indicate that the selected crops can be considered as secondary cash crops, providing supplementary income beside the main crop.

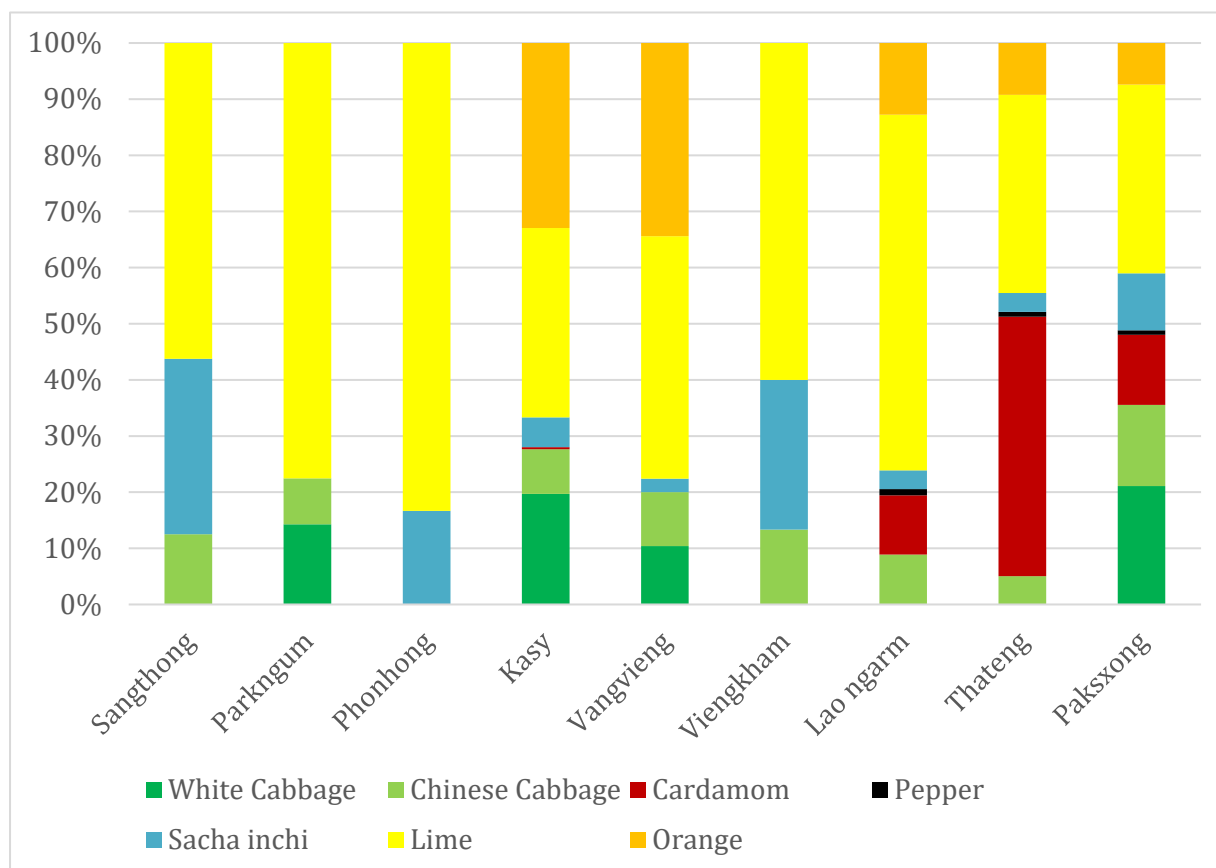
Crop occurrence (number of households producing a crop / number of households interviewed in a given district) provide an overview of the distribution of the five commodities over the surveyed area. The table below shows the percentage of farmers who grow selected crops by districts.

Table 56: Crop occurrence in the household survey sample by districts

Province	District	White Cabbage	Chinese cabbage	Cardamom	Pepper	Sacha inchi	Lime	Orange
Vientiane Capital	Sangthong		2%			13%	2%	
	Pak Ngum	6%	4%				9%	
Vientiane Province	Phonhong					5%	1%	
	Kasi	41%	21%	1%		7%	20%	48%
	Vangvieng	10%	12%			3%	12%	23%
	Viengkham		2%			20%	2%	
Salavan	Lao Ngam		16%	7%	1%	2%	26%	13%
Sekong	Thateng		6%	55%	1%	4%	9%	6%
Champasak	Paksong	43%	37%	20%	1%	16%	19%	10%
	Over HH sample	12%	10%	10%	0%	6%	44%	18%

The above table is represented in the graphic below, that shows the percentage of surveyed households that produce the selected crops in each district. When the combined percentage is higher than 100%, it means that households produce more than one crop.

Figure 4: Crop occurrence in the household survey sample by district



Occurrence of both white and Chinese cabbage production is the highest in Paksong (white cabbage 43% and Chinese cabbage 37 %) and Kasi (white cabbage 41% and Chinese cabbage 21%) districts. As evident from the table above, very few farmers (1%) grow pepper and those who produce this crop are mainly in the districts of the Bolaven Plateau.

From the household survey data, it can be assumed that white cabbage is less common than Chinese cabbage, the latter being produced in almost all districts. Chinese cabbage is more commonly used in the local food diet than white cabbage, in particular for wrap-and-roll dishes. The results show that Paksong and Kasi are leading districts in terms of cabbage production.

Cardamom is produced by more than half (55%) the households surveyed in Thateng District, showing a relative specialization compared to the two other districts Paksong (20%) and Lao Ngam (7%). Sacha inchi is present in almost all districts (produced by less than 6% of the surveyed HH), while lime is very common in all target districts. Orange (of the Citrus family) is produced mainly Kasi, Vangvieng (respectively 48% and 23% of the surveyed HH) and in a lesser extent Lao Ngam (13%) and Paksong (10%) districts. These findings may have important implications for promoting crop diversity within the CLEAN project areas. On the one hand, existing production base mentioned above can orient the project interventions in specific value chains in target districts: Cardamom in Thateng District, orange in Vangvieng and Kasi, white cabbage in Paksong and Kasi, pepper in Paksong District. On the other hand, more ubiquitous crops (Chinese cabbage, lime) can be promoted as a diversification option and complementary source of income in other districts, aiming at both production increase and market linkages improvement.

The relative importance of each of the selected crop in the farming system is reflected by its share of the cropped area. Farmers who crop white cabbage, lime or orange allocated about one fifth (20%) of their total cropped area to these crops in 2017. Other crops cover a smaller percentage of the farm cropped area: 9% for sachu inchi, 6% for Chinese cabbage and 1% for pepper. The table below provides the average area cropped by the household survey respondents in the project target area.

Table 57: Average cropped area in 2017 (in Ha / household)

	White Cabbage	Chinese cabbage	Cardamom	Pepper	Sacha inchi	Lime	Orange
Average cropped area (in Ha)	0.70	0.20	1.36	0.02	0.41	0.60	0.64
Total agricultural landholding*	3.35	3.27	4.67	3.56	4.66	3.05	3.03
Percentage of HH agricultural landholding	21%	6%	29%	1%	9%	20%	21%

(*) Average landholding owned by farmers who produced the crop in 2017. Agricultural landholding includes plot of following land use types: paddy field, shifting cultivation plot and garden

6. SITUATIONAL ANALYSIS SUMMARIES

Cabbage

Information on the total number of producers of cabbage in the project geographic area is not available. District agriculture and forestry offices do not keep records and statistics on the number of producers. Level of post-harvest loss in the cabbage value chain was estimated through data collected in the household survey. Producers of white cabbage estimated that biomass loss at harvest average 9-10%, post-harvest loss to another 9-10% and loss during transport to selling point to 1-3%. In total, post-harvest loss amounts to 19%-23%. Main reasons for post-harvest losses are: trimming practices (removal of external leaves), poor handling and transport conditions (staking of cabbage in tractor carts and poor condition of farm access track). The impact of heat accumulated in the product before and during harvest on the quality of the product is not perceived by producers and traders alike.

For Chinese cabbage post-harvest losses occur mainly just after harvest time when product affected by bacterial rot and other defects in appearance is discarded. The loss amounts to 14% on average as reported by producers in the household survey. Average post-harvest loss due to poor handling estimated at 7% on average while loss during transportation to selling point is minimal (around 0.5%). When combined, the post-harvest losses average at around 21% for Chinese cabbage.



Picture: Chinese cabbage stacked in hand-tractor cart and unloaded on the floor at selling point.

Approaches to reduce post-harvest loss are:

- (i) improve harvest practices and handling on the field directly after harvest
- (ii) reducing heat accumulated in cabbage
- (iii) improving conditions of transport to selling point
- (iv) improving handling practices at selling point.

Private sector stakeholders' incentive to invest in heat removal technology (such as hydrocooling) can only be justified if it is applied efficiently and if decreased post-harvest losses offset the investment and operation costs. In addition, improvement in packaging practices may be beneficial to the quality of the end-product. The current practice is the packaging in 12-kg plastic bag that prevent heat removal.

Producers still lack knowledge on key production aspects:

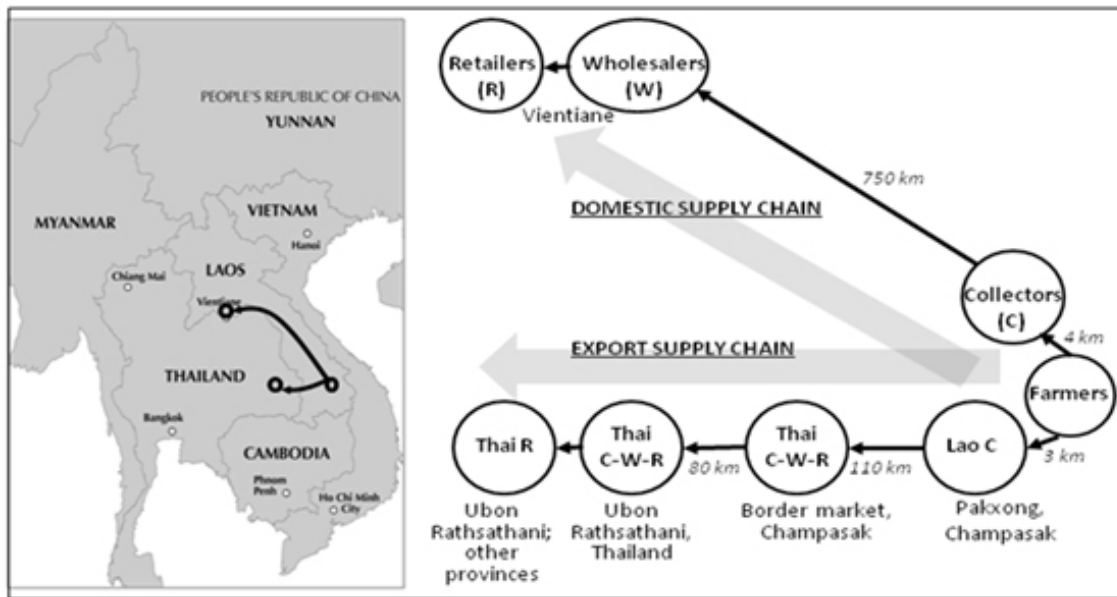
- (i) fertilization
- (ii) pest identification and control
- (iii) post-harvest handling

In addition, the producers only use inputs that are available on the market and generally have little knowledge on adequate use of commercial inputs. This is due to labelling of chemical fertilizers, pesticides and seeds in foreign language (Thai, Vietnamese), low level of education and lack of reliable technical advice. In addition, introduction of improved irrigation techniques and better access to water in dry season are key factors that can contribute to increasing production.

There were two distinct cabbage production systems in the survey area: In the Central region, cabbage is produced in paddy field after harvest of the main crop (e.g., rice). Producers can achieve two crop cycles from November to April, depending on availability of irrigation water. In the Southern region, green cabbage and Chinese cabbage is produced in dedicated gardens on the highly fertile soils of the Plateau.

Currently, the bulk of the production is transported by local traders from the collection point in the production area on the main road to the Lao/Thai border at Chong Mek, Phonthong District, Champasak province. At the border, Thai traders re-trim the cabbage, repackage in the plastic bags before transporting the commodity to the main markets in Ubon Ratchatani and Bangkok in Thailand. A small portion of the production is loaded on night passenger buses to the main domestic markets of Savannakhet and Vientiane Capital.

Figure 5: Cabbage domestic and export supply chain from Southern Laos

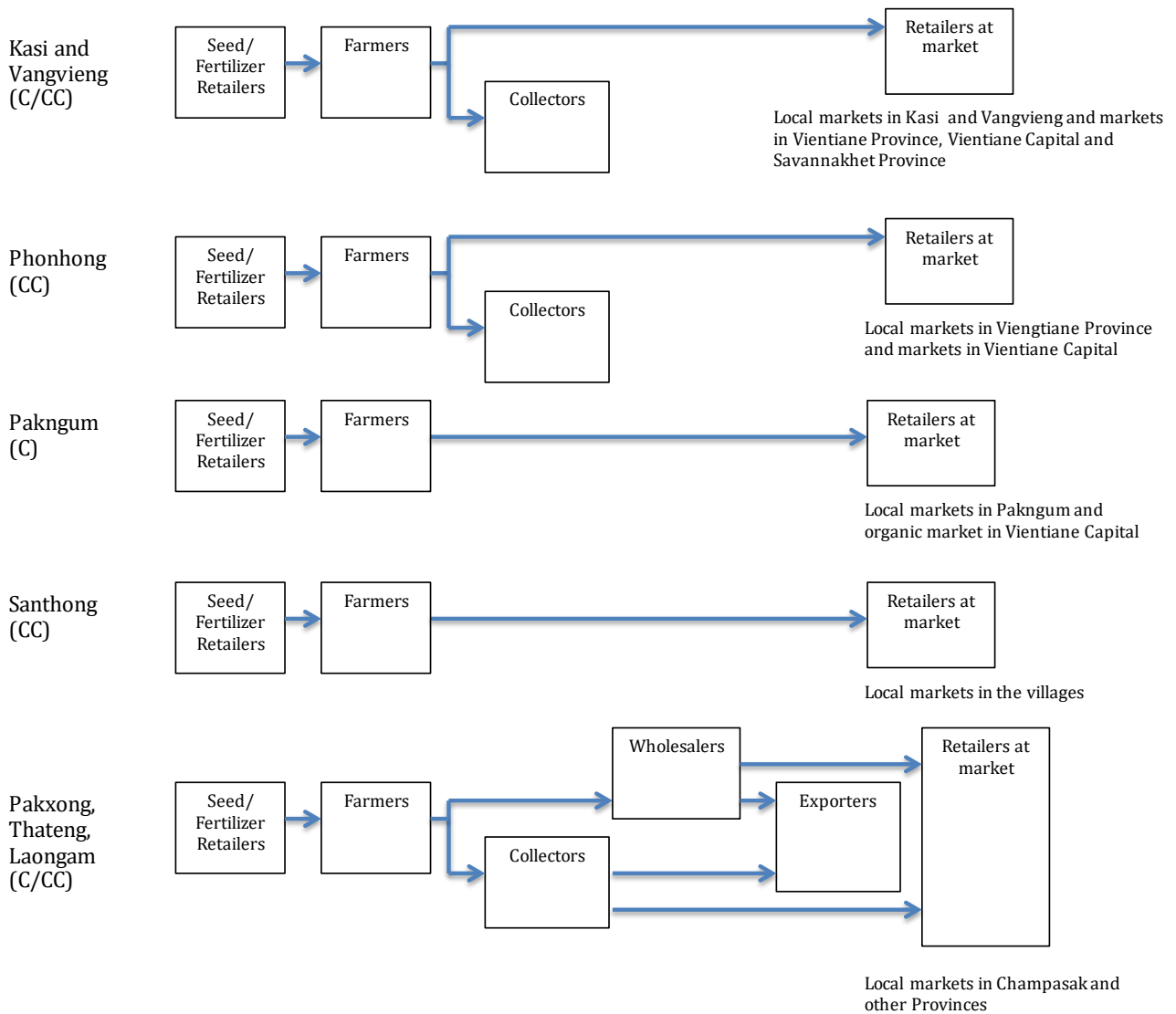


Source : Thongsavath et al. /IFRJ 19(4):1615-1620 (2012)

Discussions at village and district level confirmed that outstanding issues in the cabbage value chain remain unsolved such as: (i) producers lack capital fund to invest in machinery (pumps, tractors), (ii) high cost of transportation and limited storage capacity (iii) producers have to sell their produce immediately after harvest without any formal contractual arrangement, facing uncertain trade conditions (price, quantities) (iv) collectors face logistics constraints to transport the commodity from the collection point on the main road to the Thai border or domestic urban markets (iv) high post-harvest losses dues to physical damage during transportation, trimming and repackaging as well as bacterial soft rot.

The Cabbage Value Chains have different structures from one district to another across the target area. The diagram below shows the Value Chain mapping for white cabbage (C) and Chinese cabbage (CC)

Cabbage/Chinese Cabbage (C/CC)



Pepper

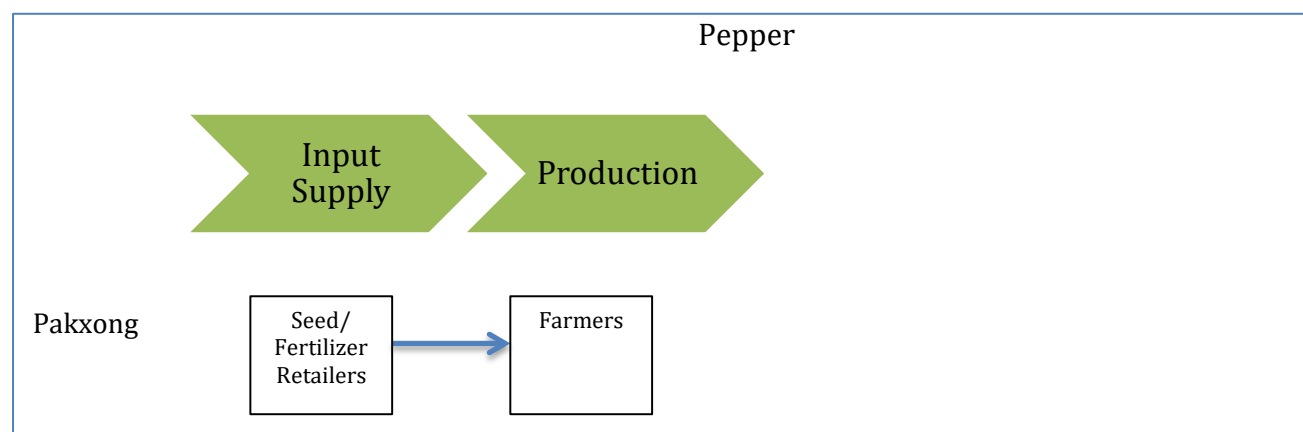
Information on the total number of producers of pepper in the project geographic area is not available. District agriculture and forestry offices do not keep records and statistics on the number of producers. Pepper being a marginal crop with very limited production and no well identified market, district officials have relatively low interest compared to major value chains (coffee, cabbage for instance).

Level of post-harvest loss are unknown. Only five pepper producers were interviewed, and pepper is generally used locally for self-consumption or sold fresh. The market for pepper is mainly in Vietnam where prices have decreased dramatically prompting a reduction in the acreage. Relying on the export market to promote commercial production of pepper might prove to be a risk-prone intervention. Risks on the production side are to be taken in account as pepper is highly sensitive to virus and bacterial diseases. Farmers' risks could be offset by promoting this crop in association with other perennials and adopting an agro-forestry approach rather than mono-cropping as witnessed in Km28 village in Paksong. There might be opportunities in developing a niche domestic market for Lao pepper for restaurants and supermarkets in Vientiane. A detailed market study would be a pre-requisite to a project intervention in this value chain.

There are knowledge gaps in access to seeds and production practices, both at district line agencies (DAFO) level and at producers' level.

The district agriculture offices in the three southern districts (Paksong, Lao Ngam and Thateng) did not have information on smallholders' production of pepper on the Bolaven Plateau. However, the study revealed that pepper is produced on the Bolaven Plateau indicating that the production is feasible. A few private ventures (such as the Khamvene in Lak28, Paksong District, a Lao family investment venture, and the Mai Savanh Farm in Thateng District) have established pepper plantations on few hectares. The Vietnamese investors have also invested in larger operations. The smallholder farmers involved in pepper production typically maintain a few plants mixed with other tree crops such as coffee, durian and other fruit trees. Unlike coffee plantations, smallholders do not seem to maintain dedicated pepper plantations.

The Value Chain pepper is still undeveloped. On the Bolaven Plateau, some farmers maintain a few plants close to their house. The fresh pepper berries are either self-consumed within the household or occasional sold in small quantities to neighbors or acquaintance.



Sacha inchi

As for other commodities, the current number of smallholders producing of sacha inchi is unknown. Information on the total number of producers of sacha inchi in the project geographic area is not available. District agriculture and forestry offices do not keep records and statistics on the number of producers. The production has followed a boom and bust pattern in the recent years, and the number of producers still involved in commercial production is likely to be marginal. Farmers who had received seeds as part of the effort to promote production may have kept a few plants for self-consumption.

Level of post-harvest losses rely on farmers' recalls for several seasons. Losses just after harvest amount to 2% on average. Post-harvest loss per se amount at 6% on average, based on data collected in the household survey. The producers did not report any loss during transport as sacha inchi fruits are relatively hard and do not suffer damage from stacking. The ratio from fresh fruits to the dried nut is about 2/1 (500 kg of nuts obtained from 1000 kg of fruits).

There are significant gaps in the knowledge smallholders have on this crop, as it is newly introduced in the Lao context. As a start, seeds are available only where farmers have kept some from previous promotion initiatives. To promote the production on a significant scale would require the sourcing of quality seeds and further distribution to producers. Farmers have little knowledge on fertility requirements, pest identification if any and effect of irrigation on productivity. Another constraint to expanding the production of sacha inchi to a commercial level would be access material and equipment to support the vines, mainly poles (wooden or concrete) and wire.

Selected crops	Harvest Loss (kg)	Loss in %	Av. harvested quantity (kg / HH)	Gross yield (Kg / ha)	Post-harvest loss (Kg)	In %	Loss during transport (Kg)	Distance to selling point (km)
White Cabbage	1,211	9%	13,159	55,431	1,138	9%	80	35
Ch. cabbage	628	14%	4,524	38,642	316	7%	24	15
Sacha inchi*	10	2%	453	1,182	29	6%	0	1
Lime*	962	32%	2,988	7,409	53	2%	1	1
Orange*	288	13%	2,195	3,262	22	1%	1	14
Cardamom	130	12%	1,094	1,074	2	0%	-	2

Sacha inchi, originated from the Andes, was initially introduced in 2010 by an investor from Yunnan, China in Luang Namtha province and in Sangthong District. Additionally, a Lao company based in Luang Prabang promoted the crop in several districts in this province. The contract farming venture followed a boom-and-bust pattern typical of industrial crops promoted for smallholders' production in the last decade in Laos. The initial guaranteed price was at 6,000kips/kg of dried seeds, and farmers benefited from prices around 20,000 Kips until 2014 when prices plummeted to 6,000 kips. Eventually, the investor renounced to buy the production and producers were left with unsold surplus.

As international demand for dried Inca nuts and oil is strong and growing, several initiatives emerged to revive production in 2016 and 2017. Promotion efforts¹¹ are focusing on Luang Namtha and Luang Prabang where seeds are still available. Seeds were also introduced in the Sekong and Salavan provinces by a Thai/Lao joint venture.

Nowadays, sacha inchi has become a speculative commodity recovering from the boom and bust event. High demand combined with an insufficient and unorganized production base has driven prices up, exceeding 20,000 kips/kg of dried seeds¹².

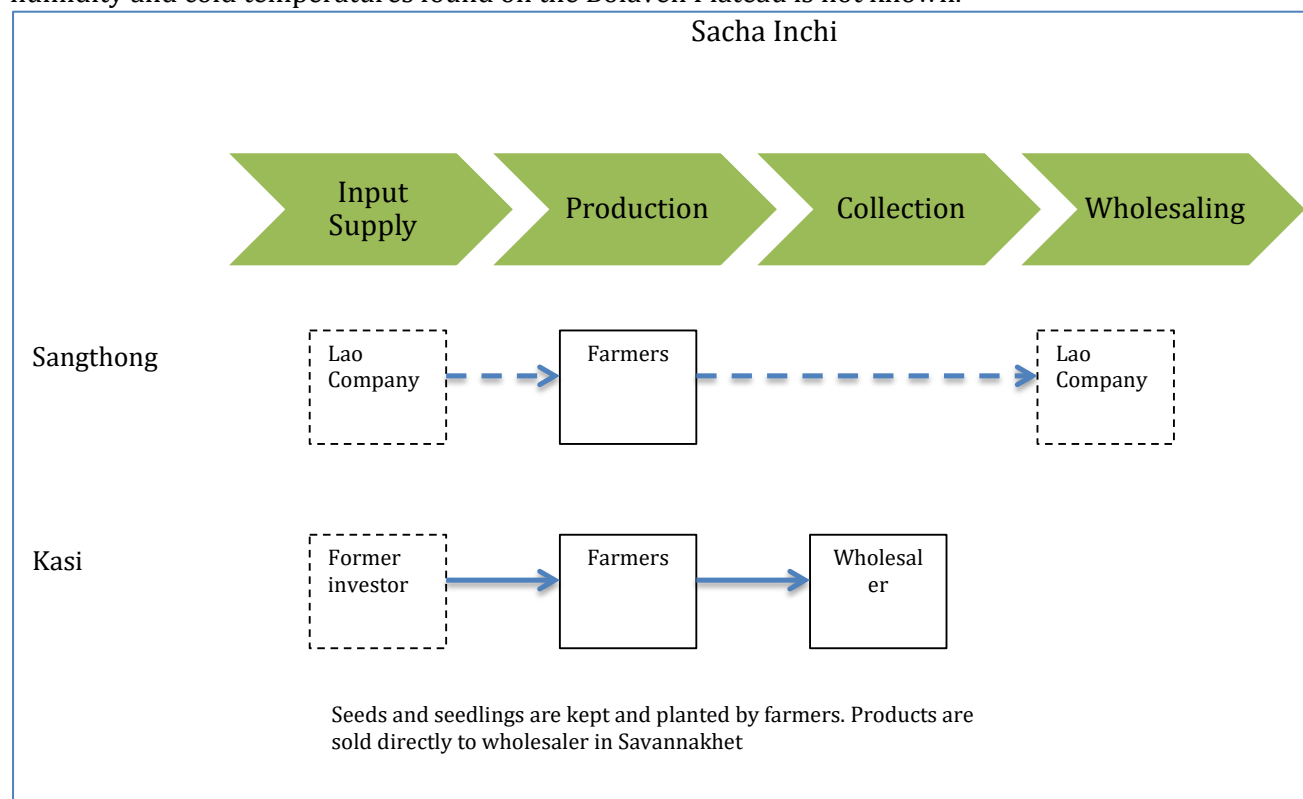
Current constraints to increasing production are as follows: (i) farmers may be reluctant to invest in the crop due to the previous failure experienced by farmers who were unable to sell their produce (ii) initial investment costs to establish the crop: wooden / concrete posts, wire to support the vines, fencing

¹¹ By Maisavanh Lao Company and Daosamai Kankha in the North

¹² Sacha inchi seeds trade at above USD10 FOB at destination port in South Korea

material (iii) lack of experience and knowledge of crop maintenance and post-harvest operations (iv) lack of policy and institutional support from agriculture departments at various levels (v) absence of qualified public extension services for this relatively new crop in the Lao context (vi) post-harvest, handling, storage and processing capacity of private operators

The pre-assessment revealed that farmers expressed reluctance to invest in this crop, particularly in Sangthong District due to the past negative experience. The crop is introduced at very small scale in the southern districts of Thateng and Lao Ngam. Adaptation to the altitude gradient, hillside slope exposure, humidity and cold temperatures found on the Bolaven Plateau is not known.



Risks on the production side appear to be relatively limited. Farmers with experience with this new crop have mentioned that it adapts well to local conditions in all parts of the project area, as demonstrated by its wide distribution in the household survey. In case of promotion, supplying large quantities of good quality seeds might be a constraint. In addition, potential risks related to pests and diseases have not been assessed and are unknown at this stage.

Risks on the marketing side of the value chain are related to issues in contract farming arrangements in the past years. Occurrence of “breach of contract” on both sides have been reported: buyer not honoring their buying obligations and farmers side-selling to informal traders offering a premium on the price. Such opportunist behaviors have undermined the establishment of a structure sustainable value chain in the past years.

Citrus

As for several other value chains, the current number of smallholders producing of lime and orange is unknown. Information on the total number of producers of citrus in the project geographic area is not available. District agriculture and forestry offices do not keep records and statistics on the number of producers. The production of orange is visibly expanding in Kasi and Vangvieng districts.

The key gap in expanding the production is the availability of well identified and quality planting material. Responding to the increasing market demand for oranges, smallholders produce seedlings from seeds extracted from fruits bought on the market or found locally. There is a knowledge gap related to the production of healthy and quality seedlings that are resistant to diseases.

The level of losses for lime seems to be significant (reported as up to 32% on average), due to premature fruit drops from the tree. Producers have little knowledge of the impact of insufficient or uneven watering and pH imbalance on fruit dropping from the trees. For oranges, the loss is more limited (13% on average). Post-harvest loss per se is relatively low (1-2% on average for both lime and orange) mainly due to damage during handling and discarding fruits with appearance defects.

Three knowledge gaps could be addressed by the project to support smallholders' production of citrus:

1. The effect of irrigation on the production,
2. The effect of balanced fertilization and pest identification and management.
3. Another key knowledge gap is related to the use of foliar fertilizers, sold by informal mobile retailers. As the label are in Vietnamese the farmers are unable to get information on application doses and schedule, application techniques and expiry dates.

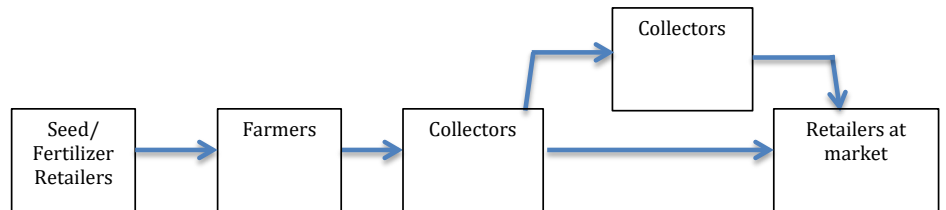
The study confirmed significant production of lime and orange in the Central region, in Vangvieng and Kasi districts in Vientiane province. Smallholder farmers are currently expanding their citrus gardens, indicating positive perception of the market demand and crop suitability in the farming systems. Lime is also produced by smallholder farmers in other areas, generally maintaining a few trees for self-consumption as well as supplying some to local markets. More detail information was collected through population-based survey by the study team throughout the baseline survey target districts.

Food and Agriculture Organization (FAO) statistics indicated that lime and lemon production in Laos has fluctuated around 5,000 tons between 2011 and 2016, covering less than 700 ha. The district agriculture officers of Vangvieng and Kasi didn't provide report or statistics on acreage and production of citrus (lime and orange) during the pre-assessment.

Lime/Orange (L/O)

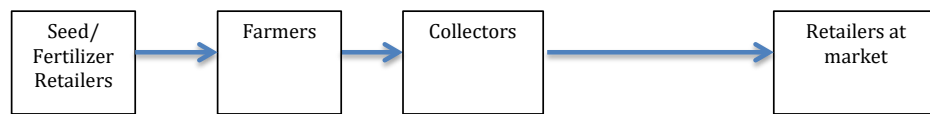


Kasi/
Vangvieng
(L/O)



Local market in Vientiane Province
and markets in Vientiane Capital

Phonhong/
Viengkham
(L)



Local market in Vientiane Province
and markets in Vientiane Capital

Pakngum
(L)



Local market in Pakngum only

Paksong
(L/O)



The company produces and export to
Thailand as main purpose

Some amount of products will be sold
in local market in Pakxong and
Thateng

Cardamom

Information on the total number of producers of cardamom in the project geographic area is not available. District agriculture and forestry offices do not keep records and statistics on the number of producers. The production of cardamom is visibly shrinking in Lao Ngam District, as cardamom plantations are being converted to cassava production. This change is not reversible on the short term as Paksong cardamom requires shade trees that take several years to grow before providing an adequate canopy cover to the cardamom plants at understory level. The attractiveness of cassava (and sweet potato a couple of years ago) over cardamom is due to the production cycle. Cassava can be harvested within one to two years after crop establishment, while cardamom can take three to four years before entering production.

The key gap in expanding the production is the availability of well identified and quality planting material. There is a knowledge gap related to the production of healthy and quality seedlings that are resistant to diseases.

The level of post-harvest loss is relatively limited or negligible. Cardamom fruits are easy to handle and suffer little damage at post-harvest stage. In this regard they have been an attractive commodity for remote communities due to its relatively high unit price per kilo, making it worth transporting on foot track to the market. This comparative advantage is less and less relevant as access tracks are developed or villages regrouped closer to the main road network.

The main knowledge gap is related to the absence of knowledge related to the end market for Paksong cardamom. The producers do not know what the end market is, and what are the preferred specifications. Cardamom is generally flue cured (dried on a fire-heat source). Techniques to improve drying practices have been developed in northern Laos using recycled metallic drums.

Cardamom is mainly used for medicinal purposes in Laos and the variety is different from the spice grown in India (*Elatarria sp*). Cardamom has been exploited in Laos for a long time, mainly through collection of wild varieties in natural forest environment. It has been considered a non-timber forest product (NTFP). This status has tax repercussions on the trade, because environmental taxes apply on products considered as NTFP.

Nowadays, most of traded cardamom is not collected from the naturally growing plants but planted and maintained in shaded area. Preferred shade tree on the Bolaven Plateau is the Pho Hou (*Trema sp*), a pioneer fast growing species.

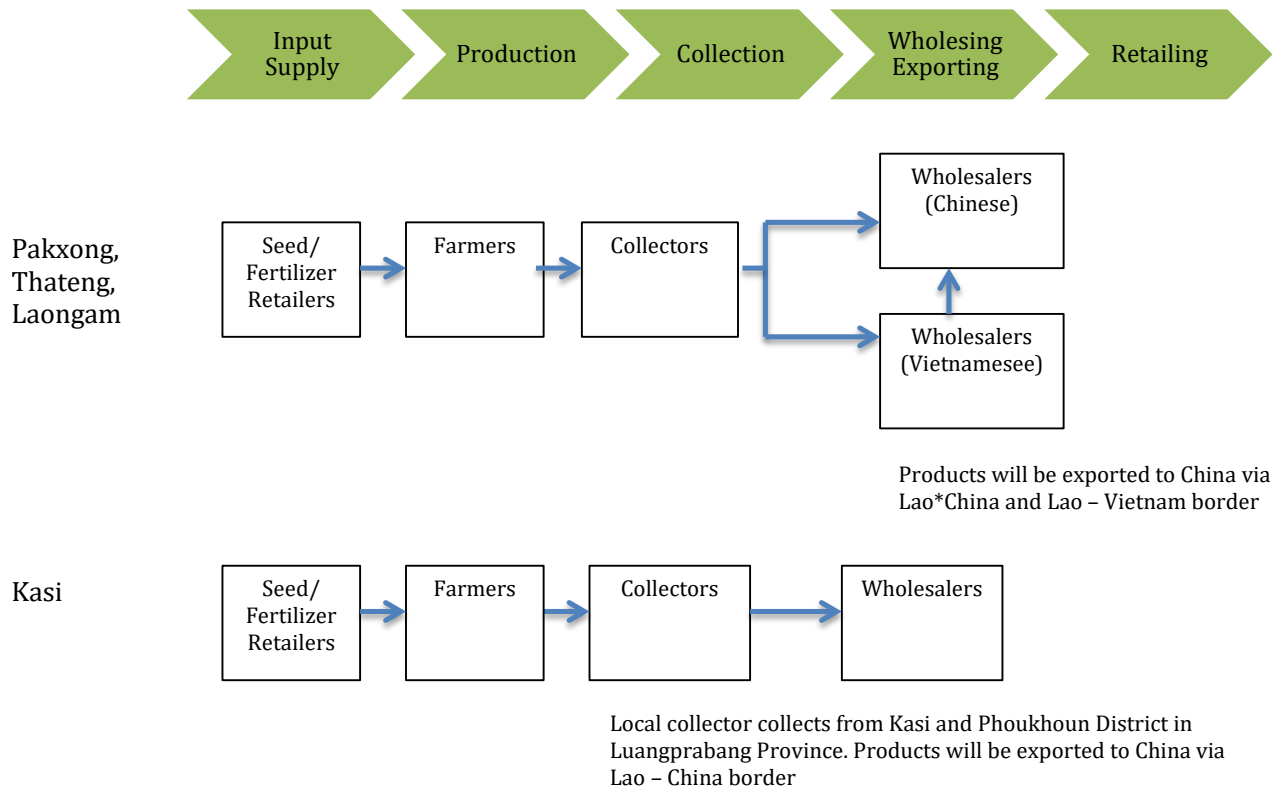
A recent development is the rapid extension of cassava production area in Lao Ngam District. During field visit, the village chief mentioned that some farmers have uprooted their coffee and cardamom plantations to expand cassava acreage. Cassava price have soared last year up to 1350 Kips/kg of dried chips (around 600 kips/kg fresh). With yields varying from 10 to 20 MT/ha and beyond, the crop returns a gross income of more than 20 million kips, while production costs are relatively limited. This new cassava boom follows a sweet potato boom a few years ago. As in many other instances, farmers were left with unsold surplus as the prices slumped and traders refused to buy the production.

Cardamom starts bearing fruit in year four after plantation and production decreases progressively until year eight. Then the plantation needs to be replaced.

In the North of Laos, another type of cardamom (Guangdong cardamom introduced from Southern China) fetched a high price in 2014 (allegedly up to 350,000 kips/ kg of dried pods) but the recent trend is downward, and prices paid at the producers is around 100,000 Kips / kg. The market dynamics (end-users, demand, quality grades, price fluctuations, etc.) in China are not well identified.

The pre-assessment conducted in May confirmed significant production of the “Paksong” type of cardamom on the Bolaven Plateau. Producers sell the dried pods to Vietnamese and Chinese traders who export the cardamom to their respective countries.

Cardamom



8. EVALUATION QUESTIONS

Sustainability

Sustainability of proposed interventions is directly conditioned by the involvement of project beneficiaries at local level and in particular village authorities, producers and local businesses. These are the key stakeholders that could take over activities beyond project completion. Therefore, to enhance potential sustainability, interventions should be designed to be directly implemented or supported by one of the three stakeholders mentioned above.

To ensure gains in productivity can be achieved and sustained, the project may include the following interventions: On the input side of the value chains, there is potential to improve the quality and diversity of inputs currently available to farmers. First, the project may **engage with formal input suppliers** (typically retailer shops established in urban centers at capital, provincial and district levels) to promote better business practices (avoiding banned and expired chemicals for instance) and encouraging the retailers to provide technical advice to their customers (farmers). In parallel, the project could **support the provincial and district agencies** (agriculture and forestry department as well as industry and commerce) to exert tight control of informal input retailers, in particular the “mobile traders” who travel from village to village to sell chemicals that may be inadequate (packaging label and instructions in foreign languages: Vietnamese, Chinese) and sometimes illegal (banned or expired products). Finally, **training farmers on adequate use of inputs and chemicals** would bring additional benefits on profit margins by reducing production costs, on the quality of agricultural produce (food safety aspects) and on the safety of the farmers and the environment in general. Farmers need training on the use of inputs including a better understanding of the advantage and downsides of each product (foliar, granular fertilizers, weed killers, pesticides, etc.) and on the application protocol (equipment used for application such as sprayers, dose and timing of application, users’ safety, safe disposal of chemical packages)

The proposed interventions related to regulating the input retail sector (and in particular informal/illegal input sellers) would actually create an **enabling environment** for better productivity, food safety, farmers health and environment. Other “enabling” interventions are needed in the SME business sector to improve the business environment but that is an outstanding issue beyond what the project can reasonably achieve.

Secondly the project may focus on specific aspects of the production technique and post-harvest practices for each of the commodities to increase productivity while optimizing production costs and promoting food safety standards. Suggestions for each crop are provided under section “Recommendations towards project implementation” below.

Relevance

The CLEAN project is directly relevant to the second MAF program set in the Agriculture Development Strategy to 2025: Agricultural Commodity Production which goal is to increase production while ensuring both quantity and quality aiming at accessing domestic, regional and international markets in connection with the improvement of farmer’s group, producer’s and agriculture processing association by taking efforts to make agriculture production as main goods as follow.

Both strategic objectives of the CLEAN project are well aligned to the Strategy. CLEAN objectives are: (i) Increased Agricultural productivity by building the capacity of producers in improved productivity and profitability; (ii) Expanded trade of agriculture products by developing both domestic and export market linkages.

The direct implication is that food production, stated as the first MAF programmatic goal, is set to be outside the scope of the CLEAN project. There are various possible strategies to combine both development focus: crop rotations and crop associations combined both commercial and food crops offer multiple benefits in terms of food and nutrition security, cash income generation and ecological functions (soil and water resources management, pollination, biodiversity, regulation of pest and disease, etc.) Such strategies would be particularly relevant for farmers living in mountainous parts of the target districts: Vangvieng, Kasi and the three southern districts of Paksong, Lao Ngam and Thateng. The baseline survey found suggests that there is potential to combine annual food crops and perennial commercial crops: for instance, support to production and commercialization of citrus provides a good basis to associated

annual food crops in citrus-tree based systems. In this regard, the irrigation of citrus plantations will also benefit associated food crops (vegetables) and will enhance the farmers' capacity to adapt to climate change. The baseline suggests that the five selected commodities are secondary crops. Selected crops cover a relatively small portion of the farm landholding: Chinese cabbage cover 6% of the farm landholding, white cabbage 21%, cardamom 29%, pepper 1%, sacha inchi 9%, lime 20% and orange 20%.

The project focus on adoption of GAP standard on commercial crops may have a positive impact on how farmers produce the main crop (paddy rice) and therefore have a positive impact on the whole farm as a result.

Efficiency

The CLEAN project will only be efficient if it is able to mobilize adequate technical support staff at local level. Relying on district-level public extension personnel (DAFO) might not be realistic due to already stretched human resources at this level. Possible strategies are: (i) involve private sector stakeholders in a medium-term partnership with the project to deliver service to farmers to promote improved production practices and higher quality of end products, (ii) locally recruit graduates of agricultural college and faculties to play an active role in the value chain. Their remuneration could partially be covered by progressively developing their function as a brokering role in the value chain.

The baseline survey showed that farmers have received very little technical trainings but are interested in receiving this support. For example, focal groups confirmed that farmers are interested in getting more technical training on maintenance of productive trees. Several options can be considered to improve service delivery. For instance, farmer to farmer extension and farmers' exchange visits are efficient ways of disseminating information on good practices.

Another strategy to ensure higher efficiency would be to redefine and reduce targets in particular in terms of target districts and target commodities. The baseline study showed that farmers have specialized in a certain crop in certain districts (citrus in Kasi and Vang Vieng, cardamom in Thateng and Paksong, etc.) Therefore, concentrating efforts in these areas will produce visible results in a more efficient manner.

Effectiveness

The effectiveness of the CLEAN project will be conditioned by level of involvement of the private sector and in particular private businesses directly in contact with the producers both upstream of the value chain (inputs and equipment suppliers) and downstream of the value chain (buyers and traders who fulfill the first stage product aggregation function). The baseline survey has shown that farmers faced uncertain market conditions linked with informal marketing arrangements. The study also confirmed that farmers are interested in formal contract farming arrangements.

Selected crops	% of Respondents engaged in contract farming	% of Respondents interested in entering in formal contract farming arrangement
White Cabbage	1%	42%
Chinese cabbage	-	57%
Sacha inchi	11%	64%
Lime	1%	52%
Orange	-	42%
Cardamom	4%	68%

When the market becomes reliable and formal contracting arrangements can be enforced, then it is expected that farmers' willingness to invest in improved production and post-harvest practices will increase, making the project interventions in GAP and market linkages more effective.

Delivery of project services is generally delayed by cumbersome planning and approval processes. Planning relying on the local level up is to be preferred but approval functions generally remains at central level. Here again, a carefully designed targeting strategy (crops, districts, villages, etc.) will most likely have positive impact on the overall effectiveness of the project.

Impact

The CLEAN project intends to create a positive impact at several levels in the value chain:

- At input supply stage
- At production stage: increase in productivity, volume and value of sold commodities, improved farm management practices, compliance to GAP and SPS requirements
- At consumer level, the project intends to disseminate information about GAP to 450,000 consumers

However, to produce visible impact, the project would benefit from concentrating the efforts and interventions in well targeted areas for each one of the commodities. The baseline study indicated key production areas for each of the commodities and also demonstrated that farmers have interest in receiving more support in production techniques, as well as in more formal commercialization arrangements. To create an impact within the project lifetime, targeting is a crucial aspect of the project inception in the target provinces.

9. RECOMMENDATIONS

Recommendations towards project design

In particular, early identification of project target villages is critical to then agree on the conditions required to promote farmers' participation and secondly partner organizations (both public and private) are to be involved to jointly define roles, mandates and terms of potential partnerships.

Two of the five selected value chains (cabbage and citrus) feature an established production base in well identified geographic areas. These have a clear potential for improvement of production and post-harvest practices and the market side is also relatively visible and transparent. Producers may be able and willing to invest in improving production or post-harvest operations, if they can see a short-term positive impact on cash income.

Two other selected value chains (cardamom and sacha inchi) have proven production potential but are considered as secondary crops by farmers. They are unlikely to divert capital, labor and land on a significant scale. In fact, the contrary is currently happening: areas previously allocated to cardamom are converted to other crops (cassava in the Lao Ngam in particular). As mentioned in section 3 of this report, cardamom status as an NTFP is different from other agricultural commodities. It may be subject to collection / production quota and a more stringent tax regime may also apply. The end market for cardamom is not directly accessible or visible to farmers, and information about required quantities and quality is not available to the producers. For sacha inchi production has been recently negatively affected by problematic market arrangements.

Lastly, pepper production could not be identified during the baseline study (only 5 producers interviewed without any marketable production so far). It is unlikely that interventions in this value chain can make a significant impact within the project time frame. Partnership with a reliable investor and a well-defined high-end market may provide the adequate conditions to promote production.

The recommendation is therefore to focus on value chains and geographic areas where visible positive impact on production (quantities, quality) and market linkages can be made within the project timeframe.

Recommendations towards project implementation

Suggestions for project implementation have been mentioned in the previous section 8. Crop-wise the following recommendations can be made based on the findings of the household survey and focal groups discussions:

White cabbage. Key production areas in Paksong and Kasi districts, although featuring different production practices and being oriented towards different markets are worth supporting both on production techniques and market linkages. In Kasi, the most pressing production issue is related to pest damage; while in the south access to water is one of the determining factors to up-scale production. In both areas, the project could involve input and equipment suppliers to participate in supplying quality inputs (pesticides, seeds, equipment) but also channel important messages to promote Good Agricultural Practices. In addition, post-harvest operations and handling can be improved to reduce losses and enhance quality of the raw product at selling point. Finally, the promising initiative to develop market

linkages with a major supermarket chain in Thailand should be continued and other options could be identified.

Chinese cabbage. This crop is being produced across the target areas, but areas closer to the city centers have a comparative advantage to supply the retail fresh markets (Vangvieng, Vientiane central market). On the production side, Good Agricultural Practices could be promoted possibly in partnership with input retailers. Issues related with bacterial rot and other pests could be addressed by solarization techniques, use of fine mesh shade nets and / or improved crop rotation for further crop diversification. On the marketing side, current informal arrangements are functioning reasonably well, and farmers did not express particular issues as long as the demand is sustained. Food safety might be an interesting aspect to further explore and short value chain model could be tested, by linking producers and wholesalers in Vientiane central market (for producers in Phonhong and Pak Ngum districts for instance) and retail market or hotel/restaurants in Vangvieng. Two potential areas of intervention regarding food safety include IPM (77% of cabbage growers use pesticides in Paksong district, leading to a risk of chemical residues) and post-harvest practices (lack of separate clean storage, poor handling).

Pepper. Smallholders' pepper production is arguably small on the Bolaven Plateau and the prospects on the regional market are on a downward trend. However, there might be potential to develop a niche market value chain to cater the city markets of hotels, restaurants and supermarkets in Pakse and Vientiane. A detailed market demand is to be conducted before investing in the production side. Pepper is a fungi sensitive crop that is technically challenging. Rather than opting for mono-species plantation, the project might opt for introduction of pepper in existing garden using potential host trees. Farmers exchange to neighboring Cambodia (Kampot pepper) and Vietnam central highland might provide opportunity to accelerate the learning process.

Sacha inchi. Sacha inchi has potential to be developed in various environments, but not much is known about the optimal conditions in the Lao context (soils, climate). Deficient market linkages in the past few years have undermined efforts to develop a sustainable value chain. But more recent co-investments by private and public/project stakeholders (Helvetas NUF-NIF project in the North) may prove that sacha inchi can be introduced in upland farming systems such as in Sanghtong and Kasi districts. In this context, the first step of any project intervention in the sacha inchi value chain would be to enter into formal partnership with formal and reliable private sector entities that would promote production and guarantee market conditions (quality, prices, quantities, etc.)

Citrus (lime). Focal groups confirmed that farmers are interested in getting more technical training on maintenance of productive trees. Identifying a priority geographic area is challenging because lime is commonly produced throughout the target districts. Where semi intensive production is established (e.g. Vangvieng, Kasi, Bolaven Plateau) efforts are to focus on identifying the preferred species and in improving current seedling production techniques and tree maintenance practices. Productivity gains can be obtained by reducing pre-harvest losses (premature fall).

Citrus (orange). Producers in Vangvieng District are rapidly expanding production capacity of oranges, indicating an undersupplied market. This has to be confirmed by a more detailed study to identify the various markets and scoping the demand. In parallel, key aspects of the production require technical support: quality of seedling, productive tree maintenance (pruning, pest control) as well as supporting functions (irrigation, use of pesticides and fertilization) that are currently neglected. Orange trees are generally not irrigated, and farmers use foliar fertilizers and pesticides sold by informal input suppliers who are difficult to identify. Regulation of chemicals sold by informal "mobile retailers" in Vangvieng and Kasi district is a priority for orange production. There is currently little, if any, control of the pesticides bought by farmers through this channel (sometimes banned, expired products, containers with labels in Vietnamese language only). Here again, entering in a formal partnership with formal input suppliers may have a beneficial effect on productivity, quality, food safety and farmers' health.

Cardamom. Particular attention has to be paid to the end market for Paksong cardamom. Currently farmers and district line agencies staff alike have little visibility on the market side: demand, prices, end use, etc. in Lao Ngam District farmers respond to this uncertainty by replacing cardamom plantations with cassava, and other cash crops with more immediate and visible potential for cash return. Villages located further from the main road access may have a comparative advantage in producing cardamom,

due its relative high value per volume. In Thateng District, more than half the respondents produce cardamom, providing a strong production base. The immediate project intervention would be assessing the cross-border market demand in Vietnam and China as well as the legal status of cardamom either as a crop or as a non-timber forest product. In the latter case, additional environmental tax may apply if the commodity value chain is to be developed with a formal approach: well defined production areas and producers, registered traders, formal arrangements with the wholesalers and exporters. Unless these conditions are not fulfilled, project interventions may primarily benefit informal traders and encourage opportunistic behaviors detrimental to the value chain sustainability.

Recommendations towards project monitoring

The project monitoring system is to support implementation and guide management decisions. The baseline team understood that the project intends to involve farmers in the monitoring data collection process. This will require time and resources and might not be the most effective approach. However, other stakeholders at local level would be in a better position to collect data: locally hired staff, district level technicians or even buyers could fulfill this function.

The project performance monitoring plan includes a total of 21 indicators. To rationalize and simplify the monitoring system, output indicators may be reconsidered. The following indicators are highlighted in the table below with comments as to whether the output they intend to measure is within the realistic reach of the project.

#	Outcome and output indicators	Target	Notes
SI-3	Number of individuals who have applied improved farm management practices (i.e. governance, administration, or financial management) as a result of USDA assistance	10,414	Target may be unrealistic given the current farm management practices of smallholder farmers
SI-9	Value of new public and private sector investment leveraged as a result of USDA assistance	\$2,640,000	The project may have little leverage on public investment in the target value chain (relatively low priority crops)
SI-11	Total increase in installed storage capacity (dry or cold storage) as a result of USDA assistance	1,250 cubic meters	May occur primarily through private sector initiative and investment
SI-12	Number of policies, regulations and/or administrative procedures in each of the following stages of development as a result of USDA assistance (Stage1, Stage 2)	3	Policy / regulation development may be beyond the project scope
CI-2	Number of agricultural input suppliers/firms that sell improved inputs as a result of USDA assistance	TBD	Relevant for intensive annual crops (cabbage), but less for perennial crops (pepper, sacha inchi, citrus, cardamom)
CI-3	Number of agreements signed (contracts, MOU, etc.) between buyers / sellers through trade promotion events (e.g. missions, fairs, etc.)	115	Agreements may not necessarily result from trade promotion events
CI-7	Number of farmer organizations meeting GAP and SPS requirements	100	Unrealistic target. Few farmers organizations currently established and information about GAP / SPS standards yet to be disseminated
CI-8	Number of consumers receiving messaging on food safety and “clean” and “safe” Lao products through awareness campaign	450,000	May be beyond project scope

Proposed mitigations measures to potential implementation risks

Identified key project risks are related to:

- (i) The informal business environment in which farmers engage in commercial production. In particular there are risks associated with mobile input suppliers and mobile buyers. The unpredictable nature of these small business entities directly affects production and

commercialization aspects and directly influence farmers decisions. To mitigate this risk, the project is to encourage and support existing informal businesses to register and to operate legally and transparently. In parallel, commitment of local authorities at village and district levels is required to effectively regulate informal and sometimes illegal business practices.

- (ii) In managing grants and incentives, there are real risks of “elite capture” and opportunistic behaviors at local levels. Continuous community mobilization and permanent project staff at village or village cluster level is necessary to ensure that information is disseminated in a transparent manner.

X. LIST OF ANNEXES

- 1- Terms of Reference
- 2- Study Plan
- 3- Study Instruments (in English and Lao languages)
- 4- Letter of Consent
- 5- Sampling Frame and Detailed Survey Schedule
- 6- List of Persons Met and Potential Project Partners
- 7- Crop Information and Harvest Calendar
- 8- Value Chain Reports

THE ANNEXES ARE AVAILABLE IN SEPARATE ATTACHMENT