Reduced-input fruit and vegetable value chain study in the Greater Mekong Sub-region

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Title
Reduced-input fruit and vegetable value chain study in GMS region

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ABBREVIATIONS

ADB	Asia Development Bank
ACT	Organic Agriculture Certification Thailand
ADDA	Agricultural Development Denmark Asia
ASEAN	Association of Southeast Asian Nations
CAPI	Computer- Assisted Personal Interview
CASP	Core Agriculture Support Program
FAO	Food and Agriculture Organization of United Nations
FAOSTAT	FAO statistics database
FGD	Focus Group Discussion
GAP	Good Agricultural Practices
GIZ	Gesselschaft fur Internationale Zusammenarbei
GMS	Greater Mekong Sub-region
GMS-WGA	Greater Mekong Sub-region-Working Group in Agriculture
IFOAM	International Federation of Organic Agriculture Movements
IOs	International Organizations
ITC Trade map	A source of trade data
LDD	Land Development Department, Thailand
MARD	Ministry of Agriculture and Rural Development, Vietnam
MFVP	Myanmar Fruit, Flower and Vegetable Producer and Exporter Association
MOAC	Ministry of Agriculture and Cooperatives, Thailand
MOAI	Ministry of Agriculture, Livestock and Irrigation, Myanmar
MRLs	Maximum Residue Levels
NAFTA	North American Free Trade Agreement
NGOs	Non- Governmental Organizations
NTMs	Non-Tariff Measures
PGS	Participatory Guarantee System
RDA	Rapid Diagnostic Appraisal
SEAPs	Safe and Environment- friendly Agricultural Products
SMEs	Small and Medium Enterprises
SPS	Sanitary and Phytosanitary Measures
SWOT	Strength- Weakness-Opportunity-Threat analysis
UN Comtrade	Trade data of United Nations
USDA	U.S. Department of Agriculture
VCA	Value Chain Analysis
VOAA	Vietnam Organic Agriculture Association
WTO	World Trade Organization

EXECUTIVE SUMMARY

Background

The Greater Mekong Subregion (GMS) is a natural economic area defined by the Mekong River consisting of 6 countries: Cambodia, the People's Republic of China (PRC, specifically Yunnan Province and Guangxi Zhuang Autonomous Region), Lao People's Democratic Republic (Lao PDR), Myanmar, Thailand, and Vietnam.
The Asian Development Bank (ADB) has supported and facilitated economic collaboration for GMS countries through the Core Agriculture Support Program (CASP), which consists of five components focusing on cross-border trade facilitation and promotion, as well as enhancing science, technology and cooperation. The CASP phase II concentrates on cross-border trade, climate change adaptation, food security and bioenergy.

To support the GMS Strategy and Action Plan for Promoting Safe and Environmentally-friendly Agro-based Value Chains 2018-2022, the study on *"Reduced-input fruit and vegetable value chains in the Greater Mekong Sub-region"* has been conducted. The objectives of the assignment were to:

- develop evidence-based policy and investment recommendations specific to, and on the basis of, case study value chains;
- propose specific immediate to medium-term initiatives to encourage the continued development of inclusive, safe, environmentally and economically sustainable fruit and vegetable value chains in the GMS countries;
- identify GMS-level implications for fruits and vegetables, as well as other agricultural value chains.

Three fruit and vegetable value chains were selected for the case studies: 1) organic coconut value chain in Ben Tre province of Vietnam; 2) PGS organic vegetable value chain in Suphan Buri province of Thailand; and 3) GAP mango supply chain in the Mandalay and Sagaing regions of Myanmar. In addition, a retail case study was carried out with leading supermarket chains in Thailand to understand their trading mechanisms and sourcing systems, particularly in relation to GMS reduced-input agricultural products

The research combines both qualitative and quantitative methods with a literature review and secondary analysis. Two hundred twenty-one actors in these value chains have been interviewed to better understand the chain in terms of production, trade and import/export of the reduced-input agricultural products in the GMS. Each case study has been analyzed separately, a supply chain map was drawn with stakeholders and their activities, margins, and quality assurance processes were discussed and assessed. The studied value chains were also compared with similar conventional systems to understand advantages and constraints.

SWOT analyses have been conducted, focusing on the opportunities and barriers for upscaling the value chain.

Case Study 1: Organic coconut in Ben Tre, Vietnam

Coconut is one of the key crops for Ben Tre province in Vietnam, as well as for other GMS countries like Thailand. Recently, the demand for value added coconut products has increased rapidly, especially for organic products. To capture this great export opportunity, public and private sectors in Vietnam have collaborated to promote organic coconut production and trade. Pilot programs with thousands of small scale coconut farmers were set up in 2012. By end-year 2017, Ben Tre province had more than 1000 ha of certified organic coconut. Coconut, in general has generated more than 180 million dollars of export for the province, accounting for 27% of its total export value in 2016.

The organic coconut case is an example of a true value chain where the coconut exporters/processors play a strong role in activities across the chain, as well as providing supporting services to the farmers from whom they purchase.

The main issues that affect the ability to upscale organic coconut production are:

- a lack of organic inputs (e.g. fertilizers and crop protection products), hindering the ability of farmers to intercrop and increasing the intensity of labor;
- economic penalties in the form of potentially lower yields, higher costs, and the opportunity cost of lost revenue due to constraints on intercropping;
- difficult requirements to achieve certification which reduces the attractiveness of converting to organic for conventional farmers; and
- Potential quality assurance risks due to insufficient standards at the pre-processing facilities.

Recommendations for increasing organic production and trade include:

- ***Invest in research and development of organic inputs*** so that farmers can intercrop, reducing their dependency on a single crop for income and increasing biodiversity on their land.
- ***Invest in access to finance for (smallholder) farmers*** to allow them to make the necessary investments to meet organic requirements
- ***Invest in building farmer cooperatives*** to allow for economies of scale in activities such as the production of fertilizers and biological control and to reduce labor the intensity of the labor required on the farm.
- ***Invest in research and development of high value-added products***, helping coconut companies to diversify their product portfolio and overcome the high costs associated with sourcing from smallholders***.***
- ***Invest in pre-processing and processing facilities*** to reduce food safety risk.

- ***Develop a strong training and farmer support component*** that replicates the successful knowledge transfer in the Ben Tre program and that includes training in calculating the costs vs benefits of converting to an organic system.

Case Study 2: Myanmar GAP mango in Mandalay and Sagaing, Myanmar

The local GAP program in Myanmar was initiated in 2006 as a stepping stone for the development of ASEAN GAP. In 2014 mango was selected to be one of the pilot products for the program. By end-year 2017, 52 mango growers in Mandalay and Sagaing regions and in Shan state had been certified with Myanmar GAP standard.

The program is still young; and several issues have been identified that will impact its future success, some of these echo findings from the coconut case:

- costs for farmers will certainly increase due to Myanmar GAP certification, but it is not certain if prices will rise, as the Myanmar GAP certification is not valued in the market;
- farmers have trouble meeting the requirements, either because of the associated costs or because the process itself is slow and lacking in transparency; and
- rejection at the border for SPS reasons is a challenge for increasing exports of Myanmar GAP mangoes. The introduction of Myanmar GAP practices should lead to reduced SPS rejections, but as Myanmar GAP mangoes are sold into the conventional chain the chance of leveraging better SPS controls to increase exports is reduced.

Recommended responses to these findings include:

- ***Harmonize the Myanmar GAP standard with other regional GAP standards*** to increase recognition and drive demand***.***
- ***Harmonize national SPS measures with measures in target import markets*** to facilitate intra-regional trade.
- ***Invest in infrastructure*** to ensure the quality of mangoes as they move across the chain.
- ***Invest in local supporting services,*** such as local offices to approve and issue Myanmar GAP certification.
- ***Improve access to training and extension services*** by increasing human resources available for these tasks.
- ***Increase transparency in the certification process*** so that farmers understand the process and know what to change if certification is not granted.
- ***Increase awareness of Myanmar GAP across the value chain*** in order to create demand that can ultimately lead to incentives for certified farmers.

Case Study 3: PGS vegetables in Suphan Buri, Thailand

The Participatory Guarantee System, a community-based organic farming system was started in the GMS region in 2008. PGS systems in the GMS have mainly focused on fruit, vegetable and rice growth. Since 2012, under the support of ADB and FAO, PGS has been promoted in GMS countries as a stepping stone to regionally accepted organic standards. PGS allows small-scale farmers with limited resources to implement organic farming practice.

The case study was conducted with PGS vegetables in the Suphan Buri province of Thailand. Thailand was selected in part as organic certification was first developed there in the 1990's, giving it a comparatively long track-record in developing organic processes, although the percentage of farmland cultivated under organic practices remains low (<1%).

Issues identified in the PGS case study include the following:

- lack of available organic inputs increases the amount of labor required to produce vegetable crops, particularly when diseases and pest infestations have occurred;
- the economic penalties of PGS farming are high, mainly due to a significant reduction in yields, but also caused by higher labor requirements and, in some groups, increased production costs;
- organic vegetable farmers were cultivating multiple crops, increasing the complexity of farming, and requiring knowledge of organic processes, protocols, and protection and treatment measures for several different crops, as well as a strong understanding of how one protocol could impact other crops on the farm, thus knowledge and training requirements were high; and
- quality assurance can be sustained through strong processes throughout the chain; however, in the case of PGS vegetables all post-harvest processes and technology are provided by the farmer group, thus there is little technical support to ensure quality is maintained all the way to the end of the chain, resulting in high rejection rates.

Recommendations to address these issues include:

- ***Adopt regional/ internationally recognized organic standards,*** such as the IFOAM family of standards when setting up national organic standards
- ***Recognize PGS as an assessment system permitted under the nation regulations*** so that it is easier to understand for those outside the system.
- ***Invest in the development of organic inputs*** to increase the options that farmers have available to protect their crops.
- ***Invest in the PGS distribution centers and transportation systems*** to improve post-harvest handling and reduce rejection rates.
- ***Increase access to technical trainings*** to support the transition to organic farming.
- ***Increase awareness of PGS as an organic system*** to encourage the development of new partnerships and value chains.

- ***Provide market intelligence to PGS groups*** to help them grow to demand.

Retail case study

Strong growth of national economies, rapid urbanization, a rising middle class with higher personal income and concern about hygiene and food safety have driven the growth of the modern retail market, including South East Asia and the GMS. The development of the Thai retail sector mirrors trends seen in other countries, yet as Thailand is leading the trend it also can provide insight into how retail could evolve elsewhere in the region.

Interviews for the case study were conducted with retailers representing 24% of food retail points of sale, but 78% of supermarkets and hypermarkets. The main issues uncovered in the case study include the following:

- quality is a critical factor for retailers and an important barrier to increasing imports from other GMS countries, as well as expanding their offering of organic products;
- providing customers with variety is another driver of retailers' purchasing decisions; as a result, fewer resources are allocated to sourcing from the region or to identifying new standards and certifications as neither of these is perceived to increase variety from a customer's viewpoint;
- the low value of regional products, particularly versus more exotic imports, and the lack of readily available information about products from the region generate economic penalties that reduce retailers' interest in importing from the GMS; and
- lack of transparency in regulations, the existence of many non-tariff measures related to sanitary and phytosanitary concerns, and insufficient information flow between governments and the private sector is reducing trade in the region.

Key findings

Drawing from each of the case studies several common themes and issues emerge. While these themes are clearly relevant for the studies discussed in this report, they are also expected to be relevant for other reduced-input fruit and vegetable chains in the GMS region.

- **Knowledge transfer is a critical success factor for reduced-input farming programs**. The example of the organic coconut case provides a successful example of knowledge transfer, mainly as a result of a tight value chain; while lack of knowledge transfer was hindering results in the Myanmar GAP mango case and the PGS vegetable case.
- **Knowledge of the standards must be disseminated across the chain in order to create value**. The case of Myanmar GAP illustrates how the lack of recognition of the program has led to a standard that is not in demand, nor perceived to be more

valuable than conventional products, thereby reducing the benefits that farmers could expect to achieve and thus reducing the attractiveness of the program.

- **Knowledge of regional production and regulations should cross borders to increase trade**. Regulations around import and export often lack transparency, making it harder to conduct cross-border trade. In addition, with some exceptions, information about fruit and vegetable sources outside of the home country is often lacking, thereby reducing demand.
- **Lack of inputs for organic products reduces yields, decreases crop diversification, and increases the organic integrity risk**. Farmers need access to biological controls that will be effective in both preventing and treating pests and diseases. These controls should address not only the primary crop, but other crops as well to ensure organic integrity.
- **Value chains where actors in the chain are well integrated and which provide support and benefits to farmers, help to counteract economic penalties incurred in converting to reduced-input methods.** Both the organic coconut case and PGS vegetable case provide examples of value chains that provide farmers with benefits such as training, price premiums, price floors, and alternative income sources. This is contrasted with the Myanmar GAP case, where certified mangoes enter into supply chains that do not recognize any additional value in the product.
- **Other parts of the chain also face economic penalties when trying to increase reduced-input production or source products from neighboring countries within the region.** The penalty can be the result of higher costs due to the strong representation of smallholder farmers within the system or the result of the opportunity cost of allocating resources or shelf space to lower value regional products instead of higher value exotic products from outside the region.
- **A variety of production and food safety standards have been created, potentially reducing barriers for farmers, but making it more difficult to assess the value of the standard, both for actors in the chain as well as consumers outside of it.** Harmonization of the standards could increase recognition. A participatory harmonization process that included both governments and the private sector could also ensure that increased recognition translates into increased demand.

Recommendations

Harmonization of standards

- **Harmonize local GAP and food safety standards across the region, developing a single regional standard with supporting certification for GAP practices.**
    - Short-term: Develop an inventory of local standards, explaining how they are operated and governed; showcase internationally recognized standards and

highlight their development process, operations and governance structures, drawing lessons learned from these examples that can be used to align with stakeholders in the region (government, growers, traders, retailers, etc.) to develop a process and objectives for harmonization.
    - Long-term: Develop and implement a harmonized standard in each GMS country through a multi-stakeholder process, training government representatives, private companies, and supporting actors in the standards requirements. Educate farmers on the standard and initiate support programs for farmers that want to transition to the regional standard. Develop accredited testing facilities for SPS/MRLs in the region to eliminate multiple testing to meet various standards/import requirements.
- **Adopt regional/ internationally recognized organic standards, such as the IFOAM family of standards when setting up national organic standards and recognize PGS as an assessment system permitted under the nation regulations.**
    - Short-term: recognize PGS as an assessment system for organic farming
    - Long-term: GMS countries should elect an existing and internationally recognized standard upon which they can develop their national standards so that there is a common framework from which all countries within the region can trade.

Investment

- **Invest in the research and development of organic inputs.**
    - Short-term: Identify crops and locations with high potential for organic expansion and inventory existing organic inputs for key crops in the GMS region and beyond. Identify opportunities for transferring production technologies across the region or introducing new supply sources of organic inputs where applicable.
    - Long-term: Develop partnerships with local governments, universities, the private sector and supporting actors to invest in the development or introduction of organic input sources in areas with high potential for organic expansion.
- **Invest in programs to counter the financial risk of transitioning to reduced-input production methods.**
    - Short-term: Assess economic penalties in diverse value chains and develop a tool-kit of solutions for addressing short-term negative financial consequences of transitioning to reduced-input production.
    - Long-term: Identify and implement public-private partnerships that can minimize or overcome the penalties by drawing on the tools of the toolkit – e.g. coconut companies can work with microfinance institutions to develop a toilet loan, government risk sharing (partial guarantees or subsidized loans)

could be included to increase the affordability of the product by reducing the interest rate.

- **Developing knowledge transfer systems**
  - **Develop reduced-input training programs for farmers in close partnership with actors from across the value chains.**
    - Short-term: Identify successful reduced-input training programs from across the region and share key success factors, highlighting specific chain characteristics essential for their success.
    - Long-term: Replicate the results, starting with introducing similar programs in the same chains and then adapting the successful programs to new value chains. Ensure that replication efforts bring together the right mix of partners to support long-term sustainability.
  - **Raise consumer awareness.**
    - Short-term: Develop safe food campaigns, highlighting the differences between types of safe products – e.g. organic, GAP, PGS, hygienic, hydroponic.
    - Long-term: Develop regional labeling system to facilitate consumer's understanding of the different safe products.
- **Increasing Access to Markets**
  - **Facilitate trade and develop export coaching programs.**
    - Short-term: Bring together exporters, importers and retailers from the region, either at an existing trade fair or in a new marketplace event, to showcase their products. Hold parallel meetings to identify products with high demand and high potential for trade. Discuss with retailers, importers, and exporters the barriers to importing/exporting as well as steps to take to remove these barriers. Support exporters participation in this event as well as other reputed trade fairs.
    - Long-term: Work with governments and industry to implement the steps to reduce the trade barriers. Coach high potential exporting companies by providing information on regional exporting requirements, as well as on marketing their business abroad.
  - **Increase transparency of government regulations with respect to food safety and quality, making them more readily available to the public, whether local or foreign.**
    - Short-term: Governments can post import/export requirements for fruits and vegetables to the internet.
    - Long-term: Harmonize SPS measures within the region and assess the necessity of Non-Tarif Measures (NTMs) affecting the imports of fruits and vegetables with the aim of reducing the number of NTMs applied to the sector.

1. INTRODUCTION

1.1 ADB CASP 2 program

The Greater Mekong Sub-region is a natural economic area defined by the Mekong River. The region consists of 6 countries: Cambodia, the People's Republic of China (PRC, specifically Yunnan Province and Guangxi Zhuang Autonomous Region), Lao People's Democratic Republic (Lao PDR), Myanmar, Thailand, and Vietnam. With support from the Asian Development Bank (ADB), the Greater Mekong Sub-region (GMS) was established in 1992 to form a sub-regional economic cooperation program (GMS program). The aim of the GMS program was to promote economic collaboration among the GMS countries in high priority sub-regional activities covering nine strategic sectors, among which agriculture is an important component. The Core Agriculture Support Program (CASP) provides guidance for the framework of the GMS agriculture cooperation while the implementation of the program is carried out by the Greater Mekong Sub-region Working Group on Agriculture (GMS-WGA). The first phase of the Core Agriculture Support Program (CASP I) was endorsed by the GMS Agriculture Ministers for the period from 2006 to 2010. The CASP I had five components focusing on cross-border trade facilitation and promotion, while enhancing science, technology and cooperation. Following the success of the first phase, the CASP was approved for phase II (2011-2015)[1] and recently extended to 2020. The CASP phase II concentrates on cross-border trade, climate change adaptation and food security and bioenergy.

1.2 Scope and objectives of the assignment

To support the GMS Strategy and Action Plan for Promoting Safe and Environmentally-friendly Agro-based Value Chains 2018-2022, Fresh Studio is contracted by ADB CASP II to conduct the "*Reduced-input fruit and vegetable value chain study in the Greater Mekong Sub-region*".

The main objectives of the study are:

- To develop evidence-based policy and investment recommendations specific to, and on the basis of, case study value chains;
- To propose specific immediate to medium-term initiatives to encourage the continued development of inclusive, safe, environmentally and economically sustainable fruit and vegetable value chains in the GMS countries;
- To identify GMS-level implications for fruit and vegetable and wider agricultural value chains.

[1] Source: https://www.adb.org/countries/gms/sector-activities/agriculture/core-agriculture-support-program-phase-ii-2011-2015

Four case studies have been conducted for reduced-input fruit and vegetable value chains in Myanmar, Vietnam and Thailand to highlight the current issues of the chain including food safety and quality, sustainability, efficiency and competitiveness, inclusiveness and gender dynamics, and empowerment, as well as to highlight the implications of these findings for the wider GMS agri-food supply.

2. METHODOLOGY

The research conducted for the Value Chain Analysis (VCA) in the GMS consists of three main phases:

- Desk research to review existing information on the vegetable and fruit chains of the GMS and to select the VCA case studies
- Field surveys for three case studies and a retail analysis
- Data analysis and report writings, including reports on case studies and the final report

Desk research provides an overview of important fresh fruits and vegetable sectors with relevant reduced-input initiatives underway, as well as highlighting regional trade flows and market entry restrictions. Potential case studies have been identified from this overview, and information gleaned from the research has determined their selection. In addition, the desk research provides relevant information to demonstrate how learnings from the case studies may be applied more generally.

Each case study has been analyzed separately, paying particular attention to the central themes relevant to this study. The detail provided by the case studies is designed to add a narrative component that makes the consequences of certain policies come alive for policymakers. Where possible, alternative solutions to overcome certain barriers will be described in detail.

2.1 Desk research

2.1.1 Desk research

To assure that the VCA builds upon previous experiences, the team began by reviewing available information about GMS vegetable and fruit production, marketing, trade, farming systems, main production areas, and processing. Related policies and reports and publications from ADB CASP 2 program have also been reviewed. This literature review led to five potential case studies being presented to ADB for their review and the selection the final three fruit and vegetable chains.

2.1.2 Selection of case studies

Five relevant fruit or vegetable value chains were identified as providing a combination of products and locations that have broader implications for GMS fruit and vegetable value chains in terms of developing Safe and Environment-friendly Agricultural Products (SEAPs).

Particular attention was paid to the relevance of selected value chains for the broader supply of SEAPs, the role they play or could play for intra-GMS trade, their connection with formal or informal trade flows across land borders within the GMS, and the potential they offer for economic development, in particular in relation to the Economic Development Corridors. The matrix approach ensures that case studies are selected which are important for the countries involved and which clearly highlight issues that policy makers are able to influence.

The following five case studies were proposed to the ADB:

- Myanmar GAP certified mango chain in Mandalay and Sagaing regions in Myanmar
- Organic coconut value chain in Ben Tre province, Vietnam
- Participatory Guarantee System (PGS) vegetable value chain in Suphan Buri province in Thailand
- PGS vegetable value chain in the north of Vietnam
- Kampong Speu Palm Sugar chain in Cambodia

Finally, three fruit and vegetable chains were selected by ADB for the field research: the Myanmar GAP mango chain, the organic coconut value chain in Vietnam and the PGS vegetable chain in Thailand. In addition, a retail case study was conducted with top supermarket chains in Thailand to understand their trading mechanisms and sourcing systems in relation to GMS reduced-input agriculture products.

2.2 Field survey

- Objective: Analyze each of the selected value chains, using a combination of quantitative and qualitative research including face-to-face interviews with actors on both sides of the border

All actors in each value chain, except consumers, have been interviewed to understand the chain in terms of production, trade and import/export of the reduced-input agriculture products in the GMS. Each case study was disaggregated along gender lines and where relevant, inclusiveness was also highlighted.

2.2.1 Rapid Diagnostic Appraisal method

A mixed methods approach has been used for the case studies, in which qualitative data is complemented by quantitative data to facilitate data interpretation and build an understanding of the broader context within which the value chain operates. Quantitative data collection has been collected using semi-structured questionnaires and administered using Computer-Assisted Personal Interview (CAPI) software, allowing full control over the data collection process and ensuring clean and structured data.

Qualitative data is collected using tools developed for Rapid Diagnostic Appraisal (RDA). RDA is both a process and a method, in that interviewers and interviewees learn together about the situation, conditions, and perceptions of various actors in a product chain. Generally, it involves diverse types of interviews (group and individual) with stakeholders at all levels of the value chain (from input suppliers till end consumers).

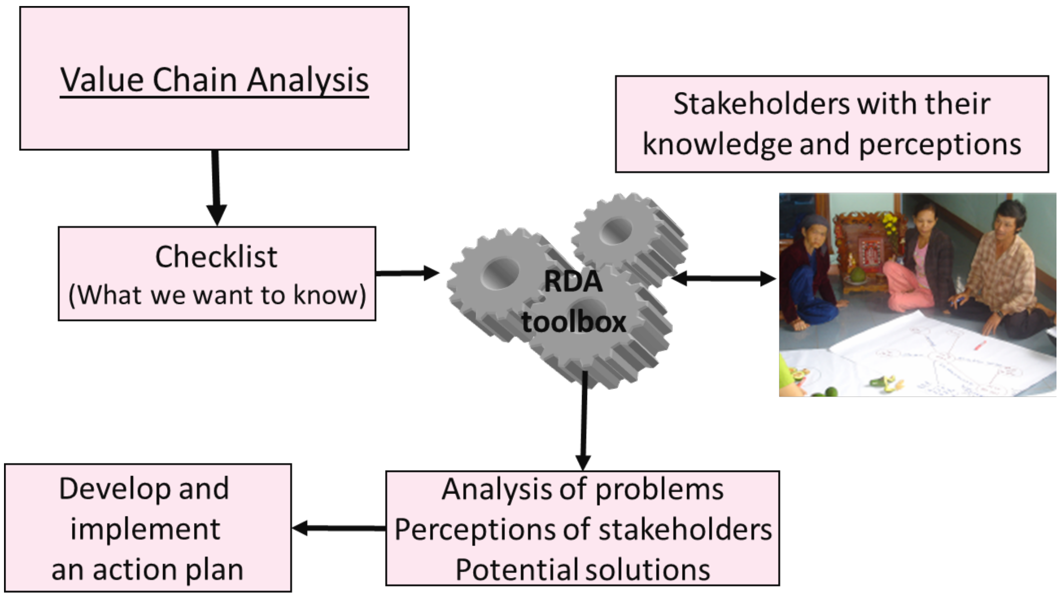


Figure 1: The Rapid Diagnostic Appraisal Process

2.2.2 RDA approach

In the present study, RDA is the core method that allowed the research team to collect valuable and diverse sources of information from many different actors in a relatively short period of time. Nevertheless, the collected information is sufficient for the analysis of the chain situation and thus adequate to provide key findings and relevant recommendations to the policy makers.

2.2.3 RDA tools

The RDA toolbox contains different tools, which are used by the interview facilitators to stimulate actors to share their opinions and to analyse a certain issue. During a single interview, different tools are often combined. Some examples of tools that have been used:

- Supply chain mapping
- Pie charts
- Listing
- Venn diagrams
- Preference ranking

- Time lines
- Production calendars
- Problem / solution trees

2.2.4 Quantitative survey

Quantitative surveys and qualitative interviews were simultaneously conducted with the assistance of Computer-Assisted Personal Interview (CAPI) and enumerators. This method was mainly designed for farmer respondents in an interview of 20-30 minutes. The quantitative questionnaires were employed to obtain brief overview of personal and household background, production and business practices and other external issues. Gender-related questions were also included in the questionnaires.

2.2.5 Research team

A team consisting of multi-disciplinary Fresh Studio consultants whose expertise covers every stage of a value chain, and local supporters have collaborated and conducted the field studies in Vietnam, Thailand and Myanmar. The composition of the contracted team is presented in Table 1.

The organic coconut case study was conducted in Ben Tre, a province located in the Mekong delta of Vietnam. The Myanmar GAP mango case was conducted in Mandalay and Sagaing regions of Myanmar, while the PGS vegetable case was carried out in Suphan Buri province of Thailand. The retail case study was conducted in Bangkok, Thailand with leading Thai supermarket chains.

Table 1: Team members of Fresh Studio in the field studies

Fresh Studio project team		
Team 1- Farmers related interviews and government officers	**Team 2- Other actors related interviews**	**Team 3- Project management and supervision**
Mrs. Le Thi Thu Huong Agriculture consultant	**Mrs. Dana Roelofs** Business Development	**Mr. Siebe van Wijk** Agricultural Economist
Mrs. Hoang Thi Thu Quality assurance consultant	**Mr. Wytse Vellema** Agriculture Economist	**Mrs. Dana Roelofs** Business Development
Ms. Esther Wintraecken Rural development consultant	**Mrs. Hoang Thi Thu** Quality assurance consultant	**Mr. Wytse Vellema** Agriculture Economist
Ms. Tran Thi Thien Uyen Consultant assistant	**Ms. Win Pa Pa Soe** Agriculture Economist	
	Ms. Nguyen Tran Nhat Uyen Marketing consultant	
	Ms. Pham Thi Thanh Consultant assistant	

Enumerators and local supporters for fieldwork		
Case 1- Organic coconut in Vietnam	**Case 2- Myanmar GAP mango in Myanmar**	**Case 3- PGS vegetable in Thailand**
Mr. Ngo Huu Tam Province supporter	**Mrs. Wah Wah Hlaing** Regional supporter	**Mrs. Phornthira** Translator & Supporter
Mr. Vo Thanh Con District supporter	**Ms. May Khaing Kyi** Administrator	**Mrs. Dusnee** Translator & Supporter
Mrs. Truong Ngoc Ha Commune supporter	**Ms. Tae Tae** Translator	**Mrs. Roongsuree** Translator & Supporter
Ms. Tran Ngoc Yen Commune supporter	**Mr. Ko Ko** Translator	**Mr. Suchanun** Enumerator
Mr. Duong Phuoc Hoa Enumerator	**Mrs. Zaw La** Translator	**Ms. Kwanruedee** Enumerator
Mr. Nguyen Van Khang Enumerator	**Ms. Htet Oo** Enumerator	**Ms. Suriya** Enumerator
Ms. Le Thi Phuong Anh Enumerator	**Ms. Eaint Eaint** Enumerator	**Mr. Chayen** Enumerator
Mr. Nguyen Hoang Phuc Enumerator		
Ms. Tran Ngoc Yen Nhi Enumerator		

2.3 Interviewed actors

The interviewed/surveyed respondents cover all actors in the chain, from input suppliers to retailers. A study of end consumers, conducted by the ADB, was underway at this time this study was conducted, and thus the results are not included in this study. A total of 221 different actors who are active in the vegetable and fruit sectors were interviewed or surveyed in Vietnam, Thailand and Myanmar.

Table 2: Number of interviewed actors the GMS vegetable and fruit chain study

Actors in the chain	Case 1- Organic coconut in Vietnam		Case 2- Myanmar GAP mango		Case 3- PGS vegetable in Thailand		Case 4- Retail study		Total
	M	F	M	F	M	F	M	F	
Farmers	42	26	49	5	14	28			164
Authority	4	2	5	7	2	3			23
NGOs					2	1			3
Traders									0
Collectors	4	2	5						11
Wholesale traders			1						1
Exporters/Processors	1	1	2						4
Input suppliers	1	2	1	1		1			6
Retailers					1	2	3	4	10
Transporters			1						1
Pre-processors	1		2	2					5
Consumers									0
Total number	**86**		**81**		**54**		**4***		**221**

*Note: *Interviews were held with four retailers. In three cases two representatives of the retailer participated in the interview, while in one case there was one participant. As the participants were representing the viewpoint of one commercial entity seven interviewees are reported as four interviews.*

2.4 Data analysis and report writing

- Objective: Summarize the findings of the analyses and draw lessons that apply to the GMS as a whole, using the case studies to highlight specific actions and policies that may be used to overcome existing barriers to the successful expansion of the production and supply of reduced-input fruit and vegetables

All primary and secondary data were analyzed and are summarized in this comprehensive report, providing an overview of the key fresh fruits and vegetable sectors, regional trade flows, and market entry restrictions.

Each case study has been analyzed separately, paying particular attention to the central themes highlighted for this study. Value chain maps, overview of actors and value added at each step of each chain have been illustrated. In each case study, at least one of the three core issues and how the issue affects the opportunities and behavior of different actors have been addressed. Moreover, gender issues, competitiveness and inclusiveness have been looked at and the results have been analyzed. SWOT analyses have been conducted, focusing on the opportunities and barriers for upscaling the value chain.
Finally, clear recommendations, generalizing the findings from the case studies, aimed at developing policy measures or activities that can be implemented to encourage intra-GMS trade at country or regional level in fresh fruits and vegetables. Potential for intra-GMS harmonization of standards have been discussed. These recommendations will also include an overview of the gaps and the institutional needs to improve the enabling environment for SEAP value chain development.

2.4.1 Gaps and biases of the study

While this study has been carried out and the report has been written according to the best knowledge of the consultant team, some aspects of the development of this report are worth highlighting.

- Although gender balance was always considered in the fieldwork, the number of females participating in this study (82 females out of 225 actors) was lower than their actual involvement of the chains due to cultural traditions (e.g. men more frequently attend meetings with outsiders as they are considered the head of household).
- The actual respondents in some case studies were lower than planned, for example in the PGS organic vegetables the chain is still relatively new and not yet fully developed so there were only a small number of farmers available to participate.
- In the retail case, retailers were willing to share anecdotal evidence about their experience with reduced-input fruits and vegetables and importing, but they would not share company data relating to these topics.

Data collection from secondary sources and the field work conducted relied on the knowledge of researchers, reporters and interviewed chain actors. Their knowledge may not reflect the whole picture, neither is it scientifically proven to be correct. Whenever possible, information is cross-checked from different sources to obtain the most accurate information.

2.4.2 Report structure

The report is organized in eight main sections, starting with a short introduction of the study, its scope and objectives. The second chapter describes the methodology adopted in this study. The third section gives an overview of the fruit and vegetable sectors in the GMS region, covering both advantages and constraints of production and trading. The main parts of the report are sections four to seven, which analyze three fruit and vegetable value chains and representatives of food retailers in Thailand. In each of these cases, a complete overview and descriptions of all actors, their activities, difficulties and opportunities of the chain in terms of production, trading and technical barriers are discussed. A SWOT analysis as well as recommendations for each chain are presented at last. Therefore, each value chain analysis can stand independently as a complete study. The last section of the report deals with the key findings and recommendations for all four cases. The recommendations are divided into the following themes: harmonization of standards, investments, developing knowledge transfer systems and market access.

3. OVERVIEW OF FRUIT AND VEGETABLE SECTORS IN THE GMS

The Greater Mekong Sub-region (GMS) covers an area of 2.6 million square kilometers with a population of around 329 million people. With great variation in topography and climate, the GMS enjoys diverse crop patterns and varieties all year around. The GMS has also become a recognized fruit and vegetable producing region of the world.

Figure 2: Map of the Greater Mekong Sub-region (GMS)
(Source: http://www.thehansindia.com/posts/index/Hans-Classroom/2016-07-27/MekongGanga-Cooperation/244938)

Agriculture occupies a substantial part of the total land in the GMS, ranging from 11% in the Lao PDR to 56% of the land area in the PRC. With a majority of the population still living in the rural areas, the agriculture sector plays a significant role in the economy and generates great values for export. In the period from 2002 to 2012, agriculture contributed more than a quarter of the economy of Cambodia (34%), Myanmar (31%) and the Lao PDR (28%) while its share was smaller for Vietnam (18%), Thailand (11%) and PRC (8.6%) (ADB, 2015). Agriculture is among the top five export sectors of Vietnam, Lao PDR, Cambodia and

Myanmar. The main agricultural crops in the region by value are cassava, fruit, corn, rice, sugar cane and vegetables (ADB, 2015).

In the past two decades, agricultural production and productivity in the GMS has improved substantially. Along with its fast development, the sector has recently faced common problems related to food safety, environmental pollution and non-tariff barriers that present a hurdle to its export to the world and that also prevent smooth cross-border trade in the GMS region and ASEAN. Intra-GMS trade accounted for only 8% of the total trade value in 2014, a figure that is very low when compared to 63% regional trade for the EU (Eurostat, 2017) or 46% for North America's NAFTA region (NAFTA, 2017).

3.1 Fruit production

Hundreds of kinds of subtropical and tropical fruits are grown in the region as a result of favorable climatic conditions. According to FAOSTAT, the total harvested area of fruits in GMS countries nearly reached 17 million hectares in 2016, around 27% of worldwide harvested area. Over the five-year period from 2012 to 2016, the total harvested area of fruits increased by 10%. PRC and Thailand are the two biggest producers of fruits in terms of area in the GMS, accounting for 86%[2] and 7% of total harvested area, respectively, followed by Vietnam and Myanmar with 3% each (Table 3).

The period 2012-2016 has witnessed a gradual growth in the production volume of fruits by 17%, reaching the highest volume of 212 million tons in 2016. The GMS contributed from 27-28% of total world production of fruits in this period (FAOSTAT, 2017). PRC is the biggest producer of fruits in GMS, accounting for 90% of total production quantity. Thailand ranked second in the production volume of fruits, but witnessed a reduction of 1% when comparing 2016 to 2012. Thailand's small decrease went against the increasing trend of the rest of the region.

[2] Figures for PRC include the entire Chinese area and volume, not only that of the two regions in the GMS, which explains the significant share that PRC represents in these figures

Table 3: Fruits production in GMS (2012,2016)

	Harvested area				Production volume				Yield	
	2012		2016		2012		2016		2012	2016
Unit	(ha)	(%)	(ha)	(%)	(tons)	(%)	(tons)	(%)	(tons/ha)	(tons/ha)
Cambodia	62,304	0%	62,732	0%	367,873	0%	377,293	0%	5.9	6.0
Lao PDR	42,870	0%	55,250	0%	573,050	0%	1,036,791	0%	13.4	18.8
Myanmar	434,173	3%	457,596	3%	2,261,355	1%	2,523,634	1%	5.2	5.5
Thailand	1,167,504	8%	1,178,916	7%	10,828,665	6%	10,635,377	5%	9.3	9.0
Vietnam	553,035	4%	587,449	3%	7,065,593	4%	7,470,613	4%	12.8	12.7
PRC	13,100,916	85%	14,555,363	86%	159,818,961	88%	190,361,323	90%	12.2	13.1
GMS	**15,360,802**		**16,897,306**		**180,915,497**		**212,405,031**		11.8	12.6
World	59,057,800		61,728,663		683,014,641		748,853,845		11.6	12.1

Source: FAOSTAT, 2017.

Note: Countrywide data from China is presented in the table, though only Yunnan and Guangxi provinces of the PRC are included in the GMS, as data from just these two provinces is not available.

3.2 Vegetable production

Total harvested area of vegetables in GMS countries reached 27.9 million hectares in 2016, accounting for about 45% of the world's area. The total harvested area increased by 7% over in 2012-2016 period. Among six GMS countries, PRC accounted for over 90% of total production area. Vietnam and Thailand are the second and third largest vegetable producers in the region respectively, but only comprised from 1-4% of total harvested area of vegetable in the GMS, as the figures include PRC's total area and not only the two provinces belonging to the GMS (FAOSTAT, 2017).

In terms of production volume, over 662 million tons of vegetable were produced by GMS countries in 2016, a growth of about 12% over the five-year period (2012-2016). GMS contributed more than a half of the world's production of vegetable in 2016. PRC still dominates other GMS countries, contributing 96% of total regional production, followed by Vietnam in second place with 2% of total production. Myanmar and Thailand are also important producers of vegetable in the GMS with 1% of total production each. Table 4 presents the production of each GMS country with three measurements: harvested area, production volume and yield in the years 2012 and 2016.

Table 4: Vegetable production of GMS countries (2012,2016)

	Harvested area				Production volume				Yield	
	2012		2016		2012		2016		2012	2016
Unit	(ha)	(%)	(ha)	(%)	(tons)	(%)	(tons)	(%)	(tons/ha)	(tons/ha)
Cambodia	96,000	0%	84,000	0%	628,000	0%	541,928	0%	6.5	6.5
Lao PDR	138,770	1%	201,419	1%	1,040,611	0%	1,921,188	0%	7.5	9.5
Myanmar	355,767	1%	373,689	1%	4,651,200	1%	4,994,813	1%	13.1	13.4
Thailand	424,539	2%	376,083	1%	3,415,749	1%	2,935,554	1%	8.0	7.8
Vietnam	885,032	3%	1,094,825	4%	13,773,705	2%	16,005,518	2%	15.6	14.6
PRC	24,118,564	93%	25,777,351	92%	567,913,867	96%	635,827,572	96%	23.5	24.7
GMS	**26,018,672**		**27,907,367**		**591,423,132**		**662,226,573**		22.7	23.7
World	58,028,533		61,756,519		1,112,403,337		1,223,393,333		19.2	19.8

Source: FAOSTAT, 2017.

Note: Countrywide data from China is presented in the table, though only Yunnan and Guangxi provinces of the PRC are included in the GMS, as data from just these two provinces is not available.

3.3 Reduced-input production of fruit and vegetables in the GMS

As consumers' food safety awareness has increased and demand for safe food has risen in the GMS countries, various regional, national, and private sector-driven initiatives have been implemented to address food safety risks and facilitate market access. At the same time, modern food supply chains and modern retail outlets have increased rapidly to take advantage of this trend. Many voluntary standards are used by supermarkets to protect their reputations and differentiate themselves from the competition. As a result, agricultural stakeholders in the GMS are under increasing pressure to demonstrate that they have the capacity to manage food safety and quality risks (ADB and Mekong Institute, 2017). Good Agricultural Practices (GAP) and Organic Agriculture are two types of production standards used in GMS countries for the mentioned purposes.

- **Implementation of regional reduced-input production standards for fruit and vegetables**

In this study 'reduced-input' refers primarily to the reduced use of "conventional" fertilizers and plant protection compounds, as well as to the avoidance of environmentally unsound and/or potentially harmful contaminants. Thus, GAP and organic agriculture production systems are referred to as reduced-input production standards.

- **Implementation of GAP in the GMS countries**

Table 5 summarizes national GAPs which are implemented in the GMS countries. Except Thai Q-GAP, ThaiGAP and ChinaGAP, most GAPs were established after the launch of ASEANGAP standards (2006) and guidelines (2008). ASEANGAP[3] was intended to enhance harmonization of production standards and facilitate trade of fresh fruits and vegetables in the region. It's adoption in the region varies between countries. Within the GMS region, ASEANGAP was used as a guideline for Lao PDR, Cambodia and Myanmar to set their own national standards. VietGAP and ThaiGAP, on the other hand, are more GLOBALG.A.P[4] oriented (Nabeshima *et al*. 2015).

Table 5: National GAP standards in the GMS countries

Country	GAP	Responsible parties	Year
Cambodia	Cam-GAP	Ministry of Agriculture, Fishery and Forestry	2010
PRC	ChinaGAP	Certification and Accreditation Administration of the People's Republic of China (CNCA)	2004
Laos PDR	LAO GAP	Ministry of Agriculture and Forestry	2011
Myanmar	Myanmar-GAP	Ministry of Agriculture, Livestock and Irrigation	2016
Thailand	QGAP	Ministry of Agriculture and Cooperatives	2004
	ThaiGAP	Thai Chamber of Commerce	2007
Vietnam	VietGAP	Ministry of Agriculture and Rural Development	2008

Source: Nabeshima et al. (2015).

Since the ASEANGAP includes implementation guidelines and training materials as well as a code of recommended practices, member countries can benchmark their country GAP programs against ASEANGAP to achieve harmonization and mutual recognition. However, the progress of harmonization seems slow and there is no specific outcome available for the public at the time of this study.

ASEANGAP also has some limitations. First of all, it covers only fruits and vegetables and not high-risk products such as sprouts. Secondly, it is not yet well-known among consumers in

[3] ASEANGAP was developed by the ASEAN Secretariat with member country representatives and an Australian project team in 2006. It is a voluntary standard that consists of good agricultural practices to control hazards during the production, harvesting and post-harvest handling of fresh fruits and vegetables in the region.

[4] GLOBALG.A.P is one of the most influential private standards in the area of food safety and sustainability. It was originally created by a group of European supermarket chains. GLOBALG.A.P aims to increase consumers' confidence in food safety by developing good agricultural practices which must be adopted by producers

Source: (FAO, 2018). http://www.fao.org/docrep/010/ag130e/ag130e12.htm;

the region nor in other international markets[5]. ChinaGAP, for example, was benchmarked successfully against GLOBALG.A.P., which is globally recognized by consumers and private retail sectors. ASEANGAP, as a regional standard to promote exports, initially shared the ambition to benchmark against GLOBALG.A.P., however, it has not happened yet. Considering that, modern retailers especially international modern retail chains are the main distributors of high-value/ reduced-input produce, there may be a need for making ASEANGAP better-known among consumers and the within the sector. Finally, the system is lacking harmonized inspection, certification and accreditation systems for enforcement of the standard, making it a guideline and not yet a true standard.

- **Implementation of organic agriculture standards in the GMS countries**

At the time of this study, there were no regional standards for organic agriculture in the GMS region. PRC and Thailand are most advanced in terms of setting up national standards for organic agriculture. Table 6 summarizes national initiatives on organic agriculture in the GMS countries. Though not a national system, the PGS organic system was also included in the table as it is a system suitable to small-scale farming, which is prevalent in most GMS countries (ADB, 2017; Win, 2017; ASEAN, 2015).

Table 6: National standards for organic agriculture in the GMS countries

Country	Organic standard	Responsible/supporting party	Remark
Thailand	ACT organic standards (1995)	Organic Agriculture Certification Thailand (ACT)	
	Thai Organic Agriculture (2002)	Ministry of Agriculture and Cooperatives (MOAC)	
	PGS	Land Development Department (LDD), MOAC	Lacking a national regulation to support PGS, though PGS is recognized by the local government
Vietnam	--	National organic standards are not developed yet	Regulations covering organic and PGS are in development
	PGS (2008)	ADDA (2008); ADB and Vietnam Organic Agriculture Association (VOAA) (2014)	
Cambodia	--	National organic standards are not developed yet	
	PGS (2014)	General Directorate of Agriculture (GDA) and Ministry of Agriculture, Forestry and Fisheries (MAFF)	PGS is recognized in a policy statement

[5] Source: FAO. Food Safety and Good Practice Certification. Retrieved January 2018 from http://www.fao.org/docrep/010/ag130e/ag130e12.htm

Country	Organic standard	Responsible/supporting party	Remark
Lao PDR	Laos organic standards (2005)	Ministry of Agriculture and Forestry (MoAF)	
	PGS (2006)	Ministry of Agriculture's Department of Certification	PGS was adopted into the government system
Myanmar	--	National organic standards are not developed yet	
	PGS	Agriculture Department and Myanmar Organic Grower and Producer Association (MOGPA)	PGS is recognized by government
PRC	China National Standard for Organic Product (2005)	Certification and Accreditation Administration of the People's Republic of China (CNCA)	
	PGS		Not well established as there are existing laws in place prescribing standards and certification procedures that exclude PGS.

Source: Compiled from http://www.gmswga.org/sites/default/files/documents/Organic%20Standards%20and%20Certifications.pdf

3.4 Production constraints

There are many factors that currently constrain fruit and vegetable production. They may include but are not limited to factors such as productivity, pests and diseases, climate change and extreme weather events, losses and wastage and food safety and food system control infrastructure.

- **Agricultural Productivity**

Improvement in agricultural productivity has been observed in the Southeast Asia region. The area has agricultural productivity growth higher than most other regions, except the rest of Asia. This is mainly influenced by increased input use (such as labor capital, machinery, fertilizer etc.) and the increased intensification of farming activities. However, it is not the case of vegetable production (Hiroyuki, 2012).

The productivity of vegetable crops remains low in South and Southeast Asian countries despite increased regional demand for them (Hiroyuki, 2012; Hughes et al., 2014). Many factors contribute to low productivity, including, but not limited to, the following:

- Government agricultural polices often do not address the importance of vegetables to a balanced diet or to food security, especially with regards to micronutrient malnutrition. An expected result of this is lack of investment, which would inhibit productivity growth.
- Vegetables are generally sensitive to environmental extremes; climate change is likely to aggravate this further.
- Rapid urbanization and competition for land and water within other sectors and subsectors. As a result, vegetables are being pushed in sub-optimal or less fertile areas, reducing productivity and production volumes.
- Lacking research and development (R&D) on improving vegetable production systems including R&D on quality inputs such as good seeds (Hughes et al., 2014).

- **Pest and disease constraints**

Crop loss due to biotic stresses (mainly pests, diseases and weeds) is one of the most serious production constraints for agriculture. The severity of losses due to biotic stresses depends on the plant health, farmers' pest and disease management techniques, climatic conditions and control options. Annual loss due to these factors is estimated at over 1300 billion dollars worldwide (Sharma, 2013). When considering similar kinds of crops, the percentages of losses differ between the subtropics (mostly developed countries) and the tropics (mostly developing countries). For examples, crop losses due to pests and disease are much higher in Africa (42%) and Asia (43%) than in Europe (25%) and America (29%) (Sharma, 2013).

Losses due to pests, diseases, weeds and other biological agents can be classified into direct and indirect types. The former includes losses of yield, quality, cost of crop control measures and contamination of plant materials; while the latter is attributed more to downstream actors of the agriculture product chain, such as traders, wholesalers, exporters and consumers and results from decreases in product quality, shelf-life and rejection due to the use of crop protection measures needed to counteract adverse impacts of the environment (e.g. pesticide residues) (Savary et al., 2012).

Pests and pathogens can attack various parts of a plant in any growth and developmental stages. There is no single method that can effectively control all pests and diseases. Crop protection measures are rather site specific. In an organic farming system, pest and disease management usually consists of a wide range of activities that require much knowledge of plant health and pest and disease ecology (Gomez, 2015). During the transition period between conventional and organic systems, pest and disease problems can be exacerbated because the natural antagonists to these problems have not yet been established in the system, but chemical treatments are no longer allowed.

Moreover, problems caused by pests and diseases can be complicated and exacerbated by climate change. As reviewed by Sebesvari et al. 2011, changes in temperature (e.g. global warming) and elevated atmospheric CO_2 concentration can strongly affect the incidence and severity of pests and diseases as well as their distribution. The damaging effects of pests and pathogens on vegetables in South East Asia are predicted to increase due to climate change. Therefore, plans for crop production control measures should consider the effects of climate change, particularly in highly vulnerable areas.

- **Climate change**

The impact of climate change on agriculture is difficult to predict because the number of variables to be accounted for when making the predictions is high. However, it is generally accepted that the potential impacts for tropical regions such as the GMS include (Gornall, 2010):

- decreases in precipitation leading to lower productivity;
- rising temperatures increasing heat stress on crops and water loss through evaporation;
- increased extreme weather events leading to drought, extreme temperatures, flooding, or tropical storms all of which have important impacts on both crop productivity and quality; and
- indirect impacts such as changes in water availability, increase in pests and diseases, and rising sea levels will also affect crops.

- **Post-harvest losses**

It is widely agreed that post-harvest loss is one of the biggest obstacles that the GMS countries need to overcome to strengthen their fruit and vegetable supply chains. Hughes *et al.* (2014) calculated that within the 10 ASEAN countries, 2.7 million tons of the 34.2 million tons of vegetables produced in 2012 were lost during postharvest and marketing processes. The authors also suggested that substantive reduction in crop losses would require improvements in both pre- and postharvest stages of the vegetable supply chain. In addition, Kusumaningrum *et al.* (2015) estimated that postharvest losses were 42% for fresh fruits and vegetables in the Southeast Asia region, mainly because of short shelf life of the tropical fruits and losses during production and distribution. Similarly, Choudhury (2006) concluded that poor infrastructure for storage, processing, distribution and the effects of seasonality (causing surpluses) could result in waste of 10 to 40% of total production.

Tropical fruits can be distinguished by their high moisture content (80-90%), very high respiratory rates, and soft tissues, making them highly perishable and susceptible to changes in temperature. Thus, diverse types of post-harvest technologies are required to extend the shelf-life of fresh tropical fruits. In fact, while many postharvest technologies such as cold chain, packaging, heat treatment, and coatings are available not all of these treatments can be applied to tropical fruits due to the characteristics described above (Kusumaningrum *et al.*, 2015). The authors recommend that combination treatments are more effective than single treatments and that more effective and eco-friendly post-harvest technologies should be developed to increase productivity and export of Southeast Asian fresh fruits.

- **Lacking food safety and food control system infrastructure**

A national food control system infrastructure often consists of several components such as regulatory, food control management, inspection services, laboratory services and capacity building, which involves training and education[6]. Assuring sufficient investment in food safety and food control system infrastructure is still one of the major challenges in the GMS countries, especially in the less developed economies. To overcome this obstacle, the governments together with other supporting parties are putting considerable amount of efforts in construction, capacity building, enhancing surveillance and inspection systems for plant health, animal health, and food safety. At both regional and national levels, many public-led/ donor-led/ and private-led initiatives have been implemented to address food safety issues and increase market access. For example, the ASEAN technical working groups are working on food safety system harmonization, such as developing regional food safety standards (e.g. Maximum Residue Limits of Pesticides), SPS harmonization etc.; Codex Alimentarius and FAO are working on implementing international food safety standards in some countries; and ADB is working on SPS capacity building, technical assistance to address food safety and market access in the region (ADB and Mekong Institute, 2017).

3.5 Trade of fruit and vegetable in the GMS

3.5.1 Economic corridors and cross-border trade

- **Economic corridors**

Economic corridors within the GMS region have been identified with the aim of strengthening the development of infrastructure and logistics to promote trade and economic opportunities as well as supporting laws and regulations. The term "economic corridor" has been used in the GMS region since 1998 to refer to economic development and trade promotion. In 2008, the GMS economic corridors forum was formed as a single component focusing solely on economic corridor development, involving both public and private sectors and the central and local governments.

There are numerous projects and programs running in the GMS within the framework of economic corridors. Three main economic corridors have evolved in the GMS, namely the North-South, the East-West Corridor and the Southern Economic Corridors as illustrated in Figure 3.

[6]Source: FAO. Retrieved March, 2018 from http://www.fao.org/docrep/006/y8705e/y8705e04.htm#bm04.

In addition, PRC announced the Belt and Road Initiative in 2013 in an attempt to repave the Silk Roads. Within this giant project, six economic corridors that connect Asia, Europe and Africa are being realized. Related to the GMS countries, PRC has 2 out of 6 economic corridors that involves mainly Myanmar, namely Bangladesh-PRC-India-Myanmar Corridor and China-Indochina Peninsula Corridor. PRC has deployed massive resources to build infrastructure to boost connectivity with Myanmar (PwC, 2017).

Figure 3: Economic corridors in the Greater Mekong Sub-region
Source: https://greatermekong.org/content/economic-corridors-in-the-greater-mekong-subregion

3.5.2 Trade of fruits

The total value of exported fruits from GMS countries grew from 7.0 billion USD in 2012 to 10.7 billion USD in 2016—-52% in five years, a significant rise that is mostly due to the growth in the export quantity. This value accounted for around 10% of total world export of fruits in 2016 (UN Comtrade, 2017). From 2012 to 2016, the intra-GMS trade of fruits accounted for 32-42% of total fruit exports by GMS countries, which equates to a total value of approximately 2.4 to 4.2 billion USD. GMS countries also extend their exported markets to other countries, which accounted for 58-68% of total exports (Table 7).

Table 7: Export of fruits in GMS (2012-2016)

	World export ('000 USD)	Total GMS export		Intra- GMS		Rest of World (ROW)	
		Value ('000 USD)	GMS/ World (%)	Value ('000 USD)	Intra-GMS/ GMS (%)	Value ('000 USD)	ROW/ GMS (%)
2012	90,156,112	7,043,665	8%	2,419,780	34%	4,623,885	66%
2013	98,980,007	7,697,727	8%	2,747,951	36%	4,949,777	64%
2014	104,991,786	8,431,150	8%	2,956,698	35%	5,474,451	65%
2015	103,225,769	10,057,878	10%	4,212,241	42%	5,845,636	58%
2016	107,753,253	10,718,800	10%	3,465,446	32%	7,253,354	68%

Source: UN Comtrade (2017) and ITC Trade map (2017).
Note: Data is missing on the export of fruit from Vietnam to other GMS countries in 2016, which may lead to the lower total exported value to GMS in 2016.

Similar to the export trend, the imported value of fruits grew by over 80% in the period 2012-2016, reached the value of 10.5 billion USD and accounted for 10% of total world fruit imports (UN Comtrade, 2017). On average, 35-45% of fruits imported into GMS countries originate from other GMS members. Hence, the intra-GMS markets play an important role in GMS fruit trade.

3.5.3 Trade of vegetables

The total value of exported vegetables from GMS countries reached nearly 13.5 billion USD in 2016, witnessing a 28% rise in the five-year period 2012 – 2016. This growth can be attributed to growth in the quantities exported for most vegetable categories. The value exported from the GMS accounted for 17-19% of total world vegetable export over this period (UN Comtrade, 2017). From 2012 to 2016, the exported value of GMS vegetables to member countries reached 2.5 to 4.3 billion USD, accounting for 24-34% of total export of vegetable in GMS. The rest of the world imported from 66% to 76% of total GMS vegetable exports over the same period (Table 8).

Table 8: Trade of vegetable in GMS (2012-2016)

	World export ('000 USD)	Total GMS export		Intra- GMS		Rest of World (ROW)	
		Value ('000 USD)	GMS/ World (%)	Value ('000 USD)	Intra-GMS/ GMS (%)	Value ('000 USD)	ROW/ GMS (%)
2012	59,092,511	10,517,153	18%	2,531,966	24%	7,985,187	76%
2013	65,933,435	10,950,683	17%	3,384,759	31%	7,565,924	69%
2014	66,355,041	11,995,832	18%	3,980,663	33%	8,015,169	67%
2015	65,789,114	12,822,219	19%	4,335,975	34%	8,486,245	66%
2016	69,822,856	13,486,993	19%	3,643,718	27%	9,843,275	73%

Source: UN Comtrade, 2017.

Note: Data is missing on the export of vegetables from Vietnam to other GMS countries in 2016, which may lead to the lower total exported value to GMS in 2016.

In terms of imports, from 2012 to 2016, the total imported value of vegetables of GMS countries increased from 2.9 to 4.9 billion USD (UN Comtrade, 2017). 83-89% of total imported vegetable were from other GMS members and only 11-17% from the rest of the world. Hence, GMS vegetables are mostly traded and consumed within the region.

3.5.4 Trade barriers

- **Non-Tariff measures within GMS region**

To promote regional trade, significant progress has been made in lowering intra-regional tariffs in ASEAN countries over the past decades. However, the number of non-tariff measures (NTMs)[7] has increased constantly, affecting the effectiveness of tariff liberalization. Even though The World Trade Organization (WTO) and its treaties impose rules on what countries can and cannot do, the WTO rules on NTMs are considered to be relatively weak because the WTO allows for regulations that are necessary to achieve legitimate policy objectives. As many NTMs can be used both as instrument for non-trade policy objectives (e.g. food safety, environment protection), as well as for commercial policy objectives (e.g. subsidies, trade defense measures) regulating them becomes more complicated as special committees such as the Technical Barrier to Trade (TBT) Committee and Sanitary and Phytosanitary (SPS) Committee need to weigh the stated aims against the effects on trade. Therefore, the WTO regulation of NTMs might prove to be a weak spot in regional and multilateral trading systems (Ing e*t al.*, 2016).

The collected data show that average tariff rates of ASEAN countries had decreased from 8.9% in 2000 to 4.5% in 2015, meanwhile the number of NTMs had increased from 1,634

[7] *UNCTAD (2016) defines Non-tariff measures (NTMs) as policy measures, other than ordinary customs tariffs, that can potentially have an economic effect on international trade in goods, changing quantities traded, or prices or both.*

measures to 5,975 measures over the same period. Among the NTMs, 33.2% were in the form of SPS, 43.1% in the form of technical barriers to trade, and the rest were in the form of other measures (Ing et al., 2016). Interestingly, breakdowns of the measures by product categories showed that vegetable products were among the most heavily regulated products (three or more NTMs), surpassed only by machinery and chemical products. Within the GMS region (excluding PRC), Thailand, Vietnam, Lao PDR and Cambodia have put NTMs on all imported products, while Myanmar was the only country with less than 100% coverage. Myanmar's NTMs cover around 42% of its imports. Though a country with high number of NTMs does not necessarily mean it is more protectionist than others, these measures clearly influence regional trade.

Table 9: Non-tariff measures by type and by country in the GMS region, 2015

	Total number of NTMs	SPS (%)	TBT (%)	Export -related measure (%)	Other measures (%)
Thailand	1630	48	34	8	9
Vietnam	379	37	37	17	8
Lao PDR	301	13	30	27	30
Cambodia	243	15	50	29	7
Myanmar	172	44	24	20	12
Total/ Average	2725				

Source: Ing et al. (2016)

Note: NTMs: non-tariff measures; SPS: Sanitary and Phytosanitary measures; TBTs: technical barriers to trade.

- **Effect of NTMs on trade**

The Overall Trade Restrictiveness Index (OTRI) and market access OTRI (MA-OTRI) developed by Kee, Nicita and Olarreaga (2009) are used as indicators to provide overall level of restrictiveness of the trade policies imposed by a country. According to these indicators, NTMs greatly contribute to restriction of international trade. Their contribution to overall trade restrictiveness is generally much higher than that of tariffs (UNCTAD, 2013).

Research by Ing *et al*. (2016) supports the finding that NTMs affect trade flows. This research points to the complex, indirect and case specific impacts of NTMs on trade, which make it difficult to completely quantify them. Nonetheless the authors concluded that NTMs impose costs on businesses that will impact trade flows, particularly when the costs associated with the NTM are variable costs, such as the costs related to sourcing the products.

4. CASE STUDY 1: ORGANIC COCONUT IN BEN TRE, VIETNAM

4.1 Background information

4.1.1 Coconut production and trade in the GMS

- **GMS coconut contribution to global production**

In 2016, the global coconut production area was 12.1 million ha, of which GMS countries accounted for 3% (about 417 thousand ha). GMS countries Thailand and Vietnam played a key role in the region with a total harvested area of 177 and 149 thousand hectares respectively in 2016. Between 2012 and 2016, the total GMS production area (excluding Lao PDR) witnessed a slight decrease, mostly due to a decline in the production area of Thailand.

In terms of production volume, GMS production increased from 3.1 million tons in 2012 to 3.2 million tons in 2016, accounting for 5% of the world production volume and 6% of Asia. Vietnam has the highest production in the GMS, producing about 1.5 million tons of coconut in 2016. Thailand with 0.8 million tons of coconut is the second largest coconut producer in GMS (Table 10). Excluding PRC[8], the other five GMS countries contributed to 7-8% of total production of ASEAN in the five-year period 2012- 2016.

Table 10: GMS contribution to global coconut production (2012-2016)

	Harvested area				Production volume				Yield	
	2012		2016		2012		2016		2012	2016
Unit	(ha)	(%)	(ha)	(%)	(tons)	(%)	(tons)	(%)	(tons/ha)	(tons/ha)
Cambodia	12,000	3%	13,190	3%	66,940	2%	69,585	2%	5.6	5.3
Lao PDR	-	-	-	-	-	-	-	-	-	-
Myanmar	47,600	11%	48,502	12%	490,717	16%	531,730	17%	10.3	11.0
Thailand	213,197	49%	177,063	42%	1,056,658	34%	815,406	26%	5.0	4.6
Vietnam	132,006	30%	146,835	35%	1,273,003	41%	1,469,960	46%	9.6	10.0
PRC	29,210	7%	31,402	8%	242,910	8%	296,986	9%	8.3	9.5
GMS	**434,013**		**416,992**		**3,130,228**		**3,183,667**		**7.2**	**7.6**
World	12,028,147		12,168,804		61,875,921		59,010,635		5.1	4.8

Source: FAOSTAT, 2017. Note: There is no data for coconut production in Lao PDR throughout the period.

- **Intra-GMS trade of coconut**

The total value of exported coconuts, including both fresh and processed coconut products, from GMS countries reached 226 million USD in 2016, an 87% rise in the five-year period of

[8] *As only two provinces of China are included in the GMS region and as production figures are only available for the entire country, China is excluded when looking at GMS contribution to world production.*

2012 – 2016. This value accounted for 3-5% of total world coconut export over the mentioned period (UN Comtrade, 2017).

From 2012 to 2016, 39% - 78% of GMS coconuts were exported within the GMS, mostly in fresh or dried forms. In 2013 and 2016 intra-GMS exports grew strongly due to increased imports of coconut inputs for producing coconut byproducts (eg. coconut water) in PRC and Thailand.

Ben Tre coconut is exported to Thailand in the form of desiccated coconut as input for further processed products. In the past five years Thailand had to import coconut from neighboring countries due to a shortage of coconut materials for processing.

Table 11: Trade of coconut in GMS (2012-2016)

Year	World export ('000 USD)	Total GMS export		Intra- GMS		Rest of the world	
		Value ('000 USD)	% to total world export	Value ('000 USD)	% to total GMS export	Value ('000 USD)	% to total GMS export
2012	3,895,671	121,050	3%	62,238	51%	58,812	49%
2013	3,398,122	116,064	3%	90,219	78%	25,846	22%
2014	4,734,265	198,444	4%	106,716	54%	91,728	46%
2015	4,114,011	217,056	5%	84,454	39%	132,603	61%
2016	4,212,082	225,811	5%	148,830	66%	76,981	34%

Source: UN Comtrade, 2017.
Note: The exported value is the sum of fresh and dried coconut, coconut oil, coconut fiber, coir and copra. There is no detailed information about the export of other processed coconut product such as coconut candy, milk, water and other coconut-original products.

4.1.2 Coconut production and trade in Vietnam

- **Coconut production in Vietnam**

Currently Vietnam has nearly 147 thousand hectares of coconut which is grown mostly in the Mekong Delta, South Central Coast and Southeast region. The production volume reached nearly 1.5 million tons of coconuts in 2016, an increase of 16% over the five-year period 2012-2016 (FAOSTAT, 2017). Vietnam is one of the most productive producers of coconut with a high-level productivity, varying from 9.6 to 10.0 tons/ha depending on the year. This is nearly double the yield of coconut in Thailand (see Table 12).

Table 12: Coconut production and trade in Vietnam (2012-2016)

	2012	2013	2014	2015	2016
Area harvested (ha)	132,006	136,206	139,236	145,634	146,835
Production volume (tons)	**1,273,003**	**1,303,826**	**1,374,404**	**1,439,119**	**1,469,960**
Yield (tons/ha)	9.6	9.6	9.9	9.9	10.0
Total export value (total) (USD)	**83,804,871**	**74,064,365**	**124,997,893**	**114,143,463**	**117,345,676**
- Intra GMS (USD)	29,930,468	43,923,597	49,760,443	30,003,710	50,096,380
Share of export to GMS (%)	36%	59%	40%	26%	43%
- Rest of the world (USD)	53,874,403	30,140,768	75,237,450	84,139,753	67,249,296
Share of export to ROW (%)	64%	41%	60%	74%	57%

Source: FAOSTAT, 2017 and UN Comtrade, 2017.

Note: The exported value is the sum of fresh and dried coconut, coconut oil, coconut fiber and coir. There is no detailed information about the export of other processed coconut product such as coconut candy, milk, water, charcoal and other coconut-original products.

- **Consumption and trade of coconut in Vietnam**

The market for coconut products is domestic and international. Most fresh coconut fruits are consumed domestically, accounting for around 15% of total production (Ben Tre Coconut Association, 2016). Eighty-five percent of total coconut production is processed into value-added products such as coconut chips, desiccated coconut, coconut milk, and oil, or into by-products, namely coconut fiber, charcoal or coconut peat. The total export value of coconut in Vietnam reached a peak of 125 million USD in 2014. Over five-year period, export of coconut grew by 39%. In terms of export markets, 26-59% of total Vietnam export was destined to GMS market, with the highest share in 2013 due to the need of coconut materials from PRC and Thailand. Vietnam increasingly exported to OECD countries and other markets which accounted for 41-74% of the total exported value (UN Comtrade, 2017).

4.1.3 Coconut production in Ben Tre Province

- **Coconut production in Ben Tre province**

Coconut has been grown in Ben Tre for very long time. According to the Ben Tre Coconut Association report in 2016, the province has the largest coconut production area of Vietnam with a total area of 70,000 hectares and a total yield of about 600 million nuts per year. This accounts for 54% of the Mekong Delta production area and 42% of Vietnam's coconut plantation area. Ben Tre has 9 districts, of which Mo Cay Nam, Mo Cay Bac and Giong Trom districts are the most important coconut production areas.

The average annual yield for coconut in Ben Tre is 50- 80 fruits per tree which converts to 10,000-16,000 nuts/ha. The Ben Tre Coconut Association estimates that the coconut trees in Ben Tre can reach a yield of 100 nuts/tree/year when coconut trees are supplied enough nutrient and water and grown under favorable climatic conditions.

There are approximately 163,000 households producing coconut with an average of 0.4 ha/ household. As estimated by the Ben Tre Agricultural Extension Center, around 40% of households in Ben Tre have coconut-related activities. Within those households, 72% of their income derives from coconut farming.

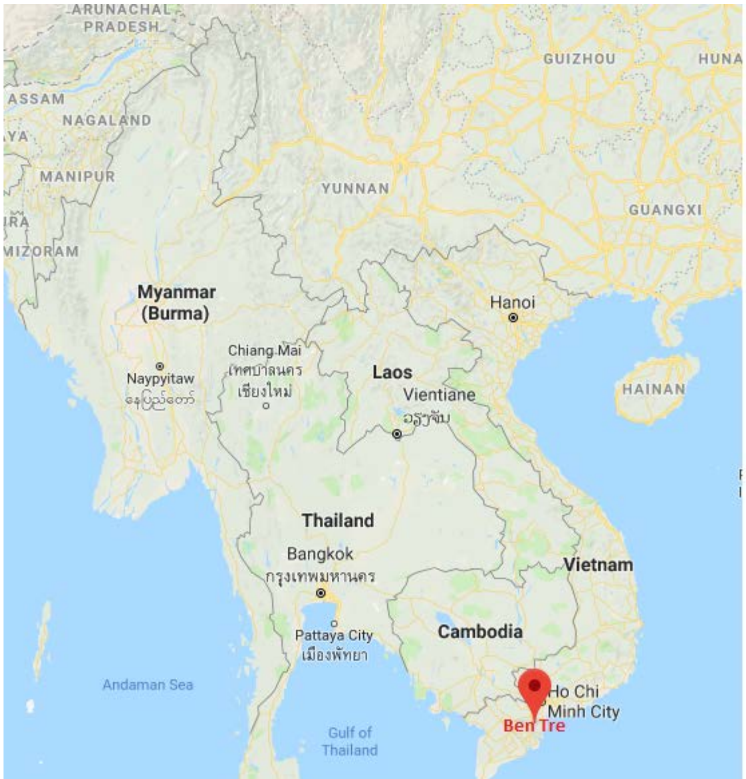


Figure 4: Location of Ben Tre province, Vietnam in GMS map
Source: Google maps.

- **Coconut production in Mo Cay Nam district**

This study was conducted in An Thoi and An Dinh communes of Mo Cay Nam district in Ben Tre. Mo Cay Nam district is one of the main coconut growing areas of the studied organic coconut companies and is located 30 km to the South of Ben Tre city. It has an area of 23,077 ha, of which 17,700 ha is agriculture land. The production area for coconut is 17,000 ha, accounting for 96% of agricultural land, though as a result of intercropping this does not mean that coconut production is the only agricultural activity. The population is 186,474 people whose main livelihoods are agriculture and aquaculture.

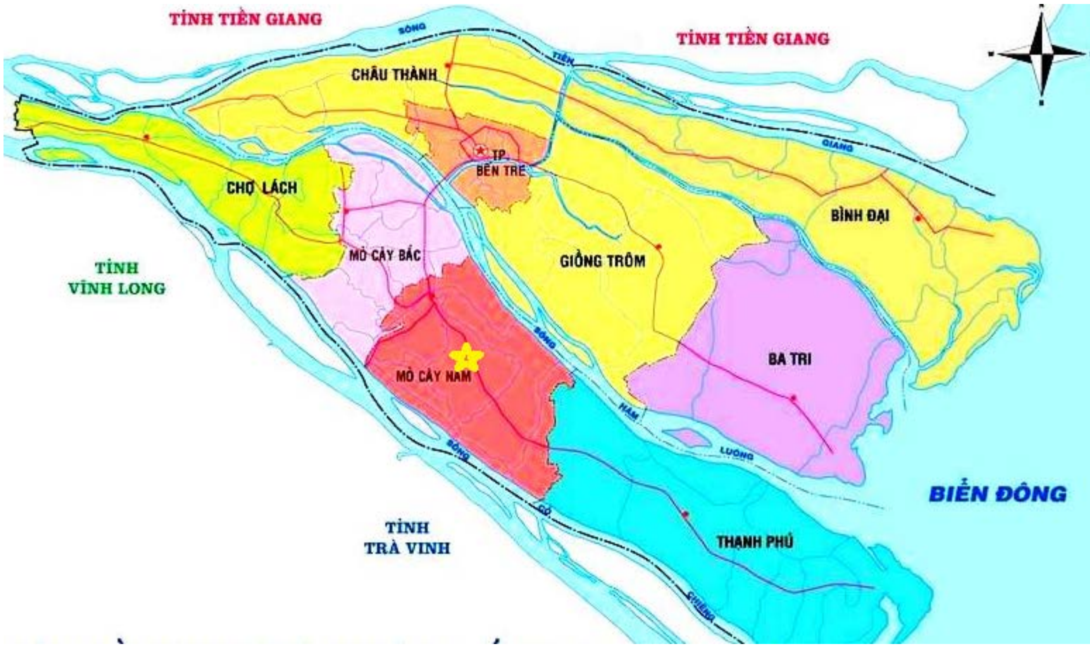


Figure 5: Location of Mo Cay Nam district in Ben Tre province
(Source: https://thuvienlichsu.com/dia-diem/tinh-ben-tre-105)

Table 13: General information about An Thoi and An Dinh communes

Categories	An Thoi commune	An Dinh commune
Population	8,549	12,354
Number of households	2,150	2,966
Percentage of poor households (%)	5	10
Total land (ha)	1,105	1,503
Agriculture land (ha)	1,056	1,301
Coconut area (ha)	975	1,201

Source: Yearly report of An Thoi and An Dinh communes in 2017.

- **Organic coconut production**

While organic coconut farming has been a traditional farming practice in Ben Tre for a long time, the organic coconut program only started in 2012. It was begun with the support of the provincial government, NGOs and private enterprises and focuses on EU and USDA certified organic.

The main organic coconut production areas in Ben Tre are Mo Cay Nam and Giong Trom districts, but in the coming years, coconut companies intend to extend their organic sourcing to new areas in Giong Trom, as well as to Thanh Phu and Binh Dai districts.

The case

Organic Ben Tre coconut has been selected as a case for deeper investigation as a result of the increasing role of GMS countries in coconut production and processing. In addition, intensive trade exists within the region, both in raw and processed products, serving a possible model for other fruit and vegetable value chains. The organic program, though young, has a track record that can be studied and provides an example of tight integration along the chain, with support from government agencies, private companies and NGOs, providing further opportunities for lessons to be learned. It also shows potential for further growth and development, so the lessons learned could have a local as well as a wider application. Finally, the chain is using internationally recognized standards for organic and its quality assurance systems providing further opportunities for learning.

4.2 Coconut farming practice

4.2.1 Coconut varieties

There are many coconut varieties grown in Ben Tre for different purposes, for example drinking or processing. Farmers were asked to list the most common coconut varieties with the relevant planting areas. "Dua ta", a collective name for 2 kinds of coconut: *Dua ta xanh* and *ta vang*, was the most commonly farmed coconut, grown by 96% (66 out of 68) of interviewed farmers. This variety is an industrial coconut, suitable for processing to create value added products such as coconut oil and desiccated coconut, as well as other products, because it has a high oil content (65-67%), thick coconut flesh (≥1,2cm), high yields (70-80 nuts/ plant/ year), and big fruits (1,6-2,0 kg/dry nut)[9]. Drinking coconut varieties, such as "Dua xiem xanh", Dua xiem do", were also common in the studied area, with respectively 13% and 7% of farmers growing them.

4.2.2 Coconut seedling stage

Depending on the variety of a coconut tree, a seedling stage may last from 1.5 to 4 years. For most local varieties (Dua ta) in Ben Tre, this vegetative stage lasts for 3-4 years. Though coconut can be planted anytime of the year, by planting in the early rainy season farmers save on the cost of irrigation.

No farmers participating in the study bought coconut seeds, they instead selected fruits from their best trees to use as seeds. Once a coconut seed has germinated, it is planted in the nursery area. After approximately 12-16 months, when the seedling has developed 6-8

[9] Ben Tre Department of Science and Technology, "Coconut varieties and coconut variety selection technique", http://www3.skhcn.bentre.gov.vn/Pages/TraiCay.aspx?ID=57&CategoryId=C%u00e2y+d%u1eeba&InitialTabId=Ribbon.Read&PageIndex=2

leaves, it is transplanted to the field where it will grow for 2-3 more years before producing the first fruits.

4.2.3 Production stage

The planting and harvesting calendars for organic and conventional coconut are similar. Coconut can be harvested all year- round, but the yield is typically 40-60% less in the low season (Aug – Nov) due to dry weather.

- **Alluvial accretion**

A cropping calendar starts in January when farmers gather alluvial deposits from the river (silt, sand and other river sediment that are rich in nutrients) and add it to their fields. Farmers either take the alluvium from irrigation canals, or hire a pumping machine to add alluvium to each coconut tree.

- **Organic fertilizer application**

Organic fertilizer is often made by farmers based on the techniques that the farmers were taught by the coconut company or by government extension agents. Farmers apply organic fertilizers twice a year, in May and October with a rate of 15-20kg per tree. Fertilizer application is labor intensive and thus farmers need to hire more labor to help them, due to the high quantities applied they also often need to purchase additional source material. Conventional farmers also applied organic fertilizer, though in smaller quantities as they could apply conventional products as well. Thus they were more likely to have the needed quantity of inputs to make their own organic fertilizer and could apply the smaller amounts by themselves. Results from focus group discussions (FGDs) with farmers show that non-organic farmers use less than 30kg of organic fertilizer per coconut tree while organic farmers apply 30-40 kg of organic fertilizers per tree. This is one of the main differences between conventional and organic coconut farming practices.

- **Pest and disease control**

There are more than 150 pests and pathogens found on coconut tree parts such as the trunk, leaves, flowers and fruits. However, only a few of them are economically important in Ben Tre province.

Three insects were mentioned as the most common pests for coconut in the study, namely: 1) coconut leaf beetle (*Brontispa longissimi)*; *2)* coconut rhinocerous beetle *(Oryctes rhinoceros or Xylotrupes gideon, 3)* coconut weevil *(Diocalandra frumenti*)*.* The most common diseases are leaf spot and coconut budrot, a disease that can be caused by different microorganisms, but these diseases are not as severe as pests for coconut in Ben Tre.

There are limited control options for organic farming systems being used in Ben Tre against coconut pests. Organic coconut farmers used two biological control products: green fungus (*Metarhizium Anisopliae*) to control coconut leaf beetle and weevils; and the entomopathogenic bee against the coconut leaf beetle.

The use of the fungus is relatively easy, and the product price is also affordable at 3 USD/kg (for 1,000 m^2). According to one of the officers from the Center of Application of Science and Technology (CAST), which produces and supplies green fungus in Ben Tre, the effectiveness of green fungus can reduce the incidence of pests by up to 65%, which might be comparable or even better than some available pesticides on the market.

While there are limited control options for organic coconut, the main control issue is not about coconut pest and disease controls, but rather that organic farmers must use bio-controls for all of their crops, making it harder for organic farmers to intercrop higher value crops such as pomelo, durian, rambutan.

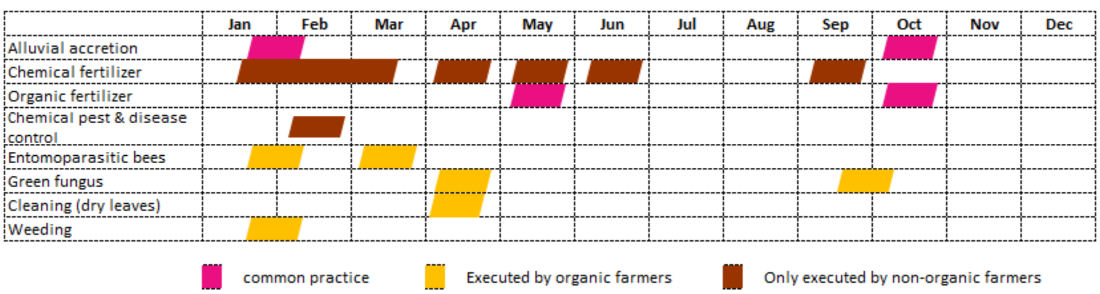
- **Weeding**

In an organic farming system, farmers are only allowed to use non-chemical treatments and thus weeding is often done manually by family members.

- **Harvesting and transportation**

The harvest for organic coconut is carried out by an appointed trader or a staff of the coconut company. Farmers typically call the coconut company once a month to inform them that coconuts are ready for harvesting and sale. Coconuts are harvested by pulling down the fruits. Organic coconuts are then directly transported on a special van or boat to either the premises of the pre-processing facility or to the coconut company factory.

Table 14: Cropping calendar for organic and conventional coconut production



Source: FGDs with farmers and interviewed with communal extensionist.

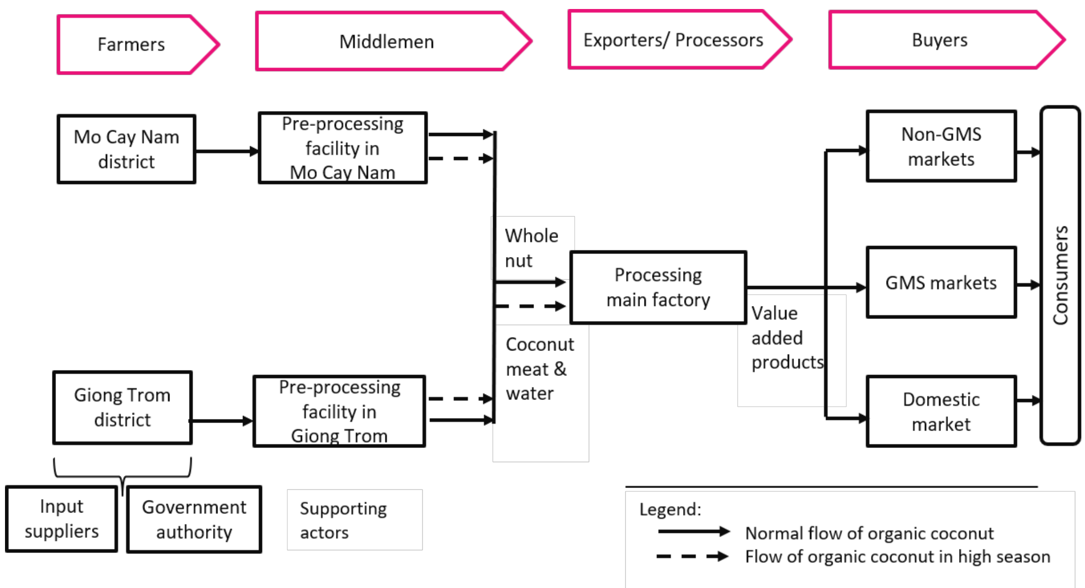
As described above, organic and conventional coconut farming activities differed from each other in several ways. The biggest difference being the use of fertilizers and pest and disease control measures. In the conventional coconut farming system, farmers can use chemical fertilizers and pesticides while agrochemicals are strictly prohibited for organic coconut farmers. This is a particularly important difference as the restriction on agrochemicals also applies to other products intercropped with coconut (e.g. pomelo, orange, banana, etc.). Although the areas and number of intercropped trees were not recorded, 41% of interviewed farmers intercropped coconut with other fruit trees, mostly pomelo. A second critical difference is that while conventional coconut farmers applied processed manure and antagonists on coconut trees like organic coconut farmers, the application is more labor intensive in the organic production process because of the large quantity of organic fertilizers and antagonists used, resulting in significantly higher labor requirements for organic farming.

4.3 Organic coconut supply chain in Ben Tre

4.3.1 Organic coconut supply chain map

The supply chain map of Ben Tre organic coconut is established based on interviews and focus group discussions with 86 actors of the chain including 68 farmers (42 males and 26 female), 4 collectors, 2 coconut processors/exporters, 1 preprocessor and 6 government officers in Ben Tre province.

The value chains of organic coconut in the Mo Cay Nam and Giong Trom districts of Ben Tre Province are presented in Figure 6. The chain starts with coconut farmers, moves to collectors and pre-processors of organic coconut, then continues to processors and ends with buyers from different markets. Other supporting services for the chain are organic input suppliers and also government officers. Each actor of the chain plays an important role, which will be described more detail in the following section.



- 1700-1900 registered farmers
- 2000ha in total
- 400ha certified organic farms

- 2 collectors/ pre-processing facilities
- 8000-12000 nuts/day

- 1 main factory
- Volume of organic products: 20000 tons coconut oil, desiccated coconuts, coconut milk & water

- Non- GMS markets: 90% total revenue
- GMS market: 9%
- Domestic markets: 1%

Figure 6: A typical organic coconut value chain of a studied company in Ben Tre.
Source: Interviewed with representative of the coconut company, collectors, and FGDs with farmers.

4.3.2 Actors of the chain

4.3.2.1 Farmers

- **Role of farmers**

Farmers of organic coconut farms are responsible for all aspects of production, as described in section 4.2.3, except for harvesting and transporting coconuts. Instead the coconut companies hire collectors to harvest coconuts for the farmer. By comparison, conventional farmers either have to either hire laborers or harvest the coconuts themselves.

In each hamlet, organic coconut producing farmers also form collective groups, which are normally lead by a good farmer or the head of the hamlet with the aim to control and support each other.

- **Volume and value**

Producers and area of coconut production

The amount of certified organic production area is low compared to the total amount of organic production area that is either certified or in transition to be certified. For instance, in 2015, one studied coconut company had 1,700 – 1,900 farmers registered for the organic coconut program with a total production area of nearly 2,400 ha, but only around 400 ha were certified. By 2017, the total area of registered farms for the organic program of the company had reduced to around 2,000 ha because many farms were not compliant with the organic farming requirements, particularly the requirement that chemical controls could not be used on other crops. The other interviewed company had 110 ha of certified organic coconut farms, which accounted for just 10% of the total 1,100 ha of registered coconut farms in 2016-2017. In both cases the area of land in transition to be certified makes up the majority of the program (84-90%).

Sixty-eight (68) farmers with a total area of coconut production of 44 ha were interviewed during this study, including 3 certified; 10 in-transition and 55 non-organic farmers. Of the farmers interviewed, 26 interviewees were women.

Table 15: Area of coconut production in the study area by 3 groups of organic certified, in-transition and non-organic farmers

	Organic-certified	In transition	Non-organic	Total
n (observations)	3	10	55	68
Female (observations)	-	1	25	26
Sum (ha)	4	10	30	43.8
Median (ha)	1.2	1.0	0.5	0.6

Farmers using organic methods (either certified or in transition) represented 19% of interviewees and 32% of the production area. Thus, while certified or in-transition farmers individually own 1.2 ha or 1 ha of coconut production area, the production area of non-organic farmers is half that at 0.5 ha.

Productivity and estimated production volume

There is large variance in the yields of one hectare of coconut planting among farmers, which can be influenced by the following factors:

- Different planting methods result in different tree density per hectare. Certified and in-transition farms had on average 180 trees per hectare, while conventional farms averaged a denser 200 trees per hectare, though the range was from 160 – 250 trees per hectare.
- Second, different farming practices affect the yield of coconut trees. According to the director responsible for the organic production of one of the interviewed companies, the yield of coconut trees could reduce 10-30% during the first year of transition to organic farming, but it should then recover, and after 3 years of organic farming, yields should be 10% higher than yields under conventional farming methods.
- In addition, some variance can be attributed to farmers not harvesting all of the harvestable nuts in one month, but delaying collection to the next month, creating greater fluctuation in reported yields.
- Finally, in the studied area, there are two ways referring to nuts, "dua" and "trai". Theoretically they have the same meaning which is "nut", however, 40 "dua" are equal to 48 "trai" and this could also explain some of the variation.

Qualitative group discussions and in-depth interviews generated different yields for the three farmer categories. According to non-organic farmers, the annual productivity of a coconut tree ranged from 50 to 80 nuts/plant/year. The in-transition group estimated that, for farms with at least one year under organic practices (i.e. after the yields have started to recover), the average yield is slightly higher than that of conventional farmers, with 60 to 80 nuts/plant/year. The difference between conventional and transitioning farmers at the low end of the range is attributed to farmers experiencing a shorter low season when organic practices are used. The yield of certified farms, however, is higher still with the range of 60 to 90 nuts/plant/year. Given the density of 200 plants per hectare of non-organic farms and 180 plants per hectare of the other two categories, the annual yield per hectare is from 10,000-16,000 nuts for non-organic coconuts, while production for in-transition farms is between 10,800-14,400 nuts, and around 10,800 – 16,200 nuts for certified farms.

Though harvested year- round, coconut trees have a low season which normally lasts for four months for non-organic farms. As reported by certified and in-transition farmers, as well as extension agents in the study area, the organic farms tend to have more stable yields and a shorter low season, approximately 2 – 3 months due to the benefits that organic fertilizers can bring to the crop, such as improving soil structure and nutrients, as well as supplying beneficial microorganisms. During the low season, while farms in all three categories witness a reduction in yield compared to the main season, the reduction rate can be 50% for non-organic farmers and roughly 25% - 30% for organic-adopting farmers.

A yield analysis was conducted amongst the three groups of farmers. In order to eliminate difference in yield related to scale, only those farms with a production area larger than 1.0 ha were included. The result shows a trend of higher yield among organic-adopting farmers compared to conventional ones.

Table 16: Productivity of coconut in studied areas (2016-2017)

	Organic-certified	In transition	Non-organic
n (observations)	3	5	6
Median coconut area (ha)	1.2	1.1	1.2
Median annual yield (nuts/ha/year)	9,972	9,900	7,264.0

The yield in Table 16 is low compared to the average yield of 10,000-16,000 nuts/ha/year for non-organic coconut and 10,800-16,200 nuts/ha/year for organic coconut provided by Ben Tre Coconut Association. This is believed to be an effect of the following climatic events:

- A severe salinity intrusion event occurred in 2016 decreasing yields on non-organic farms by 50-70%, though organic practicing farms were less effected presumably because of the benefits brought by organic fertilizers.
- The low-season (caused by low rainfall and salinity in dry season) lasted longer than normal years: 4 months from July – October for all three groups of farmers.

Annual yields were calculated based on survey results of yields in the high season. The calculation assumed that the high season lasts for eight months and that yields in the four months of the low season were 50% lower for non-organic farmers and 30% low for organic and in-transition farmers.

Prices

Prices for organic coconuts were 3-7% higher than that of conventional coconuts. Originally, coconuts were priced by the dozen (i.e. 12 nuts) though coconut companies are changing methods to price by weight. Coconut companies paid a premium to farmers in transition as well as to those farmers that had achieved organic certification, with a higher premium paid to certified farmers. For example, premiums ranged from USD11 per 1000 nuts for newly-transitioning farmers to USD36 per 1000 nuts for certified organic farmers. However, most transitioning farmers participating in this study received a premium of USD18 per 1000 nuts. In addition, companies also set a floor price of USD 183 per 1000 nuts, or USD 0.176/kg. Prices of both organic and conventional coconuts fluctuated due to market demands and seasonality, and could double in the low season when yields are low.

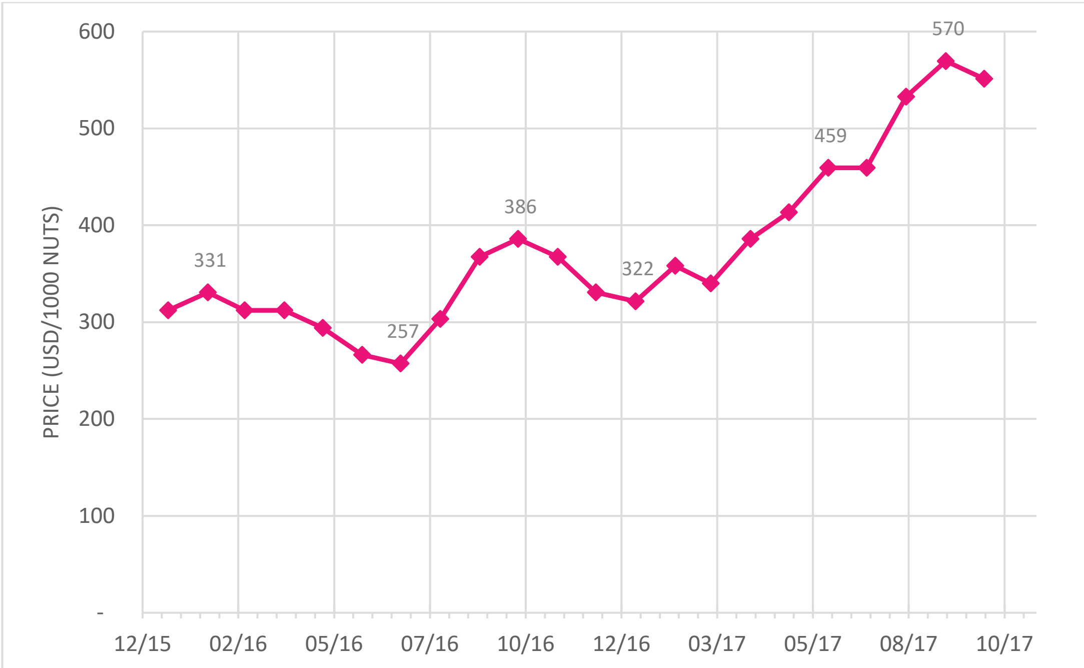


Figure 7: Monthly average price in Mo Cay Nam district (Jan,2016 - Oct,2017)
Source: Ben Tre Coconut Association

- **Margins**

A cost-benefit analysis to investigate the annual average margin of three types of farmers was conducted in 5 different focus group discussions with both organic and non-organic farmers, as well as in one in-depth interview with an organic- certified farmer. The costs in USD[10] were calculated for 1 ha of coconuts in a one-year period for farms with coconut trees at the harvesting stage (2-3 years after the seedling stage). This section also compares costs and final margins of organic-certified farms, in-transition farms and non-organic farms, using prices and the estimated yields from 2016-2017.

Costs

Production costs for growing both conventional and organic coconuts result from input and labor (including hired labor and household labor). The input costs were spent on fertilizers and crop protection products. In terms of labor costs, workers were employed mainly for tasks such as land preparation and applying crop protection products while household labor was used for spraying fertilizers. The cost of household labor was calculated based on the

[10] Cong and Vietnam dong were initially used as the measurement units of area and currency in the study. However, they were converted to hectare (ha) and USD to provide consistent units across the report. 1 ha = 10 cong. 1 USD = 22,680 VND (The exchange rate was taken on 1st Dec 2017 from Vietcombank)

estimates made by the interviewed farmers on time spent on the task and the same wage paid to the hired workers was applied. The detailed costs are presented in Table 17.

Table 17: Analysis of annual costs per ha for 3 groups of farmers

Item (USD/ha)	Organic-certified	In- transition	Non-organic
Alluvial accretion	441	265 - 441	176 - 317
Organic fertilizer	167 - 177	274 - 538	331
Chemical fertilizer	0	0	127 - 141
Pesticides	0	0	0 - 70
Green fungus	89 - 248	89 - 248	0
Weeding*	0	0 - 882	0
Cleaning	198 - 396	0 - 44	0
Harvesting	0	0	184 - 294
Total annual costs	**895 - 1,262**	**628 - 1,271**	**818 - 1,153**
Average annual costs	**1,079**	**950**	**986**

*Note: *Only one in-transition farmer mentioned weeding costs. As this was a single instance, the calculation of the total annual cost excludes the cost of weeding.*

As can be seen certain costs are only applicable for organic/in-transition farmers, such as the costs related to green fungus, weeding and cleaning, as these activities are more widely practiced when farming organically (see section 4.2.3). While conventional farmers paid harvesting costs, which organic and in-transition farmers did not have to pay as the coconut company sends laborers to harvest and collect the coconuts. There are also wide ranges in the annual costs of all farmers' categories due to the differences in costs for fertilizer, crop protection application and other optional farming activities:

- The wage for labor in alluvial accretion was similar regardless of types of farming; however, differences exist because the farther the distance between the land and the river bank the more expensive the work.
- The cost for organic fertilizers depended on the availability of in-house manure, i.e. if the farmers had enough cow dung, the amount of purchased organic fertilizers could be reduced and vice-versa.
- For green fungus, the frequency of application varied among farmers, thus leading to differences in cost.
- The wide range in the cost for weeding and cleaning is because some organic farmers had adopted these practices while others had not.

The results of this comparison raise two interesting points. First, the range of the average annual costs for in-transition coconut farming was larger than that of conventional farming, mainly due to differences in alluvial accretion and organic fertilizers. Second, the average annual costs for organic certified farmers were higher than for conventional and in-transition farmers.

The variations in costs for in-transition coconut farming can make it harder for farmers to assess, prior to switching to organic production, whether organic farming will be an economically interesting activity for them. Similarly, higher costs for organic farmers can decrease the attractiveness of switching. If farmers are uncertain of the economic benefits of converting to organic, it may make it harder to increase the outreach of organic programs.

Benefits and margin

The analysis of benefits of coconut farmers was solely calculated on the revenues generated from selling coconuts and not from other income generating activities, agricultural or otherwise. The highest and lowest price were the main season and off-season price recorded in farmer interviews. The average of the coconut price was calculated as the weighted average price of 8 months during the main season price and 4 months during the off-season price. The lowest and highest yield are taken from the yields reported in qualitative interviews, which focused on results from a normal year; while the average yield is the actual median yield recorded in the season 2016-2017 from the quantitative survey.

Table 18 presents cost and benefit analysis of one hectare of coconut, distinguishing between organic-certified farms, in-transition farms and non-organic farms.

Table 18: Analysis of benefits and margin per ha for 3 groups of farmers

	Organic-certified			In-transition			Non-organic		
	Normal year		'16-17	Normal year		'16-17	Normal year		'16-17
	Highest	Lowest	Median	Highest	Lowest	Median	Highest	Lowest	Median
Total revenue (USD/ha)	**9,821**	**3,175**	**3,957**	**8,624**	**2,976**	**3,783**	**9,406**	**2,572**	**2,669**
- Price (USD/1000nuts)	606	294	397	599	276	382	588	257	367
- Yield (1000nuts/ha)	16.2	10.8	10.0	14.4	10.8	9.9	16.0	10.0	7.3
Total cost* (USD/ha)	**1,262**	**895**	**1,079**	**1,271**	**628**	**950**	**1,153**	**818**	**986**
Margin (USD/ha)	8,559	2,280	2,878	7,353	2,348	2,833	8,253	1,754	1,683
Margin rate (%)	**87%**	**72%**	**73%**	**85%**	**79%**	**75%**	**88%**	**68%**	**63%**

In a normal year, organic-certified farmers are expected to gain the highest margin rate (ranging around 72%-87%) due to higher yields and a premium price. By comparison, in-transition and non-organic farmers encountered wider ranges (from 68%-88%) in the margins earned. In the 2016-2017 season, organic-certified farmers still earned a higher margin rate than in the low-price scenario in a normal year and reached 73% of margin rate. By comparison, median margin rates for both in-transition and non-organic farmers were 4-25% lower than in a normal year, mainly as a consequence of the slump in the yield of the 2016-2017 season, which was caused by a long dry season and high salinity.

Contribution of coconut to total household income

The majority of interviewed farmers agreed that 70% of household income comes from coconut farming, while the rest of the household income is contributed by raising goats, cows, pigs, shrimp and other crops. Some small-scale farmers with relatively smaller farm size (from 0.3-0.5 ha/farm), showed another household income composition: coconut farming only makes up around 30%-40%, the rest is earned by working as hired labor on other plantations or by knitting chairs.

4.3.2.2 Collectors and Pre-processing facility

- **Role of Collectors/ Pre-processing facility**

Organic coconut is sourced differently from conventional coconut. While for conventional coconut, farmers sell to local traders or collectors, who then sell to coconut companies, regional traders, wholesalers or importers; in the case of organic coconut, the farmers sell directly to the company. However, to facilitate the transaction, companies work with trustworthy traders who source the organic coconut from farmers. Though these traders collect the coconut they are not owners of the product. One collector interviewed was, along with the coconut company, a co-owner of the pre-processing facility in Mo Cay Nam district, demonstrating that some actors in the chain can take on more than one role.

The pre-processing facility referred to above, collects organic coconut in normal season and collects and pre-processes organic coconut in the high-season. The facility sends laborers to organic farms to harvest the coconuts and provides transportation to ensure delivery of the coconuts to the facility. Thereafter, the company collects the whole coconuts in their trucks to bring them to the main factory. The facility is responsible for the cost of labor associated with collecting, but it is not responsible for payment to the farmers for the coconuts collected as the coconut companies pay the farmers directly.

In the high season, or when the coconut company's factory exceeds capacity, pre-processing is also conducted. The pre-processing activities include peeling the husk, cutting the shell, extracting the coconut meat and water, then packing and delivering the coconut meat and water to the main plant. Payment to the farmers for their coconut and transport of the pre-processed coconut from the pre-processing facility to the coconut company is the responsibility of the coconut company.

In the conventional coconut chains, pre-processing facilities operate differently. They buy coconuts from local traders taking ownership of the stock, they then pre-process coconuts and resell the coconut meat to coconut companies. Other by-products, namely coconut water, coconut shell, coconut peat, are sold to various buyers.

- **Volume and value**

Volume

The pre-processing facility that we interviewed in Mo Cay Nam district pre-processes 12,000 nuts/day in the high season and 8,000 nuts/day in the low season. The total volume of this pre- processing factory is around 4.2-4.5 tons of coconut meat per day and around 4,000 liters of coconut water per day. Other by-products, namely coconut shell and peat will be all transported to the company. The capacity of other facilities in Giong Trom district is similar.

Value

The whole coconut or the coconut shell, coconut meat and coconut water are collected by the coconut company and brought to the main processing factory. The pre-processing facility then receives payment for collecting the coconuts and pre-processing them, if pre-processing had been requested.

- **Margins**

The pre-processing facilities costs are the labor costs for harvesting and, in some cases, pre-processing, as well as water, electricity, and transportation costs from the farmgate to the pre-processing facilities. The net profit of collectors is from 3 – 4% of the farmgate price. According to the manager of the facility in Mo Cay Nam district, after subtracting all the mentioned costs, they earn a net profit of 7.35-11.02 USD for 1000 nuts from the service of collecting organic coconuts and 7.35- 22.04 USD for 1000 nuts for both collecting and pre-processing service.

4.3.2.3 Processors and Exporters

- **Role of Processors and Exporters**

There are five exporters and processors of organic coconuts in Ben Tre province (see Table 2). Among these five companies, the two companies interviewed are the two biggest producers of organic coconut, sourcing approximately 60% of the total organic production area and accounting for more than 60% of total volume of exports.

Coconut companies, which process and/or export coconut, are a pivotal actor in the organic coconut chain. They play a critical role in supporting the development of organic farming, participating in the organic coconut program that is supported by the provincial government, attracting farmers to the program and then training them in organic methods. In addition, they maintain control over a large portion of the organic chain, from harvesting at the farm, up to processing at the factory.

The companies help farmers to implement organic farming practices from the transition phase to final organic certification. One company employed 10 staff to support and monitor 1,700 farms, while a second company had 20 staff to monitor 1,100 farms. Thus, one technical staff was responsible for advising and managing from 55 to 170 farmers, which may lead to insufficient technical support for organic cultivation. These large technical teams are necessary because of the small farm size, but ultimately lead to increased operational costs for the coconut companies.

Besides the technical support and inspection, these companies develop the price system for organic coconuts setting a premium price of 3-7% above the market price and a floor price to assure certain revenue to farms if market prices go down. The companies recently changed the buying unit for organic coconut from a dozen to kilograms to make the system fairer and encourage farmers to take better care for their coconuts. They also pay the harvesting costs and provide cash payment to the farmer 1-3 days after harvesting. Farmers receive the payment in cash, directly from the company.

When the whole organic coconut fruits or pre-processed products are delivered to the main processing plant, the companies produce the organic final products separately using advanced technology and Food Safety Management Systems (see more in section 4.4). Each interviewed company focuses on different value-added organic products, namely organic extra-virgin oil, water, desiccated coconut and milk.

Apart from processing and exporting roles, these companies also supplied organic inputs, such as organic fertilizers, and provided training to farmers. They also collaborated with the government to do research and apply biological control agents on organic coconut trees.

Added value coconut products – a comparison from Thailand

Table 19 presents volume and export value of key coconut-based products from Vietnam, Ben Tre province and Thailand for comparison. Even though, most coconuts produced in Thailand are for domestic consumption, Thailand is still one of the biggest exporters for some products such as coconut milk with total export value of 408 million USD per year. Considering that the total export volume of copra (the dried meat or kernel of the coconut) from Thailand is much smaller than for Vietnam, 339 and 12,787 metric tons respectively, it can be concluded that more value is generated from coconuts processed in Thailand.

Although great effort to diversify coconut products for more added value has been observed over the past few years in Ben Tre, the product portfolio is still quite limited to basic products such as desiccated coconut, coconut milk, coconut oil and, more recently, canned/ tetra pak coconut water. Comparing this with the products shown on the ANUGA website (the biggest food exhibition worldwide), there are many innovations of new coconut products from Thailand such as coconut flour, snack-energy bars, coconut cereals, sparkling coconut water, coconut milk and milk powder etc. This shows that the Thailand coconut industry is focusing on innovations in value added products for coconut, while Vietnam is still focusing on basic products, some which are mainly used as raw ingredients for other industries and hence are not necessarily high value products.

Table 19: Production and export of coconut-based products from Vietnam, Ben Tre and Thailand

Item	Ben Tre (BTCA, 2016)	Vietnam (APCC, 2014)	Thailand (APCC, 2014)
Coconut area (1000 Ha)	70	158	206
Total production (in million nuts equivalent)	595	1,246	1,001
Total production (in copra equivalent ('000 MT)	178	374	219
Domestic consumption (in million nuts equivalent)	na	na	1,001
Domestic consumption (in copra equivalent ('000 MT))	na	na	219
Export volume (MT)			
Coconut	na	69,548	531
Copra	na	12,787	339
Coconut Oil Crude oil Virgin coconut oil	-- 636 193	991 -- --	1,960 -- --
Desiccated Coconut	17,809	40,302	3,780
Coconut Milk	38,509	na	179,297
Coconut candy	3,660	na	na
Coconut milk powder	905	na	na
Coconut Export Value (US$ Million) *Including coconut byproducts*	150	225	408
Percentage Contribution to Export Earnings (%)	0.22	0.14	0.22

Source: BTCA (2016), APCC (2014).

- **Volume and value**

Volumes

One company confirmed that organic coconut products contributed from 30-35% of the total annual revenue of the company. The most profitable and largest revenue came from extra-virgin coconut oil, accounting for about 57% of the total revenue from organic coconut. Desiccated organic coconut and organic coconut milk contributed approximately 32% of the total revenue, while that of canned coconut water and packaged coconut water in tetra pak contributed 11% of total organic coconut value.

In the future, companies would like to focus on developing and expanding the production of packaged coconut water in tetra pak, to achieve better quality coconut water that meets customer's tastes.

Values

The prices for organic coconut final products are also at least 20% higher than conventional products. For example, the virgin oil from organic coconut may get the average price of 4000 USD/ton, while that of conventional stays at around 2100-2400 USD/ton, a price increase of at least 67%. However, due to the lower annual yield last year in Ben Tre, the total volume and revenue from organic coconut was reduced compared to the previous year.

- **Margins**

The interviewed coconut companies did not share financial data on their coconut products; however, in an interview, the director of one of the coconut companies confirmed that the business line with organic coconut is more profitable than conventional coconut products. At the same time, profitability of organic coconut products in Vietnam is low compared to organic coconut products in the Philippines due to the high cost of Vietnamese coconuts, which are double that of Philippines coconuts. As a result, in Vietnam, the final margin producing and trading organic coconut might be only 10-15% greater than the margins on conventional coconut products.

Table 20: Estimated output products and equivalent revenue from 1,000 nuts of organic coconuts

Products	Quantity	Unit	Unit price (USD)	Revenue (USD)
Coconut water	800	330-ml can	0.4	320
Coconut oil	100	kg	4	400

Table 20 presents the estimated gross margin of export/processing company for each 1000 coconuts bought. Overall, the average input cost for organic coconut of 412 USD/1000 nuts and the company can produce and sell two main types of products with an estimated revenue of 720 USD/1000 nuts. Hence, the company might earn a gross margin of 43%. Figure 8 compares the estimated margin rate of three main actors in the organic coconut chain, using the cost and benefit analysis conducted for 1000 coconuts.

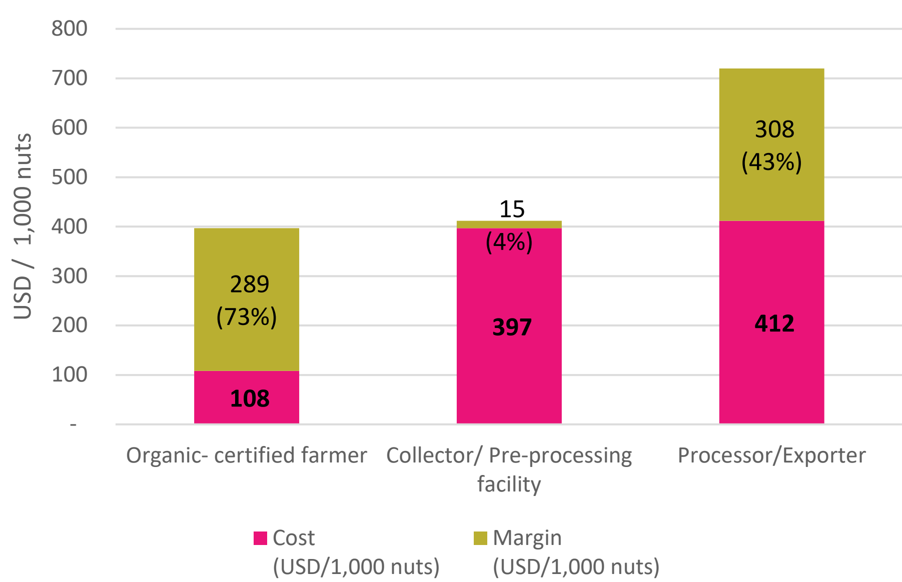


Figure 8: Analysis of margin for each actor of organic coconut supply chain in Ben Tre
Note: The average margin for the farmer and collector/pre-processing facility are net margins, though it does not take into consideration the cost of the farmer's own labor. For the coconut company it is a gross margin and does not take into consideration the operational costs. Revenue figures assume sales come from two main products: organic coconut oil and coconut water.

4.3.2.4 Buyers

The following information on buyers comes from interviews with one coconut company.

- **Non-GMS markets**

The company exported coconut products to more than 30 countries over the world (Figure 9). Almost all organic products were exported, generating 30-35% of the total revenue of the company. Eighty percent of the exported organic coconut products were via an Original Equipment Manufacturer (OEM), a private label service for importing partners, and the remaining 20% was exported under the coconut company's own brand via global sourcing companies. The company normally signs one-year contracts with fixed prices, despite the greater risk caused by substantial price fluctuations in coconut supply.

Figure 9: Map of export destinations of one coconut company, figures show the percentage of organic exports.
Source: From the company website, 2017. (http://luongquoi.vn/en/distribution-system/export-market/)

- **Asia and GMS markets**

Within Asia, Japan, Singapore and Thailand are also key importers of the company, though the majority of imports are conventional coconut products with only a fraction of imports being organic. The only GMS country where the company exports is Thailand. Within the region, it is difficult for Vietnamese companies to compete with the same products from Thailand, Indonesia and the Philippines due to high organic coconut prices in Vietnam caused by small-scale production and the greater experience in producing high-value added organic coconut products in those countries. One of the companies exports desiccated coconut and coconut milk to Thailand in the Thai off-season as buyers need these materials year-round to produce their final products.

- **Domestic market**

Both interviewed companies sell their organic coconut products in the domestic market, mainly via supermarkets, though convenience stores and their own stores also served as distribution channels. The major organic coconut products sold domestically were extra-virgin coconut oils and coconut water. However, domestic sales accounted for a small percentage of the total value of organic coconut (less than 1%).

These companies also introduced and sold their organic products via international and national agricultural exhibitions. Though these exhibitions account for only a small share of the total value of organic products sold, it helps the companies to reach both potential domestic and foreign partners.

4.3.2.5 Supporting actors

- **Input suppliers**

Organic inputs are very limited and not readily available from the normal input suppliers in the area. For the organic coconut chain in Ben Tre Province, the coconut companies are also operating as an input supplier for their contract farmers. One interviewed company supplied free organic fertilizer twice per year for their farmers, while the second interviewed company collaborated with the governmental offices to test and apply biological control agents and also plan to make organic fertilizer from organic coconut peat in the future. However, as the amount of input supplied by the companies was not enough for farmers, organic farmers themselves also need to make organic compost.

The *Department of Science and Technology* (DOST) in Ben Tre city sells beneficial microorganisms, Trichoderma, and compost maker that contains useful microorganisms so that farmers can make their own organic compost. Pre-processing facilities also sell coconut peat to make compost. Green fungus is also available from the shop at DOST. It can also be ordered from the *Center of Application of Science and Technology (CAST)* Ben Tre or via local extension officers. The price of green fungus is stable as its production is supported by the provincial public budget. However, green fungus is only produced after CAST has received an order from a farmer, which leads to delays in usage.

The *Plant Protection Department* has released *Entomoparasitic bees* on trial as one type of natural enemy to avoid pests in coconut. Once introduced, farmers can themselves propagate the bees and exchange them with others.

Government authority

The government has contributed to the success of the organic coconut chain through various agencies and at various levels.

- The *Center of Application of Science and Technology (CAST)* Ben Tre has produced and supplied green fungus to farmers in Ben Tre since 2012.
- District and communal extension agents have provided training classes and developed supporting policies. They also help farmers to order organic fertilizer and pesticide from government-related agencies like Center of Application of Science and Technology or Plant Protection Department.
- At the provincial level, coconut has been recognized as an important sector for support and development and thus has been supported through various economic programs and policies.
- All interviewed farmers and the coconut company expressed satisfaction with the government support for organic coconut programs, both in terms of technical and policy support.

4.4 Quality assurance system and traceability

4.4.1 Food safety and organic integrity risks along the production chain of organic coconut products

Section 4.4.1 describes type of food safety and organic integrity risks that may arise on organic coconut value chain, from production at farm till the products get out from the processing plant. The next section (4.4.2) discusses mitigation measures that are implemented at each point in the chain and includes an overview of food safety management systems used. Food safety and organic integrity risk along the production chain of organic coconut products

Food safety risks include the risks arising from possible contamination of coconut products, whether through chemical, physical or biological hazards that could potentially harm human health. Organic integrity risks arise when there is a possibility that substances forbidden in the use of organic production could contaminate organic products. For organic products, organic integrity is especially important when organic and non-organic coconut are processed in the same facility without proper segregation, and sanitation.

The risks found along the organic coconut chain and the key risk factors are summarized in Table 21. The risk level suggested in the study are based on the interviews conducted and should be used as an indication of the risks perceived, but not as a conclusion for the whole organic coconut sector in Ben Tre Province. Rationales for risk rankings are discussed in the following paragraphs.

Table 21: Risks along the organic coconut production chain

Hazards	Key risk factors	Risk level
At farm level		
Chemical hazards: Pesticide residues, heavy metal contaminants	Pesticide drift from neighboring, conventionally farmed lands; historical use of prohibited substances, polluted soil and water.	Low
Biological hazards: Pathogenic microorganisms	Contamination may occur during harvesting of the nuts (direct contact with soil and animal excrement) or poor worker hygiene. The use of open-type toilets may contaminate soil and water.	Low
Organic integrity: Non-organic inputs	Application of non-organic inputs due to lack of availability of organic inputs, lack of knowledge about organic farming principles.	Medium
At the pre-processing facility		
Chemical hazards	Misuse of forbidden chemicals, non-food grade lubricants during processing	High
Physical hazards: foreign materials	Possible contamination with foreign objects such as coconut husk, coconut fiber, stones, metals, plastic in coconut meat and water	High
Biological hazard Pathogenic microorganisms	Contamination due to poor personal hygiene, bad GMP; poor facility sanitation and hygiene conditions; contaminated water; Contaminations from pest and rodent infestations	High
Organic integrity	Mixing with conventional coconuts	Medium
During transportation		
Chemical hazard	N/A	
Physical hazard	Foreign materials and pest droppings (if present) in the truck may contaminate the products.	Medium
Biological hazards	Contamination due to bad hygiene condition of the truck, elevated temperatures during transportation, which can promote bacterial growth	High
At the processing plant		
Chemical hazards	Potential sources of contamination include cross-contamination of prohibited/ forbidden substances such as non-organic materials/ lubricants, bleaching agents used in conventional production.	Medium
Physical hazards: Foreign materials	Foreign materials from processing environment	Low
Biological hazards Pathogenic and spoilage bacteria, mycotoxin, …	Contamination from bad hygiene condition, worker personal hygiene practices; contamination from equipment and utensils, production operation practices.	Low
Organic integrity Mass balance[11]	Mixing of organic and conventional coconuts	Medium

[11] This term means that the mass of production or processing should be checked to ensure that output amounts are in line with input quantities.

It can be clearly seen that most medium and high-level food safety risks are found at the pre-processing facilities during the high season, when pre-processing steps are done at these local facilities instead of the main plant; while organic integrity risk appears along the chain.

Food safety risk attributed to biological contaminants at farm level is quite low, mainly due to characteristics that are intrinsic to the coconut. The industrial coconut fruit at maturity has a hard shell and thick husk cover which are great barriers to protect it from invasion of pathogens into the endosperm and juice. Even though there may be risks of chemical contamination due to chemical drift from neighboring lands, soil contaminated with heavy metals and prohibited substances from past conventional farming, farm selection criteria often help to reduce these risks to a minimal level.

Meanwhile, food safety risk at the pre-processing facility is relatively high, especially during high season when the volume is at its peak. During this period, processing activities for organic coconut take place at these local facilities separated from, but alongside, conventional coconut processing, thus increasing the likelihood of cross-contamination. Risk factors that determine the level of risk at this stage include:

- Location, establishment and layout of the facilities. Most facilities have an open layout and are located near the canals to allow access for coconuts arriving on boats. Pest control and the restriction of domesticated animals to working areas are often not respected.
- Water quality could be a concern.
- Preprocessing of coconut is done manually, which further enhances the risk of contamination due to poor personal hygiene, especially when a worker hygiene policy does not exist or is not enforced.
- Suitability of the equipment and utensils used for processing is a concern because the equipment is not well maintained and processes for cleaning may not use the highest standards. In the facility visited, some, but not all equipment is made of non-corrosive materials.
- Lack of an effective food safety/ quality management system.

After being processed, coconut meat is stored in baskets at ambient temperature while coconut water is kept cool in 20 kg-bag. They are then transported to the main plant within few hours. Food safety risks during this stage include contamination due to bad hygiene condition of the truck, elevated temperature during transportation which can promote bacterial growth, failing to keep the coconut water cool (below 5^{o}C). Foreign materials and pest droppings (if present) in the truck could also become a source of contamination if the truck is not cleaned and sanitized properly.

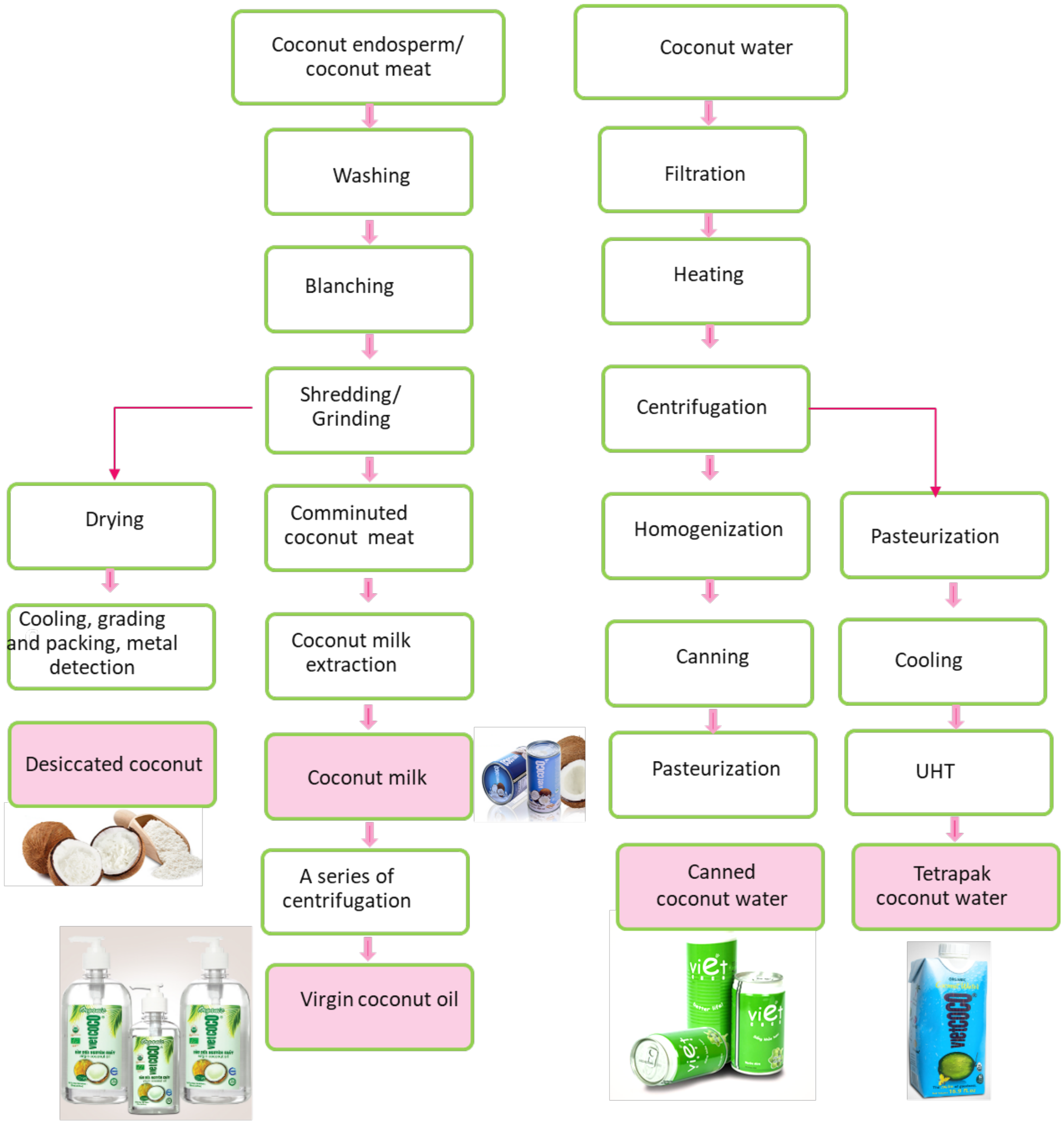


Figure 10: Flow chart of the production chain of the organic coconut products at the processing plant
Source: Interviews with exporters and processors

At the processing plant, raw coconut materials will receive different treatments in accordance with specific processing protocols for different products. Figure 10 describes the main processing steps for 4 key organic coconut products including coconut water, coconut milk, desiccated coconut and virgin coconut oil.

The four-main exported organic products are self-stable in their final formulation (canned, UHT, Dry powder) thus food safety risks that may occur during storage and distribution are low. Key risk factors during processing of organic coconuts include control of manufacturing practices, worker hygiene and control of key process parameters (critical control points) during production of the products. Common critical control points to eliminate biological hazards include pasteurization of ground coconut/ sterilization of coconut water and post-process controls to prevent re-contamination. For instance, desiccated coconut could be potentially contaminated with pathogenic bacteria like *Salmonella spp*. and *Vibrio* from the processing environment or from contact with soil. An inefficient pasteurization process will result in contamination of the product with these pathogenic bacteria.

Last but not least, failure to protect organic integrity is a risk that may occur along the chain. At the farm, the risk is often related to the availability of certified organic input materials or incidental application of forbidden substances. Interviews with the companies indicate that fake organic inputs are among their biggest concerns. At the preprocessing and processing stages, commingling of organic and conventional coconuts is a key risk factor. Given that it is impossible to distinguish the products by their appearance, an effective traceability system, such as GS1 barcode based system, could be very useful for products traded across borders. In addition, segregation procedures are crucial to protect the organic integrity and to prevent the organic products from being contaminated with prohibited substances that may be used in conventional production.

4.4.2 What is done to control: QA system

The quality assurance system of the organic coconut chain aims to mitigate the mentioned food safety risks and ensure organic integrity along the chain. In order to target premium and high-end markets, most exporting companies, have integrated different international food safety schemes into their operations, from the farm to the processing plant. These schemes are summarized in Figure 11.

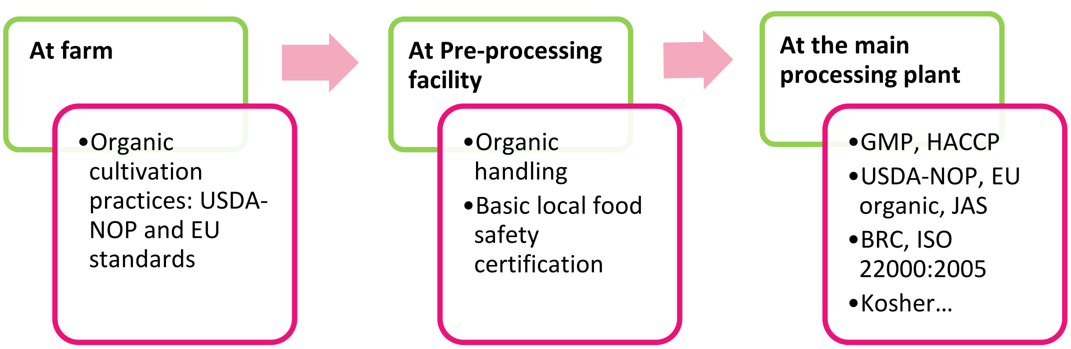


Figure 11: Integration of international food safety schemes into quality assurance system of organic coconut

The current volume of organic production is still small, and most companies process the coconuts at the main plant, which makes it easier to manage the risks because of the implementation of strong safety management schemes by the coconut companies. If volume growth of organic coconut requires that more production processes occur at the local preprocessing facilities, the risk level may rise as control over the processes decreases. Focus on strengthening quality assurance should thus be placed on actors downstream in the chain: at the farms, to resolve organic integrity issues, particularly related to inputs; and at the pre-processing facilities where both organic integrity and food safety risks are higher due to less sophisticated quality management and segregation systems.

- **Quality assurance at farm level**

Two interviewed companies have around 510 ha certified organic sourcing areas and more than a thousand hectares are in transition to organic. Many activities were carried out at the farm level to ensure food safety risks and organic integrity are addressed. They include farm selection, control of input used on farm, verifying compliance by farm visits, internal audit, testing and by third party audit. Details of quality assurance activities at the farm are listed in Table 22.

Table 22: Quality assurance at farm level

Requirements	Specific activities
Farm selection and general requirements	▪ Creating an adequate buffer zone, both companies are trying to increase the organic plantation area by encouraging farmers and their immediate neighbors to join the program; ▪ Establishing collective farmers groups, appointing group leaders to lead the groups and perform cross-checking of the team members (not efficient yet); ▪ The use of open-type of toilet, in which waste is discarded directly to the environment (e.g. canals) is prohibited ▪ Domesticated animals must be raised in segregated areas
Control of input materials	▪ Verifying that no agrochemical inputs is used on farm ▪ Releasing natural enemies of key diseases/pests, such as *Chelisoches variegatus (bọ đuôi kìm)* and *parasitoid Asecodes hispinarum* (ong ký sinh) to control coconut leaf beetle *Brontispa longissimi* ▪ Training on compost making
Farm visit and internal audit	▪ Farmers are given farm diary and farm books where they record all activities at the farm ▪ Internal control staffs visit and perform farm audits, review records at least once several months
Verification	▪ Random testing of soil/ leaf/ fruit samples for pesticide contamination and the use of prohibited substances
External audit	▪ Annual farm audit by third party certification body (e.g. Control Union)

- **Quality assurance at the preprocessing facility**

Under organic certification scheme, the local facilities where organic coconuts are consolidated/ pre-processed undergo annual audits. On site visits show that there is still room for improvement in term of food safety management at the facilities. One of the companies has plan to upgrade their pre-processing facilities to be HACCP certified in the coming years. This is essential giving that the organic cultivation areas are growing rapidly. It would also increase food safety for the conventional coconut chain, as all these coconuts are pre-processed in these facilities before being transported to the main plant.

- **Quality assurance at main processing plant**

Both companies interviewed have their organic products certified with USDA-NOP, EU organic and JAS at the main processing plant. On top of that is the implementation of GFSI food safety management schemes such as BRC and FSSC 22000, which are built on a strong base of HACCP, GMP and other prerequisite programs. Moreover, the companies also implement several private retail standards (Kosher, Costco) to meet specific clients' requirements. Successfully implementing the above standards should help the companies in reducing food safety risks to a minimal acceptable level.

4.5 Impacts of the chain

4.5.1 Social impacts

The coconut sector generates about 21,000 jobs in the Ben Tre province. Men were more strongly represented in the organic coconut system, taking on more labor-intensive jobs such as: bedding, alluvial accretion or organic fertilizer application. At farm level, women managed less labor-intensive activities such as: weeding, cleaning or applying fertilizers. Women were also highly represented in processing activities.

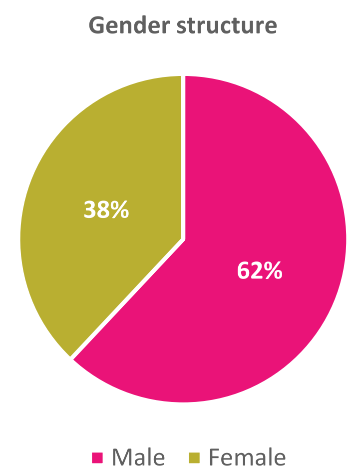


Figure 12: Gender structure of interviewed farmers in An Thoi and An Dinh communes

Coconut contributes from 40-70% of the household income for farmers interviewed in Mo Cay Nam district. This number is in line with data provided by the provincial extension office. The percentage of poor households of the two studied communes is between 5% and 10%. Households were classified as poor when they had less than a few hundred square meters of land or lacked other production assets and earned a monthly income of less than 27 USD (600,000 VND) per household member.

4.5.2 Environmental impacts

Organic coconut production has a more positive environmental impact than conventional coconut production. Areas of impact include: reduced use of chemical inputs, which reduces local environmental degradation, soil fertility improvement, and biodiversity enhancement. Furthermore, organic cultivation could address the concerns raised by the boom in coconut product consumption and the consequent negative environmental impacts caused by: intensive mono-cropping, the use of chemical fertilizers, pesticides to boost yield, deforestation and soil erosion.

Though this study does not aim at evaluating environmental impact from organic coconut farming, interviews with different actors of the chain indicate that organic farms may have weathered a high salinity event better and recovered more quickly thereafter. Indicating that there may be a role for organic coconut farming practices to create a more sustainable agriculture sector and in adapting to climate change. These findings are discussed in the coming paragraph on adaptation to climate change.

- **Soil fertility improvement**

According to farmer interviews, on an annual basis, conventional coconut farming makes use of 200 kg chemical fertilizer per hectare on average, thus if 50% of plantations convert to organic farming the whole sector could save up 7000 tons of chemicals fertilizer per year. At the same time, one hectare of organic coconut tree is enriched with 4 to 5 tons of organic fertilizer per year using either compost or vermi-compost. These fertilizers are proven to be effective in improving soil fertility, increasing soil organic matter and establishing populations of beneficial bacteria. They also help overcome serious soil and land issue such as erosion.

- **Adaptation to climate change**

In 2016, Ben Tre province experienced a severe saline intrusion resulting in a loss of up to 40% of coconut yields on farm. In an interview with a management team member of one of the biggest organic coconut exporters in the province, he indicated that it took longer for conventional coconut trees to recover their normal productivity levels than for organic ones to recover as farms managed under organic practices have improved soil structure, fertility and biodiversity as a result of the organic fertilizers used. The observation was even more pronounced when the plant had been farmed under organic practices for more than 3 years. Scientific evidence to support such a claim is required to clearly link organic practices to better climate change adaptation.

Hygiene/local environment

Good agriculture practices such as GLOBALG.A.P. standards and organic standards set out rules on animal manure management and humane waste management. This is to reduce the risk that the production activities pollute the environment. In practice, this means:

- Making sure production waste such as plastics is well managed
- Making sure human waste including human disposal from toilet will not pollute water and soil
- Making sure animal droppings is managed by segregation and access restriction to plantation area

Among these requirements, the ones around human waste seem to create the most difficulty due to the cost of investing in a modern toilet with a septic tank. For new farms that wish to transition to organic practices, coconut companies may sponsor up to 50% of the construction cost.

4.6 Key findings

4.6.1 Access to inputs and bio-controls

For farmers, difficulty in accessing inputs and bio-controls that can be used to manage pests and diseases is one of the main constraints to switching to organic farming.

Organic fertilizer

Organic farmers can make fertilizer themselves from livestock manure, coconut fronds and Trichoderma, which kills harmful microorganisms. Government extension agents and coconut companies have supported farmers by developing protocols and providing trainings on this topic. Government experts estimate that all of the materials necessary, such as livestock manure, are available; however, non-organic interviewed farmers suggested hesitation to convert due to limited resources and the intensive labor requirements of making organic fertilizer.

Bio-Controls

There are very limited biological control options for growing organic coconut. Most interviewed farmers and governmental officers only mentioned two products: green fungus *M. anisopliae* and parasitic bees (*Tetrastichus brontispae*). These agents can be effective against the three main pests mentioned by farmers (i.e. coconut beetle, weevil and rhinoceros beetle), but weather conditions need to be favorable for their proliferation. For instance, during the summer period (May-July) the efficacy of parasitic bees was strongly reduced. A third micro-organism, *Trichoderma* fungus, is incorporated during composting procedure to kill pathogens. Some products targeted at organic farming such as functional micro-organisms and compost maker were also developed and sold at the CAST.

The main issue with respect to the limited availability of biocontrol agents is that it limits intercropping options for coconut. For example, citrus plants like orange or pomelo, have a high economic value, but are not recommended to plant with organic coconut due to high risk of pest and disease problems. The provincial government has realized this and is trying to develop new biocontrol options with research institutions such as Can Tho university and the Southern institute of Fruit research.

4.6.2 Economic penalties and future uncertainty

Farmers that were already participating in the organic program expressed satisfaction with the program; however, farmers outside of the program expressed concerns about joining the program they recognized that joining the program would have an impact on their financial situation as yields, income and expenditure would all be affected by the change. Farmers need to be able to assess these changes to make informed decisions. Where possible, measures that compensate farmers for this additional risk should be put into place. The price premiums, guaranteed minimum price and trainings are examples of this type of compensation and were appreciated by the farmers. However, the risk of the coconut company changing these compensatory measures presented another risk that discouraged farmer participation. The following paragraphs describe the above-mentioned risks and their potential consequences for farmers in more detail.

- **Impact on yields**

The transition period from conventional to organic farming takes approximately three years, unless the farmers have already used organic inputs before joining the program, in which case the period may be reduced. According to farmers and government technicians, during this transition period the yield of coconut trees is normally lower than yield of trees farmed under conventional practices, resulting in lower income for farmers. Lower yields for transitioning farmers were, on average, not found in the interviewed farmer group. However, as mentioned in section 4.3.2.1, in 2016 the Mekong delta encountered an adverse impact caused by salinization and, as a consequence, the yield and quality of Ben Tre coconut was strongly reduced. Anecdotal evidence suggests that coconut farmed under organic practices recovers more quickly from such climatic events (see 4.5.2) and the data from interviews would support this view, though it is an insufficient sample size to draw any hard conclusions.

- **High variability of costs**

Interviews with farmers also revealed that the costs of production for coconut farming are on average higher than non-organic coconut cultivation, as well as being more variable than those for non-organic production, as described in section 4.3.2.1. While the premium paid for organic coconuts could cover higher costs, the wide range of costs during the transition phase increases uncertainty and makes it harder to predict whether the premium would be sufficient.

- **Fluctuations in price**

During the course of a year, the price of coconut fluctuates significantly, ranging from 2.64 USD/dozen to 7.04 USD/dozen. At the same time, in interviews with farmers that have converted, the farmers expressed satisfaction at the coconut company policies of providing a premium and a minimum price.

- **Difficulty in intercropping**

Typically, an organic farm would have an integrated program consisting of several crops to reduce pest and disease pressure and increase soil biodiversity and fertility. This requires knowledge in managing both abiotic and biotic factors. As the organic program is still young and there are limited biological control measures (see 4.2.3), to minimize risk, farmers were advised to have only few intercropped plants or even no other crops with organic coconut. This contradicts another local governmental program that is promoting high value intercropping, as well as using a mix of farming systems such as coconut, other fruits and livestock. As these intercrops, such as pomelo and orange, are considered to be more profitable, the restriction on intercropping is an economic penalty that can make the decision to convert a more difficult one.

- **Long-term perspective**

Some interviewed farmers were skeptical about the organic program because they did not believe that the benefits (premium price, training) would last. As the conversion to organic is normally a three-year process, farmers need assurance that the benefits provided by coconut companies will continue to exist for the long-term.

To increase participation in the organic program the uncertainties described above need to be managed so that farmers do not feel that organic farming results in economic penalties.

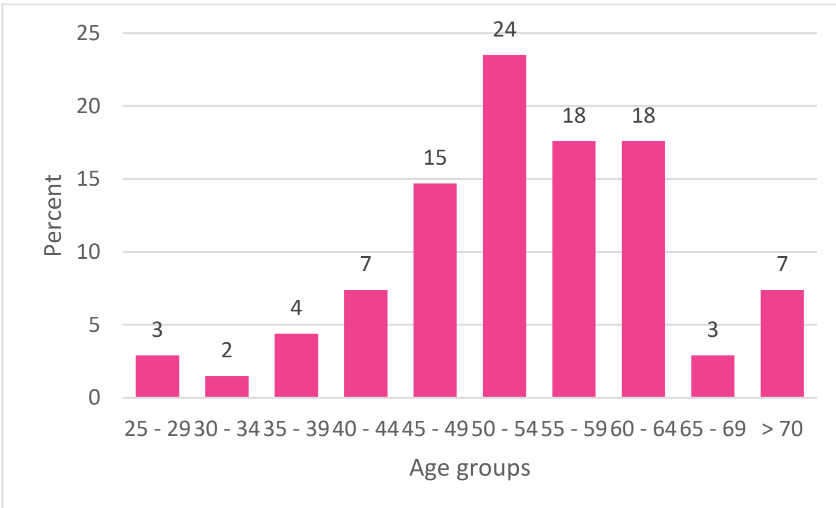
4.6.3 Difficulty meeting organic requirements

Interviewed farmers that had attended trainings on organic farming and were familiar with the requirements, but are not yet participating in the organic coconut program, were concerned that they could not comply with so many requirements. The most mentioned issues were: 1) chemical use was strictly prohibited; 2) organic practices do not permit farmers to raise animals freely in their garden to minimize contamination; 3) they had to make organic fertilizers themselves since the supply was very limited; and 4) they had to record their activities. The previous section elaborated on some of these concerns, while others are described in more detail below.

- **High labor requirements and a shortage of workers**

Organic farming requires more labor as careful cultivation of the trees and soil is required to compensate for the lack of agrochemical inputs. For example, farmers make their own organic compost, cut the grass, weed, and remove yellow leaves. In interviews, farmers cited concern about work intensity and lack of labor for hire as concerns when deciding whether or not to switch to organic farming. Farmers also indicated that many young people were moving to the cities to look for work as farm labor does not provide sufficient income creating a shortage of labor in the province. Most interviewed farmers were above 45 years old (85%) with the largest age category farmers from 50-54 years old (24%). This migration to the cities can reduce the availability of household labor, as children seek opportunities elsewhere, while also potentially increasing the cost of hired labor due to scarcity in the farming areas.

Figure 13: Age group distribution of interviewed coconut farmers in Ben Tre



- **Small scale farming**

Most farmers in Ben Tre, as well as in the rest of Vietnam are small scale farmers. Farm size for coconut farming in both An Dinh and An Thoi communes in Mo Cay Nam district was relatively small with a median size of 0.6 ha. This area is larger than the average coconut farm size of Ben Tre province, which is 0.4 ha per household (Ben Tre Provincial Agricultural Extension Center). Figure 14 below shows the breakdown of interviewed farmers by land size. Organic farming standards require a buffer zone to segregate conventional and organic land (~15 meters) and the small farm size makes implementing this requirement more of a challenge. Furthermore, farmers who own larger farms tend to have more resources to invest in organic production and manage the transition period. In addition to impacting the farmer, farm size also impacts the coconut companies as they have to source from many farms to meet their needs for organic coconut. As these companies also provide support services in the form of training and hired labor for harvesting, the costs to the coconut companies increase with the number of farms in the program.

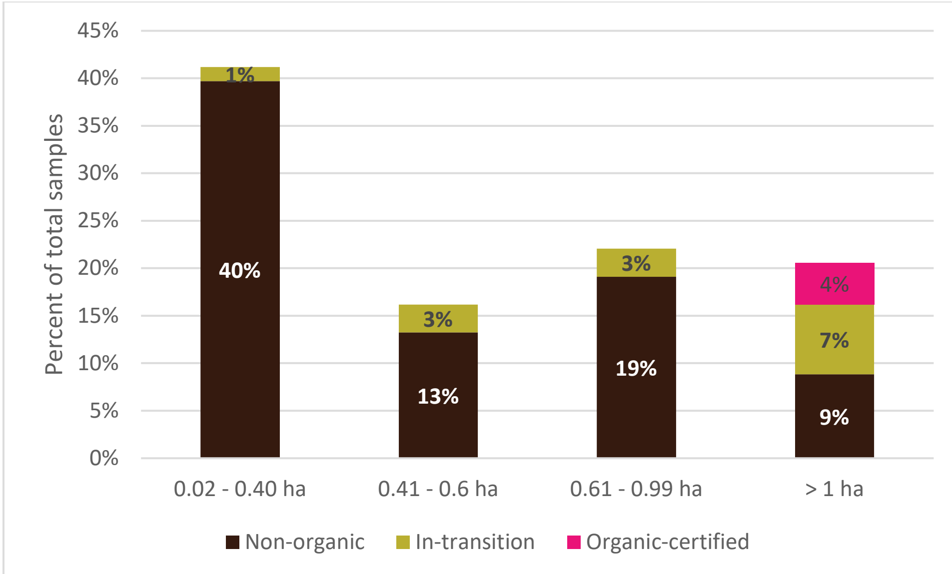


Figure 14: Farm size of interviewed farmers

4.6.4 Challenges to quality assurance

The biggest quality assurance risks occur upstream in the value chain. Food safety risk is highest during the preprocessing stage, when coconut is semi-processed at the local facilities, while organic integrity risk is high at farm level due to lack of availability of organic inputs (see 4.4.1).

As described in 4.1.3, the current volume of organic production is still small, which allows coconut companies to do most processing at the main plants where advanced food safety systems and segregation systems are in place. However, when volumes increase and pre-processing shifts to the local preprocessing facilities, risk will increase as the policies, protocols and systems at these facilities are not as well-developed nor as well implemented. Future investments in upgrading pre-processing facilities are a potential way of addressing this risk.

At the farm, the lack of certified organic inputs is a well understood issue. The lack of availability of organic inputs for either coconut trees or for intercropped plants could lead to incidental application of forbidden substances or cross-contamination to the organic coconuts. In Vietnam, pesticide management and regulatory compliance is not always strong leading to an estimated 30-35% of illegal pesticides being available on the market (Pham et al., 2013) Fake organic-inputs also pose a risk from an organic integrity perspective and the government, in partnership with other stakeholders, is working to improve controls over pesticides.

4.7 SWOT analysis and recommendations

4.7.1 SWOT Analysis

The organic coconut case in Ben Tre, Vietnam illustrates many of the key issues and opportunities facing fruit and vegetable value chains in the region. They are summarized in Table 23.

Table 23: SWOT analysis of organic coconut chain in Ben Tre province, Vietnam

Strengths	Weaknesses
• Farmers experienced in growing coconut • Tight value chain with good partnerships to support local farmers • Good quality of coconut from Ben Tre can be turned into high value-added products • Resources available on the farm reduce the cash outlay of fertilizers and seedlings • Strong government and international donor support in term of technical trainings, policies and trade promotion	• Organic process more labor intensive and shortage of available labor • Lack of organic inputs (fertilizers, crop protection products) increases labor intensity and reduces opportunity for crop diversification. • Complicated requirements from international organic standards • Large number of small-scale farmers participating in the organic program makes it costly for the sourcing companies to train farmers and monitor their program
Opportunities	**Threats**
• Possibility to expand the sourcing area of organic coconut in other parts of Ben Tre • Increasing demand for organic coconut internationally, would support expansion of the program. • Opportunity to introduce high value-added products into the product range of coconut companies. • Organic coconut practices may lead to better climate change adaptation • Developing farmer cooperatives that make fertilizers and other organic inputs could create scale in these tasks and reduce the labor of organic farming.	• Inability to intercrop may keep farmers from joining the program as it reduces opportunity for crop diversification. • Three-year transition period coupled with lack of long-term buying contract from company may keep farmers from joining the program • Aging farmer population may further intensify labor shortage in the future • High competition from other big producers in organic coconut, namely Indonesia, Philippines and Thailand where costs are lower. • Capacity constraints at certified factories force pre-processing to occur at facilities with less stringent QA standards.

4.7.2 Recommendations

- **Investment**

 Invest in access to finance for (smallholder) farmers. To convert to organic coconut production, farmers often need to make up-front investments, for instance in building a toilet to meet the organic standard's requirements. They may also be confronted with higher operating costs in the first season. While these early costs are compensated for by the premium paid, there is a delay in between when the costs occur and when the premium would be paid. Access to finance can bridge a shortfall of cash caused by the cost of infrastructure improvements and the higher operating costs in the first year. The premiums returned will allow for repayment of the credit.

 Invest in research and development of organic inputs. As the case has described, the lack of organic inputs is affecting farmers as it restricts their ability to intercrop. This increases their dependence on coconut and reduces diversity, increasing the risk profile of organic farming. Developing organic inputs for crops typically intercropped with organic coconut would address this issue. An inventory of existing and potentially relevant organic inputs from outside of Vietnam or the region could be developed with the intention to test their use in the region. Stakeholders (government, input providers, traders) can work together to identify roadblocks and solutions for introducing the products locally/regionally.

 Invest in research and development of high value-added products. The range of coconut products produced in Vietnam is smaller than that seen in some other countries. Investment in research and development at these companies can support them to expand their product portfolio. Emphasizing high value-added products could ultimately make it easier for coconut companies to compensate for the higher price of Vietnamese coconut. Governments could support this research and development by giving priority to sustainable products in the registration and approval process, thereby creating a fast-track process that would also incentivize companies to invest in sustainable products.

 Invest in pre-processing and processing facilities. Organic coconut has a strong value chain, which gives it high potential for further expansion. However, expansion will require additional processing and pre-processing capacity, which to minimize food safety and non-compliance risk, means that pre-processing facilities will need to be upgraded to support more stringent requirements.

 ***Invest in building farmer cooperatives**.* Cooperatives allow farmers to pool resources, share costs and reach economies of scale that individual smallholders are not capable of reaching on their own. For instance, cooperatives can take a leading role in producing organic fertilizers and biological controls then sell these products to the farmers at cost or with a minimal profit margin. This would reduce the work load of farmers, which is particularly important for an aging farmer population.

- **Knowledge systems**

  Develop a strong training and farmer support component. The organic coconut program in Ben Tre has successfully implemented several training components that should be replicated in similar programs started elsewhere. For example:

  - Enhancement of knowledge of crop nutrient and pest management is essential to improve yield and income from organic farming. Target trainees should be technical staff of the government and sourcing companies (who can become trainers) and coconut farmers. Materials and necessary inputs are available for making organic fertilizers, thus as is being done in the coconut case, farmers should be trained and encouraged to make their own fertilizers to make use of the resource and reduce cost of production. The government, international donors and organizations and private sector are the potential supporters for this training programs as they have been doing.
  - Farm management is also an important topic of training. Farmers should be trained how to calculate the cost-benefit of conversion, as well as which kinds of crops or animals can be grown or raised economically in the organic farming system to help reduce the uncertainty related to transitioning to organic farming.

5. CASE STUDY 2: MYANMAR GAP MANGO IN MANDALAY AND SAGAING, MYANMAR

5.1 Background information

5.1.1 Mango production and trade in GMS

GMS mango contribution to global production

GMS countries contributed on average 21% to the world harvest area of mango, approximately 1.1 million ha in 2016. The volume of mango produced in GMS in 2016 was nearly 9.6 million tons, totally accounting for 21% of worldwide production and 28% of Asia total production volume. Excluding PRC, which accounted for around 50% of total mango production in GMS, the five other GMS countries had nearly 0.6 million ha of harvested area in 2016 and produced nearly 4.9 billion tons of mango. Thailand was the biggest producer of mango in GMS5, then followed by Vietnam and Myanmar. Table 24 presents both harvested area, production volume and average yield of mango in each GMS country over two years, 2012 and 2016, based on the extracted newly updated data from FAOSTAT.

Table 24: Mango production of GMS countries

	Harvested area				Production volume				Yield	
	2012		2016		2012		2016		2012	2016
Unit	(ha)	(%)	(ha)	(%)	(tons)	(%)	(tons)	(%)	(tons/ha)	(tons/ha)
Cambodia	4,480	0%	4,765	0%	59,974	1%	67,001	1%	13.4	14.1
Lao PDR	520	0%	586	0%	4,400	0%	4,858	0%	8.5	8.3
Myanmar	71,534	7%	83,900	7%	482,235	5%	659,722	7%	6.7	7.9
Thailand	398,372	37%	410,694	36%	3,295,586	37%	3,432,129	36%	8.3	8.4
Vietnam	73,692	7%	74,499	7%	775,942	9%	725,306	8%	10.5	9.7
PRC	529,422	49%	569,660	50%	4,318,406	48%	4,664,272	49%	8.2	8.2
GMS	**1,078,020**		**1,144,104**		**8,936,543**		**9,553,288**		**8.3**	**8.4**
World	5,438,753		5,425,054		42,418,914		46,508,697		7.8	8.6

Source: FAOSTAT, 2017

Note: The data taken was for the category Mango, Guavas and Mangosteens, but in most countries, mango accounts for 99% of the category (UNTAD, 2014). Data focused on the provinces of PRC[12] included in the GMS is from 2007, so countrywide data for the PRC is included. The data for Myanmar was taken from MFVP report in 2012, 2016. Data of yield is calculated by FAOSTAT/author.

Intra-GMS trade of mango

The total export value of mango, mangosteens and guavas of GMS reached roughly 250 million USD in 2016. GMS saw a significant growth of 76% over 5-year period (2012-2016)

[12] Data from 2007 for Guangxi and Yunnan provinces showed that Guangxi and Yunnan have the mango production area of 32,900ha and 14,200ha, accounting for 24.7% and 10.7% of total PRC mango production area in 2007 (Aiping et al, 2011).

and contributed 11% on average to the world's mango export (ITC Trade map, 2016). The dominant export market driving the growth of total GMS export was Intra-GMS market, with growth of 113.2%, while export to the rest of the world grew at only 0.2% over the same period. This is mostly due to market access, although a slight increase in harvest area and volume played a minor role with growth rates of 6.1% and 6.9% respectively. Between 2012 and 2016, while export value from Thailand to other GMS countries went down, the trade partnerships between other GMS countries were enhanced and a few new partnerships (Laos PDR – PRC; Cambodia – PRC; Myanmar – Thailand; Vietnam – Thailand) were established.

While there is a substantial variance in export values, all six GMS countries export mango. The GMS mango are intensively traded within the region, the contribution of intra-GMS market was increasing from 67% in 2012 to 81% in 2016 (ITC Trade map, 2016). After PRC, Thailand is the largest exporter in the region, followed by Myanmar.

Table 25: Total GMS mango exported value breakdown by groups of partners in 2012-16

Year	World export ('000USD)	Total GMS export		Intra- GMS		Rest of the world	
		Value ('000USD)	% to total world export	Value ('000USD)	% to total GMS export	Value ('000USD)	% to total GMS export
2012	1,616,821	142,095	9%	95,265	67%	46,830	33%
2013	1,895,039	241,556	13%	186,829	77%	54,727	23%
2014	2,166,282	315,926	15%	247,857	78%	68,069	22%
2015	2,175,653	297,695	14%	210,472	71%	87,223	29%
2016	2,326,588	250,041	11%	203,107	81%	46,934	19%

Source: ITC Trade map, 2016.

- **The North-South economic corridor and Myanmar trade**

The North-South economic corridor is one of the three main markets for the mangoes sold in this case study, with mangoes grown in the studied regions of Mandalay and Sagaing, exported to PRC through the Muse border. The Muse-Ruili border trade is the largest trade point in term of value and volume of all goods, not just mango, between PRC and Myanmar. This cross-border trade point has witnessed a rapid increase in trade from approximately 1.1 billion USD in 2005 to nearly 6 billion in 2016 (PRC gov. 2006 and Xinhua, 2017). PRC mainly exports manufactured products to Myanmar, while importing mostly primary products from Myanmar (e.g. rice, jade and raw materials).

Mango is one of the top Myanmar perishable agriculture products exported to PRC via the Muse border and growth in demand from PRC is considered to drive the growth of Myanmar mango exports. The Chinese government has many import requirements for Myanmar agri-food exporters, such as import quotas, income tax for importers and SPS criteria which can affect the mango trade (Koji, 2016).

Until now, mango exporters from Myanmar to PRC have not experienced stringent SPS requirements, but this situation could change, as occurred in 2014 when PRC stopped imports of rice from Myanmar. Though PRC cited SPS reasons for stopping rice imports, this was thought to be a protective measure to support the domestic production (Koji, 2016).

5.1.2 Mango production and trade in Myanmar

- **Mango production in Myanmar**

Mango is one of the most important fruit sectors in Myanmar. It is the second most produced fruit crop in terms of area, after watermelon, with 83,900 hectares under production in 2016 (MFVP, 2017). There are hundreds of different varieties of mango grown in Myanmar, but the top export varieties are Sein Ta Lone, Shwe Hin Thar and Yin Kwe.

Mango can be cultivated almost anywhere in Myanmar despite wide ranges with respect to climate, altitude and soil. Two exceptions are Chin State and the Northern areas such as the mountainous region of Kachin State. Major mango production regions in Myanmar are Mandalay, Sagaing, and Southern Shan State.

The mango season in Mandalay and Sagaing regions lasts from mid-April to end of May for the main varieties, while other regions grow alternative varieties with different harvesting seasons. Figure 15 illustrates different mango seasons between Myanmar and other countries, notably PRC.

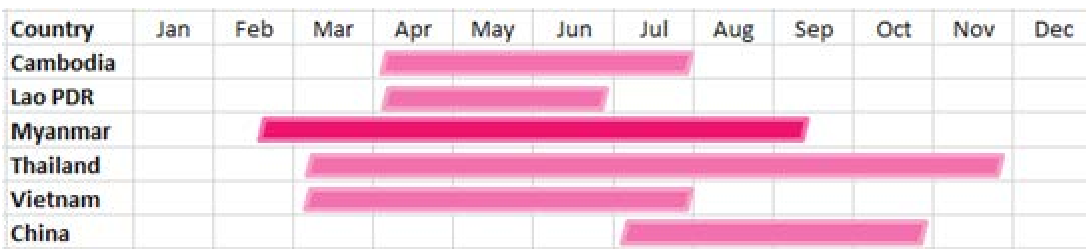


Figure 15: Mango seasonality in GMS countries
Source: Kaung Myat, 2012

- **Consumption and trade of mango in Myanmar**

Most mango is consumed domestically (95% of total production). Although most mango is consumed fresh, some processing does take place. Value-added products like mango puree, juice, and candy are increasingly common. Young fruit may also be turned into mango pickle. Most mango exports are destined for PRC. In 2016, PRC imported nearly 29,352 tons of mango from Myanmar (98% of total export value of mango) valued at 10 million USD (MFVP, 2017). Other export destinations are India, South Korea, Singapore, Thailand, and Malaysia (ITC Trade map, 2017), which accounted for around 2% of total national exports.

- **Mango production in study areas**

The case study was conducted in Mandalay and Sagaing regions, which are two of the three main export-oriented regions and which were selected by the government, with the addition of Shan state, to implement Myanmar GAP standard for mango in 2015. These regions have large production areas and supply high quality mango fruit. In the two regions, there were 17,694 ha of mango with a total production volume of 150,300 tons in the harvesting season 2016-2017 (23% of Myanmar's total production) (MFVP, 2017). Approximately 30% of mangoes from these areas were sold to domestic markets, 68% were exported to PRC via Muse border markets, and only 2% exported to other markets, namely Singapore, Korea and Russia.

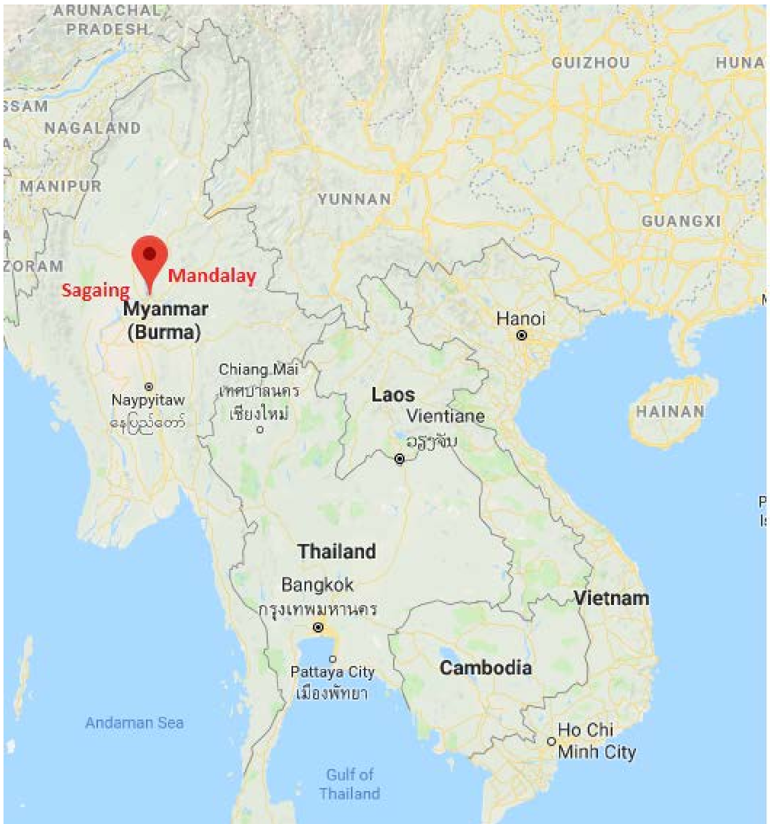


Figure 16: Mandalay and Sagaing regions, Myanmar in GMS map
Source: Google maps.

5.1.3 Myanmar GAP for mango

- **History of Myanmar GAP**

Myanmar is one of the ASEAN countries that adopted ASEANGAP guidelines in 2006. The ASEANGAP standard consists of four modules covering food safety, environmental management, workers' health, safety and welfare and produce quality. Currently, the implementation of the ASEANGAP program within the ASEAN region varies. Some countries have already developed government certified systems (like VietGAP and ThaiGAP), while others (e.g. Laos, Cambodia and Myanmar) are introducing and implementing local versions of ASEANGAP. In Myanmar, the Department of Agriculture (DOA), under the Ministry of

Agriculture, Livestock and Irrigation, has been trying to implement Myanmar GAP with the support of NGOs and FAO since 2006.

- **Myanmar GAP for mango**

According to one government official interviewed, Myanmar has great potential for exporting larger volumes of mango because some of Myanmar's mango varieties are recognized internationally for their high quality. Most of the Myanmar mango are exported to PRC through Muse border trade with different product quality classes. A smaller amount of mango is exported to Singapore for a higher price, but this destination also has more complex requirements, such as strict SPS regulations and high food safety standards for fruits (MRLs, in particular).

Mango is among the first 15 vegetables and fruit for which Myanmar is developing GAP standards. These standards are aimed at controlling the type and quantity of inputs used, making sure that adequate pre-harvest intervals (pesticide waiting periods) are used, and that protocols for food safety are in place. Trials for the Myanmar GAP mango standard started at the end of 2016. The DOA issued GAP certificates to 27 mango farms in 2016 and 25 farms in 2017 (Table 26).

Table 26: Summary of GAP-certified farms in Myanmar

Region	No. of farms			Harvesting areas (ha)
	Government Farm	Private farm	Total	
Mandalay region	4	2	6	20.6
Sagaing region		7	7	14.8
Southern Shan State	1	11	12	61.3
Total	5	20	25	96.8

Source: MFVP, 2017.

- **The case**

Myanmar GAP mango provides another interesting value chain to look at more closely. It has a high level of exports to PRC using an identified economic corridor within the region. Unique varieties are recognized for their taste and attempts to register as a Geographical Indication have been made, indicating that there could be an opportunity to trade as a premium product. The Myanmar GAP program is very young, so insights gained in the study can influence future developments of the program as well as the development of other programs. In addition, the chain focuses heavily on fresh mango, yet opportunities for processed and frozen products exist providing yet another avenue of study.

5.2 Mango farming practice

5.2.1 Mango varieties

Mango is a perennial tree crop whose productivity is heavily influenced by the age of the tree and how well it is cared for. Trees start bearing fruit 3-5 years after planting, with grafted plants bearing fruit sooner than plants grown from seedlings. Mango trees may have more fruits for commercial purpose when they are 5-8 years old and they are most productive when they are between 10 and 25 years old, but may live up to 100 years. On average, one hectare of mango yields around 7-8 tons of fruit (FAOSTAT, 2016), but under intensive management the yield may reach up to 10 tons.

Different mango varieties such as Sein Ta Lone, Shwe Hin Tha, Yin Kwe, Mal Thi, Padamyar Nga Mauk and around 15 other varieties are grown in the regions of Mandalay and Sagaing on a total area of 11,855 ha and 7,283 ha respectively. The most widely grown mango variety was Sein Ta Lone accounting for 64% of the mango plantation area in Mandalay and over 55% in Sagaing region. This is also by far the most popular variety for export because of its "aroma and sweetness" and its "excellent fruit quality" (Hirano R., 2011). In fact, Sein Ta Lone is special enough to be used as a brand name for one of the biggest mango exporters in Myanmar and attempts are being made to register it under a geographical indication (GI).

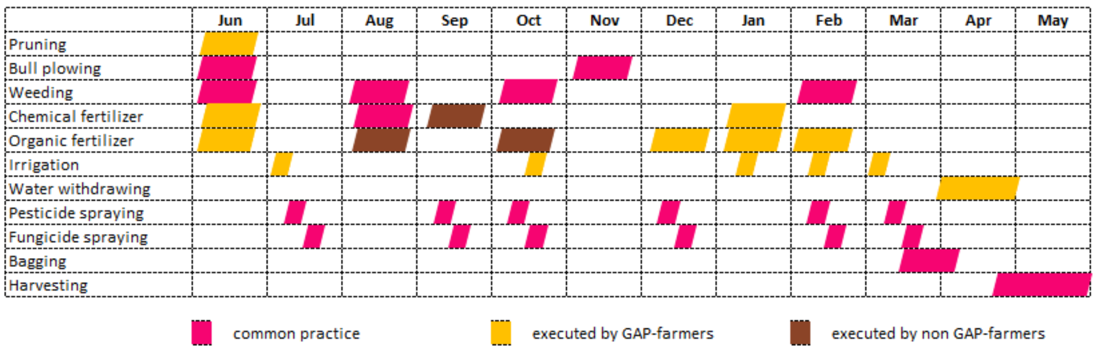
Most interviewed mango farmers intercrop 1 – 2 mango varieties on their farms. There are no major differences in cultivation practices between mango varieties, although the timing may be different depending on the harvest season. However, the main export varieties – on which we focus in this report - Sein Ta Lone and Shwe Hin Tha have the same growing season and harvesting period, and therefore have a similar cropping calendar.

5.2.2 Mango farming practices

This section presents cultivation practices for both GAP and non-GAP mango farmers and where appropriate differences between the two systems will be highlighted. For simplification, we consider a crop season of mango to last for the whole year, starting from pruning activity in June until the harvest that happens at the end of May of the following year (See explanations in the following section). In June, farmers start pruning, fertilizing, bull plowing and weeding activities. In July, the first irrigation is carried out. Spraying pesticides is occasionally practiced throughout the season from July to March and bagging of the fruit takes place in early April, prior to the harvest period (see detailed descriptions of farming activities below).

Most cultivation practices are similar for GAP and non-GAP farmers. An overview of the cultivation activities of the two systems is given in Table 27, where pink shades indicate common practices and yellow shades are specific to GAP-certified farmers. The major differences are in pruning and irrigation, which are practiced more frequently by GAP-certified farmers.

Table 27: Cultivation practices for Myanmar GAP and non-GAP mango farmers



Source: FGDs with Myanmar GAP and non-GAP mango farmers.

- **Pruning**

Mango trees are pruned at a young age if the density of the mango orchard is high, as well as annually after 2 – 4 years to maintain a suitable height that allows the plants to be easily harvested and managed. Pruning is done immediately after harvest, usually in the second week of June. However, pruning can be difficult for mango farmers to implement due to lack of financial resources to pay workers, and lack of technical support to learn methods. None of the non-GAP farmers pruned their trees for these reasons.

- **Irrigation**

Water supply is important for a good mango crop. The amount and frequency of irrigation depends upon the type of soil; prevailing climatic conditions, especially rainfall and its distribution; temperature; relative humidity; and the age of trees (Diczbalis et al., 2006). While most conventional farmers depend on rain-fed irrigation, GAP-certified farmers invested in establishing an irrigation system as the GAP guidelines recommend that one-year old plants should be irrigated every fortnight. Myanmar GAP guidelines also provide an irrigation schedule, specifying that mature plants should be watered 3 – 5 times from flowering time to two weeks prior to harvest. Thereafter, the mango plants should not be irrigated to ensure that a good ripening process occurs (water withdrawal period).

- **Weeding**

Weeds in the mango orchard can be removed by bull plowing, grass mower or be eaten by cows. Weeding is usually done in June after the harvest, then it is conducted three more times, in August, October and February.

- **Fertilization**

GAP-certified farmers applied both organic and chemical fertilizers 3 – 4 times per year, following the optimal amount recommended by Myanmar GAP guidelines. The aligned practice can help balance the nutrition for mango plants, thus resulting in higher yield. There were, however, differences in timing and the number of applications between GAP and non-

GAP farmers. Non-GAP farmers fertilized twice a year between August and October. Most of them depended on natural fertilizers such as cow manure and bean husk while a few indicated using chemical fertilizers. They also wanted to increase the number of applications and the amount applied but hesitated to adopt this recommendation due to increase in cost.

- **Pest and disease control**

Seven main pests of mango are mentioned in Myanmar GAP guideline, namely fruit flies, mango stone weevil, mango pulp weevil, mango stem borer, mango hopper (thrip), mango scale insect and mango mealybug. In addition, ten main diseases of mango were also mentioned: anthracnose, blossom blight, dieback, powdery mildew, grey leaf spot, algal leaf spot, mango scab, malformation of mango (caused by Fusarium mangiferae), stem-end rot and bacterial black leaf spot.

In the study in Sagaing, the prevalence of five pests and seven diseases were mentioned by farmers. In general, interviewed farmers could differentiate between different pests and diseases based on the physical symptoms. Farmers conducted regular checks on plants and fruits themselves.

Pesticides are used specifically to fight against thrips and aphids. Some farmers sprayed pesticides themselves while the others hired workers. Most farmers stated that they used protective equipment such as masks and gloves because they experienced skin irritation and burning after spraying pesticides. After spraying, bagging and painting lime on the trees were the dominant control practices.

Bagging can protect the fruit from infestation by fruit flies, prevent the spread of common diseases (e.g. anthracnose, die back and blossom blight) and, at the same time, prevent accumulated water or dew on the fruit, while also protecting fruit from the abrasion of branches and leaves. In interviews, both GAP and non-GAP farmers indicated that they practiced bagging.

- **Harvesting**

Harvesting activities include picking the fruit, sorting and putting them into the baskets. The whole process of harvest often takes place within one day, in which fruit picking and sorting are in the morning and delivery to the exporters or brokers happens in the evening. Due to the large quantity of fruits harvested, workers from outside the family were hired to carry out these activities. In the first half of the day, male workers usually pick fruit while female workers are responsible for sorting the fruit and putting them in baskets. On average to harvest one ton of mangoes in a day, four men and seven women are required.

5.2.3 Training and knowledge building

There are several sources of technical knowledge for farmers in the studied areas. According to farmers, their most reliable source of knowledge comes from experienced acquaintances including neighbors. In addition, many of them mentioned that media sources like TV news and journals were among the methods used to learn farming techniques. Organizations such as the DOA and Mango Association were reported to provide trainings for farmers and a few GAP-certified farmers also mentioned that they received trainings from multilateral or foreign aid organizations like FAO and GIZ.

An interview with the Chairman and Vice Chairman of a newly-established mango association in a village in Mandalay region also revealed their demand for different types of knowledge. Five topics are most requested: pest and disease control, pruning, mango farming practices for new mango farmers, training on specific Myanmar GAP topics and export market information. However, there are limited qualified government trainers available to work with mango farmers. For example, in Sint Kaing township, the extension staff to household ratio is roughly 1/300 (or 23 staff for 5,900 households), as shared by an officer in Mandalay region.

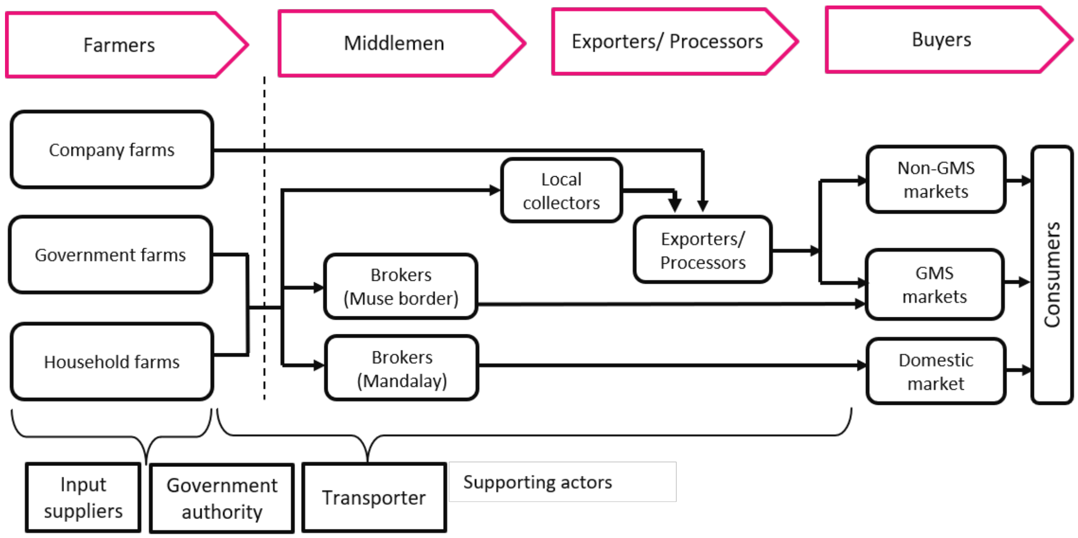
The mango association, with 25 members, is working to improve the knowledge of its members by cross-teaching and discussing within the group; helping them to gain access to the market, to improve environmental management and to increase food safety.

5.3 Supply chain of Myanmar GAP mango

5.3.1 Myanmar GAP certified mango supply chain map

A survey was conducted to study the supply chain of mango in Mandalay and Sagaing regions of Myanmar. Overall, 81 stakeholders were included in this survey of the mango supply chain, including 54 Myanmar-GAP-certified and conventional (non-GAP-certified) farmers; 6 middlemen; 6 exporting/processing companies; 2 input suppliers; 12 government officers; 1 transporter and 1 retailer (See Table 2 for more details).

An overview of the supply chain of Myanmar GAP mango in the two studied regions, Mandalay and Sagaing is provided in Figure 17. The chain map was drawn based on information from interviews with all involved stakeholders. The supply chain for Myanmar GAP-certified mango starts with farmers, the mangoes then pass to brokers or local collectors working for exporters/processors. Brokers then sell the mangoes into GMS or domestic markets, while exporters sell to either non-GMS or GMS markets. More detailed descriptions of each actor are provided in the following sections.



• **11 Myanmar-GAP-certified farms**	• **Collectors to companies**	• **4 exporters/processors**	• **Non- GMS markets: 10 – 23 tons**
• **31.8 ha of production area**			• **GMS market: 49 - 56 tons**
• **82.2 tons**	• **56 – 66 tons**	• **16 – 26 tons**	• **Domestic markets: 1 – 3 tons**

Figure 17: Supply chain of Myanmar GAP-certified mango in Mandalay and Sagaing, Myanmar
Source: Focus group discussions and interviews with stakeholders in the survey
Note: The majority of mango exporters are also processors and vice versa, hence they are shown here as one step in the chain. The dashed line shows that there is no recognition of Myanmar GAP- certified mango after leaving farmgate. The loss rate of mango sold to the non-GMS market is from 10-40%, whereas the loss rate for mango to the GMS market and domestic market is around 10%.

5.3.2 Actors of the chain

5.3.2.1 Farmers

Table 28 summarizes information, including farm size, production volume and median yield from the interviewed Myanmar GAP and non-GAP farmers in the Mandalay and Sagaing regions. Fifty-four farmers were interviewed, including 11 out of the 13 Myanmar GAP farmers in the regions. As the Myanmar GAP mango program was only begun in 2016 the number of Myanmar GAP farmers remains small. Forty-three non-GAP farmers were randomly selected from interviewed regions to also participate in the study. Of the total 54 farmers, 5 were women. The total mango area of the 11 Myanmar GAP farms is 31.8 ha, with an average farm size of 2.4 ha. Interviewed non-GAP farms have 122.6 ha of mango area and the median farm size is around 2.0 ha. As shown in Table 28, Myanmar- GAP farms had slightly larger farm sizes than non-GAP farms, ranging from 1.2 to 4.8ha each farm.

Table 28. Summary of studied Myanmar GAP mango farms versus non-GAP farms in the studied area

	Myanmar-GAP	Non-GAP	Total
n (observations)	11	43	54
Females (observations)	2	3	5
Median mango area (ha)	2.4	2.0	2.4
Total mango area (ha)	31.8	122.6	154.4

Role of farmers

There are three types of Myanmar GAP-certified mango farms: company, government[13], and household farms. There are some major differences between these types of farmers in terms harvesting and transporting of mango and source of inputs.

While production activities are largely common across farmers (see details in Section 2), farmers play different roles in the harvesting and transportation mango depending on the channel to which they are selling:

- Exporting/processing companies use local collectors to harvest and transport, except at the company farms where the company farmer assumes this role.
- Brokers arrange for the harvest and transport of mangoes going to the Muse border market.
- Household farmers selling to the domestic market arrange the harvest and transport of the mangoes themselves using either their own resources or hiring workers and/or trucks to deliver the mangoes to the Mandalay wholesale market.

In terms of input sources, company farms received all from the companies. For government farms, inputs are partly subsidized by the government, namely seeds, fertilizers and electricity, and they only need to pay for labor costs and pesticides. In contrast, household Myanmar GAP farms had to cover all input costs themselves - labor, fertilizers and pesticides, energy and water.

Volumes and values

Yield

Of the 54 farms included in this study, 9 Myanmar GAP farms and 20 non-GAP farms were selected for further analysis of yields[14]. Table 29 provides information about the total volume and yield for the selected Myanmar GAP farms and non-GAP farms. The table shows that the median yield of Myanmar GAP farms was relatively higher than that of non-GAP farms, at 3.5 and 2.4 tons/ha respectively. However, for both types of farmers the yields given were 35-

[13] Myanmar GAP-certified government farm refers to the Myanmar-GAP certified farms owned by the government. Under instruction from the government, these farms started to implement GAP on 4 ha of land.

[14] To compare yields and farm size, data from farmers whose plants were younger than five years or whose yields were not between 0.81 – 9.43 tons/ha were excluded.

40% of published average yields from previous years. One recorded explanation for the low yields was that production had been heavily affected by unusually cold temperatures occurring at the end of 2016.

Table 29: Median area and yield of selected farmers (2016-2017)

	Myanmar-GAP	Non-GAP	Total
n (observations)	9	20	29
Median mango area (ha)	4.0	2.4	2.6
Median yield (tons/ha)	3.5	2.4	2.6

With respect to the differences in yields between conventional and Myanmar GAP farming, the higher yields of Myanmar GAP farmers can be attributed to the better practices used under the GAP system. For instance, Myanmar GAP farmers are advised to reduce the density of mango trees. Data from qualitative interviews shows that while only one certified Myanmar GAP farm grows more than 60 plants/acre, 13 out of 26 of non-GAP farmers grow more than 60 plants/acre.

Volume and value of interviewed Myanmar GAP farms

In total, the 11 interviewed certified farms produced more than 82 tons of Myanmar GAP mango. Based on the price range in Figure 18, the approximate value of Myanmar GAP mango with 20-30% of Class 1, 40-50% of Class 2, 20-30% of Class 3 was around 60,000-63,000 USD.

- **Margins**

GAP farmers are not yet receiving a premium compared to the conventional price. The price for mangoes is instead differentiated based on two factors: selling channels and classes of mango (Figure 18). According to the supply chain figure, mango could be sold through three main channels:

(1) to exporting/processing company,
(2) to the Muse border market, and
(3) to the domestic market.

The first channel often offers higher prices than other channels, especially for the best quality mangoes (size 350-450gr/fruit). The second quality mangoes (size 250-350gr/fruit) are mostly sold to PRCPRC via Muse border market, for example about 90% of mangoes in a studied village in Sagaing region are sold via the second channel. The third channel normally buys third quality mango (size <250gr/fruit) and some of the second quality mango supply. The prices offered by the third channel were the lowest among the three channels. Apart from the size, mango also was sorted into the three classes based on their maturity, appearance and variety.

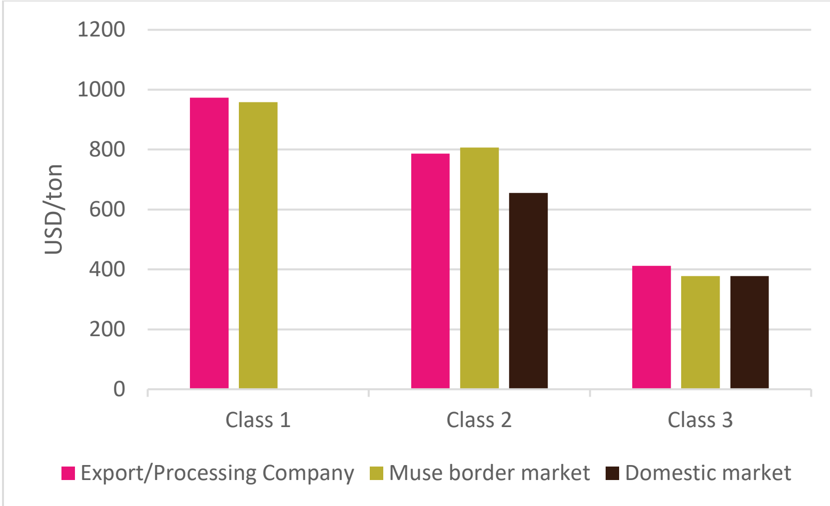


Figure 18: Price differences between classes of mango and selling channels.
Note: Mango is classified primarily on fruit size, Class 1 (350-450gr/psc), Class 2 (250-350gr/psc), Class 3 (<250gr/psc).

In terms of costs, farmers pay production expenses, harvesting, packaging and transportation costs, duties and commissions, and the expense of certification testing. For Myanmar GAP farmers, the production costs are on average higher than that of non-GAP farmers (Table 30), mainly due to higher spending on fertilizers, including chemical fertilizers. This may seem to contradict the idea of reduced-inputs, but it is thought that spending on fertilizers reflects the available funds of the farmer and the higher spending by GAP farmers may simply reflect greater financial resources. Post-production costs will vary depending on the selling channel, as shown in Table 31.

Table 30: Production cost of Myanmar GAP farms versus non-GAP farms

Item	Myanmar-GAP farms (USD/ha/year)	Non-GAP farms (USD/ha/year)
Pruning	20	0
Bull Plowing	167	278
Weeding	29	111
Chemical fertilizer	301	125
Organic fertilizer	318	11
Irrigation	124	185
Crop protection	185	185
Bagging	173	136
Total production cost	**1,317**	**1,030**

Myanmar GAP farmers sold their mangoes to all three channels and their main product was Class 2 mango. In interviews with buyers and exporters/processors, no party was found to pay a premium price for Myanmar GAP mangoes, so any price differential achieved by a

Myanmar GAP farmer is based purely on which class of mango he sells and the channel that he sells into. Thus, in order to analyze the margins achieved by farmers, the average price of Class 2 mangoes for each channel is used as the basis to calculate revenues. As 70% of conventional mango is sold to the Muse border, the Muse border price is used to calculate revenue of conventional farmers. Although production costs are fairly consistent among Myanmar GAP farmers and non-GAP farmers, the profit margin of farmers will vary due to the differences in prices between channels, fluctuations of price in a season, yields achieved, and the class and varieties of mangoes sold.

Table 31 shows that Myanmar GAP farmers who sold their second-class mangoes to exporters received the largest margin due to fewer costs. Although Myanmar GAP farmers selling second class mango to the Muse border market received the highest price, they had more post-production costs, leading to a lower profit margin, 24% versus 51% if sold to exporters/processors. In comparison, non-GAP farmers selling their mango to Muse border market can have an even lower margin rate of 16%, due to lower productivity. If Myanmar GAP farmers sell to the domestic market, they can expect a return that is 10-20% lower.

Table 31: Benefit and margin of GAP mango farmers

	Myanmar-GAP farmers			Non-GAP farmers (to Muse Border)
	To export/ processing company	To Muse border market	To domestic market	
Median yield (tons/ha)*	3.5	3.5	3.5	2.4
Price (USD/ton)	787	807	656	807
Total revenue	**2,755**	**2,825**	**2,296**	**1,937**
Total cost	**1,362**	**2,137**	**1,992**	**1,629**
- Production cost	1,317	1,317	1,317	1,030
- Harvesting cost	0	79	79	79
- Packing and transportation	0	524	321	402
- Commission fee	0	141	230	97
- Custom duty	0	30	0	21
- Certification cost	45	45	45	0
Margin per ha (USD/ha)	1,392	688	304	308
Margin rate (%)	**51%**	**24%**	**13%**	**16%**

Source: Interviews/focus group discussions with farmers and calculations of authors

As noted previously, data collected from farmer interviews gave an average yield of only 3.5 tons/ha, 40-50% lower than the average national yield of 6-7 tons/ha in previous seasons. While some costs, such as the commission, are tied to volume of mangoes, not all costs are, so higher yields would have an impact on profitability.

In addition, for this study average prices from the various channels were used; however, these prices will fluctuate and, in particular, prices in the Muse border area are known to have strong variation during the harvest season, declining by up to 30% within a day. Additionally, with the fact of 30% of total GAP-certified mango selling to export/processing company, 68% to Muse border and only 2% to domestic market, the weighted average margin rate of Myanmar GAP mango was from 32% in the year 2016-2017.

The results of the above analysis show that the economic case for conversion to Myanmar GAP farming depends on two factors: 1) sales to export/processing companies and 2) higher yields. However, when interviewing exporters/processors they did not indicate any specific demand for Myanmar GAP mangoes, so it is difficult to claim that Myanmar GAP opens up a new sales channel. At the same time, it is out of the scope of this study to prove that the higher yields of Myanmar GAP farmers are the result of using GAP practices, especially given the youth of the program. Thus, while the above calculations establish a potential higher profit margin for Myanmar GAP farmers, the assumptions underlying these calculations are not proven to be linked to Myanmar GAP.

- **5.3.2.2 Exporters/Processors**
- **Role of local collectors**

Exporting companies contract the needed mango volume with some selected key farmers (collectors). These collectors are often farmers with a leadership position in the community, such as the head of the village. In the pre-harvesting period, the exporting company contracts their collectors to arrange for harvesting and delivery of a specific volume of mango. Collectors visit mango farms in early fruit stage and buy the whole orchard with 50% of the payment made on the visiting day and 50% after the harvesting day. The collectors provide the farmers with carton/paper bags from the exporting company for bagging young fruits to avoid fruit flies. Collectors then arrange labor for the mango harvest and delivery to the packing house of the exporting company. Delivery can be done in company trucks or hired vehicles.

Collectors might do the first sorting into three grades on the farm right after harvesting or this activity might happen at the packing house of exporters, depending on the protocol set by each company. The collectors receive payment for the contracted amount of fruits with prices set by the company for each grade, collectors are also paid 50% up-front and 50% after delivery. Fruits that are rejected due to small size, less maturity, partial damage or deformation might be returned to collectors to sell to other markets or the exporter/processor will purchase them for processing, in which case the collector would receive an extra payment for this sale.

Collectors do not keep Myanmar GAP and non-GAP mango separate when they collect them from the farms.

- **Role of exporters**

Exporting companies purchase all types of mango, both Myanmar GAP and non-GAP, from collectors. They pay collectors for the contracted amount of mango, including providing pre-financing. At the packing house, mango is sorted, handled and packed based on the class. There is no distinction between GAP and non-GAP mango at the exporter warehouse. After packing, the exporters send trucks of fresh packed mango to Yangon for export via air or sea freight.

- **Role of processors**

As a processor, third-class mangoes (less than 250gr/fruit) or mangoes that are partly damaged, over-ripe or rejected for export are processed into products such as mango puree, jam, fruit leather, juice and frozen dried mango. Then, processed mango products are packed and stored under suitable conditions and then exported to different destinations. The main reason for processing initiatives from one studied company is the high rate of rejection from export markets, for instance 35-40% of mangoes exported by the company to Singapore are rejected each year due to the existence of fruit flies. Additionally, the investment in processing equipment offers the chance for these exporting companies to access high requirement markets. Most mango processors, except for small-scale family processors, are also exporters, but the share of processed products was less than 30% of total exported volume of the company.

These companies mainly trade Sein Ta Lone- the most famous mango variety from Myanmar, then Yin Kwe and Shwe Hin Thar varieties. Sein Ta Lone and Shwe Hin Thar mango are mostly exported fresh, while Yin Kwe and other cultivars are processed into puree and dried mango.

- **Mango value added products**

The interview with the biggest export/processing company confirmed that less than 1%[15] of mango fruits are exported in processed form. The following paragraphs focus on processing technologies for mango and the potential for value added products.

Mango fruit consists of three parts: peel, flesh and kernel. Processors in Myanmar sell mango seed for propagation at an average price of 700-1200 kyats/seed (or USD 0.51-0.87/seed). Mango skin is treated as waste in Myanmar, without any by-products having been developed from it. In contrast, flesh from third quality class mango or rejected mango is used to produce a range of products, namely mango puree, jam, leather, juice and frozen mango. High quality

[15] Data combined from interviews with two biggest exporters/processors of Myanmar and the official export data extracted from ITC Trade map, 2016. There were around 30 tons of puree exported to Russia and 18 tons of frozen puree exported to Korea in 2016 and small amount of dried mango exported to Singapore but not specified by the companies. The loss rate is from 60-65%; hence 137 tons of mango were needed (which is less than 1% of total production (652,790 tons in 2016) to make 48 tons of puree.

mango can also be processed into fresh-cut mango, which is a high-value added product. Figure 19 presents the handling and processing procedures of some major mango products.

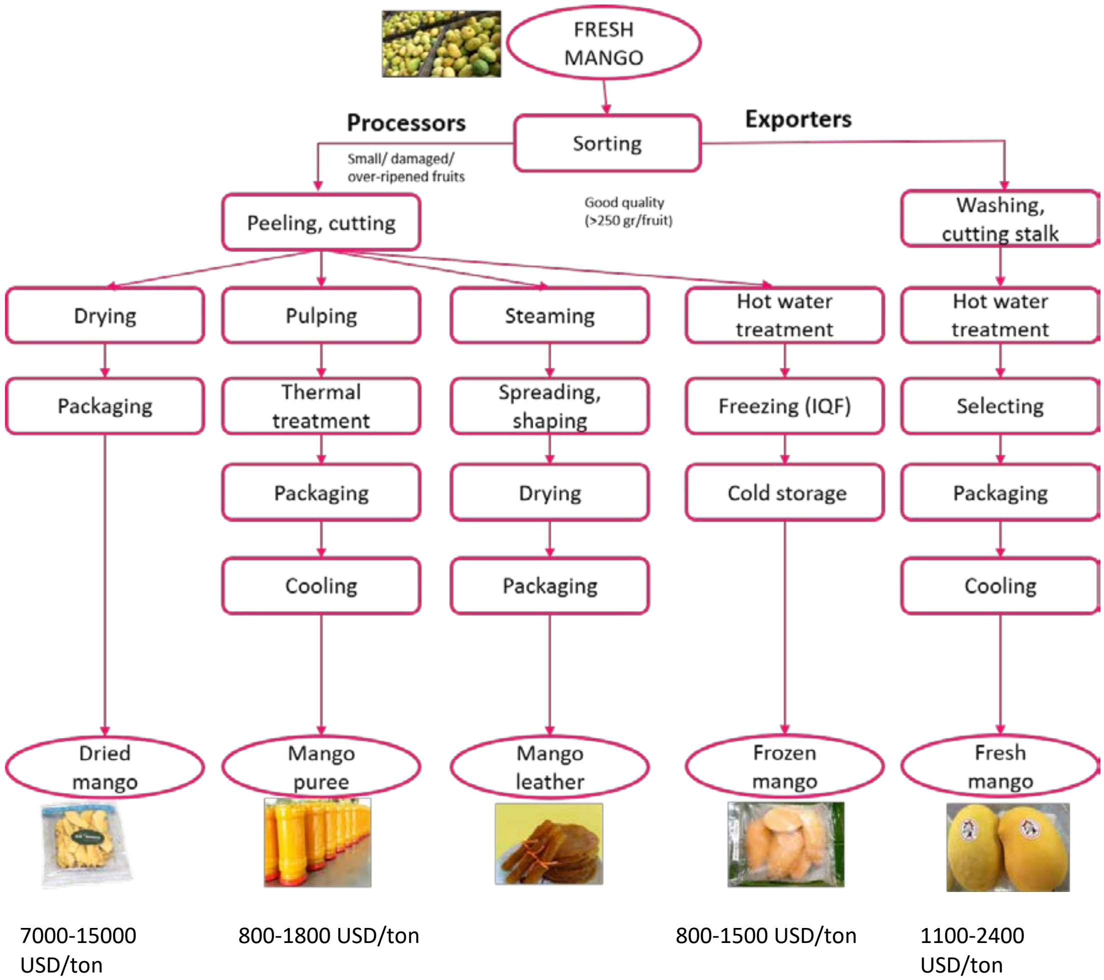


Figure 19: Processing and handling procedures of mango in Myanmar
Source: Interviews with exporters and processors.
Note: The bold arrows leading to Fresh mango present the major category of exporting mango products from Myanmar.

Mangoes purchased by exporters/processors are first sorted by machine. Thereafter, mangoes that will go to the washing machine, have the stalk cut, then go through hot water treatment for two minutes, then cold water and drying. After drying, if being sold as fresh, laborers manually select and pack the mangoes into boxes of 5kg or 15kg.

As described in Figure 19, processed products are made from smaller fruits (<250 g/fruit), or partly damaged and over ripened mango. Each product will have different processing stages and end at the packaging stage. For mango puree, after peeling and cutting ripened mango (mostly Yin Kwe cultivar), they then crushed it into pulp and cook it in high temperature to kill bacteria and fruit flies. Finally, it is packed into tins of different sizes and cooled before storing. For dried mango, slices of partly ripened mango will go through the drying stage and then be packed. Mango slices can also be frozen, packed, and kept in cold storage as a frozen mango product using Individual Quick Freezing (IQF) technology in order to meet the high standards of the Japanese and Korean markets.

Fresh mangoes are the largest mango export product, just around 1% of total exports volume comes from processed products, such as puree and frozen mango. Myanmar mango processors see the potential in processed products and are investing more in their processing plant in order to improve the quality of these products. In addition to the investment in IQF described above, they are also investing in the pureed and canned mango which have increasing demand from the Russian and Ukrainian markets.

Mango leather is a purely domestic product and accounts for a small share of total processed products. It is mainly produced as a family business at a small scale. Mango juice is still in the trial phase, but the processing technology has not been upgraded for export markets yet.

At each stage of processing and handling, 5-15% of the mango is lost. Mango processing units generate mango wastes consisting of variable proportions of peels, pulp, seeds and flesh. These wastes could be converted into by-products, such as de-oiled mango kernel meal, materials for generating biogas, or producing fertilizer.

- **Volumes and values**

The interviewed exporters in the present study buy mango in Sagaing and Mandalay region and export mostly fresh mango, puree and dried mango. For fresh mango, Singapore imported 50-80% of total exported value of fresh mango. Other countries such as Russia, Malaysia, mainland PRC, and Thailand make up 20-50% of the total exports. Processed products, such as mango puree and dried and frozen mango are mainly exported to Russia (80%), and other markets, namely Singapore and Korea.

One interviewed company, which is considered the biggest exporter and processor of mango in Myanmar, said that they buy 150-200 tons of Sein Ta Lone and 50 tons of Yin Kwe mango each year, exporting 80% of fresh mango to Singapore with the remaining 20% divided among fresh mango to other markets and processed products.

- **Margins**

As mentioned above, most processors are also exporters, but the share of processed mango products accounted for less than 20% of total selling volume of the exporting and processing companies. Hence, in this section, we focus on the margin rate for exporters of fresh mango.

Prices are highest in non-GMS export markets. Data obtained from UNCOMTRADE shows the price per ton for a container of mango received in Singapore, the largest export market for Myanmar mango, ranged from 2,050 to 2,430 USD in the period 2012-2016, as compared with 378- 958 USD in the GMS market and 378- 656 USD in domestic markets. However, shrinkage losses – mostly caused by fungal disease and deterioration in quality during transportation – may reach 10-40% in all markets.

In terms of cost, the buying prices of first and second-class mangoes from both Myanmar GAP and non-GAP farmers were around 700-1000 USD/ton. The interviewed export companies estimated an average of 20-40% shrinkage losses, which would reduce the actual selling price per ton of mango to approximately 1500 USD/ton on average. Data for the operating costs (personnel, facilities, transportation, etc.) of exporters was not available, so the gross margin is provided below.

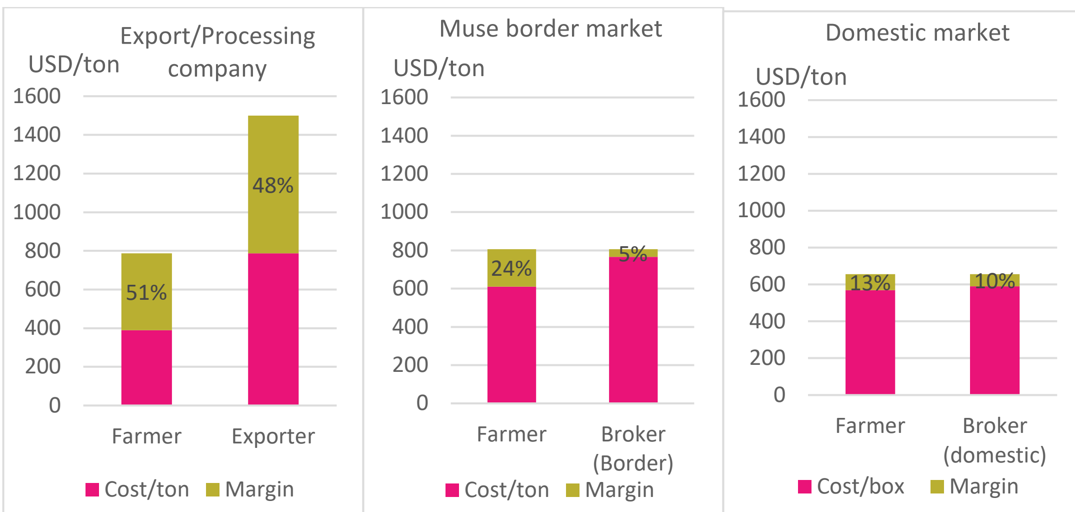


Figure 20: Margins of exporters and other middlemen (gross margin) versus farmers (net margin) in the supply chain of mango
Source: Calculated by authors based on interviews with different actors

Figure 20 shows that exporters earned nearly double the purchasing prices, a gross margin of 48%. In comparison, brokers in Muse border markets and domestic wholesale markets had significantly lower margins of 5% and 10%, respectively. The figure also highlights the economic advantage for both farmers and exporters of selling to exporting companies.

5.3.2.3 Brokers

Role of brokers

There are many brokers working with farmers in the studied regions, mainly in the Muse border market and the Mandalay wholesale market. Brokers in both markets negotiate the price with the buyers, deliver the mangoes and then pay the farmers with the proceeds of the sale.

For the Muse border market, farmers inform brokers of their estimated harvest by phone, after which brokers send trucks to the farms and arrange labor for harvesting. Brokers advance the costs of fuel and labor related to transportation; plastic crates or carton boxes for packing; and custom duties, and deduct these amounts from the final payment to the farmer. The brokers and the Chinese importers negotiate the price, though farmers can propose prices to the broker for each class of mango before the negotiating session. After the sale, the brokers pay the farmers the sale price less a commission of 5% and the advance provided for transport costs, packing materials, and duties.

Brokers at the Mandalay wholesale market also negotiate with retailers and set the price based on the daily price of the Muse border market. However, they are not always responsible for arranging harvesting and transportation from farms in Mandalay and Sagaing regions. These brokers mostly trade in second and third-class mangoes. Mandalay brokers take a larger rate of commission (5-15%), which they deduct from the payment made to the farmer after the transaction is completed.

- **Volumes and values**

According to official export data of Myanmar in 2017, of the 5% total production of mango for export, 98% of total mango exports via the Muse border market are to PRC with the total volume of around 29,352 tons/year, valued at around 10 million USD. For Mandalay and Sagaing region, which are two mango export-oriented regions of Myanmar, the share of exported mango to PRC via brokers in Muse border market was typically high, even at around 50-90% of total production volume In De Pae In Kwe and Ywar Thit Kyi village of Sagaing.

- **Margins**

As shown in Figure 20 brokers/collectors earn a commission of from 5-15% on their sales, with domestic brokers earning a higher commission than brokers that are exporting. While some brokers pay the up-front costs of transporting and packing the mangoes, as well as any customs duties, they deduct these costs from the payment made to the farmer and so these costs do not affect the brokers margins.

5.3.2.4 Buyers

As previously stated, the three markets of Myanmar GAP-certified mangoes in the studied area are: non-GMS, GMS and domestic market. Non-GMS countries where Myanmar mango is sold include Singapore, Russia, Korea, and Malaysia. Within the GMS, PRC is currently the only importer. Interviewed companies had sold two containers to Thailand; however, these containers were rejected as they did not meet certain regulatory requirements.

Myanmar GAP mangoes are not kept in a separate value chain, but rather enter the general supply chain of mangoes. Consequently, once they have been sold by the farmer, data is not available on the volumes or percentages of Myanmar GAP mangoes sold to each market.

5.3.2.5 Supporting actors

- **Input suppliers**

Farming inputs like pesticides, fertilizers, seeds available in the studied area are sold by either small or large shops or directly by the input manufacturers. Shops must be licensed and attend the pesticide-related trainings by Department of Agriculture in Mandalay.

Interviews with two small input suppliers in the study revealed that only a small portion of their customers are Myanmar GAP farmers, as in most cases, GAP farmers purchase their inputs from large input suppliers in Mandalay or order directly from input companies. According to the interviewed suppliers, though they give advice to farmers on the usage of inputs, they have not received any training in the guidelines on input usage as per Myanmar-GAP standards.

Input suppliers also play an additional role in the chain by allowing their long-term customers to purchase on credit or by providing them with a discount for large orders.

- **Transport companies**

Transporters are hired by farmers, brokers or export companies to deliver mango crates to the wholesale markets (in Muse border or in Mandalay) or to the packing house of export companies. From the packing house they also transport mangoes to the sea port or airport in Yangon. Transport companies do not require certification and offer identical services to conventional farmers.

Most transporters use ambient trucks, which often leads to a high rate of damage during transport (5-20%). Transport companies charge farmers/brokers from 1.05- 1.27 USD/15.5kg crate, with prices varying depending on the distance to the market. This cost will be deducted from the price paid to the farmers after brokers sell the mangoes. For farmers selling mango to Muse border, the packing and transportation costs comprise ~25% of the total production cost (see Table 31), compared to ~16% of total cost for farmers selling their products to Mandalay wholesale market.

In the harvesting season, exporters also hire ambient trucks to transport fresh mangoes from farmgate to the packing house. However, after post-harvest handling and packing, products are delivered to the Yangon airport or sea port in cold trucks hired from an Japanese company.

The export companies can choose to pay high fee for air freight in order to transport fresh mango to Singapore in 2 hours, or a lower fee for cold containers that will be delivered within 4-5 days. Though air freight costs are higher the damage rate is lower than for sea freight where damage can be up to 20% due to a longer transport period.

Government authority and international donors

As described in the history of Myanmar GAP, government authorities played vital roles in developing and implementing the national GAP standard in Myanmar. The key agencies and their roles in promoting GAPs and other postharvest practices in Myanmar are summarized in Table 32.

Table 32: Key agencies in promoting GAPs in Myanmar

Organizations	Type	Development of Myanmar GAP	Implementation Myanmar GAP
Ministry of Agriculture, Livestock and Irrigation (MOALI) Myanmar Agriculture Service (MAS)	Government	Developed the national guidelines for Myanmar GAP for fresh fruit and vegetables	Promotes and conducts trainings of Myanmar GAP through extension services. Audits and certifies Myanmar GAP
Yezin Agriculture University	University	A member of the advisory committee that developed Myanmar GAP guideline.	Conducts trainings about Myanmar GAP for students
Myanmar Flower, Fruit and Vegetable Producer and Exporter Association (MFVP)	Intermediary between government departments/agencies and private sector		Organizes many Myanmar GAP training courses for farmers Applying to be the certifying body for Myanmar GAP products
Mango association	Independent organization, including both producers, traders and exporters/ processors since 2010	Collaborate with MFVP to implement training courses for mango farmers since 2010.	Trained 200 farmers from 10 villages under supervision of MOALI. Provide training on capacity building on pre-and post-harvesting technology, funded by FAO Provide training on environment safety, funded by GIZ
DEAR Myanmar	NGO		Provided trainings on Myanmar GAP to their farmers
AusAID	International donor	Provided the first GAP training program to 20 officers of the MAS in 2005 under the project: Australia- ASEAN Development and Cooperation Program (AADCP)	
FAO	International donor		Supported MAS to implement the Myanmar GAP program Supported MAS to establish a National Accreditation Body (AB) and a Certification Body (CB) for Myanmar GAP

Source: Than, 2016.

5.4 Quality assurance system and food safety

5.4.1 QA system- the Myanmar GAP system

The Myanmar GAP standard for mango is a farm-level standard developed and led by the government. The standard principles are based on the ASEANGAP and consists of 14 sections with 44 control points. The ASEANGAP has 4 modules covering food safety, environment management, worker health and welfare and produce quality (ASEANGAP, 2006). Our rough comparison of the Myanmar GAP versus ASEANGAP shows the following highlights:

- Myanmar GAP is a "simplified version" of the ASEAN GAP in that it is mainly focused on the food safety component. The majority of these control points aim at reducing the risk of biological, chemical, or physical contamination of produce and products.
- Environmental management, a separate module in the ASEANGAP, is only partly emphasized in the Myanmar GAP. Sections such as Waste and Energy Efficiency, Biodiversity, and Air, which in ASEANGAP set out requirements for producers to minimize negative production impacts on the environment, do not appear in the Myanmar GAP standard yet.
- Steps to ensure quality are emphasized in the produce quality module of the ASEANGAP standards, both through identifying critical production practices and through market awareness, e.g. selecting crop varieties that satisfy market requirements. In the Myanmar GAP standard, such recommendations are not incorporated in the standard inspection checklist. However, some production techniques are introduced in the Guideline document aim at helping farmers to produce quality mango (Myanmar GAP guideline document).

- **Myanmar GAP Organization structure**

Myanmar GAP is a public standard, meaning the government of Myanmar is responsible for its development and operation. Government officials from different levels of the hierarchy are involved: federal, regional, district, and township level. These officials form part of six teams or bodies: accreditation, certification, inspection, laboratory testing, advisory, and audit (Figure 21).

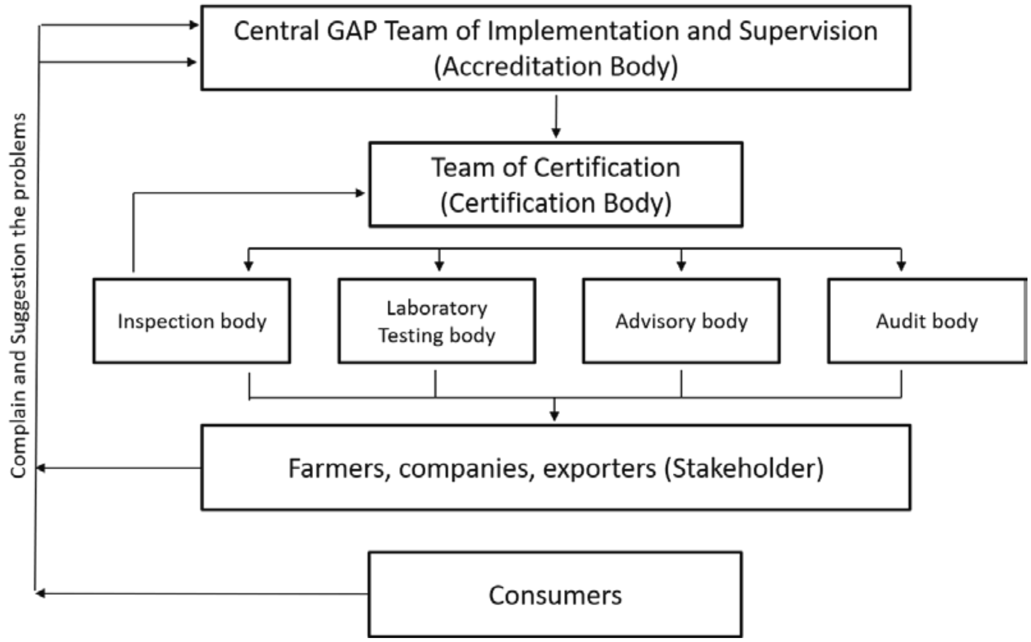


Figure 21: Organizational structure of Myanmar GAP
Source: Interview and document adopted from Myanmar GAP development officer

The Central GAP team of the Head office of DOA under the Ministry of Agriculture, Livestock and Irrigation (MOALI) oversees the implementation and certification process of Myanmar GAP. The Head office decides whether or not a farmer – based on application or inspection documents – is eligible for receiving the certification. It is also responsible for issuing the certificate.

Inspection, laboratory testing, advisory, and audit activities take place at provincial level, although at the time of research, no clear responsibilities are assigned to the specific persons and departments within the provincial government. The main reason for this was a lack of a budget dedicated to Myanmar GAP. For instance, Mandalay has its own laboratory for testing, Sagaing does not and has to send samples to the government laboratory in Yangon. Collection of soil, water, and produce samples is usually done by township-level officials, although representatives from other levels of government may join as well.

- **Myanmar GAP application and certification process**

The current procedure to apply for Myanmar GAP certification is relatively complex and involves stakeholders from different administrative levels. The procedure may be divided into three stages: applying, inspecting and approving (Figure 22). In the first stage, township-level extension officers distribute application forms to interested farmers to fill out and then submit them to the township manager, who forwards the forms to the Regional office. From there, the application is sent to the Head office of the Department of Agriculture in Nay Pyi

Taw. Most farmers said that the application form is very complicated and that they need help from the extension officers to complete it.

The second stage starts once forms are received by the GAP-responsible at the head office. If the application is considered eligible, a regional inspection team is sent to the farm. This team collects soil, water, and where possible, production samples and checks the record book kept by farmers. All findings are recorded in the Inspection Form (checklist). In theory, a single inspection should be sufficient, but in practice 2-3 visits may take place to collect all required information. Filled out Inspection Forms and test results are sent to the Head Office.

In the third phase, the Head Office will inspect all submitted documents including the record book and decide whether or not a farmer is eligible for certification. Eligible farmers get issued a certificate. In theory, farmers should be notified when they are not considered eligible. However, in practice this often does not happen. Moreover, neither rejected farmers nor local government officials are informed of the reason for rejection, making it difficult for farmers to improve and re-apply. Myanmar GAP certificates are valid for one year, meaning a new application must be submitted each year. Applications may be submitted at any time during the year, but because it requires an MRL test on a ripe mango it should ideally take place 2 – 3 months prior to the harvest. From start to finish, the application process may take up to three months. Although farmers do not need to pay for a fee for certification, they are responsible for paying the costs of the related tests. According to an interview with the Myanmar GAP development officer, soil and water tests for one ha cost approximately 22 USD in total. Testing of fruit samples cost an additional 22 USD.

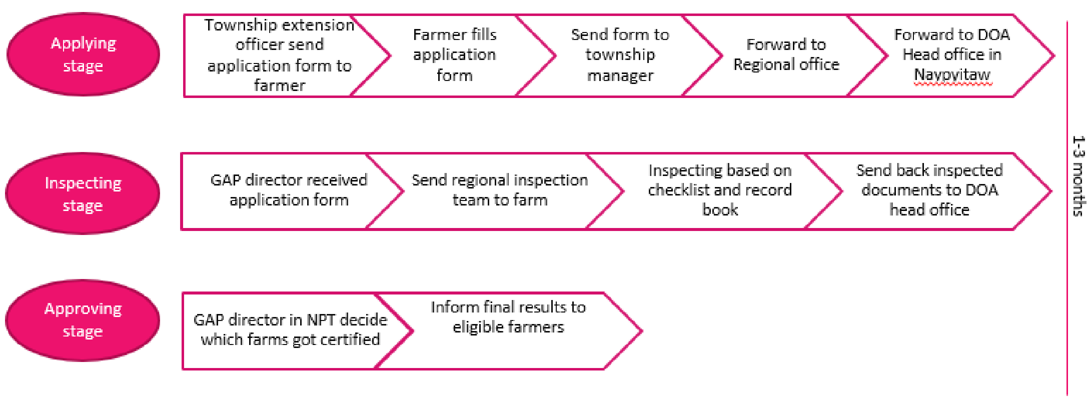


Figure 22: GAP procedure

Source: Interview with Myanmar-GAP development officer

Note: During the visit by the regional inspection team, soil and water samples are collected. A separate visit may be required to collect produce samples for MRL test.

5.4.2 Food Safety and Quality risk along the chain

- **Sanitary and Phytosanitary (SPS) and food safety**

Sanitary and Phytosanitary (SPS) measures are set by the importing countries and aim at providing safe food for domestic consumers and preventing the spread of pests or diseases among animals and plants. In the case of mango, it is shown clearly that these SPS requirements vary depending on the types of product and the countries of destination. Interviews with the exporters shows that while the companies were successful in exporting their mangoes to Singapore and other countries, they were not successful in exporting mango to Thailand yet. One of the exporters mentioned that they got an order of two containers from a Thailand importer, but the containers could not get through the border as they did not meet "the importing policy" of the country. A detailed look at the SPS measures that Thailand is imposing on exporting countries for Mango (HS code 080450) shows that 17 out of 22 measures applied to mango are SPS measures. Singapore, on the other hand, has 5 SPS measures imposed on imported mango[16]. Though, the number of measures does not always imply that a country is more stringent or protective than the others, it may require extra effort for importers to comply with all the requirements. In fact, the Singapore government is making lots of progress in making the importation requirements visible and transparent to importers by providing tools and resources, including through their official website - AVA17. Requirements within the GMS countries are not as transparent yet. The Thai Plant Quarantine ACT for example, is a complicated document that is not easy to understand.

Meeting SPS requirements though possible, sometimes requires investment in special processes. For mango, SPS treatments against common fruit fly are hot vapor, hot water treatment, and irradiation. Hot water immersion is a relatively low-cost measure that doesn't require significant investment, while irradiation requires a lengthy procedure and expensive equipment making it much costlier. Both treatments are effective. One of the interviewed exporters shared that they had experienced high rate of border rejection due to presence of fruit fly. The company then began applying hot water treatment, which protects the mango against fruit flies and rot-end disease. As a result of the treatment, the rejection rate declined from 35-40% to 5-10% each year. The company also provides their farmers paper bags for bagging young mango at early stage.

- **Quality risk**

From the interviews, it can be seen that quality loss and rejection occur along the chain at farm, exporter facilities and at the ports of imported countries. At farm level, the biggest reason for rejection was because the mango did not meet export quality requirements

[16] ASEAN.ORG. Retrieved from http://asean.i-tip.org/Forms/TableViewDetails.aspx?mode=modify
[17] https://www.ava.gov.sg/tools-and-resources/

including size, weight, variety, maturity level and uniformity. Interviews with the exporter shows that about 50% of the mangoes was rejected at farm-gate, and another 20% of the remaining mangoes were rejected at the exporter site, implying that only 40% of the total mango is acceptable for export. As mentioned, besides weight which is the most important criteria, other visual quality appearances are also incorporated in sorting in grading processes.

While export grade mango enters a value chain that can support the preservation of the mangoes quality, mangoes for domestic trade are facing high risk of quality loss due to:

- the lack of proper cool storage facilities at trader/ wholesale facilities;
- seasonality which results in surplus
- poor post-harvest handling techniques;
- improper transportation conditions; and
- short product shelf-life.

5.5 Impacts of the chain

The Myanmar GAP standard for mango was developed with the aim to attain four objectives: food safety, environmental protection, produce quality, and worker safety. However, as mentioned in section 1055.4.1, the main focus is on food safety and several components related to environmental protection that exist in ASEANGAP are not covered by Myanmar GAP. Thus, the positive social and environmental impacts of Myanmar GAP may not reach as far as other GAP programs. At the same time, the Myanmar GAP program has been running for only two years, thus it is not yet possible to assess whether it is meeting these objectives in even a limited way.

While introducing a local standard was meant to make GAP standards more accessible to small-scale farmers and to provide a path towards more widely recognized certifications – ASEAN GAP, GLOBALG.A.P. - requirements regarding farm location and investment, detailed below, may limit farmers' participation in the Myanmar GAP program, limiting its inclusiveness and further spread.

5.5.1 Social impacts

- **Food safety**

Ensuring food safety is the primary objective of the Myanmar GAP standard and all interviewed certified farmers were well aware of this. Specific practices aim to reduce the risk of biological, physical, and chemical contamination.

- Myanmar GAP farmers are trained in the use of agro-chemicals and spraying equipment and must comply with standards on their usage. Furthermore, Myanmar GAP also requires that soil and water quality and MRLs in mangoes are checked. Thus, the risk of pesticide residues in mango fruits should be reduced.
- Adoption of new practices such as bagging the fruits and controlling the water and soil quality are also introduced to reduce pesticide contaminations in the food chain.

By complying with all requirements of the Myanmar GAP standards food safety is improved.

- **Worker welfare and safety**

Worker safety is also one of the objectives of the Myanmar GAP standard and specific requirements address this issue. For example, workers on farm are required to wear protective clothes and equipment when spraying pesticides. The welfare of workers on farm premises is also stipulated. For example, a toilet and washing area must be available for farm workers.

5.5.2 Environmental impacts

Increased environmental sustainability is one of the major objectives of Myanmar GAP. The Myanmar GAP guideline lists major pests and diseases of mango and the respective control measures. Farmers are also trained on pesticide use and management and advised to use only legal products. It should be noted that correct application of agro-chemicals as recommended by GAP can increase productivity while reducing costs for producers as well as minimizing adverse impacts on the environment.

Interestingly, in interviews with farmers, Myanmar GAP farmers had higher chemical fertilizer costs than their conventional counterparts, but the difference seems to result from financial constraints of non-GAP farmers who could not always afford to purchase chemical or organic fertilizers. For this reason, it is hard to claim that Myanmar GAP certification results in less chemical usage; however, Myanmar GAP can be linked to better knowledge of how to use chemicals correctly since, to obtain the Myanmar GAP certificate, farmers must be inspected and audited on their GAP knowledge and their use of pesticides and other control measures. In this way potential negative environmental impacts should be reduced.

5.5.3 Increasing impacts: Addressing barriers to entry

To become a certified farm, farmers must participate in training and then adopt new agricultural practices. These two steps present a relatively low barrier to entry that is counterbalanced by the positive impacts resulting from better food safety, higher food quality, environmental protection and worker safety. At the same time, certain Myanmar GAP requirements present higher barriers to entry that may limit the number of farmers that convert. Two such examples are:

- Requiring certified households to have adequate facilities for sanitation: Many disadvantaged households lack the Myanmar GAP-required facilities for sanitation and storage as well as the financial resources to construct them.
- Requiring that the farm be located at a certain distance from polluted soil and water or industry: Farmers are likely to have limited influence over the activities of their neighbors and few resources to put toward cleaning up chemical residues in the soil or water of the area around them.

These requirements are clearly designed to reduce food safety and environmental risks, yet the effort to comply may be beyond the reach of some farmers. The number of mango farmers not qualifying due to these types of requirements is unknown, but as governments and organizations seek to promote conversion to Myanmar GAP standards, both low and high barriers to entry should be considered when designing support programs.

5.6 Key findings

5.6.1 Economic penalties and future uncertainty

All farmers were clear about one thing: for Myanmar GAP to be relevant, it needs to be profitable. Although several farmers expressed sympathy for the objectives of the standard, in particular food safety and environmental protection, participation remains first and foremost a business decision.

Two factors are currently limiting the attractiveness of the standard from the farmers' point of view: its cost and the absence of a premium price. In addition to costs associated with implementation of the standard, such as changing farming practices, farmers are also required to pay for the soil, water, and chemical-residue tests. Although the cost of the test may seem minor at ~45 USD, since these costs constitute a cash expenditure they are 'sticky' for farmers. As the tests should be conducted in the period prior to the harvest, the costs also come at a time when cash positions are likely to be lower and cash outlays higher.

Requiring farmers to spend money on the implementation of the Myanmar GAP standard is a particularly hard sell because it currently does not deliver any tangible benefits in the form of higher productivity, higher demand, or a higher price. In the interviews conducted, not a single farmer was found who received a premium price, no exporters/processors were seeking the product in the market, nor were any traders willing to pay a premium for it.
Traders are not willing to pay a premium price for mango produced under the Myanmar GAP standard because the standard is not recognized by their buyers. This holds true both for the domestic market and exports. To obtain this recognition, retailers need to be informed of the advantages of the standard, in particular with regards to food safety. This may well be a long process. Most collectors and traders interviewed had heard of Myanmar GAP, but they

could not name its advantages or even explain what the objective of the standard was. Collectors and traders also did not pay farmers a premium for GAP mango nor did they segregate non-GAP and GAP mango at their warehouses. This is not surprising as communication efforts to promote the standard have been directed only to farmers.

When traders were asked whether their buyers had ever expressed concerns about food safety, only traders targeting the high-value export market indicated such concerns. In these interviews, traders and exporters indicated that international buyers (from Thailand, PRC and Singapore) do not recognize Myanmar GAP certificate as a proof for food safety and SPS. Furthermore, formal MRLs test and SPS certificate are still required by the authorities of the importing countries, so even if buyers recognized the Myanmar GAP certificate, additional testing would be required to meet government import requirements.

5.6.2 Difficulty meeting Myanmar GAP requirements

- **Meeting the criteria**

Some of the criteria in the current GAP standard are difficult to attain for farmers. Particularly difficult requirements relate to having a storage facility and toilet. The application process with it complicated registration form was also mentioned as an area that needs improvement.

- **Timing**

Several farmers received the Myanmar GAP certificate more than a month after their mango had been harvested and sold. They were thus not able to prove to buyers that they had been working according to the standard neither could they use the certification as an argument in the negotiation process. It is not clear whether this delay is best explained by a lack of resources at the government or by the process itself.

Authorities in Sagaing region indicated samples had to be sent to a laboratory in Yangon. Due to the time required to collect samples, ship them, test them, and then send the results back to the local authorities, this process could take up to a month. In Mandalay, some of the tests are conducted at regional level, shortening the process. Even once the result is received in the province, the head office still has to approve and release the certification.

To avoid delays, the process would have to be shortened substantially in order to fit within the current harvest procedure. In several instances, chemical residue samples were taken in the morning of the harvesting day. Since the harvest is finished within one day, transported overnight, and sold the next morning, test results and certification approval should take place within 24 hours in order for the certificate to be available at the time of sale. The MRL test on a mango also presents a challenge as the window for testing is quite small (maximum of

2-3 months) thus any delay, either in requesting the test or in the testing process itself can easily lead to a situation where the result arrives after harvest.

- **Transparency**

Myanmar GAP procedures are not only unclear due to insufficient information and training, but also because of a lack of transparency in the certification process. In Sagaing, a total number of seventeen farmers applied, but only seven actually received the certification. Most rejected farmers did not know why they had been rejected.

The reasons for rejection were also not shared with district- and township-level officials. This absence of information makes it difficult for staff to provide adequate technical support to help farmers attain certification in a future round. Even worse, it makes farmers lose trust in the certification system as well as the capacity of the technical support staff.

- **Resource capacity**

Government officials at regional, district, and township levels are struggling to allocate sufficient resources to implement the GAP program. Since no budget has been made available, staff can only dedicate time to the program if their regular responsibilities allow it. Moreover, since there is no dedicated budget, travel costs and other cash expenditure have to be claimed on other projects.

To make implementing the program possible, the local government has integrated the Myanmar GAP program into existing programs for training and extension. Although this approach does generate some basic awareness among the farmers that attend these meetings, it does not support building a profound understanding of the requirements and procedures. Even farmers who attended several meetings only knew the objectives of GAP, but not its details. For example, several farmers did not apply for GAP certification in 2017, because they were not aware that the certification was only valid for one year.

Sector organizations, such as the Mango Association and the Mango Market and Technology Development Association, also work to promote the Myanmar GAP program. However, sometimes they cannot find the right trainers for the topics that farmers want to learn or have limited financial resources to organize such training.

- **Awareness**

Few farmers outside of the current program have heard of the Myanmar GAP standard. These are the farmers who regularly attend the information sessions organized by the government extension service and mango association.

Of the few farmers who have heard of the program, only a small share understands what the GAP standard entails, beyond that its core objective is food safety. Farmers are unaware of even the most basic parts of the procedure, for example that they have to fill in an application form to enter the program.

5.6.3 Sanitary and Phytosanitary measures from importing country

The studies validated that though there might be a need from the demand side, the Myanmar mangoes did not always make it through the border. This is especially true when the importing country has more stringent requirements on their exports, but lacks tools and resources to support exporters in understanding all their requirements. Sanitary and Phytosanitary measures, even though they are necessary to protect consumer health and the health of plant and animals, can create trade barriers. Myanmar mango, though, successfully exported to developed countries such as Singapore, could be rejected at Thailand border. This draws an attention on the importance of harmonization of SPS measures within the region, which is a key focus area of the GMS-CASP objectives.

In particular, if SPS controls were to become more stringent at the Muse border region, exports of mango would be affected. The introduction of GAP practices should increase the likelihood that mangoes pass border inspection and, if the Myanmar GAP certification were recognized outside of the country, it could lead to greater demand for the Myanmar GAP mango.

5.7 SWOT Analysis and recommendations

5.7.1 SWOT analysis

The Myanmar GAP mango case illustrates many of the key issues and opportunities facing fruit and vegetable value chains in the region. They are summarized in Table 33.

Table 33: SWOT analysis for Myanmar GAP mango in Mandalay and Sagaing, Myanmar

Strengths	Weaknesses
• Farmers are experienced in mango cultivation • Government and donors are supporting the program • Natural conditions favor production and expansion of the producing area. • Different mango season compared to PRC	• Farmers need additional training to increase knowledge of Myanmar GAP practices • Shortage of technical staff for training and promotion and no specific government budget or staff allocation for supporting the Myanmar GAP programs • Lack of transparency in the certification process • The Myanmar GAP standard was not in demand, either inside or outside the country. Buyers do not associate it with food safety and quality.
Opportunities	**Threats**
• Educating exporters/processors and brokers about the benefits of Myanmar GAP could generate demand for the product • Harmonizing standards and testing across the region can reduce costs and lead to better recognition. • Investment in infrastructure such as post-handling processes and cold trucks to increase quality and reduce rejection rates • Productivity gains can be made with additional training and support • Opportunity to develop processed mango high value-added products	• Distrust in the program because of lack of recognition in the marketplace - no demand, no price differentiation - may affect ability to attract new farmers and retain existing one. • Singapore, with strict food safety policies, is rejecting Myanmar mango at high rates, if a country like PRC were to tighten controls mango imports from Myanmar could decline sharply. • Increasing extreme weather events, such as the cold in 2016 could lead to reduced yields

5.7.2 Recommendations

- **Harmonization of standards**

Harmonize the Myanmar GAP standard with other regional GAP standards to increase recognition and drive demand. The Myanmar GAP standard is not well-recognized within Myanmar and even less so outside of it. Harmonizing this standard with the standards of other GMS countries would increase the recognition of the product in the market, which should have a positive effect on demand, thereby incentivizing farmers to apply for Myanmar GAP certification.

Harmonize national SPS measures with measures in target import markets to facilitate intra-regional trade. To achieve this objective, it is important to upgrade the current national food control systems, especially inspection and laboratory infrastructure, so that these systems meet regional/ international standards. The development of accredited testing facilities/certifying bodies that can comply with international standards such as ISO/IEC 17025 could be beneficial. For example, exporters can use their MRLs testing results to show compliance with the Myanmar GAP standard and their compliance with the SPS requirements of importing countries, thus saving time and money.

- **Infrastructure investment**

Invest in infrastructure to ensure the quality of mangoes as they move across the chain. Regardless of how well farmers have complied with Myanmar GAP farming techniques, if post-harvest technology and transportation are at basic levels, the loss rate of high-quality mangoes will be higher than it needs to be, as is the case with mango sold into the domestic market and at the Muse border. A financial package aimed at upgrading transportation from the existing means - ambient trucks – to cold trucks, can lead to a longer shelf-life of mangoes and a lower rejection rate. Another option would be to provide financing to support processors or exporters to enhance their current post-harvest handling techniques and storage facilities, thus, decreasing the loss rate.

Invest in local supporting services. Another area for investment would be the establishment of an authorized office for approving and issuing Myanmar GAP certification in the center of the dominant mango-growing areas. Alternatively, the government could accredit a third-party to become a certifying body for Myanmar GAP. In these ways, the process of becoming Myanmar Gap certified would become faster and simpler. Given that most of Myanmar mangoes are produced in the central area of Myanmar or further to the North in Shan State, the transporting of application forms and documents to Nay Pi Taw capital (277km – 528km away) would become unnecessary, thereby saving time. The office could also include a laboratory center for testing so that the time required for this step in the approval process could be reduced. If the standard becomes more recognized and buyers start requesting evidence of certification, then producers will need to show certification at the time of sale, or very shortly thereafter, so reducing the application time will become critical to ensuring that farmers gain all of the benefits related to adopting the standards.

- **Knowledge system**

Improve access to training and extension services by increasing human resources available for these tasks. Government and non-government agencies must build a dedicated technical team with relevant expertise to develop a strong knowledge transfer system that farmers can tap into. As pointed out in 5.2.3, currently there is not only a shortage of available staff but also a limit in the timing and financial budget assigned to Myanmar GAP.

In parallel with increasing the number of extension staff, trainings related to complying with Myanmar GAP standards and general mango farming techniques should be developed and delivered to a larger group of farmers on a more frequent basis. In terms of farming techniques, the training topics could include, but are not limited to, pest and disease control, pruning, bagging, controlling water and soil quality, etc. As agreed by different actors in the chain, these above-mentioned topics, despite being basic, require more thorough training, as does introducing more advanced techniques.

Increase transparency in the certification process. Even for the farmers that have applied for Myanmar GAP, the criteria and process of issuing this certificate remain unclear. Hence, protocols and a guideline for certification should be developed and widely disseminated. In addition, rejected applications for certification should come with clear feedback as to the reason for the rejection.

- **Market Access**

Increase awareness of Myanmar GAP across the value chain. It is clear from the study that demand for Myanmar GAP mangoes has been almost non-existent, both in the domestic market and from importing countries. The program needs to educate actors across the chain on the standard and the benefits of choosing Myanmar GAP. In order to convince farmers to convert there should be an economic incentive to do so. This can happen if farmers are connected to buyers that recognize Myanmar GAP as a quality standard. The government, mango association, and other supporting players can work to promote the standard with buyers, as buyers' key concern is about quality. Gathering evidence to show that Myanmar GAP does lead to higher quality and lower rejection rates, would be one way of convincing buyers that the standard also has a financial benefit for them. As a further step, educating consumers to help pull demand through the chain could be considered.

6. CASE STUDY 3: PGS VEGETABLE IN SUPHAN BURI, THAILAND

6.1 Background information

6.1.1 Vegetable production and trade in GMS

As described in section 3.2, the GMS accounted for 45% of the world's vegetable production in 2016. Amongst the GMS countries excluding PRC, Vietnam stood in the first place in terms of vegetable production volume, followed by Myanmar and Thailand. Only 27% of vegetable exported from the GMS countries are traded within the region.

6.1.2 Vegetable production and trade in Thailand

Though representing less than 1% of the world economy, Thailand was ranked as the world's 13th leading food exporter and the 3rd biggest food exporting country in Asia. Thailand's GDP was 406.8 billion US dollars in 2016, of which agriculture contributed 33.9 billion US dollars, accounting for 8.3% of GDP (WB data, 2017). Crop production is the biggest sub-sector, accounting for 68% of the total agriculture value, followed by fisheries (17%) and livestock (11%). Total land area of Thailand is 51.3 million ha, of which agricultural production area comprises 20.97 million ha or 40.9%. Vegetable area is 0.45 million ha (2.1%) with total production of 5.35 million tons. The agro-climatic conditions enable Thailand to produce several kinds of vegetables year-round.

Data from ITC Trade map (2017) reveals that the total export of Thai vegetable witnessed a 32% growth during 2010 – 2015, reaching around 1.8 billion USD in 2015, but the growth rate significantly reduced in 2016. In total 79-86% of Thai vegetable exports were to other GMS countries over the period (2012-2016). PRC is the largest importer, accounting for over 98% of total intra-GMS exports from Thailand.

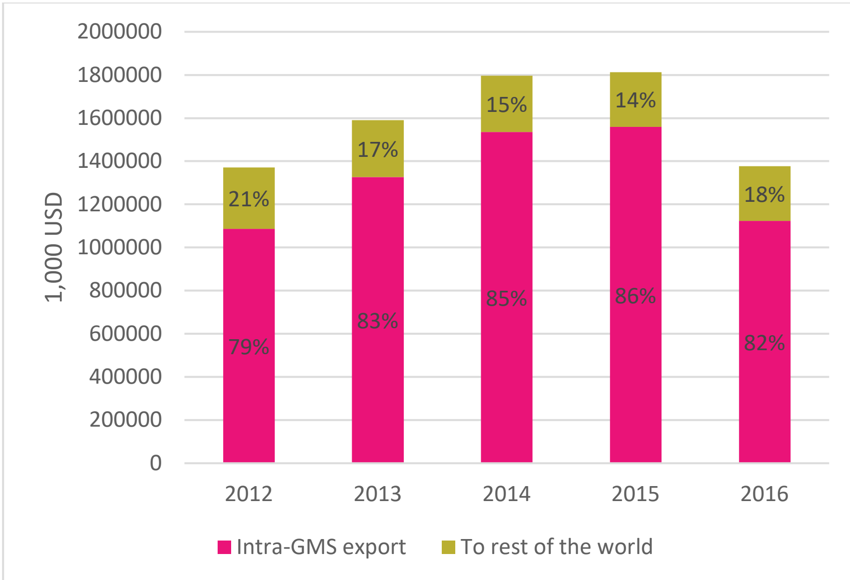


Figure 23: Thailand vegetable export value to GMS countries (2012-2016)
Source: ITC Trade map, 2017.

6.1.3 Organic vegetable production in Thailand

Organic agriculture has been practiced in Thailand since the 1980s. However, in the early days only NGOs and farmers were involved in the promotion of organic farming and organic farmers were self-proclaimed i.e. operating without third-party certification. In the 1990s, certified organic agriculture was introduced, mainly with the support of NGOs and other organizations working on sustainable agriculture. In 1999, the first Thai organic standards were developed and in 2002, the first produce labeled with "Organic Thailand" appeared in the Thai market. The Organic Agriculture Certification Thailand (ACT) organic standards have been recognized by domestic and international organizations, including IFOAM and the EU, since 2001 and 2011, respectively (ACT, 2017).

Since 2006, several pilot projects in organic agriculture boosted the development of Thai organic agriculture. These projects were developed with the support of international donors and in collaboration with the Thai government. In 2008, the National Organic Development Strategic Plan (NODSP) was approved for the period 2008 – 2011. However, after this NODSP finished, no new plan was developed.

Though the Thai agricultural sector is the most developed of the GMS countries, having made considerable advances in agricultural productivity, post-harvest technologies, and value chain development, Thailand is still in the learning stage with respect to organic agriculture (Chinvarasopak, 2016). Until now, organic agriculture only accounts for about 0.2% of the total land area and 0.2% of the value of agriculture sector (Chinvarasopak, 2016). To put this in perspective, globally approximately 50 million ha of land (1%) was farmed organically in 2016 supplying 81.6 billion dollars in value (1%). The top ten countries with the largest percentage of land under organic production have 10-30% of land under organic farming practices and 2.5-8.4% of domestic market share (IFOAM EU, 2016). One of the main reasons attributed to this slow development is due to the lack of knowledge about organic farming, among both producers and consumers (Chinvarasopak 2016).

6.1.4 Participatory Guarantee System

- **PGS around the world**

"Participatory Guarantee Systems (PGS) are locally focused quality assurance systems. They certify producers based on active participation of stakeholders and are built on a foundation of trust, social networks and knowledge exchange" (IFOAM).

PGS initiatives have existed for more than 40 years in many countries but the term came into common practice in 2004. PGS initiatives, under the support of IFOAM - Organics International, aim to help thousands of small organic farmers and consumers all over the world by offering a low-cost and local-based alternative to third-party certifications. Until now, at least 241 PGS initiatives are operating in 66 countries with more than 300,000 farmers involved.

- **PGS program in GMS**

Within the GMS there is a trend toward national and regional recognition of PGS standards. The most advanced country for PGS programs, in terms of national recognition and support, is Cambodia (FAO, 2017), where a national registration system has been developed. When a PGS group meets the standards, they become certified and receive permission to use the national logo. The standard in Cambodia is based on the Asian Organic Standard, which was developed within the IFOAM standard. Eventually, this should allow recognition of the country-level standards within the entire GMS region.

In Vietnam, the PGS program was initiated in 2008 with the support of ADDA – a Danish NGO. Since the project concluded in 2012, farmers and other actors of the vegetable chain have carried on with the PGS program using their own resources. In 2014, PGS Vietnam received technical support from CASP to conduct 3 PGS pilots. Recently, the Vietnam Organic Agriculture Association (VOAA) and the Ministry of Agriculture and Rural Development have discussed about establishing a Vietnam Organic Standard, as well as policies to provide support for PGS.

One interviewee described the process within Thailand as slower than that of Vietnam, since the government wants to maintain control over the process. This means that the government is reluctant to work together with private sector organizations and give them a voice in the process.

The most successful PGS products in the GMS region are rice and vegetables. Vegetables are more challenging because of high input requirements and greater pressure from disease and pests. Access to commercial organic inputs is practically non-existent in Myanmar and Cambodia, but better developed in Thailand.

- **PGS vegetable in Thailand**

The PGS approach was introduced to Thailand in 2014 with the support of the ADB CASP and Thailand's Ministry of Agriculture and Thailand Organic Agriculture Foundation (IFOAM, 2017).

According to a 2017 report of IFOAM- Organics International to ADB about Participatory Guarantee System (PGS) Capacity Building in GMS, Thailand has had the largest number of PGS initiatives and farmers involved. There were four major institutions and organizations supporting PGS in Thailand: Lemon Farm- a private social enterprise; Thai Organic Agriculture Foundation (TOAF); Green Net and Earth Net Foundation; and the Participatory Organic Agriculture Association (POAA) (FAO, 2017). TOAF is the biggest organization involved in PGS with the highest number of farmers, and largest production area and value (LOA, 2016). By comparison, Lemon Farm operates the largest network of PGS initiatives with 11 initiatives (IFOAM PGS Global map, 2017).

Of the total 23 PGS groups currently existing in Thailand, 10 groups were growing vegetables. This study drew upon information collected from two groups comprised of 36 vegetable farmers located in the Suphan Buri region. However, the study could only interview 19 PGS vegetable farmers with a total area of ~6.4 ha

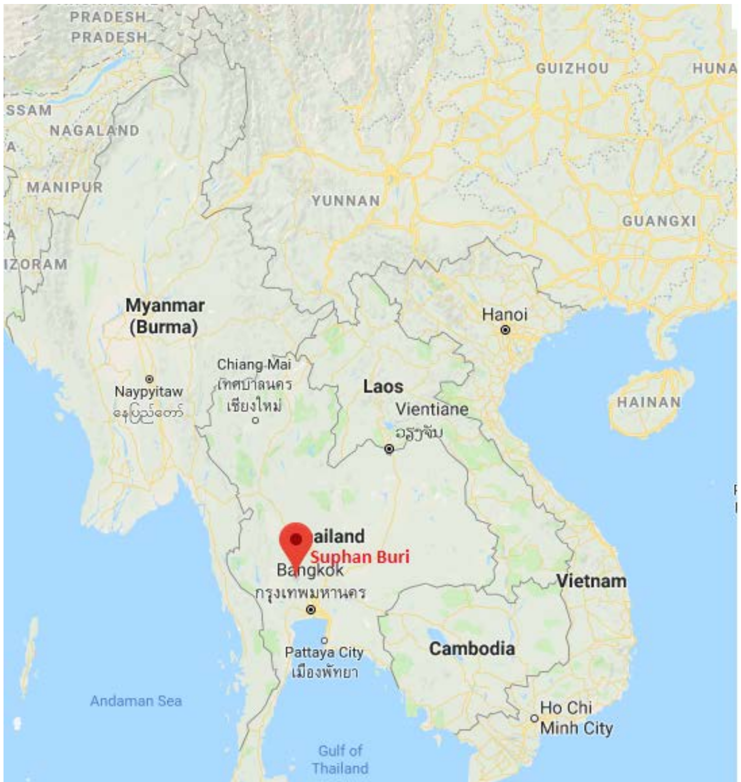


Figure 24: Location of Suphan Buri province, Thailand in GMS map
Source: Google maps.

- **The case**

Thailand has the 2nd largest vegetable production in the GMS region with strong growth in exports over the previous years. It benefits from a long history of organic agriculture that includes a national organic standard and certification system. It has also supported the growth of PGS groups and these groups have a unique position within the organic market as they target smallholder farmers, aiming to make organic farming more inclusive by using a model that relies on assessments conducted by all actors in the chain to ensure conformity to common standards, rather than third-party audits; ultimately reducing the cost to the farmer. However, the linkages required make PGS a typically local product. Looking at how these aspects of the model fit into the larger trends of growth in vegetable production and exports will provide opportunities for drawing further lessons learned that can be applied in the GMS region, which continues to be characterized by smallholder production.

6.2 Vegetable farming practices

6.2.1 General vegetable farming practices

Cultivation practices of vegetables vary greatly according to type, variety, climatic conditions and local traditions. Furthermore, crop duration and crop inputs also differ significantly across areas and between countries. Therefore, this section does not attempt to select a typical agronomic practice for one type of vegetable for the region. Instead, it describes common practices for most, if not all kinds, of vegetable production.

- **Land preparation**

This practice is normally carried out before seeding or transplanting activity. It can be done manually or by machine depending on resource availability. Some vegetables require raised beds while others can be planted on any type of land level. Manure is usually incorporated in the soil during the land preparation period.

- **Seeding/transplanting**

Many types of vegetables are directly seeded, such as lettuce, cucumber, bitter gourd while others (e.g. tomato, bell pepper) are more often grown in nursery before being transplanted to the field. Transplanting practice requires more work for farmers but provides plants a better and stronger start. With organic vegetable production, the seeds or seedlings must come from an organic source, or they must be washed thoroughly to remove any chemical residues on the seed before planting.

- **Pest and disease control**

There are many available pest and disease control methods, ranging from manual (picking, removing plant damaged parts), mechanical and physical (flooding, solarization, tillage, using trap, etc.) to chemicals (pesticide applications and fumigation). The major difference between conventional and organic cultivation is the use of chemicals, which is prohibited in an organic farming system. In tropical growing conditions, management of pests and diseases is usually one of the key production constraints for organic farming due to very limited biological products for pest and disease control available in the market.

- **Weeding**

Weed control is carried out through a crop cycle. It can start at land preparation and continue until harvesting time. Methods of weed control can be classified into: preventative (e.g. using certified weed free seed); cultivation (e.g. crop rotation); mechanical (e.g. tillage and mowing); biological (e.g. using antagonists) and chemical control (herbicides). In an organic farming system, weeds are normally controlled by mechanical, manual or cultural methods.

- **Irrigation**

In a rainfed system, farmers are solely dependent on rain water for their crops, thus the yield can fluctuate according to rain water availability. With abundant natural water sources or irrigation system farmers can control the amount and time of water supply. In organic farming or GAP systems, quality of irrigation water must be tested to ensure compliance with the defined standard.

- **Harvesting**

Due to land characteristics, small plot sizes, and limited financial resources, many vegetables and fruits in the GMS region are still harvested by hand. This practice is particularly true for organic farming, where most crops of the interviewed PGS farmers were grown by scattering the seeds, making them unsuitable for mechanical harvesting.

- **Post- harvest handling**

Post-harvest technology is considered to be underdeveloped in the GMS region. Leafy vegetable quality is mainly judged based on appearance (fresh-looking, well-shape, good size color and maturity, no physical damage or rot, etc.) while food safety issues (MRLs, microorganism contamination) are difficult to measure visually and thus neglected by consumers. Post-harvest losses are significant (40-50% of production) due to water loss, mechanical damage, temperature, and pests and diseases. To reduce post-harvest losses, a chain approach (farm-to-table), involving all actors of the chain in supply chain management, is promoted to increase production yield while ensuring food quality and safety (Acedo, 2007).

6.2.2 PGS Organic farming practices

The PGS organic chain studied for this report was set up as a collaboration between farmers and a social enterprise. The farmers selected to join the studied PGS organic vegetable chain had been practicing organic farming for many years and were usually motivated by concerns for their health and customers' health. The social enterprise participated in defining the requirements of PGS and contracted with the farmers to purchase their products and certify them as PGS organic, so long as the farmers adhered to the PGS guidelines, the IFOAM organic standards and the requirements of the social enterprise. Thus, they had to participate in training sessions lead by agricultural extension agents and technical staff of the social enterprise, as well as participate in regular meetings of the groups.

- **PGS farmers in U Thong district**

PGS farmers in U Thong district had previously produced organic rice in a triple cropping system. Then, in 2014, a group of 17 farmers started learning and practicing PGS organic production standards for vegetables. The total number of members increased to 45 farmers in 2015, of which 15 farmers grew vegetables. At the end of 2017, the U Thong PGS group had 75 farmers, including 26 vegetable farmers, as well as other farmers growing PGS rice and fruits. All farmers have now completed the certification process for their individual farms but are still in the transition stage as the distribution center must also be audited and certified to complete the certification process.

The studied farmers typically grow two rice crops per year and grow vegetables on a separate plot and/or on the same plot where rice is grown when rice is not in season. Figure 25 shows the most common cropping calendar of the U Thong PGS group. Weather conditions in the area allow farmers with farms at higher altitudes and with sufficient water supplies to grow vegetable crops and harvest fruit trees year-round.

There are more than 20 types of vegetables grown by U Thong PGS farmers, of which the three most common types are lettuce, morning glory and Chinese cabbage. Farmers were trained by the social enterprise technical staff in general organic farming practices and the PGS standards. After that, the farmers had to sit down to discuss which crops were suitable for their situation and then develop cropping calendars together. This practice required trial and error as the rice farmers did not have experience with vegetables crops at first.

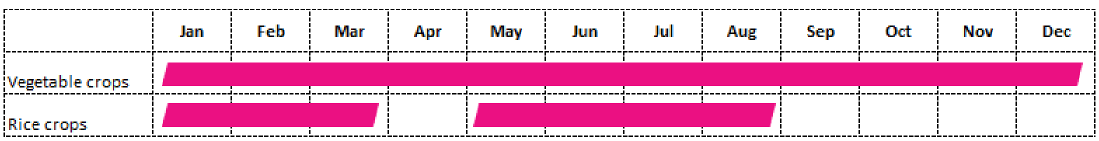


Figure 25: Cropping calendar of PGS farmer group in U Thong
Source: Our individual interviews and focus group discussions (FGD) with farmers.

- **Organic input availability and access**

One of the most difficult aspects of PGS farming in U Thong is the access to organic inputs. To comply with the standards, farmers must use organic or chemical-free seeds, which are not readily available for them in the region. Farmers can exchange or purchase seeds from other PGS farmers in order to have access to organic or chemical-free seeds; however, this limits the PGS farmers' choice of crops, quality of seeds, and alternatives available when confronted with pests or diseases.

There are also very few options for disease and pest control in this region. Farmers rely on the natural system to adjust itself. Farms might produce their own crop protection products such as products made from the neem tree (*Azadirachta indica*). However, these natural products were not effective when the pests were severe. Some biological control agents, like Bt (*Bacillus thuringiensis*) are sold in a shop; however, the shop is a 2-hour drive from the village. For some pests or diseases, the only remedy for farmers is to remove them by hand. Organic fertilizer is mostly made by farmers on their farm using microbiotics purchased from the organic shop.

As farmers had already implemented organic practices on their farm for rice farming, the transition period to the certified PGS system usually took one year. During this time, farmers sold their products to wet markets or normal traders. This is a difficult period since the income of farmers may be reduced due to lower crop yield. After 2-3 years, the system should improve, and farmers can achieve higher yields. When certified to a PGS standard, farmers can sell their products to the social enterprise with a premium.

- **PGS farmers in Dan Chang district**

In Dan Chang district, farmers have been growing organic vegetables for many years. The social enterprise selected this group of farmers for PGS standards because farmers have long experience on growing organic vegetables and thus their land does not need to go through a transition period. This farmer group has implemented PGS standard for four years. At the time of the study, the Dan Chang group had 11 PGS certified farms on an area of 13.6 hectares (85 rai). There were many types of vegetables grown by this farmer group, among which kale, bok choy and lettuce were the most common types. Vegetables were grown year-round. Unlike the U Thong group, the group is focused on vegetables and does not grow rice. Farmers sell their organic vegetables to the social enterprise.

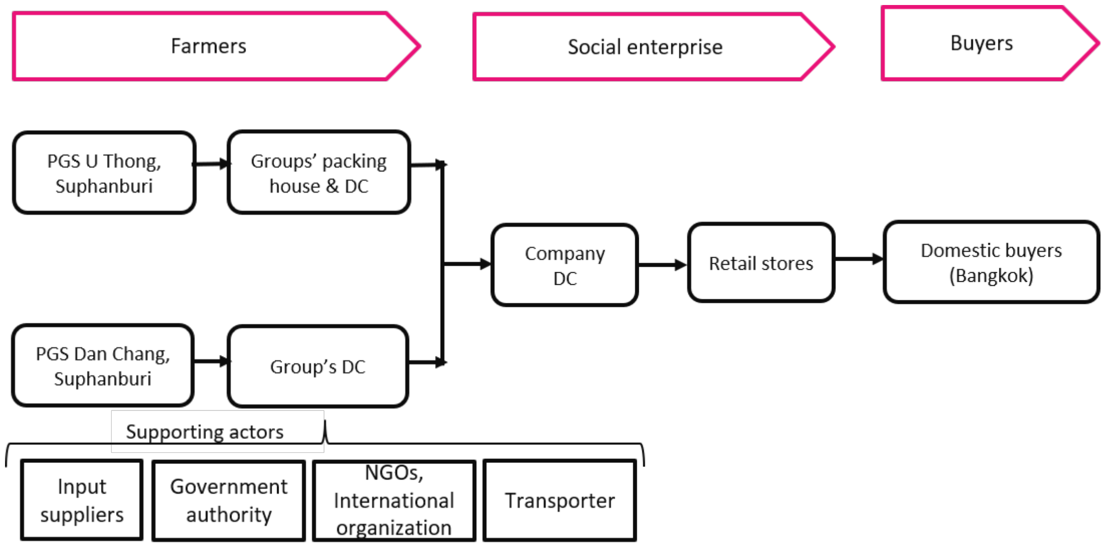
- **Organic input availability and access**

Similar to the U Thong group, the PGS Dan Chang group also did not have enough organic inputs and those that existed (products made from neem or jatropha plant or Tinospora) were not very effective. Therefore, manual removal of insect larvae or damaged plants was a common practice, but one that required a lot of labor. Most organic fertilizers were made by farmers using animal manure and plant debris. Water for irrigation was taken from ground water or storage pond and it was enough for crop growth. Harvesting of organic vegetables was usually done by hand.

6.3 PGS organic vegetable supply chain in Thailand

6.3.1 Overview of supply chain map

The PGS supply chain map in Figure 26 was established based on interviews conducted in U Thong District and Dan Chang districts. In total, 54 people were interviewed or surveyed, 63% of participants were female. Forty-two farmers (14 males and 28 females) participated in focus group discussions (FGDs) and in-depth qualitative and quantitative interviews. Five government officers, from MOAF and the local district, were interviewed about supporting activities provided by the government. In addition, NGOs and international organizations, who supported and coordinated the PGS program in Thailand were also interviewed via phone or face-to-face. At the social enterprise interviews were conducted with both the managers and the technical staffs. Interviews were also done at the shop of a large input supplier in Suphan Buri.



36 PGS farmers 10-12ha of PGS vegetable Production volume: 30-40 tons/year	Packing, transporting, group fee: 0.3-0.6 USD/kg	1 distribution center in Bangkok 13 retail stores	60,000 customers (mostly in Bangkok)

Figure 26: A typical supply chain map of PGS organic vegetables in Thailand
Source: Interviews with PGS group leaders, the social enterprise, and supporting actors, FGDs with farmers.

6.3.2 Actors of the supply chain

6.3.2.1 Farmers

Role of farmers

The most important role of farmers in the chain is the production role, which was described in section 6.2.1. In addition, as some of the farmers had traditionally only been growing rice, they also had to test and undertake trials to determine which vegetables were suitable for each farm.

Farmers in the PGS value chain were also responsible for harvesting, transporting the vegetables to the packing house or the consolidation point, and for packing. The packing location differed between the two groups. Farmers in U Thong District cut and delivered their vegetables to the packing house of the group immediately after harvesting, then stayed there for post-harvest handling and packing vegetable in plastic packages of 50-200gr, depending on types of vegetables. The group in Dan Chang district followed a different procedure where they themselves harvested, cleaned and packaged at the farmgate before transporting their packed vegetables to the consolidation point of the group.

Farmers also played an important role in peer reviews of farmers within the group and with other PGS groups, inspecting for non-compliance practices of other farms, as well as sharing learning. They were also required to continuously update the other members within the group and the technical staff of the social enterprise (via a social network app) on the situation at their farm, for instance sharing information on pests and diseases.

- **Volume and value**

Table 34 summarizes information from interviews related to the vegetable production area, volume, and yield for both PGS groups in Dan Chang and U Thong district, in comparison with non-PGS farmers in both two districts. It is clear that the average size for growing PGS vegetable in both PGS groups (around 0.2-0.4 ha/farm), is by far smaller than that of non-PGS farmers at around 0.8ha/farm. In terms of yield, the PGS Dan Chang group gets the lowest yield per hectare of organic vegetable, at about 1.9 tons/ha, which is less than half of average productivity of the PGS group in U Thong district. It is noticed that the yield of interviewed non-PGS farmers is nearly four to eight times higher than that of two PGS groups.

Table 34: Summary of studied vegetable farms in two PGS groups and non-PGS farms

Farmer group	PGS farmers		Non-PGS farmers
	U Thong Dist.	Dan Chang Dist.	
Number of vegetable farms	9	10	11
Total farm area (ha)	52.8	20.6	34.1
Average farm size (ha/farm)	5.9	2.1	3.1
Total vegetable area (ha)	2.2	4.2	10.2
Average vegetable area (ha/farm)	0.2	0.4	11.0
Total production volume (kg)	9,000	7,800	182,920
Average production volume (kg/farm)	1,000	780	16,629
Average yield (kg/ha)	4,140	1,857	17,933

Source: Our in-depth interviews with farmers

Note: The table summarized the interviewed farmers from the PGS group in U Thong, the PGS group in Dan Chang and non-PGS farms in both U Thong and Dan Chang district. The data for total production volume for the 9 PGS farmers in U Thong district is taken from a qualitative interview with leader of the group.

According to the leader of the PGS group in U Thong district, each week a single farmer sells up to 40kg of vegetables in the high season and from 7 to 20kg in the low season. For the Dan Chang group in Dan Chang, the individual sales were by far smaller than in the former group, about 20-30kg per week in the high season and around 10kg per week in the low season.

- **Margins**

Costs

PGS organic vegetable farmers had to pay for land preparation, organic fertilizers, organic crop protection products, packing, transporting and a group fee, if applicable. Household labor was used, and no other workers were hired, so no out of pocket expenses for labor were incurred. Thus, no labor costs are included in the overall cost calculation. Table 35 compares the average costs for 1 ha of PGS vegetable in U Thong and Dan Chang district versus the annual cost for non-PGS vegetable farmers.

Table 35: Annual costs of 1 ha vegetable by groups of farms

Item (USD/ha)	PGS U Thong	PGS Dan Chang	Non-PGS farms
Land preparation	577	577	123
Seeds	0 - 577	0	87 - 538
Organic fertilizer	577	41	0
Chemical fertilizer	0	0	192 - 962
Organic pesticide	0 - 385	0 - 385	0
Chemical crop protection	0	0	101 - 2,308
Irrigation	577	692	308 - 385
Harvesting	0	0	308 - 577
Transporting, packing, group fee (if any)	1,325	493	31 - 192
Total annual cost	3,056 - 4,018	1,803 - 2,188	1,150 - 5,085
Average annual cost	3,537	1,996	3,118

The total average annual costs for 1 ha of PGS vegetable in U Thong district is much higher than that of Dan Chang district, due to the higher fertilization costs and packing and transporting costs. For PGS farmers, costs for packing, transportation and the group fee accounted for the highest percentage of the total cost, at about 33-43% for U Thong PGS group and 23-27% for Dan Chang PGS group. In both groups, farmers spent similar amounts of money on land preparation and organic pesticides, while the U Thong group spent considerably more on organic fertilizer, 577 USD vs 41 USD. The cost of irrigation included the cost of setting up a pumping system and electricity or gasoline to run it, which varied from 577-692 USD/ha of vegetable.

The cost for seeds and pesticides ranged widely among PGS farmers depending on whether farmers purchased the seeds and materials to make pesticides or used seeds and materials from their own farm. Farmers also exchanged seeds and materials for inputs with other PGS farmers.

Table 35 excluded the cost of household labor as it did not represent cash out for the farmers, yet household labor should be examined in terms of the opportunity cost of working on the farm instead of undertaking other income generating activities. Dan Chang farmers spent the equivalent to 1,500 working days in order to grow 1 ha of vegetable, roughly twice that of the U Thong group. Using a daily wage rate of 9.23 USD per day, the generated cost for Dan Chang farmers would be 13,846 USD/ha if they hired external labor. For both groups hired labor is simply unaffordable.

In comparison, non-PGS farmers pay from 1150-5085 USD/ha for producing vegetable, a larger variation in the total annual cost than shown for PGS farmers. The largest and most wide-ranging cost is the cost of agrochemicals for fertilization and crop protection. The total cost for these agrochemicals also occupied more than half of production cost for a hectare of conventional vegetables. Non-PGS farmers that were interviewed did not list costs for organic fertilizer or pesticides. The costs for seeds and irrigation are similar to that in PGS farms, but non-PGS farmers need to pay laborers for help with harvesting. The cost for packaging and transportation are significantly reduced because most non-PGS farmers sell their products to nearby markets or to local traders or collectors, while PGS farmers pay transport to Bangkok.

- **Benefits and margins**

For farmers in both groups, vegetables sales were an important source of income (10-50% of total income), with fruits and rice representing the other key crops. However, the actual contribution to income by vegetable sales varied significantly from farmer to farmer due to differences in the types of vegetables sold and the amount of land dedicated to growing vegetables. One interviewed farmer, who was known as the best farmer in the PGS U Thong group, got around 308 USD per month from selling celery, which is sold at a high price (about 4.6 USD/kg). In contrast, farmers selling only morning glory, which had one of the lowest prices (0.8 USD/kg) might earn from 30-120 USD monthly. By selling around 10-40kg of vegetables each trip, at an average price of 1.5-2.5 USD/kg, farmers could earn from 60 to 350 USD/month. The detailed calculation of farmers' benefits and margin is presented in Table 36.

Table 36: Annual benefits and margins of 3 farmers' groups (2017)

Item	PGS U Thong			PGS Dan Chang			Non-PGS		
	Highest	Lowest	Average	Highest	Lowest	Average	Highest	Lowest	Average
Total annual revenue (USD/ha)	13,454	2,583	7,319	4,643	1,015	2,657	30,000	1,260	9,800
- Yield (kg/ha)	5,382	3,229	4,305	1,857	1,269	1,563	25,000	6,300	12,250
- Price (USD/kg)	2.5	0.8	1.7	2.5	0.8	1.7	1.2	0.2	0.8
Total annual cost (USD/ha)	4,018	3,056	3,537	2,188	1,803	1,996	5,085	1,150	3,118
Average gross margin (USD/ha)	9,436	(473)	3,782	2,455	(788)	662	24,915	110	6,683
Average margin rate (%)	**70%**	**-18%**	**52%**	**53%**	**-78%**	**25%**	**83%**	**9%**	**68%**

Source: Calculated from focus group discussion.

Note: The average yield is calculated in Table 36 for each group of farmers, while the average price is calculate based on information provided in the quantitative survey about the frequency of production of each vegetable variety and its actual selling price.

As shown in Table 36, the benefits and margins of PGS farmers vary widely, depending on their yield and the selling price of the different types of vegetables. Margins for growing PGS vegetables can be as high as 53- 70% when high yields are reached for high-value vegetables;

however, farmers can also incur losses on low-value vegetables, particularly in the low or off-season. Farmers with average productivity of vegetables sold at an average price earned a 52% of margin in U Thong district, while those in Dan Chang district earned 25% under similar conditions.

Despite the negative margins shown for low yield, low-price vegetables the interviewed farmers in Dan Chang district still gained a small amount of net income from growing PGS organic vegetables. This is likely the result of:

- PGS farmers normally intercrop various types of vegetables, both low-price vegetables such as morning glory and high price vegetable such as salad, bok choy, kale, and basil. Also, although morning glory is a low-value vegetable, it offers high yields. Hence, there may be few cases of low price and low yield vegetables.
- PGS farmers in Dan Chang district commonly grow vegetables and fruits in the same farm area and they could not separate out the costs of vegetables versus the costs of fruits. Hence the average cost recorded might be slightly higher than the actual cost, making margins appear to be negative.

By comparison, conventional farmers tended to have better yields than PGS organic vegetable farmers, but they also have a lower selling prices for their vegetable, and that price varied significantly due to market fluctuations. Overall, conventional vegetable farmers might gain higher margins, from 9-83%, due to higher yields and lower unit cost; however, since conventional farmers are vulnerable to price fluctuations, they might incur a loss when the market price slumps.

6.3.2.2 Distribution centers

Role of the centers

Interviews were conducted with the two leaders of the PGS groups in U Thong and Dan Chang districts. The leaders either own and/or manage the groups' distribution centers and hence were able to provide a picture of two different models of distribution.

In the U Thong PGS group, the distribution center is owned by the group leader and is used as a packing and storage house. At this location vegetables, fruits and rice are gathered from members, then these same members clean, sort and package the vegetables. The truck used to deliver vegetable from Suphan Buri province to the social enterprise warehouse in Bangkok also belongs to the leader of the group. Members pay the costs of gasoline, plastic packaging and the group fee, equaling 0.32 USD/kg. According to the leader, in the year 2018, the group will be charged to 0.63 USD/kg so that they can hire laborers for packaging. Additionally, in 2018, in the packing stage, vegetables from different farmers will be traced throughout the handling process and then packed and printed with a barcode denoting the farmer and the group. In addition to the above functions, the distribution center is also where farmers are trained and where members can meet to exchange experiences and information.

In terms of payment, the leader of the group receives all payments in cash from the social enterprise twice per month, then divides the revenue for each farmer according to their supplied amount after deducting the transportation and packing costs.

By comparison, the distribution center in Dan Chang district is merely the consolidation point for farmers gathering their products and transporting to the social enterprise. In Dan Chang district, farmers pack their product at the farm; therefore, no cleaning, sorting or packaging occurs at the distribution center. The leader is responsible for collecting the vegetables from the farmers, recording their contribution, and then allocating the payment to the farmers once it is received from the social enterprise.

Since the PGS group in Dan Chang district is in a remote area, they have not received any training from government extension agents, though training is provided by the social enterprise. The group leader also shares know-how with other members and frequently visits other PGS farms for peer reviews.

- **Volume and value**

The distribution center in U Thong district has a handling capacity of 400 kg/day for vegetables and fruit. In the high season, the packing house of the group supplies up to 800kg of vegetable in 2 trips per week, while in the low season they typically supply 400kg of vegetables per week. Thus, the distribution center manages the post-harvest handling and packing of 26 tons of various vegetables per year, valued at 46,800 USD (based on a median price of 1.8 USD/kg).

The Dan Chang PGS group sells up to 400 kg of fruits (~100 kg) and vegetables (~ 300kg) per week during the high season, while for the rest of the year the volume is reduced to 100 kg of vegetable per week. In total, this group supplied around 7.8 tons of vegetables to the social enterprise, valued at 11,700 USD (based on a median price of 1.5 USD/kg).

- **Margins**

Currently, the distribution center in U Thong district keeps 0.3 USD/kg for transportation and packing. The deduction just covers the actual costs and is published at the group meetings. The manager of the distribution center does not receive any compensation for his role in managing the distribution center. In 2018, the U Thong PGS group will increase the cost for transportation and packaging to 0.6 USD/kg. The additional revenue will be reinvested in expanding the distribution center and hiring labor for packaging. By comparison, at the Dan Chang district consolidation point the costs deducted cover only the transportation costs and no fees are paid to the manager for his support, nor reinvested into distribution center.

6.3.2.3 The social enterprise

- **Role of the social enterprise**

The social enterprise recognized early on the demand for organic products from domestic customers, hence they have worked closely with farmers to grow organic vegetables, assuring access to the market for these products through their retail stores in Bangkok. At an early stage, IFOAM provide documentation and training for a pilot group of nine farmers growing fruits in Mae Hong Sorn. As this pilot proved successful, the retail company expanded the PGS initiatives, forming ten other PGS groups in 8 provinces by the end of 2017. Additionally, the social enterprise collaborates with international organizations and governmental officers to organize the training and inspection of PGS farms. They also help farmers meet the PGS standards and get the PGS certification for their farms.

The social enterprise had four technical staff members that train PGS farmers on topics related to making organic fertilizers and pesticides. These technical staff also randomly check each group 2-3 times per year, following the PGS checklists of the social enterprise. If farmers have any difficulty or questions about farming practices, they can easily contact to the social enterprise, technical staffs and other farmers via a social media app. For example, if farmers need to use a chemical pesticide for their vegetables, they will take a picture and provide all information about the product to the technical staff so that the staff can check the product and give or deny permission. If farmers are not compliant with the requirements of the social enterprise or PGS guideline, they might be penalized or excluded from the group.

The social enterprise commits to purchasing vegetables from the farmers according to set quotas, based on the production capability of each farmer, as well as to paying a premium price for their PGS organic products. The offered price is typically 50%-100% higher than the price for conventional vegetables.

In addition, the social enterprise developed the Eat Right-Eat Organic campaign in 2015. The project aims to connect both farmers and consumers for better organic production and consumption. In addition, the social enterprise has educated their consumers about health and better eating habits. These efforts fit with the PGS system which encourages interaction across the value chain, from farmers to consumers.

Figure 27: One retail shop of the social enterprise in Bangkok.
Source: Eat Right project (http://www.lemonfarm.com/?page_id=2151).

- **Volume and value**

The social enterprise buys organic vegetable from 4 PGS groups (the U Thong and Dan Chang groups in Suphan Buri province, as well as 1 group in Phetchabun and another group in Chaiyaphum). Fifty-two percent of vegetables were purchased from the PGS group in U Thong district, while Dan Chang district and the other groups supplied around 16% each. As the average price paid varied from 1.5 USD/kg to 1.8 USD/kg, the total purchasing value of the social enterprise is around 82,000 USD per year.

- **Margins**

Since it is difficult to estimate the operational costs for each retail shops of the social enterprise, we only could analyze the prices of three different types of vegetables, namely morning glory (with the lowest price), kale, bok choy and lettuce (with the average price) and celery (with the highest price) in terms of buying and selling price. The selling prices of the social enterprise retailed stores were normally three to four times more than their buying prices.

Table 37: Comparing buying and selling price of the Social Enterprise

	Farmgate price (USD/kg)	Price at retail store (USD/kg)
Morning glory	0.8	3.6
Kale	1.5	5.4
Bok choy	2.2	6.0
Lettuce	2.5	8.0
Celery	4.6	13.5

Source: Price was taken from the interviewed farmers and visiting the retail shop of the social enterprise in Bangkok.

6.3.2.4 Buyers

According our interview with the Director of the retail company, there were around 60,000 customers visiting 13 specialty shops with variety of organic brands in 2017. Annually, the demand for organic products is dramatically increasing by around 18% (IFOAM report, 2017). The social enterprise even had a request from foreign customers in Singapore, but due to the limited supplying capability, the social enterprise can only serve domestic customers.

6.3.2.5 Supporting actors

Input suppliers

In the value chain of PGS organic vegetable in Thailand, input suppliers play an insignificant role. The first reason is due to a lack of recognized organic inputs; namely seeds, fertilizers and crop protection products. Second, when these products do exist, the PGS farmers were unable to afford them or the location of the shop was too distant to make them accessible (two or more hours by car). Instead farmers made organic fertilizers and crop protection liquid for themselves with advice from training classes and other members, or from their own experience.

One of the biggest input supplier in Suphan Buri sold two types of organic fertilizer and some pesticide and fungicide, but the products sold by the store were not recognized as pesticides that could be used for organic farming. Furthermore, there were no truly organic seeds in the store, they only sold boxes of seeds with less chemical treatment. Thus, instead of purchasing seeds, farmers propagated seeds themselves or exchanged with other farmers.

By comparison, input suppliers play important role in terms of supplying material inputs for conventional vegetable farmers. Since growing conventional vegetables required frequent application of agrochemicals such as fertilizers and pesticides, conventional farmers might pay more than 40% of their total annual production cost for these products. As input suppliers did not give any financial supports for farmers, conventional farmers need to save significant amounts of money prior to the harvest for purchasing these inputs.

- **Government authority**

As mentioned in section 6.1.4, government officers, especially Ministry of Agriculture and Cooperatives and its specific departments played a vital role in setting organic agriculture policy through the first Strategic plan for Organic Agriculture Development (2008-2011) in Thailand (Greennet, 2016). In specific, the Office of Provincial Agricultural Extension under the Department of Agricultural Extension has been responsible for promoting organic agriculture and the Land Development Department (LDD) is responsible for promote organic fertilizers and for facilitating the project: *"Promoting Participatory Guarantee Systems (PGS) for small scale organic farming in Thailand"* with support from ADB.

The project selected and supported five organic agricultural groups in Chiang Mai, Lampang, Nakhon Pathom, Petchabun and Surin provinces. LDD officers coordinated with local extension agents to provide training about PGS procedure and peer review, then followed-up and monitored the PGS groups. In addition, the project organized a national forum on PGS for policy advocacy with key stakeholders in public and private sectors. The project directly funded and provided technical supports for the Thai Organic Agriculture Foundation (TOAF) to launch TOAF PGS website for online registration process and data base.

The 2012-2016 strategic plan, developed under the consideration of the National Economic and Social Development Board, invested USD 145.56 million on 104 projects (Greennet, 2016).

- **NGOs, International organization**

IFOAM Organics International was funded by ADB for the Technical Assistance Project TA 8163-REG (henceforth TA): *"Implementing the GMS Core Agriculture Support Program (Phase 2)"*, which aimed to support PGS project activities through capacity building, facilitation of market linkages, information and technical support, and national and regional policy support. Specifically, IFOAM organized regional workshops to launch and conclude the project, and supported national workshops in each GMS country to engage governments and other stakeholders and to provide an entry point for starting or building on existing PGS initiatives. They also developed criteria for the selection of PGS pilots and selected 2 PGS pilots in each country for technical training via a distance-learning package.

For the development of the studied PGS vegetable value chain, IFOAM provided technical support and training to the technical staff of the social enterprise. It also audited the implementation of PGS farming practice. Green Net and Earth Net were the coordinators and trainers of PGS program in Thailand. These organizations have also developed their own PGS farm cooperatives.

6.4 Quality assurance system and traceability

6.4.1 Food safety risk along the production chain of PGS organic vegetable products

In section 6.4.1 food safety and quality risks will be discussed, then in section 6.4.2 risk mitigation measures and quality assurance methods will be examined.

- **Food safety risk**

Table 38 summarizes food safety risks found along the PGS organic vegetables chain starting at the farm and continuing to the retail shops.

Table 38: Risks along the PGS organic vegetables chain

Hazards	Key risk factors	Production stage	Risk level
Biological hazards: Pathogenic microorganisms, fecal bacteria, spoilage bacteria.	- Contamination may occur at any step, from cultivation to harvest of the vegetables. - Improper manure composting procedures where temperature is not raised high enough to eliminate pathogenic bacteria. - Improper fertilization method such as incorporating raw animal manure into soil where plants are present on field. - Contaminated irrigation water. - Contamination during harvest due to poor personal hygiene, contact of the vegetables with contaminated soil/ harvesting equipment.	During cultivation and harvest at farm	High
	- Contamination due to poor personal hygiene, poor facility sanitation and hygiene conditions; contaminated water; Contaminations from pest and rodent infestations.	During post-harvest handling at the Distribution Center or at farmer houses	High
	- Contamination due to bad hygiene condition of the truck, elevated temperature during transportation which can promote bacterial growth	During transportation	High
	- Contamination from bad hygiene condition, worker personal hygiene practices; contamination from equipment, utensils and production operation practices. - Risk is specifically high for ready-to- eat products made from fresh produce.	At retail shops	High
Chemical hazards: Pesticide residues, heavy metal	- Pesticides drift from conventionally farmed neighboring lands; historical use of prohibited substances, polluted soil and water.	During cultivation and harvest at farm	Low

contaminants etc.			
Physical hazards: presence of foreign materials such as worms, stones, straw etc.	➧ Pests infestation leads to presence of insects in harvested produce.	During cultivation and harvest at farm	Medium
	➧ Foreign materials from operations environment	During post-harvest handling at the Distribution Center or at farmer houses	Medium
Organic integrity: Non-organic inputs	➧ Application of non-organic inputs due to lack of availability of organic inputs.	During cultivation and harvest at farm	Low
	➧ Mixing of organic and conventional vegetables	At retail shops	Low

Most high-level food safety risks are attributed to microorganism contamination which may occur along the chain. Even though foreign materials such as insects, straw etc. have a high probability of entering the food chain, they do not seem to create a serious food safety concerns. Thus, in the following paragraphs, focus will be on analyzing food safety risks attributed to micro-organism contaminants.

At farm, food safety risk from biological contaminants is high due to contact of the plants with soil enriched with organic fertilizer made from composted animal manure. The risk of fecal bacterial contamination in organic produce is often higher than in conventional vegetables which depend heavily in chemical fertilizers.

Post-harvest activities, including removal of the damaged leaves, trimming and washing, currently happen at the farmer collective packing center or at the farmhouse. Risk can be high for these activities, depending on the following factors:

- Location, establishment and layout of the facilities. Neither the facility nor the farmhouses are designed to be a pack-house. They are often open and without pest control measures.
- Hygiene and sanitation of the tools and equipment. If no specific procedures exist to ensure proper safeguards, tools and equipment can contaminate the produce.
- Effectiveness of food safety procedures. Lack of procedures, such as a personal hygiene policy and cleaning and sanitation procedures, increases the potential spread of contaminants.
- Effectiveness of washing and sanitation procedures. Lacking consistent washing and sanitation procedures for washing the produce will increase the risk of contamination.

- Temperature controls. Lack of temperature control in the processing environment or lack of cold storage can result in high ambient temperature promoting spoilage and growth of pathogenic bacteria.
- Moisture controls. Excessive moisture in the final packed produce can also promote spoilage and growth of pathogenic bacteria.

These factors could lead to rapid deterioration of the produce, resulting in quality and quantity loss and increased food safety risk.

After being packed in plastic bags, the vegetables are stored in plastic crates and delivered to the shops in Bangkok at ambient temperature. Transportation often takes hours depending on location of the groups. Food safety risks during this stage include contamination due to bad hygiene conditions in the truck and crates, as well as elevated temperatures during transportation which can promote bacterial growth.

At the retail shops, fresh produce is sold in bags or as ingredients for making ready to eat products such as salad rolls, which requires effective sanitation procedures to kill the germs and prevent cross-contamination. Failing to eliminate pathogenic microorganisms could lead to food borne illnesses.

- **Quality Risk**

Our observations indicated that the two biggest quality losses in the chain are due to pest/ disease invasion and the lack of post-harvest technology.

Quality loss at the farm is high. Farmer focus group interviews showed that 40-50% of initial losses often took place at the harvest moment. The main losses resulted from the removal of physically damaged leaves, old leaves and leaves which had been invaded by pests. Post-harvest technology was very basic, including sorting, trimming, and then washing the vegetables in a solution of water and vinegar and/or lime. Vinegar was added into wash water to inhibit spoilage bacteria, while dipping the vegetables in a water and Calcium Hydroxide Ca(OH)2 solution was also used to prevent spoilage, butt-end rot and fungi.

The washed vegetables were drained manually to remove excessive water before being packed in plastic bags and placed in plastic crates for delivery. Loss during this stage could be around 10-30% depending on the type of vegetables, the season and the farmers.

On the other hands, "damaged leaves, yellow leaves, insect infested leaves and excessive free moisture" are among the most common quality complaints. One group of farmers claimed that on average, 10% of their vegetables were rejected due to the mentioned quality issue. As there is no cold chain utilized prior the products arrival at the social enterprise distribution center, physical loss due to high respiratory rates and fast deterioration due to high temperature after harvesting are ongoing issues.

6.4.2 Quality system: what have been done to address the risks

- **The food safety quality assurance system of the social enterprise's PGS groups**

The Thailand PGS is based on organic principles set by IFOAM-Organics International. In addition, it adopts the Thai national organic standard and designs its own group-specific requirements/ compliance criteria. This is possible because the system engages all stakeholders in the process of formulating and selecting specific sets of standards, as well as in developing their own implementation and compliance verification procedures.

The social enterprise's PGS groups share the principles of the above standards. In addition, each group has their own agreements on implementation and verification criteria. One group that we interviewed does not allow the members to use any of the "claimed to be organic inputs" on the market as they do not trust what written on the label of the products. The other groups allow members to use organic inputs on the market with conditions, meaning that prior to applying any inputs on the field, the farmers need to consult with and obtain permission from the social enterprise technical support team.

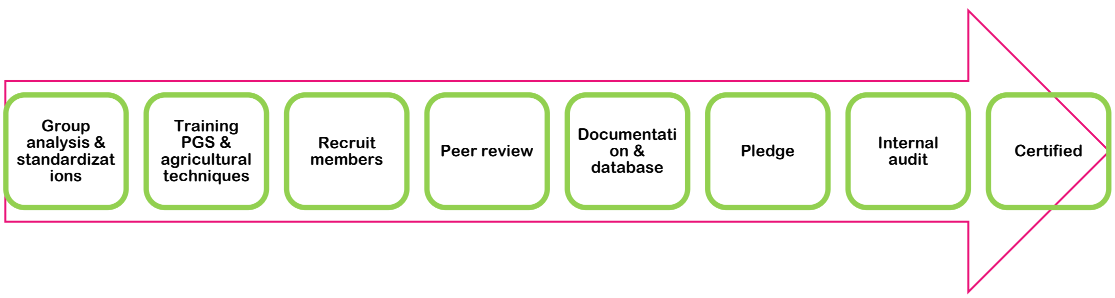


Figure 28: The social enterprise PGS implementation process

The company PGS implementation process consists of 8 steps, as described in Figure 28. Among these, peer review (farmer peer audit), pledging and internal audits are important quality assurance activities of the system. They aim at sharing and aligning common rules and regulations among members, defining consequences for non-compliance, sharing knowledge and ensuring compliance of all members.

- **An online quality assurance tool – a special feature**

The social enterprise established a means of continuous communication with the PGS groups and members through the creation of online chat groups on a free communication application that can be used on a smartphone. Each group and each member are assigned their own unique codes for traceability purposes. All members of the groups, have access to the group chat. They also receive purchase quotas as well as quality feedback online, for instance, the QA/ QC team often takes pictures of defective products and sends to the group, thereby promoting transparent communication among the group.

Farmers of the PGS have the right to appoint the group leader, and remove a member from the group if there are serious noncompliance or integrity issues. Pledging is a distinctive feature of the PGS quality assurance system, in which farmers with their family members pledge to adhere to organic principles and acknowledge that they are aware of punishments for non-compliance.

There are several verification activities that happen along the chain. The first check happens at farm level through peer review audits consisting of at least 3 farmers. Second, the social enterprise technicians also visit the farm regularly to check compliance and give advice. Samples are randomly collected at the store for laboratory testing every week as a final compliance check. On top of that, buyers and consumers can visit the farms at any time to check on the practices implemented.

6.5 Impacts of the chain

6.5.1 Social impacts

All PGS farmers as well as the social enterprise believed that the PGS production and trading is good for society in terms of health benefits (for both producers and consumers) and environmental sustainability.

PGS, as defined and supported by IFOAM, is a model for inclusiveness, where small-sized farmers can produce high value organic products which can utilize on-farm available resources at minimal costs of inputs. Thus, this model helps farmers to be financially independent from input suppliers or traders.

6.5.2 Environmental impacts

Organic farming is considered one of the best environmental farming systems due to practices such as: reducing inputs; enhancing crop rotations and diversity; increasing soil fertility with organic fertilizers; and increasing biodiversity through the introduction of biological pest control (ISID, Policy Brief No. 13). This is particularly relevant for the case of organic vegetables. Leafy, green vegetables are, in general, quite vulnerable to pest and diseases. Thus, integrated pest management and rotation are crucial to protect the production. Furthermore, recommended practices such as the use of cover crop like the legume family help to return/ fix nitrogen in the soil, increase organic matter and prevent soil from erosion also benefitting the environment in the long run.

6.6 Key findings

6.6.1 Access to inputs and bio-controls

Farmers grow many kinds of vegetables in U Thong and Dan Chang districts of Suphan Buri province. However, access to inputs, such as certified organic seeds, commercial organic fertilizer and organic crop protection products, are limited for organic agriculture in general and even more so for PGS organic vegetables.

- **Organic seeds**

PGS farmers in both U Thong and Dan Chang district do not usually buy organic seeds from input suppliers in Suphan Buri. There are several reasons for this: 1) there is a lack of certified organic seeds available, 2) in the case of Dan Chang, input shops are very far away making it time-consuming and costly to purchase from them, and 3) farmers can cultivate their own seeds or exchange with other farmers in the PGS group, saving them money. However, the lack seed diversity and quality can ultimately lead to lesser quality products and lower yields. It also leaves the farmers exposed to higher risk of pest and disease the farmers have fewer varieties with which to rotate in case of an infestation.

- **Organic fertilizer**

Farmers either made organic fertilizers by themselves using available materials such as animal manure and plant debris or bought materials from neighbors to make organic fertilizers. An advantage of PGS is that the entire system is certified including all farming activities on the farm. As a result, inputs from the farm that are used for fertilizer are considered to be organic. When needed, PGS farmers can also buy fertilizers from each other. In these two districts, organic fertilizer was not a limiting factor of production.

- **Crop protection measures**

Crop protection products could be considered to be the most important constraint for organic vegetable production. First, only a few biological control agents are available for purchase, and, as with seeds, these products are not easily accessible to farmers because the input supply shops are far away. Farmers mainly use plant materials (from neem, Jatropha and Tinospora trees) for pest and disease prevention purposes, however these products were not effective for treatment purpose. Therefore, farmers had to remove insects or damaged plants by hand resulting in high labor requirements and lower productivity.

Common pest and disease control measures such as hedges, beetle banks, flower strips or companion plants, as well as the use of bait traps and light traps, yellow sticky traps or building simple crop boundaries were not reported by the PGS vegetable farmers These cultivation techniques should be introduced to organic farmers so that they can have more options to control pests and diseases.

6.6.2 Economic penalties and future uncertainty

The yield of PGS organic farms is four to ten times lower than non-PGS farms in the same region and heavily affected by weather conditions, pest and diseases. Some interviewed non-PGS farmers confirmed that they cannot change to PGS farming practice due to the reduction in yields and the impact that it would have on their earnings. Even with a price that is up to twice that of conventional vegetables the precipitous decline in yields would not allow farmers to maintain the same income level.

In addition, PGS farmers' costs, particularly the packaging and transportation costs in U Thong district, eroded much of the savings that the farmers gained by eliminating the purchase of chemical treatments. Lower revenue, as a result of low yields, combined with little to no cost savings makes it difficult to develop an economic case for PGS farming. If then adding in the higher labor requirements the economic penalty is significant.

6.6.3 Difficulty meeting organic requirements

- **Limited knowledge and technical support on organic farming**

PGS farmers in Suphan Buri had limited technical support for vegetable production. Although the social enterprise has provided PGS trainings for farmers, the training cannot cover all of the potential crops and crop combinations, thus farmers use trial and error methods to determine suitable vegetable types and then to develop their own cropping calendar for each crop. It might be simple for experienced vegetable farmers in Dan Chang district, but the U Thong group consists of rice farmers that are expanding into new crops, thus this process takes time. During this learning period farmers' production and income for these vegetables can be substantially lower than those of conventional farmers. The social enterprise has tried to counterbalance this effect by supporting farmers to diversify their incomes, providing training in the production of organic value-added products and then selling these products in their shops, but this does not fully address the issue, which is that farmers need to be able to improve their productivity levels. Therefore, more training and technical support on organic farming should be offered to PGS farmers.

6.6.4 Produce quality and food safety

- **Produce food safety**

Food safety risk attributed by microorganism contamination, quality loss/ deterioration caused by poor post-harvest technology and lacking cold chain utilization are among the most important bottlenecks of the PGS organic vegetables in term of quality assurance system.

It is generally agreed that consuming organic products may limit consumer's exposure to synthetic pesticides and chemical contaminants, however food safety risks linked to organic food may not necessarily be negligible, the risks are just different. Several foodborne outbreaks that occurred across the globe are associated with organic products such as Salmonella outbreaks in USA and Canada in 2014 (caused by contaminated organic sprouted chia seeds) or pathogenic *E.coli* O157:H7 outbreak in Germany in 2011 caused by contaminated organic sprouts. Vegetable products such as salad varieties are often consumed fresh, increasing the risk of ingesting contaminated products. Effective measures such as: good agricultural practices at farm; GMP for Packhouse and storage; clear cleaning and sanitation procedures; and proper transportation need to be in place to address the existing risks. Currently, the chain is lacking measures to mitigate the risks. Some procedures exist but are highly farmer-dependent, thus they are not consistent within the whole chain.

- **Produce quality loss**

A rough calculation from our study showed that up to 60-70% of the organic produce might be lost at various stages of the chain, excluding storage loss at the stores. Most of the loss is from damaged products due to pests/ diseases, poor post-harvest conditions and physical damage during transportation

A cold chain is often utilized to minimize physical and quality loss of produce. For this specific chain, a cost-benefit analysis should be conducted to see whether a cold chain could add value to the product, either by reducing loss and/or by improving the overall produce quality and enhancing food safety.

6.6.5 Policy constraints / trade restrictions

PGS vegetables are only sold as fresh vegetables and then only at high-end shops and supermarkets thus limiting their reach to a certain group of consumers. According to the social enterprise, the supply of PGS vegetables has not met the demand of their domestic market and consumers of organic vegetables usually require fresh produce. Therefore, the social enterprise currently has no interest to import or export PGS vegetables from or to the GMS region.

While the PGS initiative was designed to support small-scale farmers with a focus on the domestic markets, it is worth discussing the potential of having PGS recognized across borders. This could open more markets for farmers of the PGS chains, allowing the PGS products to reach premium/advanced markets potentially generating higher returns for the farmers. However, it is important to note that:

- A key feature of the PGS system is the involvement of all actors of the chain in setting up and monitoring standard implementation; however, this is likely to be lost when selling across borders. As will be discussed further in the retail case (7.3 Retail Sourcing), even retailers that are work primarily with direct sourcing for domestic products, rely mainly on traders for imports, thus involvement is not likely to continue across the full chain.
- The lack of involvement by all actors raises an additional challenge. As PGS systems are local, varying from group to group, upon what basis will importers judge the quality of the standard. Alternatives to harmonization, such as developing systems of mutual recognition or benchmarking could be a way forward.

6.7 SWOT analysis and recommendations

6.7.1 SWOT analysis

The PGS vegetable case illustrates many of the key issues and opportunities facing fruit and vegetable value chains in the region. They are summarized in Table 39.

Table 39: SWOT analysis of PGS vegetable in Thailand

Strengths	Weaknesses
• Reduced certification costs for small-scale farmers when compared to other organic certifications • Good practical knowledge sharing within PGS groups and across groups • Able to attract farmers with experience in organic cultivation practices • Farmers sell into a tight value chain where contracts for purchases are secured • There is a strong internal quality control system	• Programs remain very local as access to markets is limited due to lack of recognition of PGS standard • Difficulty replicating the model in other places as know-how is location specific. • Transition to organic vegetable farming is complex, requiring significant training and support • Lack of organic input supply • Heavy labor required • Yield of vegetables in the transition period is very low • Low level of postharvest technology, simple facilities for packaging, storing and transportation.
Opportunities	**Threats**
• There is an increasing demand for organic vegetables in Bangkok and high-value markets like Singapore • Increased focus on food safety and environmentally friendly production processes by consumers can further increase demand • PGS relatively unknown in the market, consumer education on the social and environmental aspects of the certification could stimulate further demand.	• A major outbreak of foodborne illness associated with PGS vegetables • Economic penalties - low productivity leading to low returns could lead to high attrition rates. • Lack of recognition of certification relegates PGS to niche retailers, stifling demand • Insufficient technical support for managing multi-product farming keeps yields low and quality poor

6.7.2 Recommendations:

- **Harmonization and recognition**

Adopt regional/ internationally recognized organic standards, such as the IFOAM family of standards when setting up national organic standards. Recognize PGS as an assessment system permitted under the nation regulations. A key aspect of PGS is that the standards are determined by the PGS group in collaboration with other actors in the chain, so when speaking of recognition by the government, it does not imply that the government should control or regulate the PGS organic systems, but rather suggests that PGS be supported and recognized at national level as a certification alternative.

Lacking recognition can make it hard for those outside the local PGS organic systems to understand the system, ultimately reducing demand for PGS products. These barriers can be lowered by the adopting a recognized standard. In addition, there are available benchmarking tools that allow local organic standards to be easily compared with each other thereby providing clarity to buyers and consumers. For countries that do not have their own organic standard, the use of an existing regional standard such as the Asian Region Organic Agriculture -AROS – would be advised.

- **Investment**

Invest in the development of organic inputs. PGS farmers are challenged by the lack of organic inputs, particularly seeds and biological controls for crop protection. The challenge is caused by few options being available on the market as well as by travel distance required to purchase inputs. Investments can be made to: 1) introduce existing inputs used outside of the country/region and 2) to support the research and development of new organic controls and the suitability of new seed varieties, leading to the development of new alternatives for farmer in the medium to long-term and overcome one of the obstacles related to lack of inputs for PGS. Participation of the social enterprise or other key actors in the chain should occur with a focus on how to manage the logistics of getting the inputs to the farmers once available e.g. as organic inputs are not available locally, they could be sent to the groups via the trucks returning to the region after vegetables are delivered to Bangkok.

Invest in the PGS distribution centers and transportation systems to improve post-harvest handling and reduce rejection rates. Post-harvest handling takes place at either the farm or the distribution center, depending on the group and the resources that they have available. Even when the distribution center is the location of post-harvest handling, the distribution center has not been set-up to implement best practices in post-harvest handling. Investments to upgrade the distribution centers to allow packing to occur there, to improve sanitation and hygiene at the facility, to improve pest control and to develop cleaning and sanitation procedures should have positive effects on quality control of the vegetables that pass through the center. Investing in cold trucks to then transport the vegetables from the distribution center to the shop would be another way to improve quality.

- **Knowledge system:**

Increase access to technical trainings to support the transition to organic farming. Farmers are currently using trial and error to fix cropping calendars and test new methodologies. Identifying key factors to develop a successful cropping calendar and sharing lessons learned from other PGS groups could help reduce the time spent on trial and error, thereby shortening the period until yields begin to recover. Similar testing and knowledge sharing regarding new methodologies and practices should also be implemented. These types of technical trainings are essential for both technical staff and farmers to improve the yields of PGS organic vegetable. Other topics to be addressed include selecting quality seeds, better organic crop protection and fertilization practices.

- **Market Access**

Increase awareness of PGS as an organic system. Outside of the actors participating in the (short) PGS value chain, there is little awareness of PGS as an organic system. As a result, it is a niche product sold in a limited number of stores. Yet the flexibility of the PGS system with respect to standards could make it attractive to large retailers as they can develop with the PGS groups their own standards, which can then be sold as organic, a premium product. Campaigns to raise awareness among buyers could allow for new PGS partnerships and groups to develop, while a consumer survey to understand what customers value about PGS products could support the implementation of a market identity for PGS products.

Provide market intelligence to PGS groups to help them grow to demand. Farmers need more support and technical advice from the social enterprise or other extension agents so that they can grow to demand. The social enterprise could conduct a market survey to find out customers' preference/needs for each period, then provide support and advice to farmers so that they can grow products that respond to the preferences of the market.

7. CASE STUDY 4: RETAIL STUDY IN BANGKOK, THAILAND

7.1 Food retail market in GMS

7.1.1 Food retail definitions and growth in South East Asia market

- **Retail sector definition and coverage**

By definition, retailing consists of activities involved in selling directly to the ultimate consumers for personal, non-business use. Food retailing can, therefore, be defined as selling food including perishable and non-perishable items to consumers. There are two models in the food retailing business: traditional and modern. Modern retail establishments differentiate themselves from traditional retail establishment through their processes, systems, technology, and networks, while traditional retailers are typically family-owned, single location establishments, wet markets, and street vendors. Modern retail is more commonly found in urban areas, while traditional retail has a stronger rural presence.

- **Modern retail history and growth in South East Asia**

Several studies point out that strong growth of national economies, rapid urbanization, a rising middle class with higher personal income and concern about hygiene and food safety are the major factors driving the modern retail market. This growth has begun in developing countries around the globe (Rasheed Sulaiman V. et al., 2011) and holds true for the Southeast Asian countries, which have witnessed a significant rise of supermarkets and modern distribution businesses in the food marketing systems (Jean-Joseph et al., 2006) and which are thought to "offer a large scope for further growth in the future" (Nori Kawazu, 2013). The rise of the modern retailer impacts traditional food delivery channels and across the region, traditional grocery retailers are losing market share to their modern counterparts as a result of this growth (Agriculture and Agri-Food Canada, 2012).

7.1.2 Food retail market in GMS and the rising trend of modern retail market

- **Overview of the retail market in the GMS countries**

  - **Cambodia:** Although no precise figures regarding the points of sale or market share of modern retail has been found, the research available indicates that the Cambodian retail market is “still heavily dominated by its traditional market, particularly street stalls and wet markets” (EuroAsia Research Experts, 2017). Phnom Penh, as the largest urban center, has a more advanced modern retail sector than the rest of the country, and one that is shared by both domestic and foreign retailers. Domestic retailers include Lucky Supermarket with 11 shops; Kiwi Mart with 12 convenience stores; Natural Garden, a chain of 4 specialty stores dedicated to selling organic rice and chemical-free fruits and vegetables; as well as other smaller retailers. With respect to foreign retailers, the big Japanese retailer, Aeon, first appeared in 2014, and the Malaysian chain, Parkson, in 2017.
  - **Laos PDR:** No specific study or official data about the retail market of Laos PDR has been found. Rimping supermarkets owned by a Thai company are present in the market. These supermarkets are mainly located in Vientiane – Laos’ national capital. According to AEON – a big Japanese retailer, Laos PDR was included in the list of ASEAN countries to be considered for store openings in 2014; however, information on the company’s website shows that only Aeon’s financial services are currently available in Laos PDR.
  - **Myanmar:** In 2010, Nomura Research Institute used interview surveys to estimate the ratio of modern versus traditional retail markets in Myanmar and determined that roughly 90% of households were still purchasing fresh vegetables and meat from traditional markets, versus only 10% at modern retail markets. Although mostly supermarkets dominate the modern retail market (Sina Hardarker et al., 2017), the types of outlets in Myanmar also include hypermarkets, department stores and convenience stores. The total number of outlets is estimated to be 500 at the end of 2015 (Beauty Palace Company Ltd., 2015). The modern retail stores in Myanmar are mainly domestically owned; however, the study of Sina Hardaker recognized an increasing interest in entering the Myanmar retail market by foreign retailers. Yangon, Napyidaw and Mandalay are the hubs where modern retail concentrates.

- **Vietnam:** Like Cambodia and Myanmar, the retail market in Vietnam is still heavily dominated by the traditional channel. The estimated coverage of modern retail ranges from 6% in 2016 by Euromonitor to 11% in 2010 by Nomura Research Institute of total sales. Modern grocery retail sales value reached 3.1 billion USD in 2015, recording an increase of around 85% from 2012. The modern retail landscape in Vietnam is dynamic with both domestic and foreign players providing approximately 2,049 points of sale, including hypermarkets, supermarkets, convenience stores. The two biggest cities, Hanoi and Ho Chi Minh City are home to the majority of modern retail outlets.
- **Thailand:** The data regarding coverage of modern retail markets in Thailand ranges from 40% in 2010 (Nori Kawazu, 2013) to nearly 70% in 2016 (USDA Foreign Agricultural Service, 2016) depending on the study. As urban penetration has increased, modern food retailers have increasingly looked to rural areas for expansion opportunities and the percentage of outlets outside of Bangkok and its suburbs rose from 40% in 2010, to 45% in 2015 (USDA, 2016).
- **PRC:** PRC is expected to be “the world’s largest retail market by 2018” (Pricewaterhouse Coopers Limited, 2015) and already offers consumers almost 200,000 points of sale from hypermarkets to specialty stores to discount stores (USDA Foreign Agricultural Service, 2017). The size of the market makes it an interesting country to look at in more detail; however, only Guangxi and Yunnan provinces are part of the GMS and finding information that provides insight into the modern retail sector for just these two provinces is challenging. At the same time the enormity of PRC’s market and its stage of development may make it difficult to draw comparisons that can be used for the region, for example online food retailers are an increasingly important segment of the food retail industry, a trend that was not seen in the other countries studied.

Although the data is not comparable across countries, there are some common trends that emerge:

- Except for Thailand, the other four countries are in an early stage of transition to modern retail, exemplified by low levels of food purchased through this channel (<20%).
- The modern retail market initiates from the big cities: Phnom Penh for Cambodia, Vientiane for Laos PDR, Yangon for Myanmar, Bangkok for Thailand and HCMC and Hanoi for Vietnam.
- Channels of modern retail market are relatively diverse in the region. For example, Cambodia, despite being in an early phase of transition to modern retail, witnessed the appearance of a specialty store dedicated to selling organic fruits and vegetables in Phnom Penh city.

With the above trends and country differences in mind, and looking at the situation purely from the perspective of development of the retail market, Thailand presents the most interesting market in which to study how trade is being conducted for reduced-input fruits and vegetables in the region. The Thai market characteristics fit with the trends mentioned, but also lead them in several aspects, which means that information gleaned from the Thai market can also be a herald of developments in other markets in the region. For instance, the Thai modern retail market is well-established, serving a larger proportion of consumers than other countries in the region; a diverse range of modern retailers exists; and the modern retail market has advanced outside of Bangkok and its suburbs and into rural areas.

7.2 Food retail market in Thailand

7.2.1 Modern food retail market in Thailand

Modern retail trade has been present in Thailand since the 1960s when the first department store was established in Bangkok. Then in the 1980s supermarkets and convenience stores started to become more widespread in Bangkok (Matthew, 2014). With the birth of well-known retailers such as Makro and 7-Eleven occurring in the late 80s and into the 90s. Between 1997 – 2002, foreign companies such as Casino Group, Siam Makro (based in the Netherlands), and Tesco Lotus, entered the market. The retail chains established by these companies have continued, though various acquisitions occurred in the early part of this decade and many of these chains are now locally owned. Since 2014, there have been two major trends observed in the market, the overseas expansion of department and convenience stores and the continuous expansion and modernization in the domestic market (Krungsri Research, 2017).

Over the previous two decades, the modern trade sector has seen rapid expansion, in particular in Bangkok and in those regional centers where the level of urbanization has been high (Krungsri Research, 2017). As a result of investments made into the sector, in 2016 total store-based[18] food sales reached a value of approximately $88.2 billion, or 59.1% of total retail sales (See Table 40). Furthermore, Thailand is projected to become the second largest retail market among the major ASEAN countries, increasing annually at 8.9% between 2015 and 2018, to reach US$155 billion (Frost and Sullivan, 2016).

Table 40: Thailand's total retail sales and store-based food retail sales in 2012 - 2016

	2012	2013	2014	2015	2016
Total retail sales (billion USD)	86.4	91.9	89.5	87.4	88.2
Store-based food retail sales (billion USD)	51.6	54.7	53.2	51.8	52.1
% store-based food retail sales/ total retail sales	63.0%	62.8%	62.7%	62.3%	59.1%

Source: Data taken from USDA Foreign Agricultural Service, 2016 and 2017

Food retailers use a variety of channels to reach Thai consumers and the expansion of the sector has led to over 15,000 points of sale having been established across the country by 2015 (See Figure 29). Different types of channels are defined by the number of stock-keeping units (SKUs) handled, the retail space area and the target customers. In Thailand, convenience stores represent the largest share with 13,322 outlets (86%) followed by supermarkets with 463 outlets (3%) and supercenter/hypermarkets with 376 outlets (2%) (USDA Foreign Agricultural Service, 2016). The advanced stage of growth for the sector is indicated by the presence of supermarkets and larger format hypermarkets in all provinces of Thailand, not just in Bangkok and its suburbs. As a consequence of the rise in modern retail, the number of fresh markets and general stores has fallen, particularly in larger towns and cities (Matthew, 2014).

[18] Store-based retailing excludes the retail formats in non-store retailing formats such as direct selling, home shopping, internet retailing and mobile internet retailing.

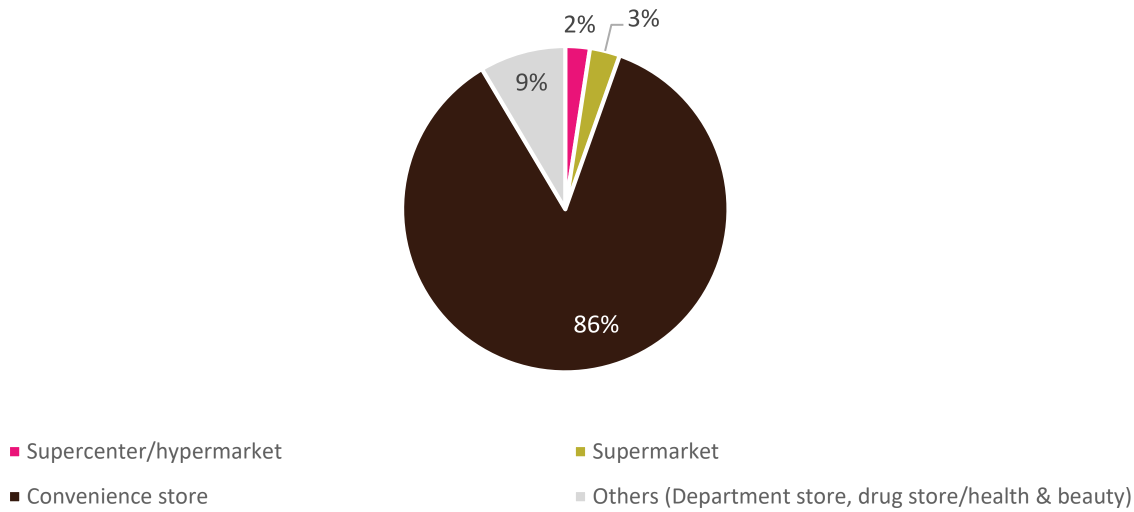


Figure 29: Number of outlets by retail channels in Thailand in 2015
Source: Data taken from USDA Foreign Agricultural Service, 2016

7.2.2 Sales channels for reduced input fruits and vegetables

It is important to note that though research indicates that the majority of spending on fresh fruit and vegetable continues to occur at wet markets with 55.5% of spending versus 36.8% at supermarkets (Gorton, 2009) the focus of this case is on modern retailers. This is because of the important role that modern retailers play in the sale of organic products, where according to one study they represent 171 out of 320 points of sale (53%), in stark contrast to wet markets, which represent only 7%, or 24 points of sale (Kongsom and Panyakul, 2016).

7.2.3 Overview of key players in retail market:

The 9 largest food retailers manage 14,439 outlets and generated total sales of 27.9 billion USD in 2016, comprising over half (53.1%) of total food retail market value. 7-Eleven was the leading retailer in value with 15.1% share, followed by Tesco, Makro and Tops.

Table 41: Sales and number of outlets of key food retailers in Thailand in 2015

Item/Company name	Store formats included	# outlets in 2016	Sales in 2016 ($billion)	% of food retail sales
Food retail segment			**52.1**	**100%**
Ek-chai Distribution System Co., Ltd. (Tesco)	Hypermarket; Compact hypermarket; Convenience store	1,950	6.2	11.8%
7-Eleven	Convenience store	10,000	7.9	15.1%
Siam Makro	Cash & Carry	115	4.8	9.1%

BigC	Hypermarket; Supermarket; Convenience store	825	3.0	5.8%
Central Food Group (Tops)	Supermarket; Wine shops; Convenience store	1,387	4.8	9.1%
The Mall Group	Supermarket	20	0.7	1.3%
Foodland Supermarket	Supermarket	20	0.2	0.3%
Max Value	Supermarket; Mini-supermarket	88	0.2	0.4%
Villa Market	Supermarket	34	0.2	0.3%
Total selected companies		**14,439**	**27.9**	**> 46.4%**

Source: Data taken from USDA Foreign Agricultural Service, 2017

- **Selected retailers for the case study**

This study is based on desk research into the Thai food retail sector as well as interviews conducted with representatives of four Thai retailers - three out of the nine biggest food retailers and one specialty organic retailer that also manages a farm and processing factory. The interviewed retailers represent 24% of all channels points of sale, but 78% of supermarkets and hypermarkets.

Though the interviewed retailers shared their experiences and observations regarding the purchase and sales of fruits and vegetables, none of the interviewees would provide data on the trends observed within their company or within the market. Efforts to receive this information from other sources in the company were also unsuccessful, despite the author's assertions that such information would only be presented in a consolidated form.

7.3 Retail Sourcing

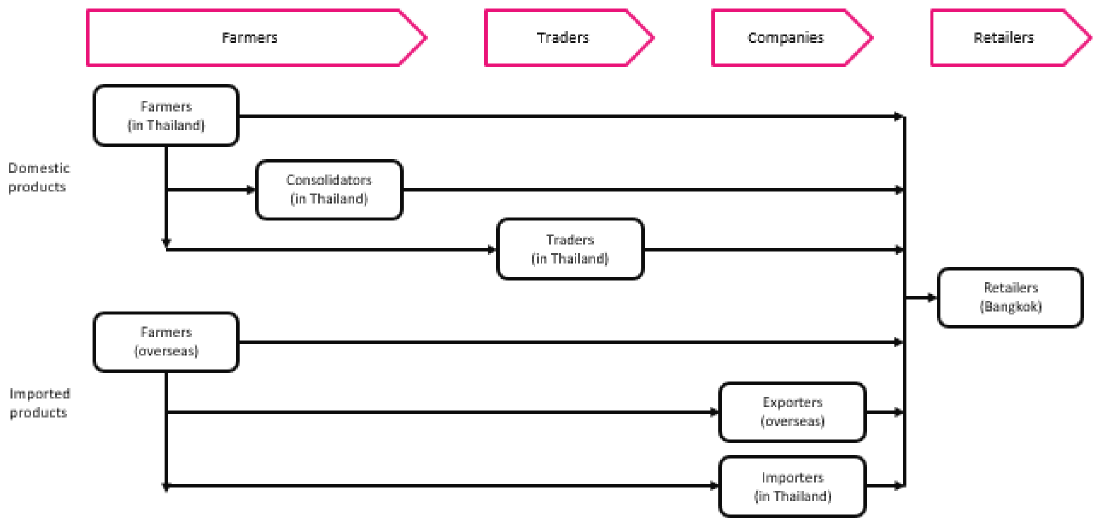


Figure 30: *Sourcing channels of domestic and imported fruits and vegetables of retailers in Thailand*

Modern retailers have developed a short market chain for organic products, working directly with farmers or producer groups for the supply of their organic products (Kongsom and Panyakul, 2016). Interviews held with representatives of the Thai retail sector indicate that this outcome is also true for conventional fresh fruits and vegetables, with interviewees reporting that from 70% to 100% of all locally procured fruits and vegetables were sourced directly. Interviewees defined direct sourcing as purchasing from the farmers or a consolidator. Consolidators are either producer groups or a lead farmer that is responsible for delivering the quantity and quality requested by the retailer. Local products not purchased directly from farmers or consolidators were purchased through traders.

7.3.1 Domestic organic sourcing

While the chain looks similar for organic produce and non-organic produce, retailers indicated that these are two separate chains and that organic sourcing is done separately from non-organic sourcing. Within the category of organic sourcing, few retailers were familiar with PGS as an organic certification scheme and those that were familiar with it were not yet purchasing from PGS growers. Those that were familiar indicated that if they worked with PGS growers, the products would be sold as organic, but it was not yet determined if a separate sales category distinguishing PGS organic from other certifications would be made. A retailer indicated that customers do not look for specific organic standards (e.g. IFOAM, Thai Organic, Japanese Agricultural Organic Standard (JAS), etc.), but only at whether a product is classified as organic. Thus, while PGS could be sold under its own label, it is unlikely that it would be tracked as a separate category.

7.3.2 Domestic non-organic sourcing

Similarly, in the non-organic category, no distinction in sourcing streams was made between the various certifications or standards, so GLOBALG.A.P., ThaiGAP and non-GAP products could be sourced through the same chain. The approach of the retailers to these certifications varied, with some indicating that the minimum requirement to purchase was ThaiGAP, while others indicated that purchasing is based on compliance with the minimum company standards and not external certifications or standards.

7.3.3 Imports

In the case of imported fruits and vegetables, retailers relied on local importers or purchased directly from exporters, which could be the farmers themselves, or exporting companies. Again, organic imports were sourced separately from non-organic imports; however, imported organic fruits and vegetables represented a very small portion of the total fruit and vegetable portfolio. Three of the four retailers interviewed stated that less than 2% of their organic products were imported.

As no distinction was made between reduced-input purchases such as GAP and non-reduced input purchases, retailers were unable to provide details on the proportion of reduced-input imports to total imports.

7.4 Key Findings

A study investigating the factors that impact a Thai shopper's decision to purchase food from a supermarket or wet market identified the key attributes that influence the shopper's decision as: quality of products, food safety, variety of products, cleanliness of place and quality of service (Gorton, 2009). From the interviews conducted, the first three of these clearly influence the decisions that retailers make around the purchase, and potential import, of reduced-input fruits and vegetables and they present important challenges when evaluating how to increase the demand for reduced-input fruits and vegetables in the GMS region.

7.4.1 Quality

Each of the retailers interviewed placed significant emphasis on the need to provide their customers with high quality fruits and vegetables and each of them cited various reasons why meeting their customers' quality expectations could be challenging. Interviews focused specifically on the quality challenges with respect to organic and imported products, as retailers divided their fruit and vegetables portfolio into organic and non-organic, with the non-organic category including standards such as ThaiGAP and GLOBALG.A.P. as well internal standards and specifications. In discussing quality retailers cited two main quality issues: customer preferences and product specifications.

- **Customer preference**

Customer preference was most frequently cited as a challenge when referring to barriers to importing fruits and vegetables from the GMS region. One retailer cited an interest in importing limes from Vietnam, but also indicated that the product was only competitive when local lime prices are at their highest levels because the aroma of the Vietnamese lime is perceived to be of a lesser quality than that of the Thai lime. Another retailer shared that though they had tried importing banana and mango from Lao PDR, they stopped importing these products because the varieties imported did not meet Thai customers' preferences.

- **Product specifications**

Quality from a product specification standpoint was cited as an issue particularly when referring to the import of organic fruits and vegetables. Three out of four of the retailers interviewed referred to the delicacy of organic fruits and vegetables as a product category and the difficulty in maintaining the quality of a delicate product when importing to Thailand. Interviewees also cited difficulties around transportation and logistics as a factor negatively impacting the quality of the product upon arrival. As a specific example, one retailer described attempts to import mushrooms from PRC that failed when the product turned yellow while in transport.

The actual loss rates described by retailers varied from 20% to 100% when importing organic fruits and vegetables. In addition, retailers explained that further losses could still occur because of the short shelf life of organic vegetables. According to interviewees, since the shelf life of organic fruits and vegetables can be, and often is, as short as one day, any organic import therefore needs to be a high-volume product so that it can be turned over quickly without further loss of goods.

The quality issues described above explain why such a small percentage (<2%) of organic products are from imports. One interviewee; however, was able to provide a successful example of an imported organic product from the GMS region – ginger from Laos. The reason given for the success of this example was that ginger is hardier than most fruits and vegetables, thereby making it easier to overcome the difficulties of a lengthy journey in less than ideal storage conditions and helping to ensure that it would have a longer shelf life than the typical fruit or vegetable. This example could provide a good indication of characteristics to focus on when selecting value chains to receive additional support for export readiness within the region.

7.4.2 Variety

- **Customer choice**

The importance of delivering variety to customers was also a commonly cited driver of retailers' purchasing decisions. Retailers were at various stages in including organic products in their product portfolio and the interviews conducted ranged from discussions with a specialty store leading the organic movement to a modern retailer that was still experimenting with organic and currently only offered organic products in 2-3 locations (<1% of their points of sale). Interviewees specifically cited that they want to make sure, "that customers have a choice", as a reason for developing their organic product line, even while three of the four retailers interviewed referred to the need to educate consumers on the differences between organic and other food safety designations such as hygienic and hydroponic.

The lack of customer knowledge on the various food safety designations and certification standards, means that they do not equate a variety of certifications with having more choices. Thus, retailers offering different standards, such as PGS or GLOBALG.A.P., do not gain customer loyalty or appreciation through this type of expanded product offering. Data collected by Panyakul in 2015 showed that though a majority of Thai consumers have heard of organic agriculture (92%), less than 10% could answer correctly more than half of the questions that they were asked on this topic. Retailers supported the assessment that knowledge of customers generally extends to asking for organic, but does not extend to requesting a specific standard or certification. It is possible that if consumers understood the various standards and programs, retailers would have an additional incentive to increase the diversity of the products offered by catering to the requests of consumers for specific certifications and standards. Retailers did see themselves as having a role to play in educating consumers to better understand the differences between the main standards.

- **Impact for imports**

Choice and variety also drive many of the importing decisions of the interviewed retailers. One buyer summarized the situation by explaining that every retailer tries to differentiate themselves from their competition with their product selection. Another, while describing the choices made about whether to import from inside the GMS region or outside of it, described purchases from within the GMS as potentially addressing seasonality issues, but not providing "excitement" to the customer because products from within the region are the same or similar to products that Thailand is already producing.

7.4.3 Economic factors

- **Profitability**

Profitability is another factor driving retailers' decisions regarding the purchase and import of reduced-input fruits and vegetables. As already indicated in the quality section the higher rates of rejection and loss for imported and/or organic products affect the interest of retailers to expand these product categories as higher rates increase the costs to the company. Even if higher rejection rates do not represent a direct cost, time and resources are spent in procuring larger amounts than are actually needed in order to ensure the desired supply. In addition, further resources then have to be allocated to the inspection and testing of the sourced goods.

- **Resource allocation**

Similarly, all retailers interviewed mentioned the lack of available information on the products originating from neighboring countries. One retailer referred to the example set by the Thai government, which has worked with the governments of Korea and Japan to match Thai companies to businesses abroad and questioned why similar efforts are not more common in the region. Having readily available information, or forums and exhibitions where product information is shared, reduces the opportunity cost for retailers. THAIFEX is another example where support provided by ADB allowed for business matching and product catalogues to be developed, essentially facilitating the flow of information.

Resource allocation comes into effect in other ways as well. As the representative of one retailer explained, when searching for new products to import, a factor to take into consideration is that most products originating in the GMS are likely to be low value products that contribute less to the retailer's performance targets, thus the focus remains on other regions where big value items originate (e.g. cherries, berries, apples, grapes, etc.). As information on products in the region is scarce, a retailer must weigh the opportunity cost of seeking new sources for products that represent a lower price point, versus seeking new sources of products that can command a higher price point. Governments and country export associations have a clear role to play in making information on the countries' exports more readily available and bringing exporters in contact with buyers to help spur demand.

7.4.4 Regulatory constraints

In half of the interviews conducted, interviewees pointed to the Pest Risk Analysis List as a constraint when attempting to import fresh fruits and vegetables to Thailand. In one interview the interviewee explained that as part of a "Taste of Vietnam" promotion event she had tried to import new products to Thailand, but that the first step in importing is to call the plant quarantine section of the Department of Agriculture to check which fruits and vegetables may be imported from a particular country. In the case of Vietnam, only four fruits and vegetables were on the list: dragon fruit, lychee, longan and sweet potato. Thus, these were the only products that the fresh produce section could offer during this event.

Another retailer described a multi-year process to import avocados from Australia, explaining that avocado was on the Pest Risk Analysis List, but with a required testing protocol. The protocol in question addressed safety concerns, but would also cause a deterioration in quality, thus, no one was willing to implement the protocol.

According to the interviewees, an updated list is not publicly available, but requires a call to the appropriate government department. Interviewees were also unaware of how the list worked, whether products were removed from the list because of quality or safety issues or whether products were added to the list when sufficient quality/safety was proven. Neither was there a clear path to requesting that a protocol be changed for a product on the list.

In general, interviewees were aware of the products available for import from some of the GMS countries (e.g. Vietnam and PRC), but not from all of them.

In the current situation, demand for fruits and vegetables from neighboring GMS countries is not high, but many retailers are unaware of the products that could be purchased from other GMS countries. If the knowledge gap were addressed, then demand could cease to be a significant constraint and the next bottleneck in the process would become the barriers put into place by regulations, such as the Pest Risk Analysis list. One step in addressing this issue will be making the regulations more transparent and accessible to actors on both sides of a border. Another would be to bring governments together, along with private sector actors, as is being done through the ADB CASP program so that information on the availability and demand of agricultural products could be exchanged and ideas for addressing consumer demand while ensuring food safety concerns could be discussed.

8. KEY FINDINGS AND RECOMMENDATIONS

8.1 Key findings

8.1.1 Knowledge transfer is critical in the value chain

The adoption of reduced-input production and the assurance of food safety and environmental sustainability require a high level of knowledge from all actors of the chain, including producers, traders, transporters, food processors, exporters, retailers and consumers.

- **Training and technical support in farming practices**

In each of the three cases the importance of training and technical support as a means of helping farmers successfully convert to a reduced-input production method is illustrated.

- Organic coconut - Private enterprises and governments have partnered to build an organic coconut sector, together they provide training and ongoing technical support to farmers interested in transitioning to organic methods. In interviews with farmers that were considering transitioning, one of their concerns was not about lack of knowledge transfer, but rather that the trainings would not last if market conditions changed and coconut companies found they were no longer sustainable. This illustrates that farmers recognize the value of training and that without training conversion is not beneficial.
- PGS vegetables - In the case of PGS vegetables training is compulsory prior to entering into the PGS program and meetings with the group and trainers are an ongoing activity. However, farmers still encountered difficulty, in part, because vegetable farming is not a single product activity, as is the case with coconut and mango, but one that requires identifying suitable crops for their farm conditions, making cropping calendars to fit those conditions and producing crop protection products from planting materials. Farmers also have to act as crop nutrient specialist because they have to make fertilizers by themselves and select suitable crop rotation. In the PGS case, lack of sufficient expertise in these areas led to low yields during the transition phase. A further knowledge gap identified was lack of good post-harvest handling knowledge, which resulted in high rejection rates. Ultimately, insufficient knowledge decreased the supply of reduced-input vegetables in the short-term and could stunt future growth in the long-term if the negative outcomes prevent new farmers from participating in the program.

- Myanmar GAP mango – farmers implementing Myanmar GAP received support from the government, NGOs and a newly formed mango association. Demand for training was high with farmers having requested a variety of topics to be covered, but access to trainers was often a barrier to making sure that farmers received the training needed and the high ratio of farmers to extension agents made it difficult to provide strong support, which is illustrated by the fact that some interviewed mango farmers were unaware of even basic aspects of the program, such as the fact that certification needs to be renewed annually.

The case of organic coconut provides the example with the most to learn from. In it a public-private partnership has been created and that partnership has then developed a true value chain, where strong linkages occur between actors at each part of the chain. Furthermore, training is supported by multiple actors, reducing the likelihood that the program is discontinued. The model of PGS vegetables is similar, but with a critical difference being that the production is more complex – one crop versus multiple crops – increasing the need for ongoing training and support.

- **Disseminating knowledge across the chain**

The standards and benefits of the various certification systems impact the rest of the value chain as well. Making sure that actors across the chain understand their role in complying with the standards and see the benefits of doing so is also critical to the success of the chain. Examples from the cases help to underscore this point.

- Organic coconut – coconut is an example where knowledge is disseminated across the chain, largely due to the strong role played by the coconut companies who essentially control the process from the moment that the coconut is taken from the tree. The pre-processing facility represents the one part of the chain less tightly controlled, and it is here that the quality assurance risk is considered to be the highest, but even here there is evidence that the importance of increasing knowledge is well understood as one of the coconut companies is working to upgrade the preprocessing facilities to meet HACCP standards.
- Myanmar GAP mango - A challenge related to Myanmar GAP mango is that while some farmers and government officers know about the program; many traders, exporters and downstream consumers are not aware of it or not aware of the benefits that it brings. Thus, the value of Myanmar GAP is reduced, and traders/exporters of the Myanmar GAP mango do not have more negotiation power than the traders of conventional mango.

The organic coconut example illustrates the power and importance of knowledge as it allows actors in the chain to identify weaknesses and focus improvement efforts on weaker areas

INTERVIEW WITH MANGO FARMER PYAE PHYO AYE

Pyae Phyo Aye is producing mango and spices according to EU-organic standards. He started producing mango in 2012 and completed transforming his mango farm to organic in 2016.

How did you become involved in organic mango production?

Through conversations with current clients and potential clients at trade fairs, I learned there is a strong and growing international demand for organic products. As a medical doctor, I have a strong conviction in the health benefits of safe food which is another reason to keep trying to produce organically – even though it not always easy.

What is your biggest challenge?

Bio-control. In Myanmar there are no organic alternatives available for flowering hormones, fertilizer, and disease management. Thankfully, I have found a solution for organic fertilizer. With a Japanese technology we can use locally produced inputs such as rice husks to produce our own organic fertilizer which is accepted by the EU organic standard.

And for disease management?

For disease management there are organic solutions available in Thailand, but due to the absence of clear export and import regulations for biologically active products we cannot import these in Myanmar. We are now working together with a professor from Thailand to identify wild strains of a beneficial organism against fungal disease. For flowering hormones, we have not yet identified a local solution.

Is your farm GAP-certified?

No, none of my clients accepts the Myanmar GAP standard. It is only for the domestic market and I focus on export. Since my clients require different standards and tests, and would still require these even if I participated in the Myanmar GAP program, it is not relevant for me. In the future, we might consider working with GlobalGAP, which is a requirement of some buyers.

Would you be interested in selling in other GMS countries?

If the price level is high enough, of course! We are already successfully working with a client in Thailand. This client does not require any specific organic certification, but requires phytosanitary and chemical-residue tests to show the product is safe and free of chemicals.

How can the government support reduced-input production?

There are two important areas where the government can help producers: (1) support development, production, and distribution of organic inputs and (2) organize trade fairs to bring producers into direct contact with buyers. For market access, farmers need to know the buyers and understand their requirements.

of the chain. The Myanmar GAP mango is the flip side of the coin, showing how lack of knowledge can reduce the benefits of the advanced practices that have been put into place.

- **Transferring knowledge across borders**

To protect domestic consumers and producers, each country sets its own regulations which are not always known by the exporters and producers in other countries. Thus, facilitation of cross-border trade requires knowledge of export processes and costs as well as technical regulations (food safety, MRLs and SPS certificates). Where these regulations and processes are opaque, a barrier to regional trade is created, as can be seen in the case of Thailand's Pest Risk Analysis list, which was cited as a critical step in the process of importing fruits and vegetables by Thai retailers. However, even those retailers familiar with the list were not sure how to initiate a change in the list or its protocols, making it highly unlikely that exporters from outside Thailand would know how to begin a process of having their product approved for import. To increase trade and gain access to new markets, exporters and importers need support from governments to understand a) the regulations blocking a product's import and b) how to address the underlying issues that prevent a product from crossing the border.

A second critical knowledge gap affecting cross-border trade is that there is often limited knowledge about fruit and vegetable production outside of the home country. For example, in interviews, retailers did not always know what products neighboring countries could provide and indicated that only a few of the GMS countries were participating in trade fairs and conventions, a good source of knowledge for retailers.

8.1.2 Lack of inputs for organic production

Very limited direct plant protection measures are available locally for organic farming. This lack of inputs is clearly one of the most important constraints faced by organic producers in the organic coconut and PGS vegetable case studies because it: affects crop yields; increases labor requirements, since manual control methods have to be used instead; and restricts the choice of intercrops. Examples from these studies illustrate the point.

- Organic coconut - limited bioagents available meant that coconut farmers in Vietnam resorted to very labor-intensive practices, increasing their costs and effort and diminishing the attractiveness of converting to organic. At the same time, it also prevented them from intercropping, reducing their ability to diversify and going against generally accepted organic principles. Accessing organic fertilizers created a second barrier as they are either not abundant in the market or costly. Thus, many farmers have to make their own organic fertilizers which requires additional time and labor, as well as the purchase of other organic materials.

- PGS vegetables - in Thailand, farmers use only 2-3 antagonists (for more than 10 kinds of vegetables) because a) few biocontrol agents are available in the market and b) access to these inputs is limited by the long distance to the input suppliers. This leads to substantial yield reduction, high labor input and low-quality of organic vegetables. For example, around 40 - 50% of vegetables were discarded due to pest and disease damage in the studied area in Thailand.

While in conventional farming systems, farmers can use whatever products are available in the market for crop protection and fertilizers, organic farmers can use only few options or none at all. As illustrated in the examples above this results in higher costs, more intensive labor, reduced income, and lower volumes brought to market.

Another challenge is that organically bred seed varieties are almost non-existent in the case study areas. The choice of high quality organic seeds and plant propagation materials is a key factor for organic farming because it provides good crop start and high yield while reducing disease and pest infection. However, most organic coconut and PGS farmers produce or exchange their organic seeds with other farmers. This practice ensures the organic origin but is not optimal since the quality of the seeds in terms of plant health, yield and conditional suitability are not guaranteed. With more than 20 types of vegetables grown by the new PGS farmers in Suphan Buri province of Thailand, the selection of suitable and high quality organic seeds is quite difficult.

8.1.3 Economic penalties in the value chain

- **Economic penalties for converting farmers**

Price premiums for organic or safe food products can provide an incentive to switch production methods. For instance, farmers of organic coconut and PGS vegetables could count on receiving a price that was, respectively, 3-7% and 50-100% above the price for conventional farming because their product was recognized as a unique product in the marketplace. In contrast, Myanmar GAP mango entered into the conventional supply chain once it left the farm, meaning farmers were paid the same rates as conventional farmers. While GAP practices should allow for higher quality and increased productivity, which would ultimately lead to higher income, this outcome was more uncertain as there was no recognition of the uniqueness of the product and hence no price premium. These premiums are more likely to be available when the product is part of a value chain as in the cases of organic coconut or PGS vegetables and less likely when it is part of a supply chain, as seen in the Myanmar GAP mango case.

These premiums also serve to counter the impact of lower yields that may arise during the period when farmers are transitioning from conventional to organic farming, as was seen in the case of PGS farmers.

In addition, changes in the costs of production as a result of switching to reduced-input methods could make it difficult for farmers to assess the economic impact of converting. For example, in-transition farmers in the organic coconut case estimated that their annual production costs ranged from 628-1,271 USD/ha, while conventional farmers reported a range of 818 -1153 USD/ha. Farmers weighing the decision to convert may wind up paying less money than under conventional methods, or more. The range makes it difficult to assess the economic benefits or penalties of making the switch, increasing uncertainty for the farmers.

- **Economic penalties in other parts of the value chain**

When looking at other parts of the value chain examples of economic penalties can be found to be caused by the prevalence of smallholder farmers in the agricultural systems studied and in the opportunity costs faced by companies.

Both the organic coconut chain and the PGS vegetable chain can be characterized as a value chain where there is a tight relationship across actors in the chain and where developmental support is provided. As a result, farm size becomes a factor affecting other actors in the chain as it raises the costs in relation to the volume purchased. For example, in the case of organic coconut, the processing and exporting companies had to work with thousands of farmers whose farm sizes were 0.6 ha on average, while the social enterprise in the PGS vegetable case is dealing with 19 interviewed PGS farmers having only 6.4 hectares of production area in total, or on average 0.3 ha per farmer. With smallholder farmers the cost in training and support per kg or ton of purchased product will be higher, thereby affecting the competitiveness of the product further up the chain.

The retail case presents an example of the opportunity costs that companies can face when trying to increase their purchase of fruits or vegetables from the region. Retailers that wish to increase the diversity of their product portfolio must weigh the opportunity cost of seeking products that, because they are locally or regionally available, represent a lower price point, versus seeking new products that can command a higher price point because they are considered to be exotic, such as apples or berries purchased outside of the region. A second opportunity cost for retailers is the high rates of rejection that they have experienced with organic imports. Even if retailers do not pay the cost of the rejected good, they have still invested time and resources into procuring and inspecting it. This lost time and effort can make it less attractive to seek out new imports from the region.

8.1.4 Harmonization of production and food safety standards

The international production standards that are well recognized by modern supply chains such as GLOBALG.A.P. or USDA and EU Organic are quite difficult for small farmers to achieve.

Therefore, regional and national standards were established to secure key components of GAP such as food safety, environmental protection, and better farmer health, while being accessible to farmers in the region. ASEANGAP for instance was introduced for promoting regional trade while PGS is an economical alternative certification scheme for organic production. However, while these systems have addressed barriers to entry, making these systems known in the country and the region remains a challenge that will affect their potential impact.

The case of Myanmar GAP mangoes highlights this difficulty as mangoes grown under the standard were not recognized by buyers as more valuable than conventionally grown mango, regardless of whether the buyers were domestic or international. Lack of harmonization across standards makes it harder to achieve recognition and has two main negative impacts. It reduces demand because buyers, and countries, feel more confident with the systems that they know. They therefore choose to impose their own criteria, increasing barriers to farmers and eliminating a potential benefit of the standard.

Lack of harmonization also misses the opportunity to promote better food safety with the consumer. As was seen in the retail case, most consumers do not understand the difference between the many standards and certifications that exist, but they recognize concepts such as organic, hygienic and hydroponic. If standards were harmonized, educating consumers would become simpler, potentially driving further demand.

The fact that these standards were developed without the participation of the marketplace might be a key factor reducing their popularity. One of the reasons that GLOBALG.A.P and USDA organic standards are appreciated by the private sector is that they were developed as private sector-led initiatives, and hence responded to the private sector's needs. When the private sector establishes the standard, it is assured that at least some demand for the standard will exist.

8.2 Recommendations

- The following recommendations have been developed in response to the key findings described in section 8.1. These findings are categorized under the headings of: Harmonization of Standards, Investments, Developing Knowledge Systems, and Increasing Access to Markets in line with the GMS Core Agricultural Support Program strategy.

8.2.1 Harmonization of standards

- ***Harmonize local GAP and food safety standards across the region, developing a single regional standard with supporting certification for GAP practices.*** Streamlining and harmonizing different production and food safety standards in a collaborative process involving multiple stakeholders, including the private sector, would create benefits for actors across the value chain. For example, it would help consumers to better understand the choices available and would allow buyers to more easily assess the products that they would like to import from other GMS countries. Governments could also benefit as it could simplify import requirements for certified products, reducing the resources needed for inspection and control. Harmonization of standards can also reduce the knowledge burden on exporters by reducing the number of requirements with which they need to be familiar. For farmers, the success of harmonization would be determined by the implementation of programs to support the transition from local standards to a regional standard.

- *Short-term: Develop an inventory of local standards, explaining how they are operated and governed; showcase internationally recognized standards and highlight their development process, operations and governance structures, drawing lessons learned from these examples that can be used to align with stakeholders in the region (government, growers, traders, retailers, etc.) to develop a process and objectives for harmonization.*
- *Long-term: Develop and implement a harmonized standard in each GMS country through a multi-stakeholder process, training government representatives, private companies, and supporting actors in the standards requirements. Educate farmers on the standard and initiate support programs for farmers that want to transition to the regional standard. Develop accredited testing facilities for SPS/MRLs in the region to eliminate multiple testing to meet various standards/import requirements.*

8.2.2 **Investments**

- ***Invest in the research and development of organic inputs***. As seen in both the organic coconut case and the PGS vegetable case, organic inputs present an important bottleneck in the value chain, as the lack of options can lead to reduced quality, less diversity and lower income. To address this actors in the chain can work together to research and test new technologies and inputs. Solutions should look at the whole farm and address not only the main crop, but also any intercropped fruits and vegetables in order to reduce the chance that economic penalties dissuade farmers from continuing with reduced-input production.
  - *Short-term:* inventory existing organic inputs for key crops in the GMS region and identify opportunities for transferring production technologies across the region where applicable. Identify crops and locations with high potential for organic expansion.
  - *Long-term:* Develop partnerships with local governments, universities, the private sector and supporting actors to invest in the development of organic input sources in areas with high potential for organic expansion.

- ***Invest in programs to counter the financial risk of transitioning to reduced-input production methods.*** Governments, international organizations, donors and private companies can build in economic incentives to counteract any loss in yields or quality that occurs in the transition from conventional to reduced-input farming. For instance, in one case study, the social enterprise trained farmers to produce value added products such as banana chips and rice cakes, which were then sold through the social enterprise's specialty shops. In another case, coconut companies provided a price increase to transitioning coconut farmers that was less than that price paid to certified organic farmers, but more than the price paid to conventional farmers. Developing access to finance for smallholder farmers that allows them to invest in the infrastructure required by the various standards would also reduce the financial hurdle to making the change. For instance, the need to install toilets can be a barrier for smaller farmers as it requires an up-front cash investment.
    - *Short-term:* Assess economic penalties in diverse value chains and develop a tool-kit of solutions for addressing short-term negative financial consequences of transitioning to reduced-input production.
    - *Long-term:* Identify and implement public-private partnerships that can minimize or overcome the penalties by drawing on the tools of the toolkit – e.g. coconut companies can work with microfinance institutions to develop a toilet loan, government risk sharing (partial guarantees or subsidized loans) could be included to increase the affordability of the product by reducing the interest rate.

8.2.3 Developing Knowledge Systems

- ***Develop reduced-input training programs for farmers in close partnership with actors from across the value chains***. Training programs for farmers, which support them during the conversion from conventional production to reduced-input production, are a critical success factor in developing resilient reduced-input production programs and should be included in any reduced-input program. As seen in the coconut case, key actors from the value chain can partner to develop a training program that addresses the various needs of farmers in transition. Bringing together multiple actors across the chain increases the likelihood that the program supports farmers regardless of fluctuations in the business cycle. In addition, partnerships provide an opportunity for knowledge exchange and allow the chain to be assessed from different perspectives so that the key risks in reduced-input production are identified and training and protocols to address these risks can be developed. This can result in better training opportunities for farmers, but also for other actors in the value chain.
    - *Short-term:* Identify successful reduced-input training programs from across the region and share key success factors, highlighting specific chain characteristics essential for their success.
    - *Long-term:* Replicate the results, starting with introducing similar programs in the same chains and then adapting the successful programs to new value chains. Ensure

that replication efforts bring together the right mix of partners to support long-term sustainability.

- ***Raise consumer awareness.*** Governments and other supporting actors can also work together with retailers to raise consumer awareness of safe products so that consumers understand more about the value of reduced-input agriculture production and can make informed decisions when shopping. A pull from consumers, will increase demand, ultimately providing buyers with an incentive to strengthen the chain to better meet the customer's needs.
  - *Short-term:* Develop safe food campaigns, highlighting the differences between types of safe products – eg. organic, GAP, hygienic, hydroponic.
  - *Long-term:* Develop regional labeling system to facilitate consumer's understanding of the different safe products.

8.2.4 Increasing Access to Markets

- ***Facilitate trade and develop export coaching programs.*** To increase trade flows, access to markets can be strengthened with government support. For instance, trade facilitation programs such as regional tradeshows and regional business matchmarking events help to link exporters to buyers. Governments can play a coordinating role with SMEs and subsidize their participation in such events. At the same time, to ensure that demand, once created, can be met, export coaching can be provided for small and medium exporters on topics such as value chain management, market intelligence, import policy and requirements of the import countries.
  - *Short-term:* Bring together exporters, importers and retailers from the region, either at an existing trade fair or in a new marketplace event, to showcase their products. Hold parallel meetings to identify products with high demand and high potential for trade. Discuss with retailers, importers, and exporters the barriers to importing/exporting as well as steps to take to remove these barriers. Support exporters participation in this event as well as other reputed trade fairs.
  - *Long-term:* Work with governments and industry to implement the steps to reduce the trade barriers. Coach high potential exporting companies by providing information on regional exporting requirements, as well as on marketing their business abroad.
- ***Increase transparency of government regulations with respect to food safety and quality, making them more readily available to the public, whether local or foreign.*** Though reducing SPS measures may not be achievable in a short period of time, making the process and requirements more transparent and visible for exporters and importers could reduce the opportunity costs associated with seeking out new markets or new sources, thereby stimulating further trade.

- *Short-term:* Governments can post import/export requirements for fruits and vegetables to the internet.
- *Long-term:* Harmonize SPS measures within the region and assess the necessity of Non-Tarif Measures (NTMs) affecting the imports of fruits and vegetables with the aim of reducing the number of NTMs applied to the sector.

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