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An Analysis of Maize Value Chain in Pailin Province, Cambodia

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List of Abbreviation

ACMECS	Ayeyawady - Chao Phraya - Mekong Economic Cooperation Strategy
AEC	ASEAN Economic Community
AFTA	ASEAN Free Trade Agreement
CLMV	Cambodia, Lao-PDR, Myanmar and Vietnam
CO	Certificate of Origin
CSES	Cambodia Socio-Economic Survey
DOA	Department of Agriculture
EWEC	East West Economic Corridors
FC	Farmer Cooperatives
FDI	Foreign Direct Investment
FGD	Focal Group Discussions
FAO	Food and Agriculture Organization of the United Nations
GAP	Good Agricultural Practices
GDP	Gross Domestic Product
GDCE	General Department of Customs and Excise
GMS	Greater Mekong Subregion
IFAS	Institute of Food and Agricultural Sciences
ICT	Information Communication Technology
JICA	Japan International Cooperation Agency
MAFF	Ministry of Agriculture, Forestry and Fisheries
PPDA	Pailin Provincial Department of Agriculture
PPDC	Pailin Provincial Department of Commerce
SEC	Southern Economic Corridors
VCD	Value Chain Development

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Abstract

The Mekong Institute conducted a series of value chain studies on potential crops that promote cross-border trade between the twin provinces of the countries in the Economic Corridors in order to upgrade the value chains and address the key issues that smallholder farmers face. The goal of value chain development is to improve household incomes, boost employment, reduce poverty as well as promote food security at the household level. The main objective is to identify the main problems affecting the crop value chain and propose interventions for value chain improvement.

Maize was selected for the value chain study because it is one of the most suitable crops for cross-border trade in the Southern Economic Corridor. Cambodia imports hybrid seeds from Thailand and Vietnam, while Thailand and Vietnam import Cambodia's maize.

The main problems in the maize value chain in Pailin include the decline in production and the lack of formal quality standards. The decline in maize production in recent years is attributed to a number of factors, such as changes in the maize cultivated area, the decline in productivity, and the lower profits from production. The decline in production is also associated with changes in global demand for maize and unstable import from Thailand over the past few years. Other problems include the use of poor quality seeds and agro-chemicals and the degradation of soil fertility. Inadequate farmer knowledge about soil management and the use of traditional production technology also affect product quality and productivity. The absence of formal quality standards is associated with the lack of awareness among the responsible line agencies, lack of equipment/materials, and problem related to staff motivation and mobility. The lack of awareness is due to poor information flow, lack of capacity development for the staff of concerned agencies and the agency budget constraints.

Two areas of interventions are proposed to address productivity and production decline. Improving farmer's productivity and profit margins can be achieved by the introduction of modern technologies in maize cultivation and the improvement of regulatory measures with respect to input supply and use. Problem areas such as changes in global demand and Thai producer subsidy policies are regarded as temporary constraints.

Similarly, there are two areas of interventions in formalizing quality standards for maize. These are improving the awareness and capacity of the responsible agencies and providing incentives to motivate staff to improve work performance.

1. Introduction

Cambodia lies at the heart of the southern GMS sector between two large markets of Vietnam and Thailand. The Agricultural sector remains an important driver for the economic growth of GMS countries, particularly Cambodia, Lao PDR, Myanmar and Vietnam, collectively known as CLMV. Smallholder cultivation and small-scale production dominate the landscapes throughout the southern economic corridors (SEC), a GMS dynamic economic corridor driven by the growth of infrastructure projects that enhance cross-border trade of goods, services and people and investments. Approximately, 75 percent of the population residing along the SEC is engaged in agriculture and agriculture-related industries. Small scale production, informal marketing arrangements and undependable internal transport and communications links prevail. At the same time, globalization, trade liberalization, promotion of market-oriented agricultural production, and increased regional cooperation under cooperation frameworks, notably the Association of Southeast Asian Nations (ASEAN),the ASEAN Free Trade Agreement (AFTA), the Ayeyawady - Chao Phraya - Mekong Economic Cooperation Strategy (ACMECS) and the setting up ASEAN Economic Community (AEC) by 2015 have moved CLMV from subsistence farming to more open and market-oriented agricultural systems with greater economic diversification.

Cambodia imports over 60 percent of its fresh vegetables and fruits to meet its domestic demand from Thailand. The country also exports over 80 percent of commercial crops like maize and cassava to Thailand, Vietnam, and China. In May and June 2012 alone, Thailand exported fresh tropical fruits to Cambodia and Vietnam via SEC valued at more than USD 66 million with an average of 20 tons per day.[1] Fresh fruits are widely grown in the eastern provinces of Thailand like Trat, Chantaburi, Sa Kaeo, Surin, Sisaket, and Ubon Ratchathanias well as in the west provinces (Battambang and Pailin) and northwest provinces (Bantey Meanchey and Oddar Meanchey) of Cambodia. Fresh fruits and tropical fruit products produced in these provinces are already being exported, mainly to China.

Similar patterns have also been observed for Vietnam. Vietnam shipped 7.2 M tons of rice exports in 2011. It is seen as an area with huge potential. Vietnamese lychee, rambutan, longan and vegetables are widely grown in the Southern provinces and exported to Cambodia while Cambodia exports glutinous rice to Vietnam. The volume of trade is increasing annually between the two countries. The importance of cross-border trade of these products between the two countries justifies the focus on improving the cross-border value chains for the concerned products.

From this brief discussion, the potential for the development of agricultural value chains in Cambodia, especially in light of increasing cross-border trade with Thailand

[1]Khom Chad Luk Thai daily newspaper 13 July 2012

and Vietnam, is substantial and promising, both from the input supply side (sufficient natural resources) and demand (opportunities for export) perspectives. Emerging new agribusiness and agro-industries are increasing competitiveness in international and domestic markets; however, the benefits to rural communities are not automatic as they may be not shared by all stakeholders in the agricultural and rural sector. Such changes pose risks to all actors in value chains, especially smallholder farmers, local traders, and SME processors. Smallholder farmers, in particular, can experience short-term difficulties in meeting agro-industry standards and contract requirements; agribusiness SMEs increasingly must compete with large-scale food manufacturers that benefit from economies of scale; and, traders in local markets can be squeezed by specialized procurement practices, supermarkets, hypermarkets, and certified products.

By engaging all actors, especially smallholder farmers, into an improved value chain is expected to contribute to increased income, employment and poverty reduction as well to achieving food security at the household level. Previous surveys conducted by MI along the SEC, involving interviews with key government and private players indicates the need for promoting value chains, business-to-business networking, and product-market linkages. However, value chains in these countries are characterized by a predominance of small producers, local traders and SME exporters (over 75 percent). Moreover, value chain coordination and self-organization of actors are limited and there is insufficient government support to value chain coordination and improvement, especially in the border twin provinces of the GMS countries.

The human resource development for value chain actors who are involved in the development and promotion of value chains and in improving the productive capacities of enterprises along the chain remains a key issue in the GMS countries. Value chain actors (producers, traders, processors, etc.) cannot successfully integrate into regional or global markets when they operate independently. Chain actors need to understand the benefits of forming into groups to gain market access, meet the quantity and quality requirements of foreign buyers, and to have greater bargaining power during business negotiations. Forming into groups also allows them to develop a shared vision of how the chain should perform and to identify collaborative ways among them to keep improving value chain performance.

Improvement in both human resource capacities, but also institutional capacities are required in both and private agencies and organizations to promote cross-border value chains development. This will provide necessary business support services to local SMEs. Currently, there is a lack of knowledge and limited resources among concerned agencies. The capacities of the staff of both the public and private sectors require improvement in a value chain development approach in order to be more effective in providing support to value chain coordination and upgrading efforts and responding to specific needs of relevant value chain actors in the areas of business planning and management, product development and processing, entrepreneurship development, etc.

The Value Chain Development (VCD) approach provides a framework for systematically identifying strengths and weaknesses of a particular chain and designing appropriate remedial interventions.

Nevertheless, improving the performance of specific value chains requires a good understanding of value chain complexities and the constraints and opportunities for development. Lack of information on the status of value chains of specific commodities and analysis of performance prevents the concerned agencies from designing appropriate interventions to improve the efficiency and effectiveness of crop value chains.

Therefore, value chain studies on the most promising products between the twin provinces of the countries in the corridor will assist policy makers and all stakeholders to develop policy and design appropriate strategies to upgrade the value chains in order to address key issues. One purpose of the study is understand the constraints and opportunities in each level of the chains in order to engage all relevant value chains actors and public and private agencies in a common strategy to make the value chains more efficient and competitive amidst increasing domestic and cross-border markets.

The Mekong Institute proposes a study on value chains for promising agricultural commodities between the target twin provinces in the Southern Economic Corridors. The study was conducted in two stages. The first stage was to identify the agricultural commodities that were traded across border between the twin provinces and to select the most promising commodities. The second stage was to conduct an in-depth study on value chain through mapping and analysis of the selected promising commodities in order to understand the constraints and opportunities in each level of the chains. Therefore the objectives of the stages are as follows:

1.1. Objectives of the Study

1. To identify main crops that are traded cross-border between twin provinces in the Southern Economic Corridors, i.e. between Chanthaburi province of Thailand and Pailin of Cambodia
2. To select one or two promising crops through a participatory process for an in-depth study on value chain mapping and analysis
3. To conduct value chain mapping and analysis of the selected crop
4. To propose interventions to improve performance in the selected crop chain.

2. Literature Review

2.1. Study Site's Profile


Figure 1. map of Pailin Province

Pailin is one of the 24 provinces of Cambodia and is located in the western part of the country (see Figure 1). To the west, Pailin shares border with Chanthaburi province of Thailand and to the North, South and East it shares borders with Battambang province of Cambodia. Like the rest of the country, the climate in this province is tropical, with two distinct seasons, the dry seasons and the wet season. The wet season starts in May and ends in October, but the rainfall may continue showering till mid or even late November. The annual rainfall varies from year to year, but on average, the annual rainfall is 0.92 meter height (PPDA 2012). The temperature also varies from year to year and depends on seasons. In December – January, the temperature could fall to 16 degrees Celsius and rise to 34 degrees Celsius in April.

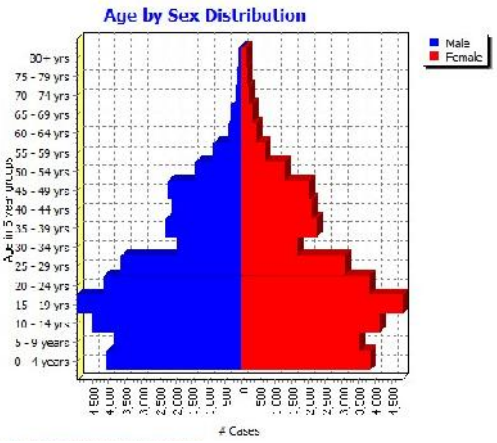

Figure 2. Age by Sex Distribution

Formerly, it was a town and was part of Battambang province. Later in 2010, it was reformed to provincial status administratively; the province is composed of two districts, namely Pailin and Salar Krau. There are 4 Sangkats (equivalent to commune) with a total of 36 villages in Pailin district and 4 communes in Salar Krau district with a total of 43 villages. It is the second smallest province in Cambodia with a population of 63,935 people in 2012. Of which 31,796 (49.73 percent) are females. There are 14,084 households in the province (PPDA, 2012). The average household size is 4.5 members and the average family labour about is 2.70 persons (CSES[2] 2011).

The society in this province is characterized by a moderately low dependency ratio of 0.38 if compared to national ratio of 0.54 (World Bank Databank). Children aged less than 15 years old comprise about 34 percent of the provincial population, while elderly population accounts for only 4 percent (see Figure 2).

Pailin maintains one of the highest illiteracy rates in Cambodia. More than 25 percent of household heads could not read and write and more than 37 percent of household-

[2] Cambodia Socio-Economic Survey (CSES), a household survey conducted by the National Institute of Statistics periodically

heads have never completed primary education (see Table 1). Totally, there are more than 61 percent of household heads, who did not complete even primary education in this province. The majority of them (55 percent) are smallholder farmers, who farm on less than 3 hectares of land, while 22 percent of them are smallholder farmers, who cultivate on land less than 2 hectares (CSES 2011). Most of them are engaged in maize cultivation, but some of them are engaged in cassava cultivation as well. Only those who have land less than one hectare are engaged subsistence farming.

Table 1. Education Level of Household Heads in Pailin

Level of Education	Male	Female	Total
Illiterate (No Education)	18.48	6.84	25.33
Primary Not Completed	32.99	4.74	37.73
Primary School	20.25	1.88	22.13
Lower Secondary	12.45	0.8	13.25
Secondary/Technical Diploma	0.58	0.03	0.61
Beyond Secondary	0.81	0.08	0.89
Other Education	0.06	0	0.06
Total	85.62	14.38	100

Source: Population Census 2008

Pailin has been one of the highest poverty incidences in Cambodia. In 2004, the poverty rate was more than 46 percent and was mainly among farm households in the rural areas (Ministry of Planning 2006), with small farm land sizes for subsistence-oriented farming (World Bank 2006). More than 39 percent of farmers or 67 percent of farmers hold land less than 1 hectare or 3 hectares, respectively in Pailin (CSES, 2011). However, the poverty incidence has declined gradually over time. In 2007, as in other rural areas in the country, the poverty rate dropped to around 35 percent (World Bank, 2009). In 2010, the poverty rate was estimated to fall to between 20 – 30 percent in Pailin town and between 30 – 40 percent in rural areas of Pailin (JICA[3], 2010). The decline of poverty incidence is observed to move in tandem with the economic growth of the country. The country's GDP grew about 7 percent during 1994 – 1999 and 8.14 percent during 2004 – 2010 (World Data Bank). Despite inequality in benefit sharing, the rural households did benefit from the economic growth within these respective periods. The inequality in living standards is due to the divergence of living standards during the 1990's, but not in the 2000's (World Bank 2006). The stabilization in living standards during the 2000's might explain the drop in the poverty rate in Cambodia as whole and in Pailin in particular.

[3] Map of Distribution of Household Poverty Rate, by District, 2010

2.2. Agriculture Sector

The province has a total land area of1, 062 km^2. Of which the cultivated area is 456 km^2 and mainly is in Salar Krau district, the forest area is 448 km^2, and the residential area is 158 km^2. More than 82 percent of the cultivated area is agro-industrial farmland and the rest is paddy field (PPDA 2012). Most cultivated areas are located within the Salar Krau district. Currently, agriculture is the main livelihood activity of the people in the province. About 95 percent of the population is farmers, while less than 1 percent is government officials and the remaining percent are self-employed or employed by private sector such as operations including casino, foreign enterprises, international NGOs and private companies (CSES, 2011).

There are two main agro-industrial crops, cultivated in this province, namely cassava and maize. The two constitutes about 67 percent of all crops grown in the province, while the remaining 23 percent comprises paddy rice field (planted in the lowland area) accounting for 19% and fruit trees (such as longan, mango, rambutan, mangosteen, orange, coconut, durian, jackfruit, guava, etc.), and other crops (mung bean, soybean, ground nuts, rubber and vegetables). Most of these crops (excluding cassava, maize, soybean and longan) are grown mainly for household consumption and for local market sale (CSES 2011). Most smallholder farmers are engaged in maize production and only a small proportion of smallholder farmers, especially those who own less than 2 hectares, are engaged in cassava and maize production. Most cassava growers are medium and large scale farmers. The medium scale farmers comprise of more than 60 percent of all farmers, while the smallholder farmers constitute about 30 percent and the large scale farmer constitutes less than 10 percent (FGD, 29 February 2013). Nevertheless, it is small scale farmers and medium scale farmers who grow both cassava and maize, while the large scale farmers mostly grow cassava and some high value perennial crops, especially longan.

Cassava and maize are the predominant crops that are traded across border between Pailin and Chantaburi although other crops such as longan, sesame, soybean, mung bean and ground nuts have been reported as exports to Thailand through Chantaburi province. Currently, the province has one international cross-border check point located in Salar Krau district, called Phsar Prom, which shares border with Ban Pakkad of Chantaburi province of Thailand. Currently, goods, services, and people moving between the two provinces pass through this border. The Provincial Government is planning to open one more gate with Chanthaburi province. It is in the process of negotiation with the Provincial Government of Chantaburi (Deputy Director of Pailin Administrative Department, per. com. 28 January 2013).

3. Research Methodology

3.1. Crop Selection

There are two stages in the selection process, desk study and field study. A two-day workshop was organized to develop tools for selecting crops. This workshop was held for MI staff on 10 – 11 January 2013 at Mekong Institute, Khon Kaen, Thailand. During this workshop, criteria with sub-criteria and guiding questions were pre-determined and developed into datasheets prior to focal group discussions (FGD) (Annex 1). Prior to the FGD, secondary data on cross-border traded crops from the Chantaburi Custom House website, were collected, reviewed and predetermined for the most promising crops for further selection for the FGD. The annual demand growth rate of each crop was calculated and was verified in focal group discussions before it was entered into the priority ranking datasheet for the discussion. Given time limitations, only five main crops were selected from this secondary data.

The participatory crop selection was conducted in Battambang and Pailin provinces on 29 and 30 January and then followed up by field observation through 3 February 2013 (Annex 2). Three main tasks were carried out in the selection, namely explaining the purpose of the project, explaining the selection process and the selection. First, the participants were briefed on the objectives of the project and the purpose of the discussion through PowerPoint presentations conducted in the Khmer language. Secondly, after the presentation was finished, questions were opened for any clarification and suggestions with regard to the pre-identified crops selection such as removing or adding new crops using the pre-determined criteria that were developed during the desk study as listed in annex A. The participants were asked to weigh the relative importance of each pre-identified crop. Thirdly, after the weights were obtained, the focal group discussion was divided into two sub-groups, the public sector group and the private sector group in Pailin. The public sector group was facilitated by Mr. Thorng Ra, MI associate researcher and assisted by Mr. Suphol Sinchaiyakij, consultant, while the private sector group was facilitated by Mr. Neath Net, MI Program Specialist and assisted by Mr. Chhean Chanrith, a local facilitator in Pailin province. In Battambang province, only one FGD was organized because there was only person from private sector attending the meeting. Next, the participants were asked to rank the five crops in relation to each criterion using the guiding questionnaire (Annex 1) and scores was assigned to the crops according to their priorities ranked by the participants. It should be noted that in this ranking, the 5 score scale was applied. The highest priority crop was given 5, while the least priority crop was given 1. Scores were entered into datasheet on Excel directly (Annex 3). After scoring was completed, the two groups met again to discuss any inconsistency in rankings. Each group was asked to clarify the rationale they used ranking the inconsistent crops. The score of each crop ranked by each group was averaged to finalize ranking in Pailin. There was no problem of crop ranking for the participants in Battambang as there was only one group. Direct observation were also made on the border between Pailin (Phsar Prom) province and Chanthaburi (Ban Pakkad) province and the border between Battambang (Kamrieng) province and Chanthaburi (Ban Laem) province to observe main products that were exported across these borders to Thailand.

To map actors and supporters and to analyze the maize value chain, three approaches were employed, namely the structured interview, in-depth interview and focal group discussion. The structured interview was conducted mainly with actors in the value chain. The questionnaire was developed for each actor and consisted of questions about general information, costs, productivity, resource access, market, policy and regulation, relationship and linkage, problems and constraints in value chain. Due to time and resource constraints, there were 4 famers, 3 collectors, 3 semi-processor and 2 exporters selected for the interview (Table 2).

Table 2. Distribution of Actor by Scale of Production

Value Chain Actors	**Sample size**		
	Small	**Medium**	**Large**
Farmer	2	1	1
Collector	1	1	1
Processor	1	1	1
Exporter	0	1	1

The in-depth interview was conducted with supporters in order to understand their roles and responsibilities with regard to the value chain. They respondents were chosen from the public and private sector and civil societies. FGDs were also conducted with farmers to understand about the role of gender in maize cultivation, such as labor division, financial decision-making, livelihood strategies, and constraints and issues in maize production. In total, there were 2 FGDs conducted during the field work divided by gender. There are no ethnicity issues in this maize production.

4. Results

4.1. Crop Selection

Initially, four main crops were pre-identified by the research team in the office from the secondary data obtained from Chanthaburi Custom House as a proxy of main cross border traded crops between Pailin/Battambang and Chanthaburi (Figure 3). These crops were cassava, maize, soybean and sesame. The initial identification and selection of these crops was based on the volume (in tons) of cross border trade and the average volumetric growth rate.

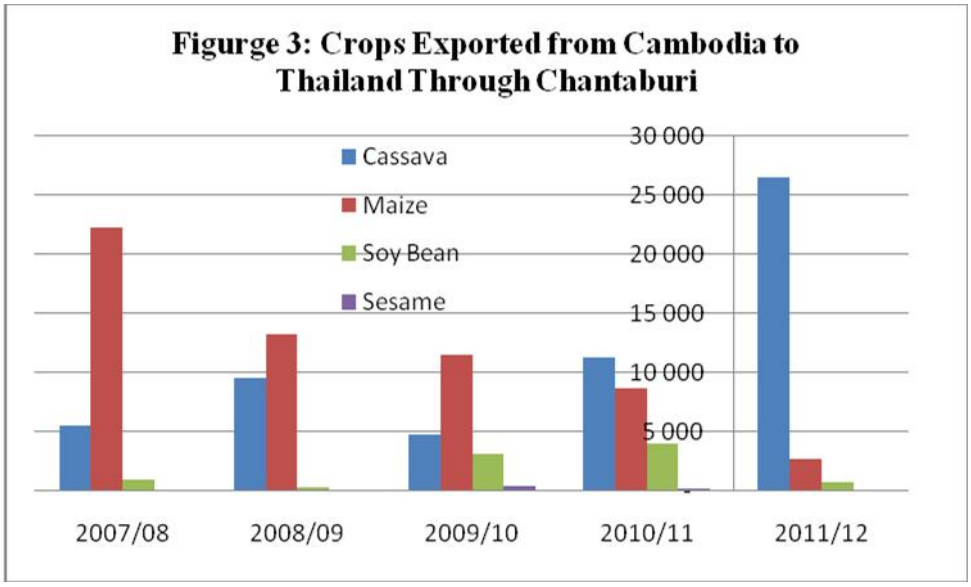

Figure 3. Crops Exported from Cambodia to Thailand through Chanthaburi

The participants in Pailin suggested dropping sesame because farmers are no longer producing the crop, but suggested including mung bean and longan for the discussion. Table 2 and Table 3 present the results of crop ranking done by public sector and public sector groups in Pailin province, respectively.

Table 3. Priority Setting Score (Public Sector) in Pailin

Criteria	Sub-criteria	Weight	Cassava	Longan	Soybean	Maize	Mung bean
Livelihood	Present integration of the poor	0.5	2.3	0.5	1.2	2.2	1.3
	Potential to generate higher net income	0.5	2.3	0.5	1.0	2.3	1.5
	Origin of the crop	0.5	2.5	1.3	0.5	2.0	1.3
Market potential	High potential of cross border trade	0.3	1.5	0.6	0.8	1.2	0.5
	Potential of value creation	0.3	1.5	0.1	0.6	1.2	0.6
	Farmer's involvement in value creation	0.3	1.5	0.5	0.9	1.2	0.5
Others	Policy supports	0.2	1.0	0.8	0.6	1.0	0.4
	Environmental concern	0.2	1.0	0.6	1.0	0.8	1.0
	Foreign investment in the chain	0.2	0.5	0.9	0.8	0.7	0.7
Average Weighted Score		**1**	**1.5**	**0.7**	**0.8**	**1.4**	**0.9**

Table 4. Priority Setting Score (Private Sector) in Pailin

Criteria	Sub-criteria	Weight	Cassava	Longan	Soybean	Maize	Mung bean
Livelihood	Present integration of the poor	0.5	1.2	1.5	1.2	2.0	1.8
	Potential to generate higher net income	0.5	2.0	2.5	0.5	1.5	0.8
	Origin of the crop	0.5	2.3	2.2	0.5	2.0	0.7
Market potential	High potential of cross border trade	0.3	1.5	1.2	0.3	1.1	0.5
	Potential of value creation	0.3	1.3	1.1	0.8	1.0	0.5
	Farmer's involvement in value creation	0.3	1.4	1.4	0.3	0.9	0.5
Others	Policy supports	0.2	1.0	0.6	0.2	0.8	0.2
	Environmental concern	0.2	0.6	0.8	0.2	0.2	0.2
	Foreign investment in the chain	0.2	1.0	1.0	0.2	1.0	0.2
Average Weighted Score		**1**	**1.3**	**1.3**	**0.6**	**1.2**	**0.7**

The two groups have different opinions on the first crop to be prioritized. The public sector group ranks cassava as the first priority crop, while the private sector group ranks longan and cassava as the first priority crop to be selected for value chain analysis. The public sector argues that the poor farmers could not afford to invest in longan as the investment cost is higher. Besides, longan is a perennial crop. The private sector group argues that although longan is a perennial crop and the investment cost is higher, longan generates higher income and could lift the poor of out poverty quicker than cassava and maize as the demand for longan is good.

Table 5. Reprioritized Setting Score in Pailin

	Selected Crops				
	Cassava	Maize	Longan	Mung bean	Soybean
Average Weighted Score	1.4	1.3	1	0.8	0.7

Unlike cassava relying on exporting to Thailand, longan can be sold locally as well as exported to Thailand or China. Nevertheless, both groups agree that the final selection should be made by averaging scores of each crop done by both groups. After averaging, cassava was ranked the first priority crop followed by maize; longan, mung bean, and soybean, respectively (Table 5).

Although cassava is ranked as the first priority crop, maize was selected for value chain mapping and analysis because more poor farmers are engaged in maize production than in cassava. It is estimated that more than 9,000 people are employed in maize cultivation if compared to 6,000 persons employed in cassava production[4]. In addition, the life cycle of production is shorter than cassava. Maize can be grown twice a year, while cassava can be cultivated only once a year. Moreover, although the participants gave the same score to cassava and maize for foreign investment criterion (Table 4), maize seems to attract more foreign investment than cassava. Cassava is exported directly to Thailand and Vietnam as raw materials, while maize, besides, is exported as raw materials, but is also processed in the country as animal feed. In terms of promoting cross-border trade among the southern economic corridor, maize is a suitable crop because Cambodia imports seeds from Thailand and Vietnam, while Thailand and Vietnam import maize from Cambodia.

4.2. Mapping of Value Chains

4.2.1. Core Process

The core process of maize value chain in Pailin province could be summarized as input provision, cultivating, collecting, semi-processing, exporting and processing (milling)for animal feeds and retailing as shown in Figure 4 below:

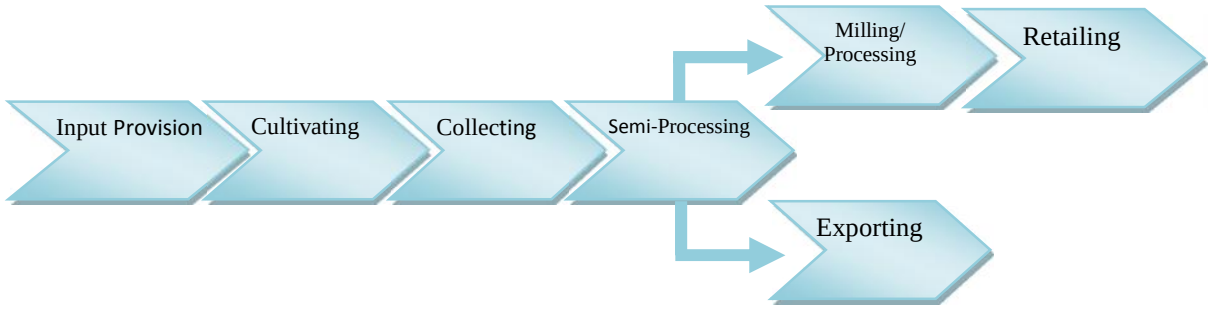

Figure 4: Core Process of Maize Value Chain in Pailin

Milling and processing is primarily carried out in animal feed factories in Phnom Penh, in Thailand or in Vietnam to produce animal feed before retailing. This part was not examined as (1) time and resources were limited in this study; (2) the concentration was to focus on the value chain within the province (input provision, cultivating,

[4] Estimated from CSEC 2011

collecting, semi-processing and exporting) because data at milling/processing and retailing were unable to obtain; and (3) the main issues occurred at these levels were principally affected by the changes in the demand for maize as animal feed inputs and its price as reflected in the global market price. It should also be noted that rising real incomes in Thailand, Vietnam and China have created preferential demand shifts from traditional food stuffs to meat. Over time, the increasing demand for meat in both domestic and cross border markets will put upward pressure on the cost of animal feed and animal feed ingredients. The meat-feed-and feed ingredient linkage is expected to result in a gradual increase in real maize prices throughout the value chain

The main actors of the value chains in the province are summarized as input providers, farmer, assembler, semi-processor and exporter.

4.2.2. Value Chain Actors

4.2.2.1. Input Providers

The main inputs are seed, chemical fertilizer and pesticide. Currently, there are three private companies selling hybrid seeds in the province. They are CP, Pioneer and Thai Binh Seed Joint Stock companies. There are two potential companies planning to distribute seeds in this province as well (Table 6). There are a number of retailers such as retailer shop, farmer associations and Thai collectors. There are at least a dozen varieties of seeds and other no brand name varieties of seeds are also sold and distributedin the province.

Table 6. Companies Selling Seeds in Pailin

Variety	Company	Yield (t/ha)	Days to Harvest
CPQQQ	CP	9.6	100-110
CPAAA	CP	9.0-13.5	90-110
CP888	CP	9.0-13.5	120-130
CP301	CP	7.2 - 11.4	90-95
CP801	CP	9.0-12.0	110-120
LVN 10	Thai Binh Seed Joint Stock	8.0-10.0	100-125
P4199	Pioneer	N/A	110
P4546	Pioneer	N/A	110-120
P30B80	Pioneer	N/A	110-120
P30K95	Pioneer	N/A	95
P30Y87	Pioneer	N/A	110
P30T60	Pioneer	N/A	110
999$	Pacific Seed	N/A	N/A

339	Pacific Seed	N/A	N/A
336	Seed Asia	N/A	N/A
345	Seed Asia	N/A	N/A
282	Seed Asia	N/A	N/A
333	Seed Asia	N/A	N/A
501	Seed Asia	N/A	N/A

Besides seed companies, there are a number of chemical companies distributing chemical fertilizers, and pesticides with different brand names to retailers, the local shops and farmers association in the province. All farmers buy hybrid seeds, while some farmers apply fertilizers and chemicals depending upon their soil fertility and insects and weed conditions. It is estimated that each year more than 700 tons of seeds, 180 tons of fertilizer, and 27 tons of chemicals sold in the province. These products are mainly imported from Thailand and Vietnam (PDC, 2013).

4.2.2.2. Farmers

Maize can be cultivated twice a year in the province. In the wet season, maize is planted during July – August, while in the dry season, maize is grown during March – April. Detailed activities in production including harvesting season are summarized in Table 6 below:

Table 7. Seasonal Calendar

Description	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Land preparation (plowing)												
Land preparation (tillage)												
Top dressing fertilizer												
Planting (machine)												
Fertilizing												
Weeding (two times)												
Harvesting												
Threshing												
Selling												
Rain fall	☆	☆	☆	☆☆	☆☆	☆☆☆	☆☆	☆☆☆	☆☆☆	☆		

Off- season — On- season — Rainfall variation ☆

Cultivating maize in the province now is carried mainly by mechanization including land preparation and planting, except fertilizing, weeding and harvesting.[5] These activities are done by men. Women involve mainly during the harvesting stage. Small scale farmers, who do not have tractors, rent tractor from others, especially from medium and large scale farmers. Small scale farmers employ mainly family labor to do many activities such as fertilizing, weeding and spraying pesticides, while medium and large scale farmers hire labor to do all of these activities. Most labor employed by medium and large scale farmers, are migrants, who migrate from different parts of the country. There is a small proportion of local labor employed by medium and large scale farmers. It accounts about 30 percent. Medium or large scale farmers employ similar numbers of labor. Medium scale farms employ about 5 labor, whereas a small scale farmer employs about 2 – 3 family labor.

There are two practical ways for maize collection. In the wet season (July-August), some farmers collect and sell maize on the cob immediately; while some other farmers do not collect, but sell to assemblers after agreeing on the price. Assemblers come with their hired labor and harvest themselves directly from farms. In this season, farmers have to sell maize on the cob because they could not keep the produce longer due to higher risks of pest infestations, disease and quality deterioration. This season has high humidity and insufficient sunlight to dry maize. In addition, most farmers do not have facility to dry and store.

An additional reason is that farmers need to clear their farms on time for the next cropping season and they do not have time to thresh, dry and clean maize. The second collecting period is in the wet season (November – January). Many farmers sell maize as gain because they have time to dry maize as there is sufficient sunlight. In this season, small scale farmers sell grain maize to assemblers, while medium or large scale farmers sell grain maize to assemblers, semi-processors or exporters as many of them own trucks or locally made trucks that they can use and deliver maize the above buyers.

There are about 5,000 households engaging in maize production each year who cultivate 15,000 hectares of land (PPDA, 2012). Of these, 3,250 households are small scale farmers and the remaining households are medium farmers. Small scale farmers and some medium farmers regularly diversify maize with cassava, while the large scale farmers and medium scale farmers are opportunistic. The small scale farmers are reported to allocate farmland between cassava and maize in a ratio of about 2:1. The first season production is about 67,500 tons and the second season production is 20,000 tons, or in order words, the average yield is 4.5 tons per hectare (PPDA, 2012). [6]

[5] The later three operations can also be mechanized, thereby resulting in greater efficiency and reduced costs through labor to capital substitution

[6] Yields of 4.5 tons/hectare are considered low for hybrid maize, using improved farming methods. Under similar soil and climatic conditions, hybrid Maize yields in the Lao PDR average 6.0 tons/ha

4.2.2.3. Assemblers

There are two ways for harvesting arrangements. One way is farmer collecting themselves and selling to assemblers. This is often observed for small scale farmers, who employ only family labor. The second way is, after settling on the buying price with farmers, assemblers collect directly from the farms, transport and sell immediately to semi-processors or to silo operators and to exporters who will thresh, dry, clean and grade thereafter. The latter is common form of collecting in Pailin. The assemblers come with their own transport and labor. Having limited capital resources and avoiding price fluctuation risk and quality deterioration, assemblers have to sell maize immediately to semi-processors or exporters in the dry season, while in wet season the assemblers have more options, either sell to semi-processors, exporters, Thai buyers or to Vietnamese buyers depending upon which could offer higher prices. In general, they are acting as agents for silo operators and exporters as they have built direct relationships and networks with farmers. The assemblers collect about 65 percent of the total maize produce at the farm gate, while the remaining farmers sell directly to silo operators or to semi-processor. Having linkages, networks or relationships, some assemblers buy maize from small scale farmers and sell directly to Thai buyers who arrange trucks from Thailand to pick up from the farm gate. The assemblers sell maize to Vietnamese buyers opportunistically as they often come to buy when the demand for the maize is high. Unlike Thai buyers, they are opportunistic buyers. The exact number of assemblers in the province is uncountable as they are not registered at the Provincial Department of Commerce. Secondly collecting is only part-time job. Often some of them move in and out depending upon whether they can buy maize from farmers and make profit from the business. Most of these do not have a strong relationship or linkages with farmers. However, it is believed that the total number of assemblers in the province ranges between 50 and 70[7].

4.2.2.4. Semi-Processors

The function of semi-processor in the value chain is hard to distinguish between assembler and exporter, and the silo operator. The difference between assembler and semi-processor is that ,rather than selling directly to buyers after buying maize in the cob form from farmers or assemblers, semi-processor threshes grains from cobs using threshing machines dries grain maize on large cement concrete containers especially in the dry season, as there is sufficient sunlight and heat, cleans using machine and grades using sorting machine and moisture measure meter before selling to the exporters in the province or Thai buyers in Chantaburi and Sra Keo provinces. However, grading is not a very complicated task. In general, semi-processors rarely sell grain maize to exporters in the province, but sell directly to Thai buyers or Vietnamese buyers

[7]This figure is estimated based on average maize bought per assembler and the total maize production in the province. It is not included other assemblers who bought maize from other provinces and sold to semi-processor and silo in the province

depending upon which offers a better price. Having agreeing on conditions, the semi-processors load maize on trucks and transport to Thai buyers in the provinces above or arrange Thai trucks from there to collect from their processing plants. The semi-processors absorb about 30 percent of the total maize production in the province and buy the rest from assemblers who transport cob maize from other provinces such as Battambang, Kompong Cham, Kampong Thom and Pursat. To be able to transport grain maize to Thailand, the semi-processors have to buy export quotas from the exporters if they see that they could make more profits than selling directly to the exporters. There are 35 semi-processors in Pailin.

4.2.2.5. Exporters

The exporters perform similar functions as semi-processors such as buying maize directly from assemblers, farmers, or sometime from semi-processors, threshing using threshing machine, drying using drying facilities such as silo, or large cement concrete when there is full sunlight and cleaning using cleaning machine, grading similar to as the semi-processors do, storing and exporting to Thai buyers, who will sell to animal factories in Thailand or sell to the animal feed factories in Phnom Penh. The distinct function difference between exporter and semi-processor is that the semi-processor does not have export license and Certificate of Origin from the Ministry of Commerce. The exporters are registered at the Ministry of Commerce and have export licenses. Exporters tend to sell most of their maize in form of grain to Thailand and only small proportion to the animal feed factories in Phnom Penh. However, this circumstance entirely depends upon the market price. In some years, where the price in the domestic market is more or less the same as Thai bids, large proportion of maize is sold in the country or exported to Vietnam. Last year the total volume of maize exported to Thailand is about 20,443 tons, down 42 percent from 35,381 tons a year earlier (Open Development Cambodia 2013). There are two exporters in the province. While not a monophony, the limitation of exporters to two firms creates incentives for price collusion.

4.2.2.6. Value Chain Supporters

4.2.2.6.1. Provincial Department of Agriculture (PDA)

The roles of PDA in Pailin are to provide agricultural extension, seeds to farmers for demonstration, to control the quality of inputs distributed in the province, and to prevent illegal trafficking of agricultural commodities such as expired products, poor quality of seeds, and no brand name of seed and to prosecute illegal persons to the court. Thus, according to its roles and functions, the department play a directly role in value chain, especially at the input level and the production level.

With regard to agricultural extension, the department has conducted a number of training and field demonstrations on fertilizer applications and seed experiment in

collaborations with NGOs and maize seed companies. With the support of some NGOs, the department has helped and facilitated to form farmer associations in the province. However, the capacity and resources are limited. As a result, agricultural extension quality and quality control of inputs are also limited.

4.2.2.6.2. Provincial Department of Commerce

The role of this department functions is to identify potential markets, organize exhibition, to facilitate cross-border trade with Thailand, to monitor and regulate market monopolies, to promote export of the provincial products, and to attract foreign direct investment (FDI) to the province. Thus, according to its functions, the department plays an important role in facilitating markets to support all actors at all levels of the value chain, except the input provider.

There have been a number of issues with regard to exporting cassava, maize and soybean to Thailand. Recently, Thai authorities restricted imports of cob maize, fresh cassava, and soybean from Pailin. All products imported from Cambodia are in form of semi-processed products in order to prevent taking subsidy advantage of Thai government policy for Thai farmers and to limit the amount imported to Thailand.

The department has involved in a number of discussion between Pailin and Chanthaburi and Sra Keo to discuss cross-border trade facilitation on agricultural commodities, especially cassava and maize. Little progress has been made on the talks in the past few years. However, recently the Thai government and Cambodian government agreed to lift trade restrictions on maize and cassava (Open Development Cambodia, 2013). It is not clear whether the lifting of these restrictions has occurred.

Like the Provincial Department of Agriculture, the department faces the same problems and issues including negotiation skills. Their activities have been limited by budget and capacity constraints. Export license issuance has not been decentralized to the department. All export companies must apply for export licenses and Certificate of Origin (CO) from the Ministry of Commerce resident in Phnom Penh.

4.2.2.6.3. Provincial Department of Planning and Investment

The Office of Investment and Promotion of the Pailin Provincial Department of Planning and Investment does not have any direct role in value chains or in facilitating any cross-border trade between Pailin and Chantaburi. Its main roles are to provide technical advice on any proposed investment plan in the province submitted by stakeholders including private sector, public sector or civil society and to study the government policies in order to promote all types of investments in the province. Thus, its functions are indirect with respect to production and marketing. One notable function is to

review, the review and providing comments on land concession for agro-industries again like previous departments, the capacity and resources of this department are limited and therefore their activities have been restricted by resource constraints.

4.2.2.6.4. Custom Checkpoint Office

The Customs checkpoint in Phsar Phrom is under the directions of Provincial Customs Branch of Pailin province. The roles and responsibilities are i) to carry out collection of all duties and taxes in accordance with laws and regulations on imported and exported goods, ii) to investigate, prevent and suppress all customs offenses, in particular combating against all kinds of smuggling activities in geographical areas under its jurisdiction as determined by the General Department of Custom and Excise (GDCE), iii) to make customs clearance and directly control all documents relating to imported and exported goods at its entry points based on laws and regulation in effect and iv) to collect data on imported and exports. Thus according to its functions, the custom office plays a role in cross-border trade between Cambodia and Thailand. Its functions mainly supporting and controlling the exporting level in the value chain.

Below is a brief summary of import and export procedures as shown in Figure 5. It should be noted that the procedural diagram appearing below is just a highlight of the basic procedure only and the detail procedures as well as enquiries must be obtained directly from the Customs office. Export declarations are made in triplicate and are submitted to the Customs Office, accompanied with related documents such as customs declarations, commercial invoices, packing lists, export licenses and certificate of origin (CO). The customs clearance procedures can take three to four days to complete. This results in produce damage and other losses as well as increased transaction costs of rent seeking practices to process documentation.

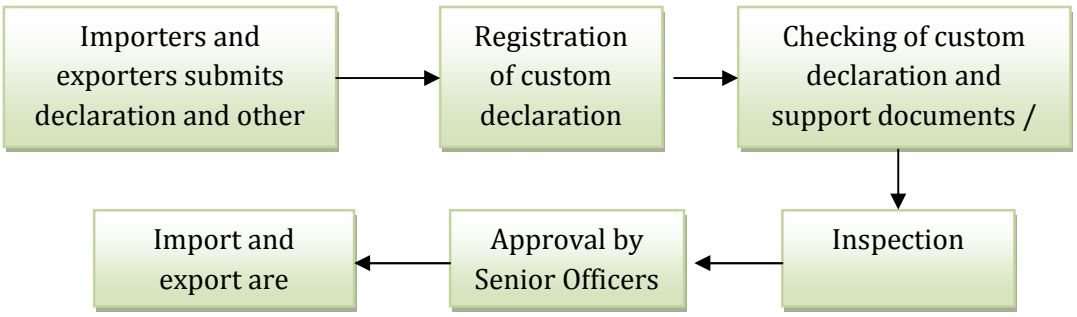

Figure 5. Import and Export Declaration Procedure in Phsar Phrom Cross Border Checkpoint

4.2.2.6.5. Civil Society

There have been a few NGOs such as CARE and World Vision which have been working in the province. However, all of these NGOs have phased out their projects in the province. Most of their programs targeted small scale farming systems, but not agro-industry farming such as cassava, maize or soybean. They don't have any direct roles or support functions in the value chain.

There are 36 farmer associations in Pailin. The functions of the farmer association are to buy agricultural products, sell seeds, and provide credit and offer savings to members and non-members. According to their roles and functions, the farmer's associations should play an important role in the value chain, especially at the input provision and production levels. However, the capacity of the associations is weak. Their marketing skills are limited and could not compete with retail shops. Unlike seed providers such as the private companies operating in the province and Thai collectors, the association could not provide agricultural extensions in terms of training to farmers on field demonstration. The associations are more engaged in credit and buying produce as brokers.

4.2.2.6.6. Banks

The banking sector should play an important role to support the value chain. However, all banks operating in Cambodia are commercial banks. There is no policy bank established to support farming in Cambodia, especially the marginalized farmers. In addition, all banks do not have any policy to support any level of the value chain. There is no special interest rate for agricultural activities, particularly at the production level.

The banking sector support to the value chain is extremely limited because they lend at commercial interest rates. Most farmers or assemblers have little access to because of complex borrowing regulations and procedures. Because of these complexities, the normal route for farmer borrowing is to borrow money from their relatives and, in some cases, from business associations, assemblers, or other non-financial entities, who often usurious rates of interest. The interest rates charged by these banks are around 3-4 percent per month. Farmers would have a better chance of getting loans to expand their production capacity if the bank lowered its rates to around 5-6 percent per year. Despite ACLEDA Bank, the Cambodia's largest domestically owned bank has been loaning money in agricultural sector for almost three decades. The Bank's operations have been converted to commercial banking operations. It charges very high interest rates with no exception for farmers. Farmers still suffer from higher interest rates charged by this bank including stringent requirements Lending terms and conditions

4.2.3. Flows of Product, Information, and Knowledge

The flows of maize and its volume are very complex as farmers have many buyers (Figure 6). Some farmers sell their maize either to assemblers, semi-processors, or to exporters directly depending upon price differences and distances to different buyers. Most of them are medium and large scale farmers who transport their own maize and sell directly to exporters or semi-processors, while the small scale farmers often sell to assemblers directly. Most maize produced in the province is exported to Thailand, while only 10 percent is used by the local factories to produce animal feeds and 20 percent is exported to Vietnam to supply animal feed factories in Vietnam. The product flow and its volume entirely depend on market forces. When there is a restriction of Thai imports of Cambodia maize, most maize in the province is exported to Vietnam or is used by the local factories to produce animal feeds.

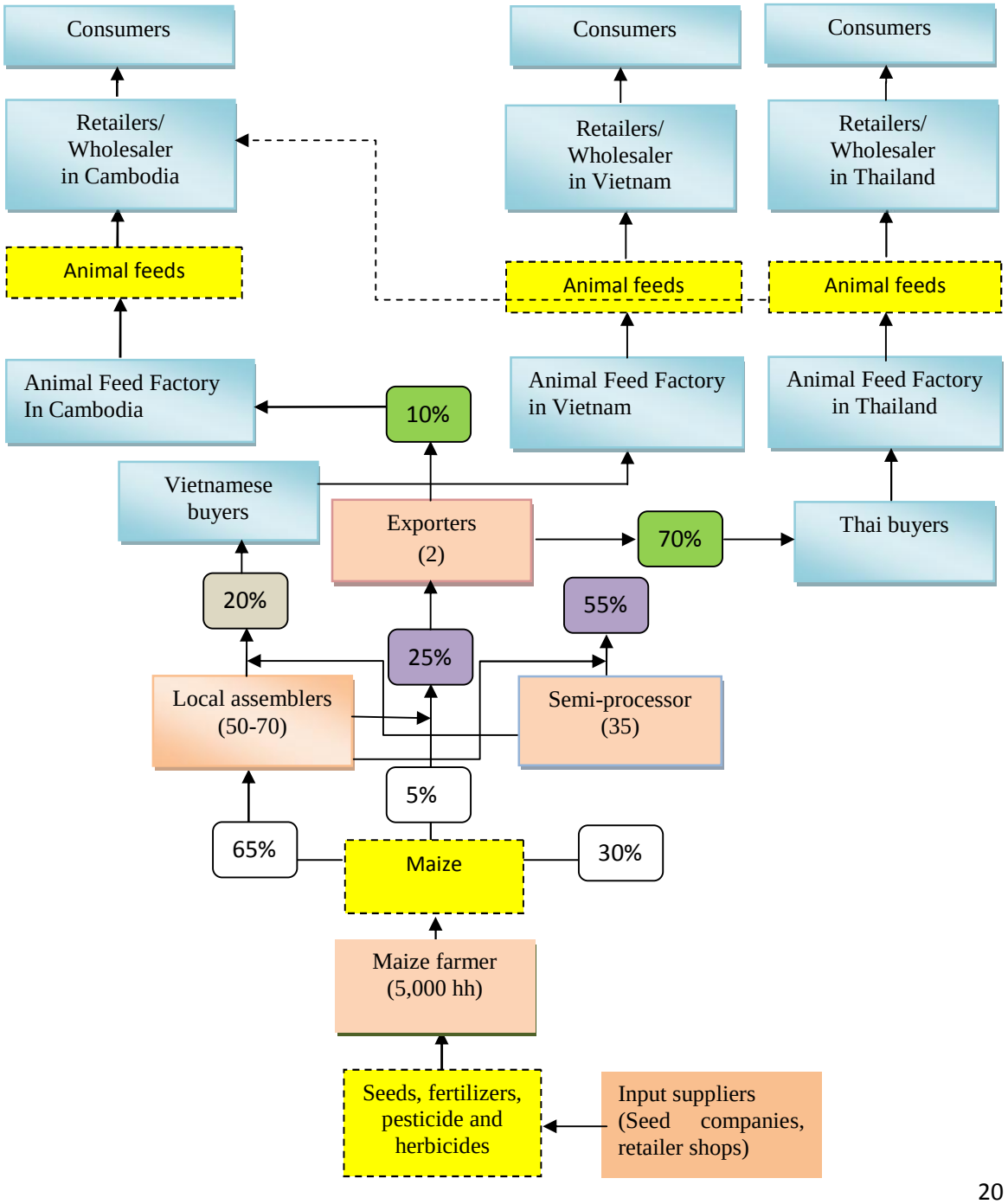

Figure 6. Flows of Product and Volume

Although knowledge and information is not perfectly shared well among actors in the value chain, there are backward and forward linkages (Figure 7). Farmers are informed about maturity of maize by buyers if they want to sell cob maize. Their maize is evaluated based on grades if they want to sell as grain in addition to the produce maturity. The grades of grain maize are evaluated based on characteristics, percentage of moisture content, percentage of waste, and percentage of small grain (Table 8).

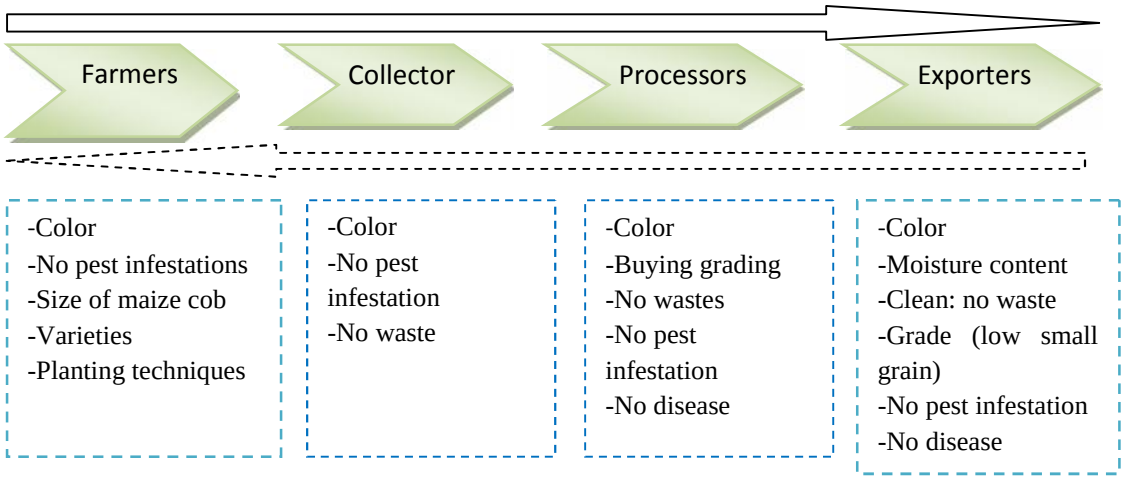

Figure 7. Information flow

Because often farmers rarely store maize after harvesting, they don't face any quality problems such as pest infection in the wet season. Assemblers, who sell grain maize to semi-processors and exporters, who export grain maize to Thailand, must comply with quality standards. Different local buyers have their own different quality standards. In general, if farmers and assemblers, who want to sell grain maize these buyers, must comply with these differently commercial quality standards. Quite often, the quality standards are not well understood by farmers and small scale assemblers. Therefore the enforcement of the rules and regulations for quality standards depends entirely upon each buyer who evaluates quality and determines the price. The semi-processors or exporters, who export grain maize to Thailand, must comply with the Thai quality standard's requirements and must provide evidence of sanitary and phyto-sanitary (SPS) from the Cambodia.

Table 8. Characteristics of Different Grades of Maize Grain

Grade	Characteristics	% of moisture	% of waste	% of small grain
E	Low broken, least proportion of floating seeds, fungus and waste (mix with cob, weed seeds, …)	14-16%	2.5 – 4	< 30
C	Low broken grain, low proportion of floating seeds, fungus, waste (mix with cob, weed seeds, …)	14-16%	4.1 – 6.5	30 – 40
D	Moderate broken, moderate proportion of floating seeds, fungus, waste (mix with cob, weed seeds, …)	14-16%	6.6 – 8.5	40 – 50
O	High broken grain, high proportion of floating seed, fungus, waste (mix with cob, weed seeds, …)	14-16%	8.6 – 10.5	> 50

The information on market prices is shared very well among all actors in the chain and no one has absolute monopoly or monophony power. Farmers and assemblers can quote the prices posted at different semi-processor or at exporters, who bid based on the price quoted from Thai buyers or Vietnamese buyers or animal feed factories in the country. These latter buyers buy based on the global market price. The market seems very competitive as there are a number of buyers whom farmers or small scale assemblers can approach. Despite, assembler, processor and exporter reporting of the price determination by Thai buyers, there are two additional markets where assemblers, semi-processor and exporter can refer. They are the Vietnamese buyers and animal feed factories in the country.

4.2.4. Relationship and Linkages

Although most actors appear to be independent of each other, there exist vertical relationships and linkages in the chain. The input providers do not have a direct relationship with farmers, except providing training in terms of field demonstrations about new seeds that the companies wish to market. The relationship between companies providing inputs and farmers is indirect. Instead, the seed companies set up their linkages with sales agents in specific target areas in order to sell seeds and chemical fertilizers to reach their targets. These sales agents set up additional networks to sell seeds and fertilizers to farmers. Selling is usually conducted in the form of credit or in cash depending upon how farmers' purchasing power. Although some assemblers do not have specific relationships with farmers, most assemblers try to build relationships and linkages with farmers in specific targeted areas through their long term buying commitments and input credits and credit loan. Some assemblers build relationship with exporters. Unlike assemblers, who build relationships with farmers,

semi-processors do not, but buy from farmers whoever can deliver cob maize to their gates. The exporters do not have a direct relationship with farmers, but rather with some assemblers. The relationship between semi-processors and exporters is seen in form of buying export quotas only. These two former actors do build relationship and linkages with Thai brokers or Thai buyers or animal factories in the country in terms of market price information and some degree of buying commitment, but based on the market prices.

There is almost no horizontal relationship or linkage among actors at the same level in the value chain. The relationship between input providers could be viewed as a fierce competition because each company opts different strategies to sell their products in the province and as well as in the country. This includes spending considerable amount of money on advertising, providing field demonstration to farmers for free of charge, and seeking for rent to enter market and to occupy market share. At present, there are at least five seed companies and a number of chemical companies which distribute products in the province and in the country. The relationship between farmers and farmers is often seen in form of exchange information on cultivation techniques, inputs quality and market prices. There is almost no relationship between among assemblers, except in the case that they are friends or relatives. In such cases, their relationship is seen in form of exchange on price information only, otherwise their relationship competitive. No relationship or linkages exist among semi-processors. . In fact, they compete with each other in terms of buying effort and buying prices. The same situation is reported for the relationship and linkages among exporters.

4.2.5. Rules and Regulations

There are no official rules and regulations governing produce quality standards. The quality standards are commercial standards which are set by buyers. These standards vary from buyer to buyer. Although Table 8 displays an example of basic quality standards set by an export company when buying maize from farmers, assemblers, or semi-processors. This standard is applied to grain maize, but not to cob maize. The rules and regulations for the cob maize is based on matured maize, otherwise buyers will not buy from farmers. Cob maize that is marketed in the province is the hybrid maize with the yellow color, but not the glutinous maize with white color. The enforcement of the rules and standards is determined by the buyers who set their standards which are often affected by market forces. Given a lack of formal quality standards, the Provincial Department of Commerce cannot enforce rules and regulations about the quality standards.

Nevertheless, there is a law on the management of pesticides and fertilizers in Cambodia. The creation of this law aims to ensure food safety and public health through the effective control of pesticides and fertilizers and the uses of these chemicals in conformity with international standards. The law is enforced by the Provincial

Department of Agriculture in collaboration with line authorities such as the Police Department and the Military Police Department and the Department of Justice.

4.3. Value Chain Analysis

Despite having the highest percentage of added unit cost (Table 9), farmers receive the highest percentage of added unit profit, while the assemblers have the lowest percentage of added unit cost and receive the lowest percentage of unit profit. The semi-processor has the second lowest percentage of added unit cost, but receives the second highest percentage of unit profit. The exporter receives the second highest percentage of added unit cost, but receives the lowest percentage of unit profit. Although farmers receive the lowest net profit (Table 9) and exporters receive the highest net profit, farmers enjoy the highest ratio of net profit to total cost and the exporters have the lowest ratio of net profit to the total cost. The differences in net profit among actors in the chain are affected by the differences in quantity they produce, buy, or sell.

Table 9. Costs and Marketing Margins

	Cost/Kg			Profit/Kg			Margin	
Actors	Unit Total Cost	Added Unit Cost	% Added Unit Cost	Unit Price	Unit Profit	% Total Unit Profits	Unit Margin	% Retail Price
Farmers	$0.12		**69**	$0.17	**$0.050**	**32**	$0.17	57
Assemblers	$0.17	$0.01	7	$0.21	$0.028	18	$0.04	13
Processors	$0.19	$0.02	11	$0.25	$0.040	26	$0.04	13
Exporters	$0.21	$0.02	13	$0.27	$0.039	25	$0.05	17
Total		**$0.17**	**100**		**$0.190**	**100**	**$0.30**	**100**

The data seem to suggest that the cost and net profit are shared more toward lower value chain actors although farmers incur the highest percentage of added unit cost. The results seem to support the conclusion that the market in the province is competitive. The differences in percentages of unit profit between assemblers, semi-processor, and exporters are mainly due to the differences in percentages of unit added costs. The unit added cost increases from 7 percent for the assembler to 13 percent for the exporter. This increase is attributed to the increase in the fixed costs on facilities such as warehouse, drying facility, and threshing and cleaning facilities as the capacity of buying maize increases.

Table 10. Cost and Net Profit per Actor

Actors	Farmer	Assembler	Semi-processor	Exporter
Total Cost	$2,609.51	$58,3612.5	$1,028,153.71	$1,884,413
Net Profit	$1,087.30	$96,124.41	$216,453.41	$355,434.00
Ratio	0.42	0.16	0.21	0.19

The major costs of farmers are consisted of imputed land rental, land preparation and labor for harvesting. They costs constitute about 70 percent of the total production cost. Land rental alone constitutes 43 percent (Table 10). Normally, most farmers do not rent land, but instead own land. It is included in the calculation as an opportunity cost because farmers are able to rent their lands to others or the land can be used for cassava cultivation or longan growing. The rental price here was extrapolated from the rental price for cassava or longan cultivation. Land preparation cost is attributed to the cost of renting tractors for plowing, which is associated with the price of fuel, labor wages and the deprecation and maintenance of the equipment.

Table 11. Production Costs of Maize

Activity	**Cost/ha**	**Share (%)**
Land preparation	$ 105.00	14.2
Seed	$ 56.67	7.7
Planting	$ 31.25	4.2
Fertilizer	$ 45.00	6.1
Chemical	$ 30.00	4.1
Weeding labor	$ 22.50	3.0
Harvesting labor	$ 78.13	10.6
Upload labor	$ 11.67	1.6
Land rental	$ 333.33	45.1
Transporting (farm to house)	$ 25.00	3.4
Total	**$ 738.54**	**100**

4.4. Problem Tree Analysis

It seems that the maize value chain in the province is functioning reasonably well. The underpinning structure is the market based trading system. The market in Pailin is very competitive as there are a number of buyers within the Pailin's chain and outside the Pailin's chain. Within the province, there are 50 – 70 assemblers, 35 semi-processors

and 2 exporters. In addition, there are a number of animal feed mills[8]in Cambodia that buy maize from the province. Betagro Company[9] is planning to build a new mill in Phnom Penh, Cambodia in 2014. Outside of the country, there are a number of Thai buyers and Vietnamese buyers to supply inputs of animal feed factories in Thailand and in Vietnam. Some assemblers and many semi-processors are able to access foreign buyers and domestic buyers regardless the existence of two exporters. Although the value chain within the province appears to have been functioning reasonably well, there have been some problems at each level as indicated below

4.4.1. Problems along the Chain

At the production level, there is a lack appropriate cultivation technology, with labor, seed control, and production planning. In addition there are exogenous issues of erratic weather, high price of inputs such as seeds. At the collection level, large quantities of maize produced by farmers do not meet the required quality standard standards. At the semi-processing and export levels, besides the above problems, there are trade facilitation issues at borders such as informal charges, and congestion and time consuming in processing. These problems can then be grouped into two main categories that are encountered at the production level and information and knowledge.

At the production level, productivity and production have recently declined. This decline is associated with a number of factors. At the flow of information and knowledge level, there is a lack of uniform and formal quality standards that are shared among all actors. Such a lack of information is related to a number of factors which prevent information smooth information flow, especially the backward flow within the chain at the province level. Changes in the global demand and maize subsidy policy in Thailand are seen as temporary disturbances to the value chain in the province.

4.4.1.1. Production Decline

Maize production in Pailin has recently declined since 2010 (Figure 8).About 52 percent of maize production in the province dropped during 2010 and 2011. Although rebounding in 2012, the production remained a 45 percent drop if compared to the production in 2010.The production decline was attributed to a number of factors. These are the reduction of maize cultivated area, lower productivity and the lower profit of maize compared with cassava.

4.4.1.1.1. Reduction of Maize Cultivated Area

[8] One Chinese mill, one Korean mill and Cambodian mills

[9]http://www.worldpoultry.net/Broilers/General/2013/2/Cambodia-embraces-intensive-livestock-production-1177745W/

The reduction of maize cultivated area in the province was attributed to two major factors, the drop in the demand for maize and the switching to cassava cultivation. The drop in the demand for maize was attributed to the reduction in the demand of Thailand's import of Cambodian maize since 2010. This drop moves in tandem with the drop in the global demand for maize as well as Thailand's import restriction of Cambodia's maize as to prevent the Cambodia's maize from interfering with Thai government's subsidy policy, called Corn Pledging Program implemented in 2009/2010 (Prasertsri, 2012). Cambodia's maize export to Thailand decreased by about 42 percent in 2012 if compared to 2011. Due to a drastically drop in the demand for maize, many farmers have switched to cassava production (Figure 8).In the meantime, the demand of Thailand's import of cassava from Cambodia has risen since 2010. As the result, the production of cassava has moved in the opposite direction to maize production (see Figure 8). The main driver of Thailand's increased demand for cassava in the rapid growth in the country's bio-fuel production and consumption.

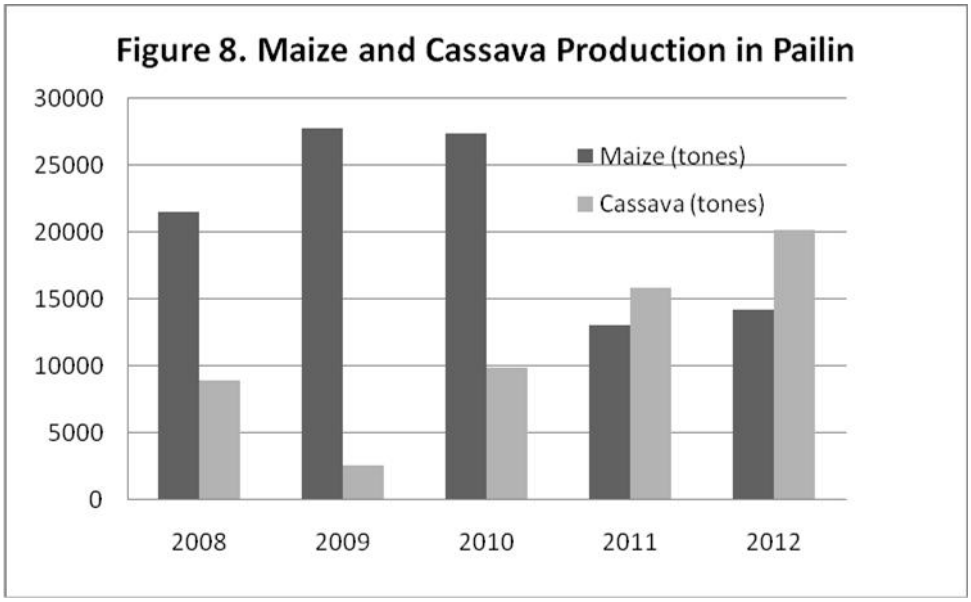

Figure 8. Maize and Cassava Production in Pailin

4.4.1.1.2. Decline in Productivity

The decline in maize production in Pailin is partly attributed to the uses of the poor quality of seed and the poor quality of chemicals by farmers as well as soil degradation. Given that the price of seed has increased over time and the heavy competition in seed markets, there have been reports of selling poor quality of seed in on the black market. During focal group discussion, farmers reported that the quality of both brand named and non-brand named seeds has recently deteriorated. Respondents believe that the seed market is very competitive and the law enforcement on seed and chemicals quality control is less strictly enforced, despite Cambodia's law requiring that all seeds circulated in the market be registered at the Ministry of Agriculture, Forestry and Fisheries (MAFF).

Another factor attributed to this decline is the degradation of soil fertility which is associated with improper soil management. Farmers still practice traditional methods, plowing soil twice or more without mulching and are unaware of the benefits of mulching. Despite of having many years of experience, many farmers do not have solid knowledge and understanding about the applications of chemicals such as insecticides herbicides or fertilizers. Their knowledge and understanding is inadequate In addition, their knowledge about seedbed preparation and suitable conditions for seed germination is also inadequate. To have good germination and healthy seedling, seedbed, planting depth and right conditions must be properly observed (Belfied and Brown, 2008). Again, their knowledge about this technique is inadequate because plowing and sowing is carried about by machine owners whose interest is to provide service only. Dulioust (2011) also noted that mono-cropping such as maize and cassava would jeopardize the future performance and resilience of the agriculture because of soil fertility degradation. This suggests the practice of maize mono-cropping over a period may attribute to the degradation of the soil fertility.

4.4.1.1.3. Rise in Production Cost

The increase in production cost is attributed to a number of factors. First of all, cost escalation is driven by mechanized land preparation and planting. Thus, product costs must increase linearly with the price of oil and higher machinery interest and depreciation costs. Farmers still apply traditional methods in land preparation and planting. Plowing is done at least twice before sowing. Secondly, there is overuse of inputs such as seeds and in some cases chemical fertilizers, pesticides and herbicides. Most farmers use seeds of 18 – 22 kg per hectare, higher than the dose recommended by seed companies of 16 kg per hectare. Thirdly, there is a lack of linkage between farmer associations with input suppliers, such as seed companies and chemical companies. As a result, farmers could not enjoy economies of scale and with corresponding lower production costs. There are two or three brokers in the maize seed supply chain before the seed reaches to farmers. Therefore it is important that farmers be linked directly to the seed companies. The same system has also been reported during interview with farmers and focal group discussion for chemical fertilizers, especially for those who are unable to pay in cash, but have to buy on credit.

Although the input cost and labor cost constitute only 28 percent of the production cost (Table 10), the prices and the wages have been increasing overtime. The low demand for maize along with high production has resulted in lower profit of maize cultivation

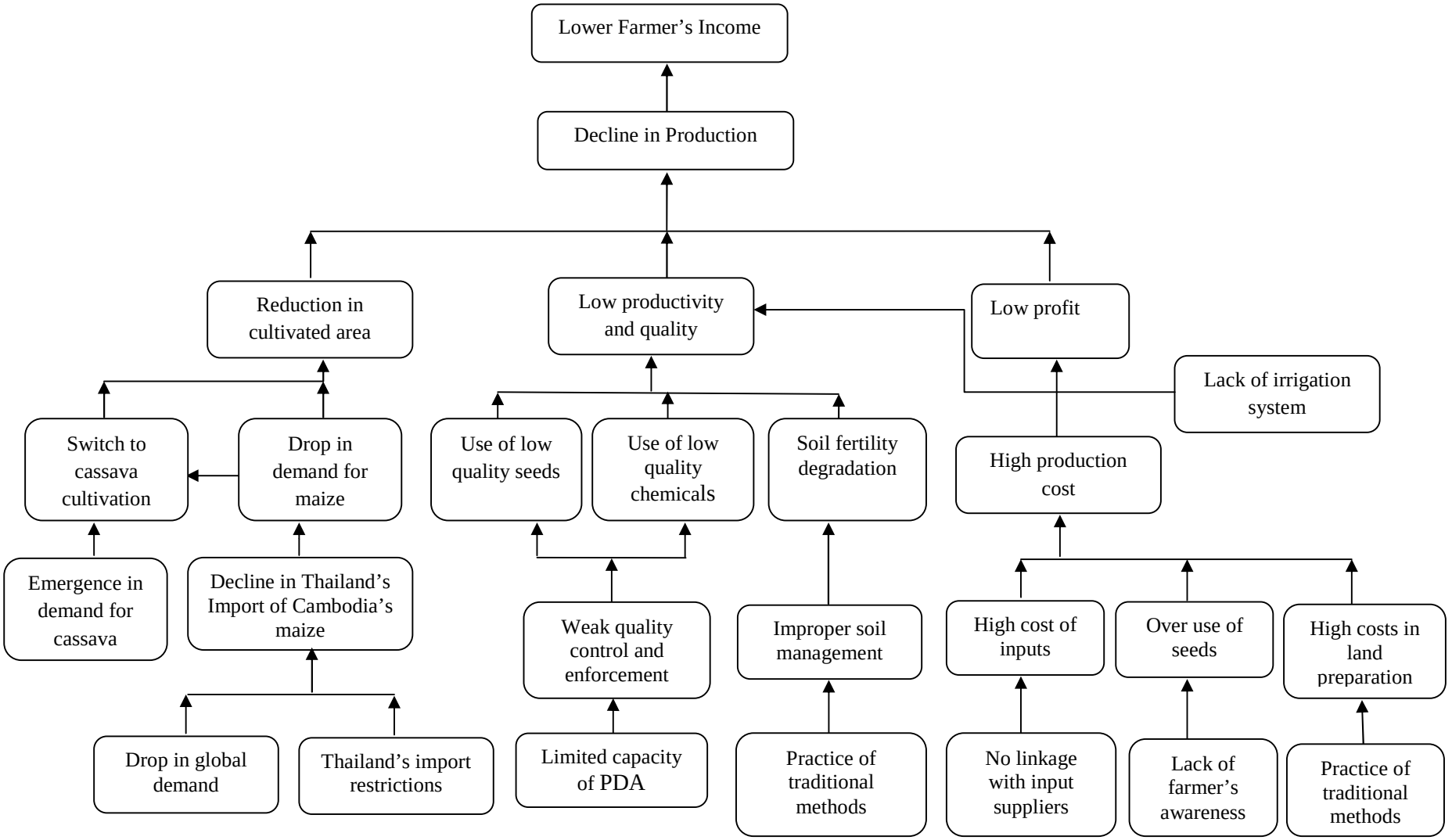

Figure 9. Problem Tree Analysis of Production

4.4.1.2. Lack of Formal Quality Standards

Despite the existence of free trade agreement among ASEAN member countries, non-tariff remains a major problem of the CLMV countries to export their agricultural products to other ASEAN countries. One of the recent bans of the Cambodia's maize export to Thailand is the Thailand's demand for the Cambodia's maize quality standards to meet the standards required by Thai feed-meal producer (Pratruangkrai, 2012) because Cambodia does not official rule and regulation about quality standards of the maize product. To avoid such accusation, it is important that Cambodia's maize quality standards should be established. The standard is normally set by respective buyers in the chain. It varies from buyers to buyers. Farmers are informed about maturity of maize by buyers if they want to sell cob maize, but do not know well about different grades and quality standards if they want to sell grain maize. Similarly, assemblers reported that different buyers have their own standards. They don't know clearly about the basic quality standards and grades. Their products evaluated and bought on based on buyer's quality standards. Although the market is competitive, such a lack of quality standards could result in a number of consequences such as non-tariff barrier when exporting to Thailand, price manipulation, weight manipulation, law enforcement, and possibly food safety concerns. The lack of formal standard is attributed to a number of reasons.

4.4.1.2.1. Use of Poor Quality Seeds

As indicated earlier that most farmers do not have clear knowledge about the basic quality standards and grades. There is no national quality standard that they can refer to when producing maize as well as a lack of control of seed quality circulation in the province. As the result, farmers use poor quality seeds. This was attributed to a lack of awareness rising to farmers by the department of agriculture. The lack of awareness was further attributed to a lack of capacity of the provincial department of agriculture to have enough information and evidence to provide to farmers as incentives for changing practices. As described in supporter section, one of the many functions of the department is to monitor and control market monopoly and enforce regulations and law. However, the capacity of the department is limited in terms of technical and legal capacities including negotiation skills. The department does not have a clear plan for staff capacity development as this links to the department's budget constraints.

4.4.1.2.2. Lack of Adequate Cultivation Technology

In focal group discussions, farmers reported that they lacked technology to produce maize to meet the quality standards. This is also linked to inability and limitations of agricultural extension to provide such technology. Farmers still use traditional methods that they learn through trial and error process.

4.4.1.2.3. Lack of Soil Typology

During focus group discussion, the agricultural department raised the point that soil typology in the province is also necessary to determine which seeds are suitable for which soils. However, due to capacity limitations, such efforts could not be carried out to inform farmers about the suitable soil type and conditions. This capacity limitation is constrained by budget limitations and capacity development planning. Moreover, low staff motivation has been linked to staff's capacity, knowledge and skills as well as to incentives, both financial and non-financial. The current salary of public sector staff is very low although the government has pledged annual increases. Most staff has to seek additional part-time jobs such as cultivating maize, cassava, longan or other activities to supplement their low salaries so as to cover their daily living costs. This results in part time government support to farmers rather than full time as required to boost maize productivity. Although the government has issued guidelines with regard to staff promotion, the implementations of the guidelines remain unclear.

4.4.1.2.4. Lack of Irrigation System

Lack of sufficient water supply is thought of as one of major problems in ensuring quality standards of maize, especially in flowering and milking stages. Such insufficient water could affect the quality of maize in terms of size, color and nutrient contents. At present, there is no irrigation system establishing in the province to supply water during the dry season. The present cultivation of maize relies on erratic rainfall which affects not only the quality of maize, but also the production of maize. Inadequate water supplies are expected it further reduce maize yields from rising temperatures cause by climate change.

4.4.1.3. Outcomes

The decline in maize production in Pailin would imply a reduction of farmer's income although farmers opting shifting to cassava cultivation as the price of cassava is subject to very high volatility. Cassava is not the best option for smallholder farmers in Pailin as it can be cultivated only once a year. In addition, farmers cannot afford not afford to wait so long before recovering costs of production and receiving their returns to the use of labor, land and capital. The lack of formal quality standards results in farmers not producing produce the right maize qualities. The inhabits the enforcement of government rules and regulations on quality requirements. As the result, farmers and

low level value chain buyers bear high production costs and the prices they receive for their efforts are open to manipulation by upstream buyers

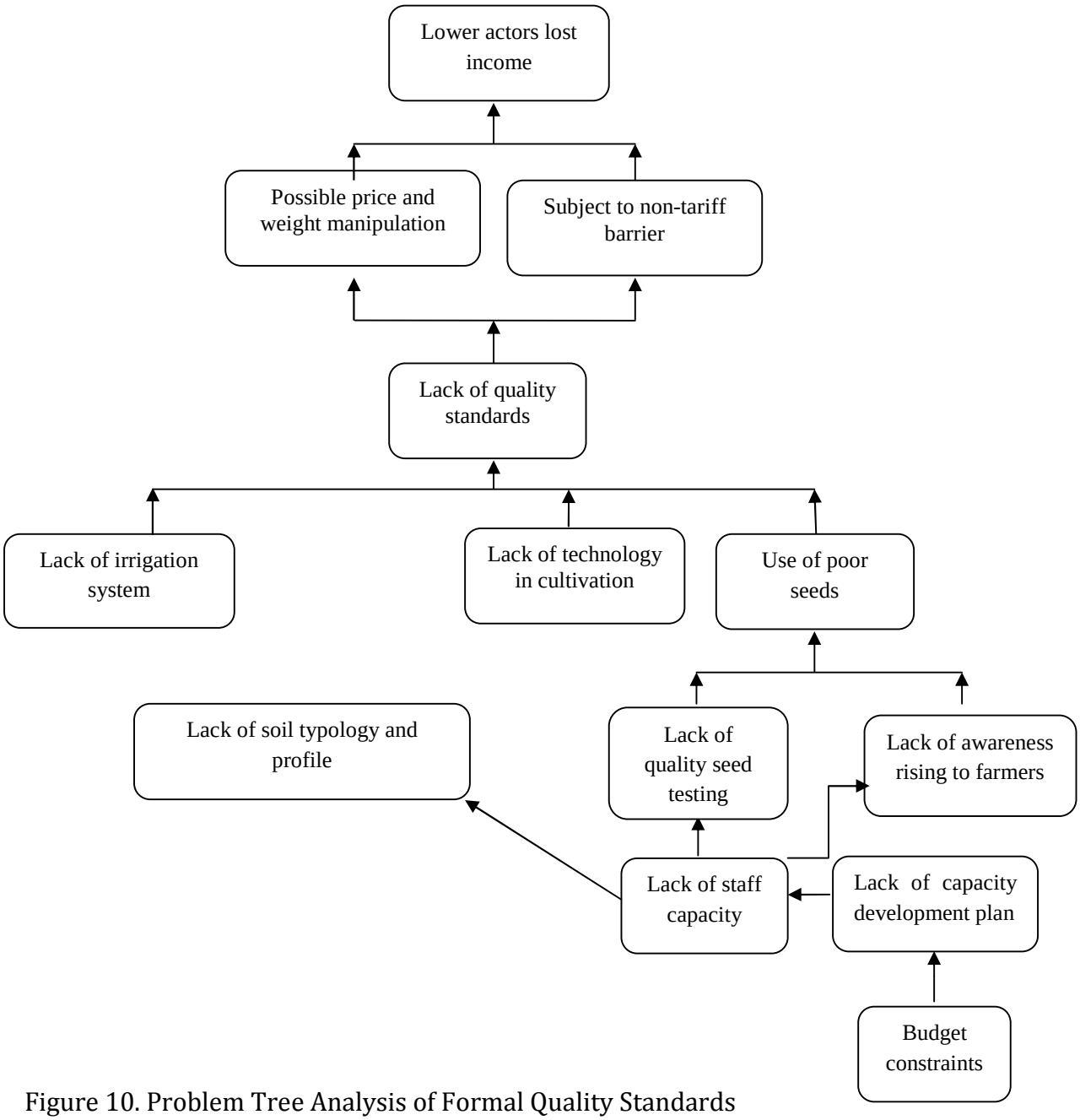

Figure 10. Problem Tree Analysis of Formal Quality Standards

5. Recommendation

As indicated in the problem analysis above, there are two main problems in the value chain of the province. These include the decline in production and the lack of formal quality standards. The decline in production is caused by changes in the maize cultivated area, the decline in productivity and with lower profits. The change in maize cultivated area is due to changes in global demand for maize and Thailand's import restriction of Cambodia's maize in the past few years and the switch to cassava

production due to the emergence of high cassava demand in recent years. The decline in productivity is associated with the uses of poor quality seeds and chemicals and the degradation of soil fertility. The use of poor quality seeds and chemicals are complicated by a lack of or weak quality control and enforcement on uncertified seeds and chemicals circulated in the market. The degradation of soil fertility is attributed to inadequate farmer knowledge about soil management. The drop in profit is related to the increase in production costs as the results of several times of soil plowing in land preparation, overuse of inputs, especially seeds and a lack of linkage with input suppliers to benefit from economies of scale.

The absence of formal quality standards is associated with a lack of awareness of the line responsible agencies, and farmers. Such absence affects quality of maize produced by farmers. This attributes to a number of factors as described above. Therefore, in order to improve the value chain, the production decline and absence of 0formal quality standards should be addressed

5.1. Objectives

1. To improve maize production in Pailin so that farmer's income, especially the smallholder farmers who are mostly engaged in this activity can be improved
2. To formalize quality standards so that all actors use the same quality standards as part to improve knowledge and information flow in the value chain

5.2. Areas of Intervention

There are two areas of intervention that should be addressed in to reverse the production decline. These are productivity and profit improvement, measures while other areas such as changes in cultivation area of maize is affected by the changes in global demand and subsidy policy in Thailand, which are exogenous constraints and are considered temporary effects.

Similarly, there are two areas of intervention in formalizing quality standards of products. These are improving awareness and capacity building of the Provincial Department of Commerce, while other areas such as equipment/materials and staff's motivation will be gradually improved as the department's budget is increased overtime and as the department's staff motivation policy is improved.

5.2.1. Interventions in Production Stage

5.2.1.1. Building and Strengthening Capacity of PDA

To improve the use of good quality of inputs by farmers, it is important that control of inputs distribution and law enforcement in the province should be implemented. Control and enforcement is under the responsibility of Office of Agricultural Legislation

and Enforcement of the Provincial Department of Agriculture. However, its capacity is limited in terms of ability to implement the law, to raise awareness to farmers and sellers, and necessary equipments and materials to implement the activities. Therefore it is essential that the capacity of this office must be built up and strengthened.

5.2.1.2. Introducing Modern Practice in Maize Cultivation

To improve soil fertility, farmer's knowledge on soil management and cultivating technique should be reviewed and improved. Modern practice does not require cultivating soil to plant maize at all as long as stubble is retained from previous crop and provided that the field is relatively even and kept free from weeds (Belfied and Brown 2008). The use of grain drills pulled by tractors with overlying vegetative cover is the correct method for planting and increasing maize yields. Plowing the soil is costly and reduces soil fertility. One of the benefits of retaining crop residues is to reduce soil erosion as well as to reduce emergence of weeds and to reduce the risk of crop failure as a result of drought. Seed germination is directly linked to seedling survival. The modern practice requires that maize seeds are planted at 2-5 cm depth with right conditions (moisture and temperature). However, the current use of tractor plowing with disc harrows at deeper depth may cause the poor growth of seedlings. Therefore, it is important that awareness of such techniques be made available to farmers.

As indicated earlier, high production cost is attributed to costs of land rental, land preparation, input cost, and labor costs. To reduce the production costs, the modern practice should be introduced to farmers. The number of times of land plowing should be reduced or stopped and replaced with of mulching of residual crops. If such technique is adopted, farmers should be able to save 14.2 percent of their production cost (Table 9). Moreover, maize should be planted in rotation with leguminous crops (mung beans, soybeans, etc) as a measure to boost soil nitrogen and carbon capture as well as provide cover for water retention and improved soil tilts**.**

5.2.1.3. Reduction of Seed Overuse

The second possibility of reducing the production cost is to apply the right amount of seeds as the indicated in the guidelines of the seed companies so that farmers would be able to save 2 – 4 kg of seeds per hectare. This appropriate application implies that farmers would be able to save $5 – $10 per hectare. By applying mulching technique, there is a possibility to reduce or prohibit emergence of weeds and therefore farmers would be able to save the cost of herbicide and the cost of hiring labor to do weeding. This could save farmer up to $52 per hectare.

5.2.1.4. Linkage with Input Providers

The third possibility is to link farmers with input suppliers through farmer associations. The input suppliers are seed companies, such as CP Company, Pioneer, Seed Asia, Pacific

Seed, etc. and chemical companies so that farmers could enjoy economies of scale and therefore a lower price. The whole sale price of CP seed is only $2.36/kg, while the retail price is $2.5 – $3.5/kg. If farmers were linked with seed companies, they were able to save $0.14 – $1.14/kg of seed and would be able to save more they were linked with chemical companies

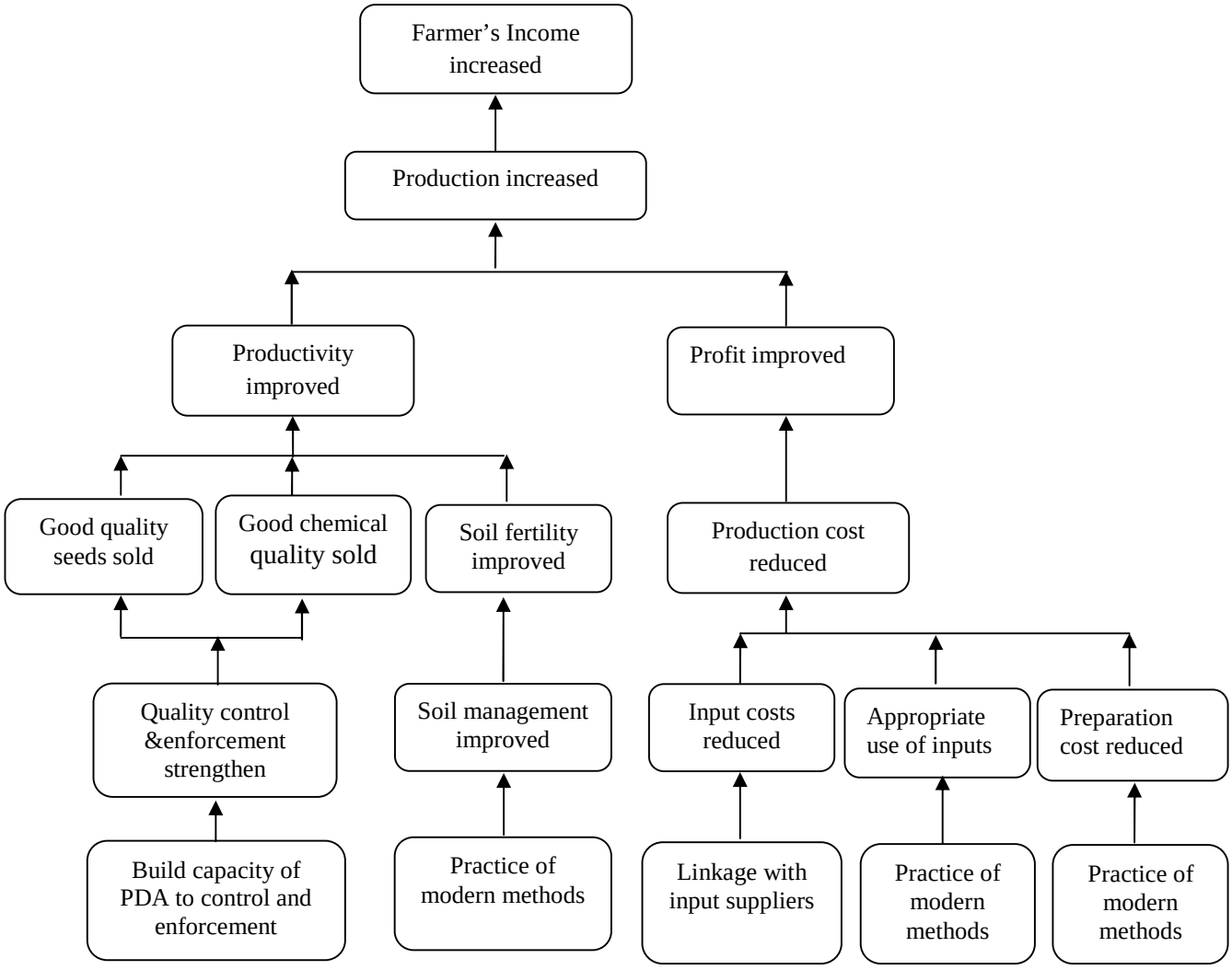

Figure 11. Objective Tree Analysis of Production

5.2.2. Interventions in formal quality standards

As described before, the backward flow of information appears less apparent. Farmers are informed about maturity of maize by buyers if they want to sell cob maize, but do not know much about different grades and quality standards requirements if they want to sell grain maize as there is no formal regulatory mechanism in the value chain. Different buyers set their own quality standards. They vary from buyer to buyer. The consequence of absence of the formal quality standards is that lower value chain actors are less informed about the quality standards and with lack of enforcement, they are

easily manipulated by buyers. Provincial departments appear to be unaware of this problem.

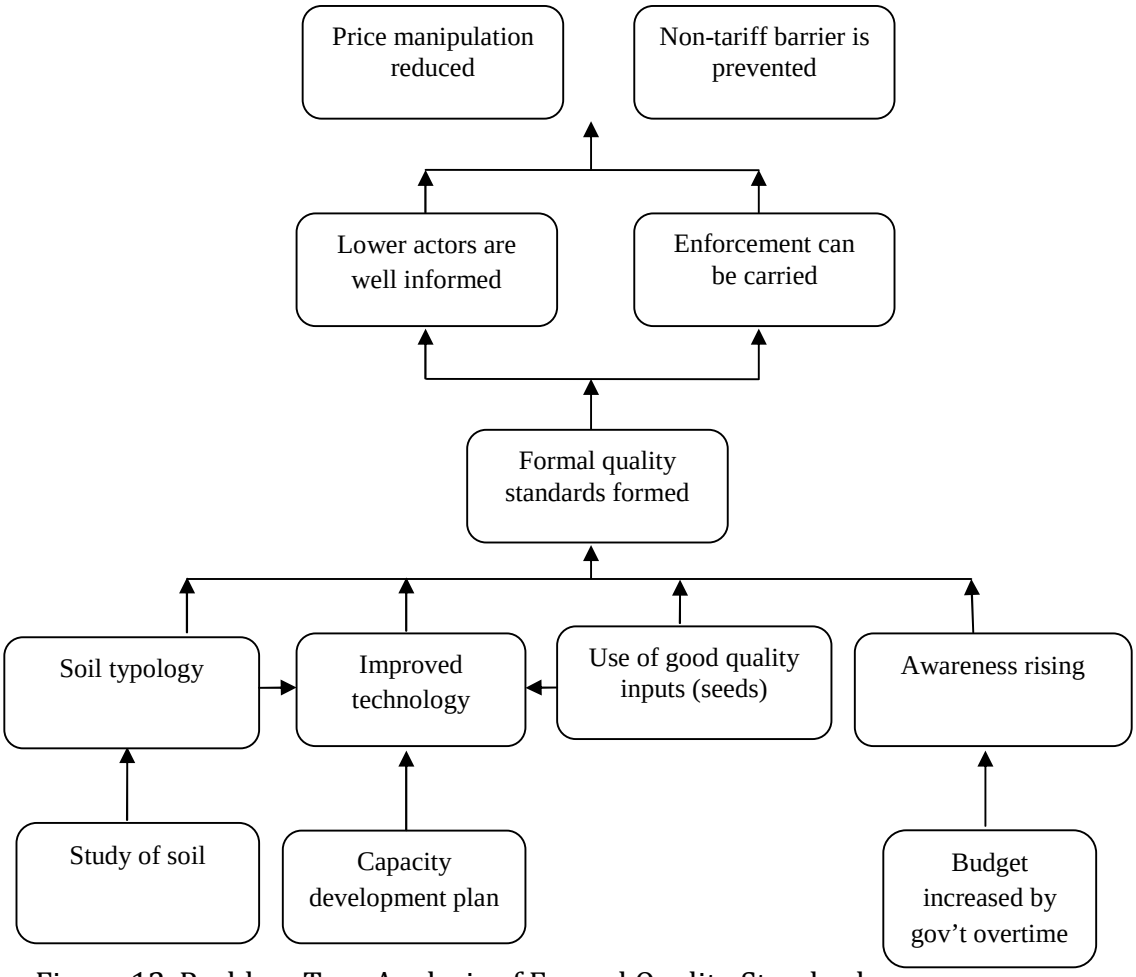

Figure 12. Problem Tree Analysis of Formal Quality Standards

5.2.2.1. Raise Awareness

To raise the awareness to all actors about the quality standards, it is essential that formal quality standards be developed and factors affecting the quality of maize be identified. It should be noted that in order the line department can raise awareness, it is important that the budget be increased as current budget allocations is very limited and impeding them to do many necessary activities and programs. The formal quality standard enables the line departments to monitor the situation over time and enables them to enforce the rules and regulations and enables the department to develop capacity development plan in the long run.

5.2.2.2. Improved Technology

It is believed that part of quality maize is affected by the use of good quality of inputs such as seeds, chemical fertilizer, and effective pesticide to kill insects and weeds. In

addition, farmers believe that different seeds have different adoptability and growth in different soil that therefore it is important that soil typology be conducted in order to recommend to farmers which seed is suitable for which area and soil. This requires that soil type and profile be made available in the province.

A pointed out earlier, the capacity of the provincial department of agriculture is limited and to be able to implement the above activities, therefore it is essential that their capacity be built and strengthened.

5.3. Systematic Changes

5.3.1. Production

As farmers practice modern technology in maize cultivation, soil fertility is improved and the production cost is reduced. And as the capacity of the Provincial Department of Agriculture is built and strengthened, the department will be able to carry quality control regularly and enforce the law. As the result will show, the quality of seeds and chemicals will be improved and farmers are able to use good quality seeds and chemicals. These would lead to the improvement of productivity and the improvement of farmers' income.

5.3.2. Quality Standards

Having developed quality standards, line departments and other actors would be aware of the issues and would be able to develop their capacity. The formal quality standard bestows the line departments the rights to enforce the rules and regulations, and also enables all actors; especially farmers to produce maize to meet the quality standards. As the department is able to enforce rules and regulations to ensure the fairness in quality and grade evaluation and the lower echelon actors would be better informed of the quality standard; and therefore, the chance of price manipulation is reduced and non-tariff barriers can be mitigated.

5.4. Outputs

5.4.1. Production

- The capacity of the Provincial Department of Agriculture is built and strengthened for production quality control and monitoring
- Modern cultivating technology of maize introduced and applied by farmers
- Guidelines on seed and chemicals applications are used by farmers
- Farmers Associations are linked to input suppliers

5.4.2. Quality Standards

- The capacity of Line Provincial Departments are built and strengthened
- Formal quality standards of maize are available

- All actors are aware of quality standards,

5.5. Outcomes

5.5.1. Production

- Productivity would be improved at least by 20 percent as farmers apply the modern technologies
- Production cost would be reduced by at least 22 – 25 percent from applying these same technologies
- Farmers would be able to save at least $165 – $185 per hectare
- Maize production is increased by at least 25 percent

5.5.2. Quality Standards

- As the lower value chain actors are aware of formal quality standard, the backward information flow is improved
- The Line Provincial Departments are able to enforce the rules and regulations on quality standards and negotiate with the country of trading partners

5.5.3. Summary of Key Issues and Problems in Maize Production and Marketing

Summary of Key Barriers to Competitiveness in the Maize Sector in Cambodia[10]

Market Constraints

- Inadequate access to information about seed variety selection and grades and standards
- Insufficient access to appropriate seed varieties
- Inadequate access to finance through banking sector drive farmers to use high cost financing through brokers
- High cost of tractor hire due to high cost of fuel
- Lack of adequate market information to allow farmers to improve negotiation leverage with brokers and other buyers
- Absence of a contract mechanisms to help bind relationship between farmers and their investors/sponsors
- Absence of a code of conduct among players in the sector to limit pirate purchasing
- Price discovery process for maize is not reflective of actual cost due to the lack of insufficient market information
- High cost of transporting

Governance

[10] Dr. Steven Shepley, Research in Cambodia

- Lack of promotion and awareness to take advantage of local seed varieties
- No soil conservation programs in place to limit negative impacts of monocropping, and to offer alternative methods of farming through soil improvement regimes
- Lack of regulatory framework and enforcement capability to help ensure that seed varieties follow established standards and certification requirements
- Better access to affordable farm land and land titling is not addressed
- Absence of grading, classification and quality standards to differentiate product pricing and to reward farmers for producing a quality product
- Excessive government interventions in cross border commodity trading.

Institutional

- Absence of or weak extension services, particularly for rural farming communities
- Lack of knowledge about multiple or intercropping techniques to improve soil productivity
- Lack of better access to improved farming techniques, particularly for rural farming communities
- Soil deterioration from monocropping, climate change and other factors including improper use of agro-chemicals
- Absence of an awareness campaign to move farmers away from the use of retained hybrids to more productive local seed varieties
- Inadequate awareness among rural farming communities regarding crops and cropping options
- Absence of metrological services, particularly to measure moisture content of maize at the lower end of the value chain
- Lack of farmer know-how regarding post-harvest handling and storage techniques, resulting in high grain losses and reduced margins for small holders
- Weak farmers associations to help pool resources and to organize community or communal storage Sheds
- Lack of climate change strategies

Human Resources

- Poor on-farm farming technique
- Little knowledge about farm management
- Limited knowledge and skills base of extension workers and other technology transfer agents

6. Policy Improvement Recommendations

6.1. Demand Side Policy Imperatives

The preceding Value Chain Analysis shows a reasonably well functioning value chain on the **demand side** with functional linkages and a high degree of competiveness. The most prominent constraints in the demand side include cumbersome and time consuming border transaction and export procedures, including Thailand import quotas and rent seeking behavior on the part of some officials on both sides of the border. Both of these phenomena inhibit value chain strengthening in the upstream end of the total chain from functioning efficiently and tend to add costs rather than much value to the export track beyond the production area in Cambodia.

The factory gate price from Cambodia maize in Thailand is $0.35/kg. The Ex-farm gate price in Cambodia is $0.27. Taking the mean distance from the Cambodian border to Thailand animal feed factories of 120km and a mean Thailand transport cost of Baht 4/ton-km, the transport cost from the border to the factory is 4 baht/$31/ton x 80km = $0.13/ton-km, or $0. 01.3/kg/km. This suggests that transaction costs from fees and rent seeking at the border amount to 0.35-0.27-0.013= US$ 0.05/kg. These estimates show that there is an urgent need for the EWEC states to agree on a common single window border procedural regime, including uniform SPS standards with a regional inspection mechanism to curb border rent seeking and non-tariff barriers to cross border trade.

Although the value chain study regards the Thailand import quotas to be temporary exogenous restraints to trade. There is no room for import and export quotas in a common market framework. ASEAN states should be encouraged to discuss and dismantled import and export quotas within the framework of the emerging EWEC economic cooperation

The study shows that the majority of value chain constraints occur on the supply side at the production level of the supply chain. Summarizing the supply side constraints already enumerated in detail in the previous sections, the main supply issues include: (i) high costs of unnecessary ploughing; (ii) lack of farmer knowledge of no-tillage planting under vegetative cover; (iii) lack of farmer knowledge of crop rotations for improved soil nitrogenation; (iv) poor understanding of farmer seed knowledge; (iv) poor farmer understanding of farmer agro-chemical use; (v) lack of farmer understanding of soil and seed relationships; (vi) absence of uniform maize grades and standards; (vii) insufficient farmer market information; (vii) soil degradation from multi-year monocropping. The value chain study estimates that mitigation of these constraints would reduce maize production costs from 22 to 25% per hectare and increase farmer productivity by 25%. The main policy issue is not the remedial measures, because these are well known. The main supply side issue is how to implement the well known remedial measures to enable farmers to realize the cost saving and productivity gains of changing practices. Before discussing the required institutional initiatives need to affect a change in farmer practices, there is a need to discuss an issue not covered by the value chain study namely the issue and effects of climate change.

6.2. Effects of Climate Change

Maize is sensitive to both temperature and humidity. The optimal temperature for maize growth and development is 18 to 32 ^{o}C, with temperatures of 35 ^{o}C and above considered inhibitory. The optimum soil temperatures for germination and early seedling growth are 12 ^{o}C or greater, and at tasselling 21 to 30 ^{o}C is ideal. Low temperature is rarely a limiting factor for crop production in Cambodia. However, high temperatures, which can exceed 38 ^{o}C in March and April, may be limiting during crop establishment in the EWS, when the plant is most sensitive to heat stress. Rainfall requirements Maize can grow and yield with as little as 300 mm rainfall (40% to 60% yield decline compared to optimal conditions), but prefers 500 to 1200 mm as the optimal range. Depending on soil type and stored soil moisture, crop failure would be expected if less than 300 mm of rain were received in crop. Generally in Cambodia the growing season rainfall is less than optimal during the EWS but adequate in the MWS, as outlined in Table 12.

Table 12. Estimated Growing Season Rainfall for Battambang and Kampong Cham Provinces

Sowing Time	In Crop Rainfall (mm)
EWS-April sowing	340-480
EWS-May sowing	420-600
MWS-July-August sowing	560-690

IPCC global climate change models utilizing middle range carbon emissions scenarios forecast an average annual temperature worldwide to rise 2 degrees celsius by 2050. But the impact and adaptation study forecasts a far more extreme future for the lower Mekong. As shown in the map below, some parts of the basin, including the eastern plains of Cambodia and parts of the central highlands of Vietnam could see average annual temperature increases of 4C to 6C. This increase will mean dramatic changes in the comfort zone of crops and fish and livestock species, which could have serious negative consequences for the livelihoods, health and food security of the local communities in these areas.[11]

The Climate Change Impact and Adaptation Study for the Lower Mekong Basin study adopts a basin-wide, spatial approach in quantifying shifts in the geographical suitability of the key crop species and impacts on other livelihood sectors by 2050. Statistical downscaling of Global Circulation Models was used to regionalize global climate projections and coupled with a land use suitability assessment tool to examine the impacts of projected changes in climate on the suitability of seven crops: fruit, rainfed rice, soya, maize, cassava, robusta coffee and rubber. The spatial approach

[11] Source: USAID Asia. Climate Change Impact and Adaptation Study for the Lower Mekong Basin

applied in the Study not only highlights areas projected to experience major changes due to climate change but also identifies the priorities for adaptation response.

The Integrated Water Resources Management (IWRM) watershed model, developed by the EIA Ltd, MRC, World Bank, Aalto University and ICEM was applied for the whole Mekong Basin. The Land Suitability Evaluation Tool (LUSET), developed by IRRI, was adapted by the study and coupled to the IWRM model to assess the suitability of seven crop species when projections of future changes in climate are factored together with topographical characteristics. These crops are: ***fruit, rainfed rice, soya, maize, cassava, Robusta coffee and rubber***. Lastly, the Aqua Crop yield model developed by FAO was also coupled to the IWRM model to estimate impact of climate change on rice and maize yields in a number of locations across the basin.

An important output of the study is the identification of climate change hotspots to better understand how climate change will alter ecosystems and impact the '*comfort zones*' of key crops and other community livelihood and subsistence options. Comfort zones are ranges where temperature, rainfall and soil conditions create favorable conditions for production. These will shift as a result of climate change making conditions unsuitable that are today thought of as ideal for certain crops, like the Central Highlands of Vietnam for coffee or Thailand's Chiang Rai Province for rice.

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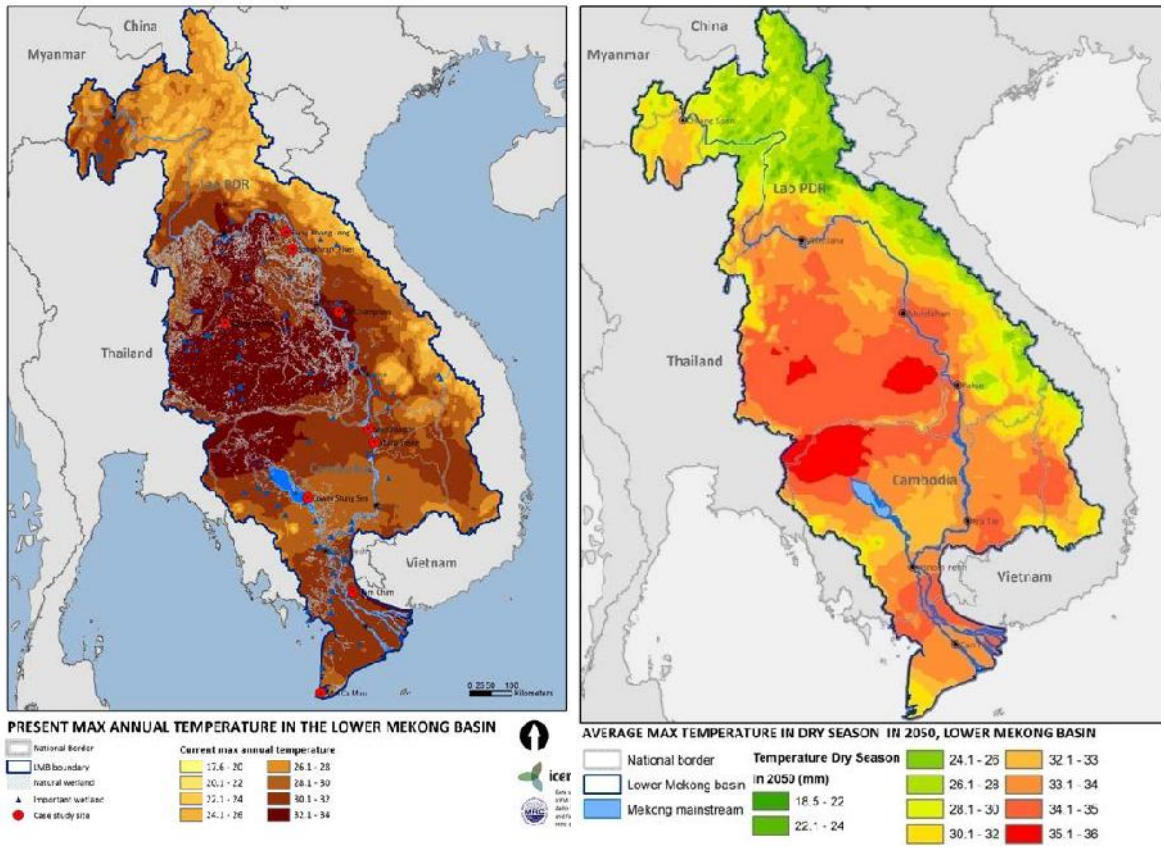

6.3. Projected Changes to Livelihood Sectors

Non-rice Crops

Climate change may induce geographical shifts in the suitability of the basin for several crop species assessed, including potentially:

- Suitability of industrial crops like rubber, Robusta coffee and cassava shifting to areas of higher altitude with optimal suitability in 2050 centered on northern Thailand, northern Lao PDR and central highlands;
- Plains and lower altitude areas becoming less suitable for rubber, robusta coffee and cassava, especially in eastern Cambodia;

Dramatic increases in precipitation in central Lao PDR affecting cassava, soya and maize culture. For these crops, the rainfall suitability also decreases in central highlands and eastern Cambodia;

- An increase of suitability is projected in northeast Thailand due to an increase of rainfall during the crop;
- Maize yield projections show a general decreases across the basin, with Gia Lia (-12%), Mondulkiri (-6%), Kampong Thom (-6%) provinces being the most severely affected of the hot spot areas.

The policy issues related to climate change include the need to integrate research with extension agencies in order to conduct research on crop resilience to climate change as well as develop on-farm extension packages that will assist farmers develop resilience

to climate change through developing draught resistant crops and cultivation practices to retain soil moisture and maintain and/or improve soil productivity in the face of higher temperatures and reduced rainfall in the climate change hot spot areas.

However, through practicing reduced tillage, maintaining ground cover or applying crop residues such as rice straw and crop residue, the impact of drought can be greatly reduced by lowering soil temperature and surface evaporation. In addition, mulching also raises the nitrogen content and soil carbon capture. In one area experiment maize yield was increased by 61% by simply adding crop residues to the soil (known as mulching). The results of this mulching trial are shown in Table 9. The effect of mulching aids in lowering the risk of crop failure in the EWS and lifts yield potential. These and other measures are required to enhance farmer climate change resiliency.

Table 13: Productivity and Income Effects of Direct Seeding Under Vegetative Cover

Crop: Maize, without Mulch
Area: 1 Hectare
Yield and Income

2.933t/ha x 120.00 USD = Total Income (A) $ 352,00

Operation	Month	Machinery/Labour		Seed/Fertilizer/Chemicals			Total Cost
		Details	Total US$/ha	Rate /ha	Cost (US$)	Total US$/ha	US$/ha
Land preparation		Disc plough twice	40,00				40,00
Land preparation		Harrow once	3,65				3,65
Fertilizer-Mo Superphosphate		Before planting with KCL		114	0,34	38,76	38,76
Fertilizer-KCL		1 person/ha/day	1,25	50	0,36	18,00	19,25
Planting and Seed	June/July	Planting	15,00	40	2,86	114,40	129,40
Fertilizer-topdressing Urea		1 person/ha/day	1,25	50	0,32	16,00	17,25
Thinning		10 person/ha/day	12,50				12,50
1st hand-Weeding		15 people/ha/day	18,75				18,75
2nd hand-Weeding		15 people/ha/day	18,75				18,75
Harvest	Nov/Dec	20 people/ha/day	25,00				25,00
						Total Cost(B)	**323,31**
						Gross Margin (A-B)	**28,69**

Crop: Maize, with Mulch

Area: 1 Hectare

Yield and Income

4,72t/ha x 120.00 USD = Total Income (A) $ 566,40

Operation	Month	Machinery/Labour		Seed/Fertilizer /Chemicals			Total Cost
		Details	Total US$/ha	Rate /ha	Cost (US$)	Total US$/ha	US$/ha
Land preparation		Disc plough twice	40,00				40,00
Land preparation		Harrow once	3,65				3,65
Fertilizer-Mo Superphosphate		Before planting with KCL		114	0,34	38,76	38,76
Fertilizer-KCL		1 person/ha/day	1,25	50	0,36	18,00	19,25
Planting and Seed	June/July	Planting	15,00	40	2,86	114,40	129,40
Spread rice straw				3	18,00	54,00	54,00
Fertilizer-topdressing Urea		1 person/ha/day	1,25	50	0,32	16,00	17,25
Thinning		10 person/ha/day	12,50				12,50
1st hand-Weeding		15 people/ha/day	18,75				18,75
2nd hand-Weeding		15 people/ha/day	18,75				18,75
Harvest	Nov/Dec	30 people/ha/day	37,50				37,50
						Total Cost (B)	**389,81**
						Gross Margin (A-B)	**176,59**

6.4. Supply Side Approach to Improving Maize Productivity and Production

The key policy issue related to improving maize productivity is whether the approach to delivering yield enhancing technology and knowledge to farmers should be delivered by provincial agencies or whether an alternative approach should be applied.

The value chain study notes the institutional weaknesses of provincial agencies involved with agricultural production and marketing. The fond hope of the study is that these institutions will improve both their capacity and motivation over time as their incentives are increased and their capacity is strengthened. This would be an evolutionary approach to supply side improvement of the value chain.

The policy required should be more revolutionary as a shorter time frame is needed to deal with the twin issues of productivity and production decline. As noted earlier, the demand for maize, driven by the escalating demand for meat with in the region offers bright future prospects for the regional maize market, the key animal feed ingredient.

A number of innovations are required to implement the recommended strategies. These relate to village level MFI schemes, integrated maize production technology development and technology delivery by hired service providers. In this approach, the service providers will be gradually phased out and will be replaced by trained

government technicians motivated by salary increases and working capital for field operations.

In a departure from existing practices in Cambodia, the strategic approach should set up a Group Conditional Capital Transfer Scheme (GCCTS) which will transfer funds to village based Improved Group Revolving Funds (IGRFs) over a three year period conditional on their performance through a set of milestones. It shouldalso support training to households members of the IGRFs in terms of financial literacy, support group linkages with MFIs and provide specific support to past donor supported group revolving funds in the project area in terms of access to financial services and linkages to MFIs. The expected outcomes of this component include a minimum of 980 Improved Group Revolving Funds (IGRFs) established and experiencing a substantial increase in the size of their fund after three years of operation. Moreover, it is expected that a high proportion of the 49 000 IGRF member households display improved financial literacy and access to financial services through use of savings and credit opportunities in Microfinance Institutions (MFIs).

6.5. Improved Access to Technology and Markets

This element will finance three sub-components: (i) support to innovation in capacity building, (ii) applied training and capacity building and (iii) small rural business development. The component will enhance farmer capacity in appropriate agronomic, marketing and post-harvest management techniques combined with support to the development of off farm activities and linkages to markets.

The approach will include the Netherlands Development Organization (SNV) as implementation partner and co-financier for the sub-component on small rural business development and also providing technical assistance on the development of training packages and knowledge dissemination. In addition, the approach will support the adaptation and scaling up of the National Bio-digester program to poor beneficiaries and create an additional rural business development opportunity in project areas.

The approach should establish an innovative partnership between the Ministry of Agriculture and Forestry (MAFF) and the International Development Enterprises (iDE) to substantially expand the successful Farmer Business Advisor program to new provinces and communes. This will provide beneficiaries with access to an additional source of extension support and high quality inputs as well as provide an exit strategy for some of the project activities.

This strategic element is expected to achieve a series of outcomes that will support economic empowerment of target households and contribute to agricultural development in the project areas. These include: (i) improved and innovative training packages and approaches being developed and used, (ii) Beneficiaries are able to

effectively use the funds made available through the GCCT Scheme for improved production and marketing, (iii) poor rural households diversifying income sources through adoption of improved technologies for non-rice crops, livestock, aquaculture and non-land based income generating activities, (iv) successful establishment of sustainable private extension agents (Farm Business Advisors) and associated input supply chain in project areas, (iv) establishment of around 75 profitable contractual linkages between farmer groups and agricultural markets or other business ventures and (v) pro-poor bio-digester technology being successfully adapted and 4,000 bio-digesters benefiting project beneficiaries.

The proposed strategy to deliver the required yield and income technologies is an integrated system which is driven initially by professional service providers. Professional service advisors should be hired to provide crop productivity enhancing technologies which have been described in detail in this value chain study. The role of the service providers is to set up trials and demonstrations which apply all of the productivity boosting technologies described in this study as an integrated package of interventions (e.g. matching soils and seeds, no tillage with direct seeding under vegetative cover, crop rotations, seed selection, optimizing agro-chemical usage, small scale farmer managed irrigation), post harvest technologies at the farm level and working with the national and provincial governments on developing uniform maize grades and standards. The service providers will use demonstrations, IT and other media to disseminate grades and standards information to farmers. Farmers will attend farmer field days and farmer field schools, operated by the service providers. Provincial agency technical and enforcement personnel will participate in all of the field activities. Through learning by doing, provincial personnel will acquire technologies and delivery methods from the service providers. As the provincial technicians gain confidence and experience, the Cambodian Government needs to rationalize its salary structures as a measure to provide incentive boosting rewards for effective takeover of the agricultural service providers as these temporary catalysts of change complete their mission and phase out. This training with salary increases is the core pillars of the strategic exit strategy.

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Annex 1. Datasheet for FGD (Criteria, Sub-Criteria and Guiding Questions)

	Crops				
Criteria 1: Livelihood Improvement					
1.1 Present integration of the poor (the number of the poor involved in production)					
Q1: How extensive the small scale farmers engage in the production of each listed crops?					
Q2: What is the average cultivated area per farmer for each listed crops?					
Q3: What do you think in the near future smallholder farmers can engage in production of this crop?					
Total 1					
1.2 Potential to generate higher net income					
Q1: Among the listed crops, which one can provide a higher income to small scale farmers?					
Q2: Among the listed crops, which one has most potential to generate income for smallholder farmers in the future?					
Total 2					
1.3 Origin of the crop					
Q1. How much the export proportion of the listed crops in the province?					
Q2. How much proportion of the listed crops in the province that you think they can be exported to (Thailand, Lao, Vietnam, Myanmar, Etc.) in the future?					
Q3 In what form the product is likely to export in the future?					
Total 3					
Criteria 2: Market Potential					
2.1 High potential of cross border trade					
Q1. (Rank the listed crops based on secondary data of export of the product and then ask participants to confirm) Which one of listed crops has high potential for cross-border trade?					
Q2. How the export volume of the listed crops will look like in the near future?					
Total 4					
2.2 Potential for value creation					
Q1. Among the listed crops, which one is processed in this province?					
Q2. Please rank the level of processing of the listed crops in the province?					
Q3. Among the listed crops, which one has potential of value adding in the province?					
Total 5					
2.3 Potential for farmer to get involve in value creation					
Q1. What do you think only few farmers can engage in value creation of the listed crops (level of participation)?					
Q2. How difficult is the crop to promote small scale farmer's participation in value creation?					
Total 6					
Criteria 3: Others					

3.1 Policy supports					
Q1. Among the listed crops, which one is relevant to government development policy/strategy/plan?					
Total 7					
3.2 Environment concern					
Q1. Which crop tends to have negative impacts on environment?					
Q2. Among the listed crops, which one has potential to harm the environment in the future?					
Total 8					
3.3 International investors involved in the chain					
Q1. Did foreign investors invest in value chain of the listed crops?					
Q2. In the future, which crops have high potential for investment by foreign investors?					
Q3. How the level of smallholder farmers benefit from this investment?					
Total 9					

Annex 2. Priority Setting Score Datasheet

Criteria	Sub-criteria	Weight	Crop				
Livelihood	Present integration of the poor						
	Potential to generate higher net income						
	Origin of the crop						
Market potential	High potential of cross border trade						
	Potential of value creation						
	Farmer's involvement in value creation						
Others	Policy supports						
	Environmental concern						
	Foreign investment in the chain						
	Average weighted score						

Annex 3. Summary of Actor Mapping for Maize Value Chains

	Input provision	**Cultivating**	**Collecting**	**Semi-Processing**	**Exporting**
Actor	• Private company • Retail shop • Farmer association • Thai collector	• Small scale farmer • Medium scale farmer • Large scale farmer	• Local assembler	• Semi-processor	• Export companies
Number	• 5 private companies; • 37 retail shops; • 36 farmer associations; • Thai collector	• Small scale farmers (2,750 hh) • Medium scale farmers (2,000 hh) • Large scale farmers (250 hh)[12]	• 50 – 70 local collectors	• 35 Semi-processors	• 2 export companies
Activity	• Sell seeds, fertilizer, chemicals • Sell other agricultural goods	• Plowing soil first time • Plowing soil second time • Sowing seeds • Weed and pest controlling • Fertilizing • Harvesting	• Hiring labour to collect from farm • Hiring labour to uploading on trucks • Transporting to semi-processor, silo, or arranging Thai buyer to collect • Selling to Vietnamese buyers	• Buying cobe maize or gain • Drying maize on large concrete backyard or silo • Cleaning/grading • Transporting to Thailand	• Buying cobe maize or gain • Drying on large concrete backyard or Silo • Cleaning and grading • Exporting to Thailand • Selling to Animal factory in Cambodia
Volume	• Maize seeds (700 tons/yr) • Fertilizer (180 ton/yr) • Chemical (27 tons/yr)	• 67.5k tons1st season • 20.0k tons 2nd season	• 44.k tons in 1st season • 13.0 k tons in 2nd season	• 133k tons in 1st season • 40k tons in 2nd season	• 15k tons in 1st season • 5k tons in 2nd season
Supporter		• Provincial Department of Agriculture provides agricultural extension • Medium scale farmers rent tractors to small scale farmers • Banker/Money lender	• Bank/ Money lender	• Bank	• Ministry of Commerce issues export license and certificate of origin • Provincial Department of Commerce facilitates cross-border trade • Custom Office facilitates on cross-border trade

12 Estimation based on CSES data 2011

Annex 4. Problems and Solution

Problems	Suggested Solutions
Farmer group (Production stage)	
1. Lack of Production techniques	- Right time for plantation - Use improved seeds /certified seeds - Land preparation, land leveling - Good in cultural practices include IPM - Develop the completion of technology package for maize production
2. Unfavorable weather conditions (drought)	- Observe and record the rainfall - planting the trees to attract the rain particularly fruit trees and industrial crops such rubber, longan and mango - Develop irrigation systems - Use drought tolerance Seeds (resistance seeds to pest and drought)
3. Seasonal Labor Shortage	- Use machineries like plantation machines and harvesting machines - Increase price of agricultural commodities so that
Farmer group (Marketing Stage)	
1. Low price (Price instability, particularly during harvesting season)	- Identify the minimize price of maize - Depend on world demand in free markets - Improve quality of maize - Develop national standard for maize
2. Poor infrastructures connecting to farmer gates (There are difficulties for farmers who have their farms far away from main roads in terms of transport their products to markets)	- Share financial resources with government to develop rural roads, particularly connecting farm gate road to the main road. - Responsibility by Department of Rural Road, Ministry of Rural Development.
3. Too much availability of seeds in the markets (Too many varieties of seed in the markets make farmers easily confuse which seeds are very suitable for their farms (soil types).	- Provincial Department of Agriculture and related authorities should take their actions to control the quality of seeds in markets and prevent illegal trafficking seeds - Testing or doing experiments to identify the most suitable seeds for Pailin farmers in collaboration among seed companies, provincial department of agriculture and agricultural research institutes. - Disseminate the results of experiments consist of technology packages to farmers through

	field demonstration.
Mixed group (production stage)	
1. Production planning	- Line departments shall guide farmers on production plan
2. Seed control	- workshop to education farmers about selecting quality seeds - prohibit poor quality seeds that do not meet standards - Enforce law on poor quality seeds - provide quality seeds and technology (PDA) - certificate of seeds
3. High price of seeds (both registered and non-registered seeds)	- Reduce price
4. Low price of maize	- price subsidy - provide credit with low interest rate
Mixed group (marketing stage)	
1. Buy only quality standard maize	- Build mill factory (government & private companies) - Educate about the quality standards to producers
2. Low price of low quality of maize	- looking for more markets - Attract investment to build mill factory
3. trade facilitation at border	- Enforce on informal charge per truck at border - The government facilitates with Thai authority about congestion of transporting maize at the border

Source: Focus Group Discussion on 26 August 2013, Pailin, Cambodia

The Mekong Institute (MI) is an intergovernmental organization with a residential learning facility located on the campus of Khon Kaen University in the northeastern Thailand. It serves the countries of the Greater Mekong Subregion (GMS), namely, Cambodia, Lao P.D.R., Myanmar, Thailand, Vietnam, Yunnan Province and Guangxi Zhuang Autonomous Region of PR. China.

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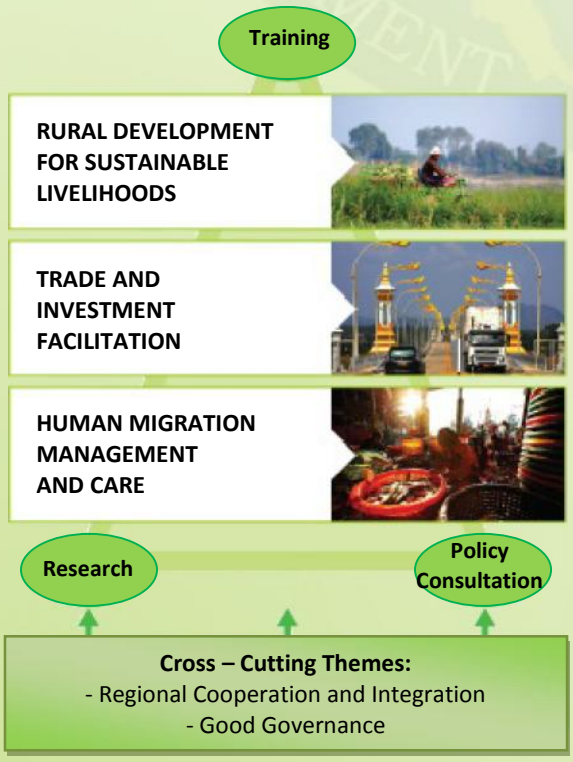

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