



**VAN HALL  
LARENSTEIN**

PART OF WAGENINGEN UR

**Fresh Thieu lychee quality improvement for the upper  
segment of the markets base on chain analysis  
approaches**



**A Research Project Proposal Submitted to Larenstein University of  
Professional Education in Partial Fulfillment of the Requirements for the  
Degree of Master of Agricultural Production Chain Management,  
Specialization: Horticulture Production Chains**

**By Nguyen Thi Phuong Lan**

**September, 2010**

**Wageningen  
The Netherlands**

**© Copyright Nguyen Thi Phuong Lan, 2010. All rights reserved**

**Fresh Thieu lychee quality improvement for the upper  
segment of the markets base on chain analysis  
approaches**

**Supervisor: Bernard Gildemacher**

**Submitted by: Nguyen Thi Phuong Lan**

**Professional master in Management of Development**

**Specialization: Horticulture Production Chains**

**Wageningen, 2010**

## **Permission of Use**

In presenting this research project in partial fulfillment of the requirements for a Postgraduate degree, I agree that the Library of this University may make it freely available for inspection. I further agree that permission for copying of this research project in any manner, in whole or in part, for scholarly purposes may be granted by Larenstein Director of Research. It is understood that any copying or publication or use of this project or parts thereof for financial gain shall not be allowed without my written permission. It is also understood that due recognition shall be given to me and to the University in any scholarly use which may be made of any material in my research project.

Requests for permission to copy or to make other use of material in this research project in whole or part should be addressed to:

Director of Research  
Larenstein University of Professional Education  
P.O. Box 9001  
6880 GB Velp  
The Netherlands  
Fax: 31 26 3615287

## **Acknowledgements**

First of all, my sincere gratitude goes to my supervisor, Mr. Bernard Gildemacher, for his advice, comments, suggestions, and encouragements during I was working on my thesis. His supervision helped and encouraged me so much in completing the research.

I also would like to thank Hanoi University of Agriculture (HUA) for allowing me to work on this subject and to support me to pursue my master study. I gratefully acknowledge the financial support from World Bank via Trig Project at HUA which has provided me tuition fee for attending this course.

I am greatly indebted to my colleagues at Agronomy Faculty and Research management office (HUA) for their helps conducting survey and collecting data. My thanks are extended to Dr. Dao The Anh, director of Vietnam Academy of Agricultural Sciences, Food Crop research Institute, Center for Agrarian Systems research and Development (CASRAD) for his insight into Lychee production and marketing in Vietnam and Luc Ngan district as well.

I would like to thanks Mr. Chu Van Bao Head of Agricultural Office and managing member of Association for lychee production and consumption in Luc Ngan district for his information, constructive criticism during the survey and for his assistance when my team conducting the survey in Luc Ngan.

I would also like to thank all the staff of VAN HALL LARENSTEIN University of Applied Sciences, Wageningen UR for their teaching and help during my study. Special thanks to Jos Leeters for introducing this program to me when we met at HUA in 2008. Thanks very much Mr. Robert Baars, your good management in the program and your care have encouraged my classmates and myself a lot. I thank all of my classmates in this course for their help and sharing things in daily life.

My deepest gratitude to my family, my husband and my daughter, who were always by my side during my study and when I was working on this thesis. I would like to express my gratitude to my parents, my parents in law as well as my relatives back home for their always supports.

## Table of content

<b>Permission of Use</b>	iii
<b>Acknowledgements</b>	iv
<b>Table of content</b>	v
<b>List of Tables</b>	vii
<b>List of Figures</b>	viii
<b>List of Abbreviations</b>	ix
<b>Abstract</b>	x
<b>Chapter 1 Introduction</b>	1
1.1 Background of study	1
1.2 Problem statement	2
1.3 Research Objective	2
1.4 Research issue	2
1.5 Report Structure	2
<b>Chapter 2 Methodology</b>	4
2. 1 Research area	4
2.2 Research Strategy	4
2.3. Surveys	4
2.4 Case Study	4
2.5 Data Collection	5
<b>Chapter 3 Literature Review</b>	6
3.1 Introduction to lychee	6
3.2 Overview of the world lychee production and trading	6
3.3 Thieu lychee production in Vietnam	8
3.4. Thieu lychee production in Luc Ngan district	14
3.5 Thieu lychee value chain analysis in Vietnam	16
<b>Chapter 4 Result</b>	17
4.1. Farm characteristics and farming management	17
4.1.1 <i>Farm characteristics</i>	17
4.1.2 <i>Farming management</i>	19
4.2 Harvest and Post harvest management	22
4.3 Transportation situation	23
4.4 Marketing channels and lychee chain map	24
4.5 Linkages in information	27
4.6 Economic aspects	29
<b>Chapter 5 Discussion</b>	31

5.1 Current situation of farming management	31
5.2. Harvest and post harvest management	32
5.3 Logistic management	33
5.4 Marketing channels and information linkages	33
5.5 Constraints in lychee production	34
5.6 Points for improvement and propose a new lychee value chain	35
<b>Chapter 6 Conclusion and recommendation</b>	40
6.1 Conclusions	40
6.2 Recommendations	41
<b>Reference</b>	42
<b>Appendices</b>	45
Appendices 1: List of lychee cultivars cultivated in Vietnam	45
Appendices 2: Morphological characteristics of promising cultivars of lychee grown in Vietnam	46
Appendices 3: Characteristics of fruits of promising lychee cultivars.	47
Appendices 4: Total lychee production area and productivity of all villages in Luc Ngan district	48
Appendices 5: Survey questioners	49

## List of Tables

Table 2.1 Number of sample for surveying in 3 villages in Luc Ngan	4
Table 2. The chain actors and potential actors in the discussions	4
Table 3.1 The World lychee production and exports in 2004	8
Table 3.2 Area and production of lychee in Viet Nam	9
Table 3.3 Criteria to classify the fresh lychee	13
Table 3.4 Area and total production for lychee in Luc Ngan	15
Table 3.5 Thieu lychee production area and production of all villages in Luc Ngan	15
Table 4.1 Relationship between farm size and the contribution of lychee production to the household's income of surveyed farmers in Luc Ngan	18
Table 4.2 Methods of fertilizer, growth regulation and herbicide/patricides application used by surveyed farms in Luc Ngan district	20
Table 4.3 Frequency of farmers using pruning and training in relation to lychee yield	20
Table 4.4 Different markets information of fresh fruit lychee in Luc Ngan	26
Table 4.5 Cost pricing, gross margin and profit of Thieu lychee	30

## List of Figures

Figure 2.1 Fruit composition of fresh lychee	6
Figure 3.2 The world lychee production area distribution	7
Figure 3.3 Vietnam map	9
Figure 4. 1 Primary business type of surveyed farmers in Luc Ngan (N=30)	17
Figure. 4.2 Lychee production contribute to household income (N=30)	18
Figure 4.3 Distribution of cultivation method among surveyed farmers	19
Figure 4.4 Frequency of grower using different method of fresh fruit preservation in Luc Ngan district (N=30)	21
Figure 4.5 Frequency of factors influencing fruit quality determined by surveyed farmers in Luc Ngan district (N=30)	21
Figure 4.6 Growers frequency based on factors influence harvesting time (N=30)	22
Figure 4.7 Criteria for sorting and grading of fresh lychee in Luc Ngan district (N=30)	22
Figure 4.8 Packaging methods of fresh lychee in Luc Ngan by growers and collectors	23
Figure 4.9 Means of transportation of fresh lychee in Luc Ngan district (N=30)	23
Figure 4.10 Current chain map of Fresh Lychee production in Luc ngan 2010	25
Figure. 4.11 Frequency of growers received information on lychee production	27
Figure 4.12 Information needed by growers in Luc Ngan district (N=30)	28
Figure 4.13 Frequency of growers that were interested in applying VietGap in Luc Ngan (N=30)	29
Figure 4.14 Value share by actor in the chain	30
Figure 5.1 New lychee value chain map proposed for Luc Ngan based on this study	36



## **List of Abbreviations**

<b>CIRAD</b>	Agricultural Research for Development
<b>DARD</b>	Department of Agriculture and Rural Development
<b>HUA</b>	Hanoi University of Agriculture
<b>MARD</b>	Ministry of Agriculture and Rural development
<b>NGOs</b>	Non – Governmental Organization
<b>FAO</b>	Food and Agriculture Organization
<b>RAP</b>	Regional office for Asia and Pacific
<b>IPM</b>	Integrated Pest Management
<b>IATS</b>	Institute of Agricultural Technology Science in Hanoi
<b>VietGap</b>	Vietnam Good Agricultural Practices
<b>VND</b>	Viet Nam Dong
<b>VASI</b>	Vietnam Agricultural Science Institute
<b>WTO</b>	World Trade Organization

## **Abstract**

Supply chain of Fresh lychee fruit was subject of value chain analysis in this study. Data collection was based on the survey conducted by means of a questionnaire, interviews, as well as secondary sources.

The objective for this research is to identify the factors that prevent producers from producing of high quality fresh Thieu lychee using value chain approaches. The ultimate aim of this study is to find out the appropriate marketing solutions and farming management methods define concrete steps which will add value to the chain and bring higher income to the chain's link participants.

The study revealed information about the lychee farming management and marketing problem in Luc Ngan as well as its potential and limitations. Fresh fruit lychee in Luc Ngan district was explained by several groups of factor such as: farming practice, quality management and post harvest handling. Low fruit quality has resulted to very limiting marketing channels and reduced the competence of lychee production in Luc Ngan.

The solution for low quality production and limiting marketing channels were proposed based on value chain approaches. VietGap cultivation method has been chosen as a major solution to improve farming practices and quality management to improve fresh fruit quality.

The study proposed a potential chain map for lychee in Luc Ngan that incorporated new potential actors to create a smooth flow of product, information and improve logistics. The new chain map could create the tight links between the existing actors and new actors together to solve the problem underlying fresh lychee quality, post harvest handling as well as limiting market channels. How the incorporation of the potential actors could facilitate the chain to run in an efficient and economical way to improve fresh fruit quality for high segment of marketing channels was also discussed.

## Chapter 1 Introduction

### 1.1 Background of study

Fruit production in Vietnam has dramatically increased in the last decade, especially three crops: Longan, lychee and Rambutan. Since 1993, these three crops have increased their production at about 37% per year and accounted for 26% of total fruit production (Mitra, 2002).

Lychee is considered as a high value commodity. Hence, commercial lychee growing has advantages to improve the farmer's income. The profit generated in producing lychee is estimated to be five times more than by rice production (Vanderveer, 2000). However, lychee producers have to bear a lot of challenges such as climate, price and productivity fluctuations.

Lychee is a popular fruit tree that is cultivated widely in Asia and has a long history of acceptance in Vietnam and many parts of Southeast Asia. Southern China and Northern of Vietnam are believed the regions that the cultivated lychee originated. In the early of 17<sup>th</sup> century, cultivated lychee was spread widely to the tropical and subtropical in Asia, Australia, South Africa and Southern America, but it is currently not widely grown as it does not flower and crop successfully over a wide range of climates (Ram B. Singh, 2002).

The major production problems that found when growing lychee are irregular flowering and poor fruit retention, while alternate bearing and small fruit size can also reduce grower returns. It takes three to five years to be productive, and will not produce substantial crops until year seven or eight. Lychee production requires regular chemical control measures for pests and suffers heavy losses to birds and fruit bats in some areas if not netted. Lychee fruit has a very short shelf- life without refrigeration as the crop deteriorates very quickly after harvest (Christopher Menzel, 2002)

Vietnam has been in recent year moving towards a more industrialized and service based economy. But still, Vietnam is largely based on agriculture. In this sector, lychee production is one of important traditional sub-sectors of some provinces in northern part of Vietnam which are only few regions in the world including Vietnam, Thailand, and South America to have favorable environment and soil condition to grow (Quynh, 2007)

China is the major market for lychee products of Bac Giang province and Luc Ngan district. According to provincial commercial department, in 2008 Luc Ngan exported to China 36.000 tons of fresh Thieu lychee fruit which account for 90% of productivity of the whole province. The exportation channel is still mainly through the small traders from border province of China, Lang Son and Lao Cai. Although the volume exported to China is rather big but it has been done only through small channel or crossing border markets. The Thieu lychee export quota to China is not a simple problem. Partly because traders already familiar the current channel, but more important reason is the administrative procedures, especially the testing of pesticide residues and requirements for the origin of goods (C/O) are very strict that make difficult to export in this way.

To solve this problem, in 2007 Luc Ngan district has collaborated with several agencies within and outside the province to build safe production areas for litchi with more than 3200 hectares in some of which VIETGAP standards were preliminary applied. This is a turning point for gradually improving the quality and competitiveness of Thieu lychee in the market. However, cost of Thieu lychee production has increased about 30% compared with Thieu lychee normal production because of investment in labor and chemical input. So the majority of producers is

still maintain the old fashion in production that is they grow, apply management practices and harvesting by their old experiences, not using pesticides according to the recommendation. This negatively influences the fruit size, low quality very often that the fruits do not meet the requirements for food hygiene and safety and pesticide residues for exportation. In order to solve this problem, value chain analysis can be a very useful conceptual tool to trying to understand the factors that impact fruit production and quality and try to find the solution to improve services to facilitate export. For this reason we propose to do this research.

## **1.2. Problem statement**

Thieu lychee production of Luc Ngan district, Bac Giang province, Vietnam has many advantages and potential to becomes a large commercial production area. However, the sub sector is now facing a lot of important difficulties; the main problem is poor product quality and therefore reduced output. The cause of this problem varies from lack of post harvest technologies and poor crop management practices as well as limiting of marketing information. This problem resulted in reduce output both in local and cross-border markets.

## **1.3. Research Objective**

The objective for this research is to identify the factors that prevent actors from producing of high quality fresh Thieu lychee using value chain analysis. This study also aimed at defining the appropriate marketing solutions and farming conditions to end up with the concrete steps to improve chain that added value to the chain and bring higher income for the actors.

## **1.4. Research questions**

MQs1: What are the main reasons behind the poor quality of Thieu lychee in Luc Ngan district?

- *Q1: What is the present situation of cultivation method, logistic, transportation availability?*
- *Q2: What are optimum inputs (fertilizer, herbicide, and pesticides) needed to produce high quality Thieu Lychee?*
- *Q3: Do the farmers have knowledge about the international standards and regulations?*
- *Q4: What is needed for the farmers to actively produce fresh Thieu lychee with high quality?*
- *Q5: What are the main problems in production of export quality Thieu lychee?*

MQs2: What is the chain overview in this sub sector and how chain should change?

- *Q1: What are the main characteristics of the chain?*
- *Q2: How many marketing channel are exiting in this chain?*
- *Q3: What are the areas of the chain that need to improve?*
- *Q4: How these problems in the chain can be solved?*
- *Q5: Who and how would benefit from improved chain?*

## **1.5. Report Structure**

The report is organized into six main chapters. Chapter one contains background information about the study, as well as the main problem and objective of the research. The chapter continues to outline the main research questions and sub-questions that guide the research. Chapter two discusses the methodology employed for the collection of empirical data during the field research. This chapter includes

information about study area, research strategy, and the tools used to gather information. Chapter three is composed of literature reviewed on the study area, government policies for the sector, production of litchi and farming system. Chapter four contains the results of empirical findings of the field research. The results of this research are discussed in Chapter five. The final chapter of this report contains the conclusions and recommendations of this research.

## Chapter 2 Methodology

### 2.1 Research area

Litchi production of Luc Ngan district contributed up to 90% for the provincial litchi production at year 2008. (40% of the whole country) (DARD Bac Giang, 2008)

This district is considered to be the biggest center for production and trading of fresh litchi of Bac Giang province as well as nation-wide (it is estimated that 80% litchi production of Bac Giang is trading at Luc Ngan).

### 2.2 Research Strategy

Fieldwork was conducted between July 15<sup>th</sup> and August 23<sup>rd</sup> 2010. Main fieldwork consists of interviews and surveys on different actors in the current chain (growers, collectors, large and small traders).

The second part of this study was to conduct a case study. This case study involve collecting information from desk study, discussion with experts and interviewing potential chain actors and supporters in order to examine the feasibility of a new chain. Several discussions and interviews were conducted covering various topics including production, agronomics, market and market development, information exchange, as well as the potential and challenges of producing high quality litchi for exportation in the district.

### 2.3 Surveys

Surveys were carried out in Luc Ngan district on 3 villages (Quy Son, Tan Hoa, Hong Giang). These three villages are major production areas of the district and have different farming conditions and therefore produce differently litchi quality and production. 30 grower samples (10 samples/villages) were grouped in to three different size (small <0.5ha; medium 0.5-1ha and large >1ha). Before the surveys were done with individual growers, early interviews with three leaders of three villages were done to get the first impression of the lychee production, consumption and social situation regarding lychee production in the areas.

**Table 2.1 Number of sample for surveying in 3 villages in Luc Ngan**

Size	Quy Son	Tan Hoa	Hong Giang	Total
Small (<0.5ha)	3	3	3	9
Medium (0.5-1ha)	4	4	3	11
Large (1-21ha)	3	3	4	10
Total	11	11	11	33

### 2.4. Case Study: *Case study is composed of two parts*

**Part 1:** Discussing with experts and interviewing potential stakeholders for lychee fruit chain in Vietnam. Expert for discussion and interviewees were selected based on the categories above:

- Dr. Dao The Anh: *Vietnam Academy of Agricultural Sciences, Food Crop research Institute, Center for Agrarian Systems research and Development (CASRAD)*
- Chu Van Bao: *Head of Agricultural office Luc Ngan district*

- Nguyen Duc Loc: *Institute of Policy and strategy for Agricultural and Rural Development (IPSARD)*
- Manager of *Freshstudio Asia company in Hanoi and Dalat Vietnam*
- Growers where Vietgap was preliminary applied in 2008

**Part 2:** Second part in the case study has been setting up few small interviews with some organizations, local processing company and the exporters/importers where they (planning) importing fresh lychee fruit.

These interviews and discussions were semi-structured with a list of questions for each interview and an outline of discussion for each expert. The outline and question were constructed to collect information on the following areas:

1. Information about the potential of producing high quality lychee fruit in Luc Ngan.
2. How feasible to apply Vietgap to get better quality fruit.
3. How feasible to have improvement company and actor to play in the new chain
4. How other supporters would facilitate this change?
5. What is the major problems of lychee fruit of Vietnam that preventing them from being exported to Europe

**Table 2.2 The chain actors and potential actors used in the discussions**

Potential actor	Number	Location
Agrexport, Bac Giang	1	Bac Giang province, Vietnam
Association	1	Lucngan district, Vietnam
Exporter	1	Freshstudio Asia

## 2.5 Data Collection

- Initial data collection through exploring all relevant documents about lychee production and marketing. This will be included reference between data from Vietnam and neighboring countries. This included looking at documents created by the Bac Giang province. Reference that gives information for production and trading experience of China, Thailand and India were collected.
- Surveys were conducted using a (semi) structured questionnaire. These questionnaires were self administered to each of the respondents. The questions in the questionnaire were composed to aid in answering several sub-questions and ultimately aid in answering main research questions. The surveys were done by 4 people in Hanoi University of Agriculture (Dinh Thai Hoang and Nguyen Thi Hong, Pham Thi Nhung, Faculty staffs of Agronomy and Vu Thi Binh colleague at the Department of Research management).

Discussion and interviews were conducted with the use of a semi-structured questionnaire. These interviews were self-administered. Questions were tested prior to interviews in order to examine the clarity of each question. Questions were guided by the main research questions and sub-questions. The formulation and pre-testing of these questions is paramount in becoming familiar with the field of research and were geared specifically for each interview. Discussion and interviewing with experts were done via email or and Skype.

## Chapter 3 Literature Review

### 3.1 Introduction to lychee

**Origin and overview of the crop:** Lychee (*Litchi chinensis* Sonn.) is believed to be originated between latitudes 23° and 27° north in the subtropical parts of southern China, northern Viet Nam. The world longest and largest producer of lychee is China that grows lychee for more than 2000 years. By the end of 17<sup>th</sup> lychee is introduced to Myanmar and spread to India and Thailand about in 18<sup>th</sup>. Lately in 19<sup>th</sup>, Lychee reached Madagascar and Mauritius and was introduced in Hawaii in 1873. During this century because of the blossoming in economic worldwide, lychee is quickly distributed to Florida and India. And later in last century, lychee made its destinations to some of newly but significant production areas such as Australia and South Africa. (Mitra, 2002)

In terms of growing habit, lychee is very sensitive to the environment which lychee favors the tropical climate and warm subtropics between 13° to 32°N and 6° to 29°S. The maximums temperature in winter should be below 20°C. Lychee also needs a long and hot summer for the ripening stages (daily maximums above 25°C). High rainfall (1200 mm) with good humidity is ideal condition for lychee development.

The most important substrates in lychee fruit is its sugar content that ranges from 7 to 21 percent. 0.7 percent protein, 0.3 percent fat, 0.7 percent minerals (particularly Ca and P) were found in fresh fruit of lychee depending on variety and the weather in which lychee is grown. There is considerable content of some important vitamins such as C (64 mg/100 g pulp), A, B1 and B2). The use of lychee is mainly as fresh fruit which accounted for 60 percent fresh, 20 percent canned and 20 percent dried. Fruit can also be processed into pickles, preserves, ice-cream, yoghurt, juice and wine. (Christopher Menzel, 2002).

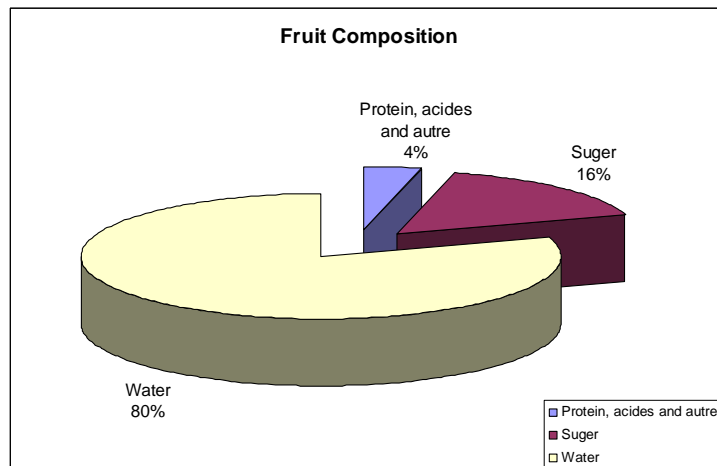


Figure 3.1 Fruit composition of fresh lychee (Source: CIRAD, 2004)

### 3.2 Overview of the world lychee production and trading

The world production of lychee is estimated to be around 2.7 million tons mainly in Asia. The fruit is grown commercially in many subtropical areas in China and Southeast Asia such as Vietnam, Thailand and Taiwan. Other relatively small places also have favorable condition for lychee growing including Israel, Australia, India, parts of Africa, and at higher elevations in Mexico and Central and South America. The distribution of lychee area production is shown in fig. 3.2



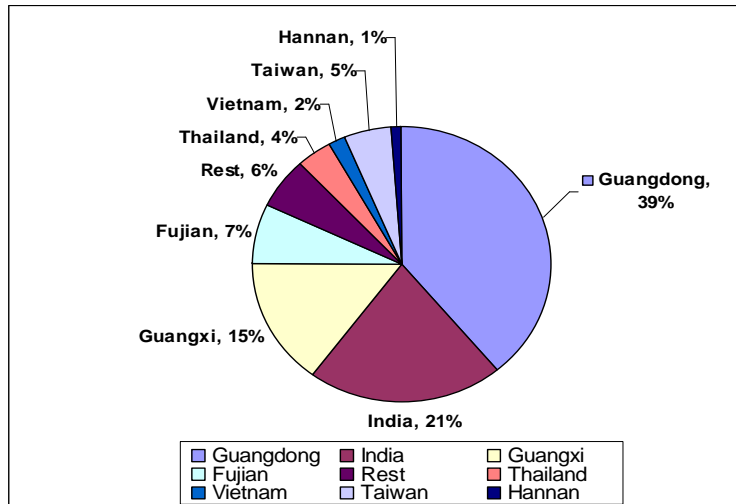


Figure 3.2 The world lychee production area distribution (Source: RAP-2002)

The fruit is consumed mostly (about 60%) in fresh, drying and canned lychee are equally accounted for 20% each. The fruit consumption in Asia is done dominantly in local markets. Less than 5% of the world's production, or approximately 100,000 tones, enter into world trade on an annual basis although this amount is expected to increase in the coming years. The fresh fruit market dominates the trade, followed by dried and canned fruit. The main importing countries are the European Union, the United States, Hong Kong, Singapore, Japan, and Canada. The main exporting countries are China, Taiwan, Thailand, Madagascar, South Africa, Australia, and Mexico (most of it sent to California). The reasons included both short shelf-life and poor marketing systems. (Evans et al., 2004).

China is the leading country in terms of volume production followed by India, Taiwan, Thailand, and Vietnam (FAO, 2002). Current production covers approximately 600 000 ha, over 60% of which have been developed in the past 10 years. Total annual Chinese production of the fruit is 1.5 million tons in "good" years and about 0.6 million in "bad" years. Yields are relatively low even in the "good" years, averaging about one ton per acre. Because of the number of young trees which have only begun to bear, total output is forecasted to reach 2.5 million tones by 2010. The main harvesting season extends from mid-May to mid-August.

India is the second largest lychee producer, averaging approximately 500,000 tons of lychee annually on 56000 ha. Lychee yield in India is relatively high compared to other growing regions, averaging about 6 tons per hectare. Because cultivation occurs over a wide range of climates, the production period extends from the first week of May to the first week of July (FAO, 2002).

The third largest lychee producer is Taiwan where lychee peaked cultivation was found in 1988 at over 14826 ha, but since then the volume has declined to about 12000 ha. In this country, about 100,000 tons of lychee are produced annually, with more than 90% is used domestically. The harvest period in Taiwan is usually from June to August, due mainly to the myriad varieties being grown (FAO, 2002).

Thailand produce yearly of 85,000 tons from 22000 ha and therefore is the fourth largest producer. Lychee production is found mainly in the northern region of the country in the provinces of Chiang Mai and Chiang Rai where climate condition is favorable for this tree and the harvesting season runs from April to June (Edward A. Evans, 2005).

Vietnam annual production is estimated at about 50,000 tons from 14000 ha. The major production area is in the northern region of the country. Lychee is considered a

major crop in Vietnam, with commercial production increased quite fast. Harvesting of the fruit extends from May to June. The majority of the productivity is domestically consumed as fresh. Only one-fourth is actually sold to cross-border markets or being exported (Ha Minh Trung, 2000)

There are two main sources of supplying the world lychee fruit markets. The first comes from Australia and South Africa to Europe (competition occurs as they exhibit commodity at the same season, from December to February). The second channel is from China to Singapore, Hong Kong and Europe for the summer season. Such short seasons produce a big variation in supply and price fluctuation. In the peak summer season, the price drops to US\$ 0.4 per kilogram while in the winter season, it can reach US\$ 10 and even more.

**Table 3.1 The world lychee production and exports in 2004**

No	Place	Area (ha)	Production (tones)	Export (tones)
1	China	600000	1200000	295
2	Inde	95000	650000	763
3	Vietnam	30000	50000	47
4	Thailand	12000	40000	8000
5	Madagascar	25000	75000	20600
6	Taiwan	11800	79100	
7	Bangladesh	4800	13000	
8	Nepal	2380	1400	
9	Australia	1500	6000	2100
10	Mexique	4000	25000	
11	Afrique du Sud	1500	8000	4930
12	Reunion	950	11400	200
13	Israel	300	200	873
14	Mauricius	350	4200	115
15	Florida	240	1000	
<b>Total</b>		<b>789820</b>	<b>2176900</b>	<b>37923 (= 1.74%)</b>

(Source: CIRAD, 2004)

Even the data showed that there was only less than 2% of product exported in to international markets. But the major part of harvest is now locally marketed. So there is still a potential market waiting for lychee. Especially in Europe, where there is almost no production of lychee and therefore lychee is considered expensive and even more valuable than longan and some other tropical fruits. With the ability of longer shelf life for the fruit resulting from improved cultivars, post harvest technology and among others, the fruit is expected to increase its export volume. The potential markets in Europe, Japan and America are the focus of Asia exporters.

### 3.3 Lychee production in Vietnam

Together with China, Vietnam is also considered be the origin of lychee for a long time. In Ha Tay province, wild lychee trees were found by a French scientist in 1942. In 1970 wild lychee plants also were found by a group of scientists from the Industrial and Fruit Crop Institute in Tamdao (Vinhphuc province) and Tuyenhoa (Quangbinh province) forests (Chien, 2003).

In northern part of Vietnam (Ha Tay, Bac Giang, Bac Ninh and Hai Duong) lychee is growing widely because of the favorable climate of this regions, where winter is short, dry and a little bit cold and summer is long and hot with high rainfall and humidity, is quite suitable for the growth of lychee.

Lychee is grown in the northern part of Vietnam and its production is about 40,000-50,000 tons per year (Chien, 2003). Lychee can be considered to have originated from Hai Duong province. Lychee then spread to other locations in northern Vietnam and some places in central part. At present, lychee is mainly commercially cultivated in Luc Ngan, Luc Nam and Yen The districts in Bac Giang. Other smaller production area could be found in Hai Duong, Bac Ninh, Ha Tay provinces (Table 3.2).

**Table 3.2 Area and production of lychee in Vietnam**

Province	Area (ha)		Yield (tones/ha)	Production	
	(ha)	(%)		(tones)	(%)
<b>Bac Giang</b>	<b>39.900</b>	<b>44.8</b>	<b>5.82</b>	<b>228.558</b>	<b>53.3</b>
Haiduong	14.219	8.41	3.77	47.632	11.1
Langson	7.473	7.72	2.31	12.684	3.0
Thainguyen	6.861	7.51	3.67	17.219	4.0
Quangninh	6.700	15.57	4.51	22.465	5.2
Other provinces	13.812	15.99	41.3	100.342	23.4
<b>Total</b>	<b>88.900</b>	<b>100.00</b>	<b>5.53</b>	<b>428.900</b>	<b>100.0</b>

(Source: General Statistic office of Vietnam, 2007)



Figure 3.3 Vietnam Map with Bac Giang province highlighted  
(Source: <http://en.wikipedia.org/wiki/File:VietnamOMC.png>)

### ***Lychee varieties grown in Vietnam***

The major varieties of lychee grown in Vietnam are local varieties which have not been scientifically classified. The naming of variety is mainly done by local people based on the morphology of the tree and fruits. Color and fruit quality are also the significant criteria for grower naming the varieties. Because of this, the exact number of lychee varieties is much less than those named and recognized since the same varieties can be named differently from location to location.

The largest collection of 33 varieties with fully characterization is presented in Appendix 1. The 33 cultivars of lychee has been grown in different locations in northern part of Vietnam in home gardens and consolidated farms. Morphological and fruit quality characteristics of this collection were presented in Appendix 2. Out of 33 cultivars, 8 varieties showed better quality and produced good yield were considered promising cultivars were presented Appendix 3.

It is understood that Vietnam is rich in terms of genetic recourses however lack of elite varieties is a major factor limiting lychee production toward exportation. With predominant use of one variety (Thieu lychee) with about 90% throughout the country this is because this variety can grow on many different types of soils in northern parts of Vietnam especially in the Hai Duong and Bac Giang, is recognized as being the best for producing the “Thieu” lychee. The quality of this lychee has a good reputation and is very much appreciated by consumers (Anh et al, 2008).

The area of Thieu lychee production has increased quickly from 1998-2004. As the productions are increased, the farmers at the same time experience difficulties in achieving good prices. Despite the consumers’ preference for Thieu lychee it is sold at the same price as lychee from other varieties.

Several surveys on consumers in Hanoi in recent years revealed that less than 30% of consumers could differentiate the Thieu lychee from others in the market. While consumers lack information on the credence attributes of Thieu lychee, it was also apparent that the domestic market was failing to separate or to differentiate the Thieu lychee from the more common alternatives in the market. The consumers still prefer buying any kind of lychee at lower price rather than looking for a quality product (Anh et al, 2005)

To solve this situation, quality management and improvement must be adopted in the value chain (Fetter and Kaplinsky, 2001). The experience on fresh fruit quality management of other developed countries suggested that labelling fresh fruit and vegetables in France and the US market provided a good strategy for sustaining consumers’ confidence and assuring consumer satisfaction (Codron, Stern and Reardon, 2000). In this process of labelling, producer participation is critical for sustainability. Baker (1998) suggested that for the fresh fruit sector, private sector solutions can include a grower, a retailer or a third party label.

### ***Production of planting materials***

There are three popular methods of propagation such as seedling (sexual multiplication), marcotting and grafting in lychee production area in Northern provinces in Vietnam. These methods have existed historically. It’s recorded that by 1997, the general practice for lychee multiplication in Vietnam was marcotting (air-layering). This method showed various advantages and most importantly it retains the characteristics of the mother tree and is quite simple method. However, as compare to other practices, this method has several disadvantages including a weak root system as it lacks a taproot and is easily uprooted by strong wind. The root system can also be easily affected by drought and other environmental stresses.

According to Vietnamese institute of Agriculture and Technology, in 1997, grafting was usefully used widely in Vietnam. The technology learns from China had positive

effects on the rootstock varieties or healthy and straight stem were selected from local varieties. By selecting of rootstock, we may cradle knees that are adapted to different soil types and resistant to certain soil born diseases while size of the tree can be controlled. This method allow the new plant could grown well in the local condition that resist again local diseases as well as vigorous development because of better selection of mother is manageable.

### ***Establishment of orchards***

Lychee is grown in Vietnam in more dense population then other country. The average distance between trees is 7 x 7 m or 8 x 8 m depending on the fertility of the soil and the topography of the orchard as well as growing regions. It's made of 150-200 trees/ha to 300-400 trees/hectare. The standard practice showed the dimensions of holes are at 70 x 70 x 70 cm and in some case bigger dimensions up to 1 x 1 x 1 m are applied. The normal practice made use with organic matter such as farmyard manure and compost which are applied in the planting holes together with phosphate fertilizer and sometimes nitrogen one month before planting (DARD Bac Giang, 2008).

Because of lychee is mainly grown in hilly areas, the growing season normally start during March to May (for spring planting) and September to early November (for autumn planting) to have rainfed the young trees. However, it should be realized that watering of young litchi is definitely needed in areas where the rainfall is quite limited and irregular. Moreover, better irrigation system would result in to a better yield of the lychee production.

Hai and Dung, 2002 showed in their report that the overall design of lychee orchards consist of two main designs which are the raised-bed model in the lowlands and contour making in steep land. Intercropping with annual crops such as corn, legumes and vegetables is also recommended and useful to maintain soil humidity in some lychee plantations at the first stage of the biological cycle, when land space is available between lychee trees.

### ***Agronomical practice management***

It can be observed how farmers have changed their training and pruning management in lychee orchard over the last four years. Before, there is almost no or very few growers in this province apply training or pruning lychee plants but only removed the pest and disease affected branches. Thanks to training course and the better extension service, growers now understand the importance of these techniques and number of growers applying new techniques in to their farms is increasing.

Applying fertilizer and irrigation is also now popular in most of the growing regions. Mulching and intercropping also found in some farms.

No serious problem is found in lychee production in these regions. However, in certain conditions the brown bug, which sucks the sap of young shoots and fruit causing them to fall off, and the mite, which sucks leaf sap, are the main problems to be mentioned. In fact, both pests can be controlled easily by using insecticides. In 1998, lots of adult lychee trees in Lucngan district declined and died rapidly. Some fungus and nematodes were observed in the affected trees and fungicides were then applied in combination with proper cultivating technologies, i.e. making the soil aerobic, pruning, fertilizer application, etc., and the problem was solved.

Northern parts of Vietnam have suitable climatic conditions for the growth of lychee. Even with rather poor hilly soil, lychee is growing well however, the standard management practice is only introduced lately. And the application of new technology is rather slow. This makes the sector is less competitive in the markets. Moreover, because of irregular bearing resulting mainly from the changing temperature

requirement for flower initiation, production of lychee may be quite low in some years.

### **Harvesting**

*Harvest:* The harvesting season of Thieu lychee in northern Vietnam is from May to June. Lychee fruits are ready for harvest as soon as they start changing color towards reddish in the 1<sup>st</sup> to 2<sup>nd</sup> week of May.

The Thieu lychee is very short lived and remains in the market for about 1 to 2 weeks. This is the time when the commercial activities are observed in the peak. Short harvest time is greed and makes it more difficult for growers to sell the product while the capacity of the processing companies is weak in these provinces. It is difficult for growers to sell all their harvest at that time as most fruit ripens during a short period (a month). Early varieties and accessions can be harvested earlier in April but most of these are poor quality. However this kind of genetic resources could serve as breeding materials for a breeding program for lengthening harvest season.

*Harvesting time:* Harvesting time is an important factor contributing for fruit quality at most of growing regions in the world. The harvesting time could be monitored using brix: acid ratio-based for all varieties. After harvest, Lychee skin color can be manipulated externally, such that browning process can be avoided/delayed. Lychee has to be harvested prior to extreme day temperatures that occur from late morning to early afternoon. The beginning of the season is at the end of May. The peak season is middle of June and also the lowest price period.

Maturity standards for harvesting of each cultivar must be adopted according to maturity standards developed, which depend on growth conditions and climatic factors. Ripeness standards also affect the post harvest performance with respect to different technologies. However, for higher price, households often wait until mid and late season, they pick litchi late when fruits change into dark red and there is a high rate of lychee dropping (sometimes 50% of lychee). This is difficult for storing and transporting in a long distance, especially to the South and China.

### **Grading and sorting**

In most of lychee growing region in Vietnam, Thieu lychees are packed in baskets or crates lined with leaves. Freshly picked lychees keep their color and quality only 3 to 5 days at room temperature. If pre-treated with 0.5% copper sulphate solution and kept in perforated polyethylene bags, they will remain fresh somewhat longer.

According to our observation, fruits once harvested are sorted in to three kinds depending on their size, appearance and ripening levels. All are done by hands with eyes and tastes of growers. These standards are composed through traditional experience of producers with the agreement of the collectors or traders. This is also due to very poor quality management system here. But mostly, traders focus only on the size and appearance of fruits and they rarely pay attention on the taste of litchi. The table below shows the criteria for grading and sorting of fresh fruit lychee in Vietnam.



**Table 3.3 Criteria to classify the fresh Thieu lychee**

<b>Criteria</b>	<b>First class lychee</b>	<b>2nd class lychee</b>	<b>3rd class lychee</b>
Fruit shape	Evenly globe	Evenly globe	Globe
Fruit weight	40 - 45 fruits/kg	40 - 45 fruits/kg	50 – 60 fruits/kg
Peel color when ripe	- Pink red and light, there are scarlet line in inner side - No color changed 2-3 days after harvesting	- Pink red and light, there are purple line in inner side - Peel is quickly changed to grey 1-2 days after harvesting	- Black red, light grey. - Peel is quickly changed to grey
Peel thorns when ripe	Tense and smooth thorns	Tense and smooth thorns	Pointed thorns
Peel thick	Thin peel	Thin peel	Thick peel
Tasty	Aromatic, deeply sweet, no sour, no acrid	Aromatic, deeply sweet, no sour, no acrid	Less aromatic, less sweet, little bit sour and acrid

(Source: VASI, 2008)

### **Storage**

Short-term storage and transportation is mainly used for fresh market purposes. In many growing regions in the world, Thieu lychee fruit are stored and transported under refrigerated conditions either after air-pre cooled or ice-added-water cooled. Sometimes fruit are stored and transported with preservatives added, film packaged or under non-refrigerated conditions after being treated with a chemical, hot-water, wax coating, growth regulators, irradiation, sulfur dioxide fumigation or their combination (Lai and Ao, 1998). Fair color and eating quality of litchi can be maintained by this for 7 to 10 days at ambient conditions (Li, 1999).

For fruit destined to overseas, sulfur dioxide fumigation is used (Zauberman, 1991). Mid-term storage and transportation is mainly based on a cold chain system. Preservatives and film packaging could extend fruit cold storage and transportation life up to 30 to 40 days. Quick-frozen technology is commonly used in long-term storage and transportation (Li, 1985), which prolongs storage life up to one or even more years.

### **Transportation**

Litchi producers now mainly transport fresh Thieu lychee by themselves to the collectors. The two main transport means which producers use for their Thieu lychee are motor cycle and bicycle which is respectively 70% and 30%. After selling to traders, fruits are then carried by big vehicle with cold storage. Care should be taken during transport to avoid crushing of fruits and damage of the skin. Thieu lychee being a highly perishable fruit therefore selling should be done as early as possible (Anh.T.D and et. 2009)

However infrastructure is still weak with old transportation facilities in Vietnam and the inadequate refrigeration facilities result in a lower quality product. The continuous demand is low, due to the poor product quality and the inadequate reliability of deliveries. Availability of cold chain storage of the harvested Thieu lychee prolongs their shelf life and decreases the losses incurred by all actors with respect to money and quality, but this has to be accompanied with post harvest handling techniques.

### **Marketing**

It is shown that only 20% of Thieu lychee product (mainly fresh fruit) is exported yearly to China through small traders and cross border trading. Small percent is

exported to other ASEAN countries and some to European countries such as France and Russia. Up to about 75% is used for domestic consumption. Lychee fruits are also processed as syrup and dried fruit (V. N Quynh, 2007).

Even there is high market demand yearly locally and from all around the world especially the need from China, a country which also loves to consume lychee but Vietnam cannot produce lychee that meet the quality requirement of the international markets. The poor exportation is due partly to lack of post-harvest technologies involving equipment needed for conservation and packaging.

#### **3.4. Thieu lychee production in Luc Ngan district**

Lychee production in northern Vietnam occurs primarily in the mountainous region bordering the northern edge of the Red River delta. Luc Ngan district in Bac Giang province, located about 80 km northeast of Hanoi, was selected for the study, since it is an important center for litchi production in the province but also the largest production region nationwide.

Luc Ngan district has about 1012 km<sup>2</sup> and is home to 173,000 people living in 31,100 households. Luc Ngan district's labor force works primarily in agriculture. Ethnic Vietnamese comprise about 54% of the local population, while 10 other ethnic groups living in the more mountainous areas of the district comprise the rest. Lychee production occurs mainly among the Vietnamese ethnic group. The climate and topography of Luc Ngan district are well-suited for production of a tree crop like lychee. Annual rainfall is about 1800-2000 mm per year, average annual temperature is 18-23°C, and Luc Ngan is seldom affected by severe storms. Only about 18% of the district's land is considered suitable for rice and other field crops while the area suitable for cultivating fruit trees, consisting of rolling hills, is quite large.

Lychee saplings are established by cutting and planting small branches from existing trees. The young trees begin to bear fruit in their third or fourth year, and they continue growing in size and productivity until perhaps the age of 15 years. They can remain productive indefinitely, with one tree in the area reportedly being more than 200 years old. The trees blossom in early spring (February and March), and the fruit is harvested over 1 month's period in late spring (May-June). However, a tree may not bear fruit every year; reportedly only about 60% of trees bear fruit in a given year. This may reflect weather conditions during the flowering period or other weather and disease-related conditions. New management practices such as reducing planting depth, improving soil drainage, and greater tree pruning are being promoted to reduce this risk, and a chemical treatment has also been developed which saves about 60% of affected trees if they can be treated at an early stage of the disease. Litchi was introduced into the area in the 1960s by farm families migrating from nearby Hai Duong province. Lychee production in Luc Ngan district has developed primarily since 1987, about the beginning of the Doi Moi economic renovation period in Vietnam.

Table 3.4 showed data of Thieu lychee production in Luc Ngan district from 2004 until now. The production area was slightly reduced in recent two years and total productivity was also clearly reduced. The reason is due to some farmers was difficult to sell the because of too much production in 2007, therefore they has cut their lychee to go for another crops. According to growers and local officers, the yield reduced in recent year was mainly because of unstable temperature and too much rain during flower initiation. However, local officials still hope to see the expansion again with a goal of 20,000 ha planted by the year 2020.



**Table 3.4 Area and total production for Thieu lychee in Luc Ngan district**

Year	Land area planted (ha)	Total output of lychee (tones)
2004	19.192	76.593
2005	19.192	46.736
2006	19.192	52.500
2007	19.000	110.103
2008	19.000	85.110
2009	18.818	60.120
2010	18.500	60.170

(Source: Agricultural office, Luc Ngan, 2010)

The data of lychee production of three districts where our study was conducted is given in table 3.5. Thieu lychee production area and productivity of all 18 villages in Luc Ngan district 2010 was also recorded (see Appendix). Clear variation in terms of area production and total output showed the different capability as well as the production skills of villages. Quy Son, Hong Giang and Tan Lap were selected in our study because, according to production data and Mr. Chu Head of Agricultural Department of the district, the villages could represent the different situation for the whole districts. Hong Giang has the average production area (689 ha) but being the most developed place the district in terms of new advanced method application with about more than 80% farmers in the village are now applying VietGap and hence, the average yield (4.2 tones/ha) and fruit quality of the farmers in this village were higher than others. Farmers in Hong Giang district can sell their fresh lychee at 16-24.000 VND/kg (0.7-1 Euro/kg), some family even could sell their lychee for 28-30.000VND/kg. VietGap application in this village was introduced and helped by Hanoi University of Agriculture therefore the process was well monitored.

Quy Son is the village that has largest lychee production area (1.781 ha) therefore the total productivity of this village is highest about 5.700 tons and the yield is intermediate between Hong Giang and Tan Hoa (3.2 tones/ha). Thieu lychee was produced at Quy Son for the long time; therefore farmers in this region have a lot of traditional production skills and also have strong passion in lychee production. Also we could see the various methods of lychee management presenting in Quy Son.

Tan Hoa is one of the villages that have lowest yield of lychee production (average yield 2.3 tones/ha). Tan Hoa also has poor infrastructure that makes difficult for lychee production.

**Table 3.5 Thieu lychee production of 3 villages in Luc Ngan district 2010**

No.	Village	Area (ha)	Production (tones)	Yeld (tones/ha)	Price (1000VND)
1	Honggiang	689	2.904	4.2	16-24
2	Quyson	1.781	5.699	3.3	12-22
3	Tanhaoa	672	1.450	2.2	8-15

(Source: Agricultural office, Luc Ngan, 2010)

In terms of profitable, Thieu lychee production appeared more economical efficient than other crop production. As compare to rice production, lychee production showed significant advantages in terms of profit. Five times profit higher than rice production, has made lychee is interested crop in the area. However, as also discussed above inn the higher market in Hanoi. At the local markets, lychee price varies markerly from during season, with a low of about 5,000 VND/kg at harvest and an off-season high of as much as 22,000 dong (0.2-1 Euro/kg). Farmers always take the main risk of all of these problem since insurance in agricultural production is not popular at all in Vietnam. So that they will always happy to have an average price of about 15,000 VND/kg (Luc Ngan district, Office of agriculture report, 2009)

### **3.5 Thieu lychee value chain analysis in Vietnam**

As lychee production increase yearly in terms both produciton volume and production area. Several studies on value chain analysis were conducted with emphasis on Bac Giang and Hai Duong province. Chien (2003) conducted a research on supply chain management of lychee in Bac Giang Province. This research focused on the fresh marketing channel of lychee in Bac Giang province, Northeast Vietnam since it is the most profitable but also most unstable.

Bac Giang is the largest lychee growing region in Vietnam. The province is located about 50 km Northeast of Hanoi, thus has potential for promoting lychee marketing. However, the cooperation along the chain remained weak. The value chain does not allow smooth flow whole lychee, information and logistic leading to great losses because the fruits are handled by many actors before reaching the consumers. The farmers in the chain are represented because they have limited access to mechanical equipment and rely on market availability so they produce low quality lychee fruit. The transportation infrastructure is still weak with old transportation facilities. All farmers sell their fruit lychee to collectors and trader, but this is not profitable for farmers because of the high production costs. There is no supply chain system innovation. There are mixed roles played by Vietnam government, supporting and influencing that affect how well the value chain functions. This has also led to the failure of integrating other stakeholders into the chain such as financial institutes, NGOs, research institutes, and quality monitors among others

The current situation of lychee production in northern part of Vietnam because of the characteristics of specialization and new business in Thieu lychee growing, it might be useful to organize lychee association for sharing cultivation and post harvest experience between each other and sharing trading experience with older agriculture business.

Most of above studies have focused on indentifying the factor underlying marketing opportunity. However, there is very limited effort to find the solution to promote output/markets base on solving quality problem from the root of the matter at production site. This is important because evidences and experience from Thailand and India showed that growers and their production habit is a key factor for a sector that is newly entered the international business. That why focusing on agronomical matters for improving fruit quality and finding a higher market segments for these products based on a chain approach is our main interest.

## Chapter 4 Result

### 4.1 Farm characteristics and farming management

#### 4.1.1 Farm characteristics

As described above, Luc Ngan is an agricultural area with hilly topography. The condition is not allowing farmers growing rice and other vegetable crops but mainly fruit tree in combination with animal and castle raising. The overview characteristics of farming condition in Luc Ngan districts were examined and the result is given in figure 4.1. The characteristics of farms in Luc Ngan and in the surveyed group are composed primarily of fruit tree with crop, animal, castle raising. Small percent of farm that consists of agricultural production in combination with small business were also found in this district. The large percent of farms in these districts are currently growing fruit trees (mainly lychee, persimmon and small percent of citrus) and raising animal/castle (pig, cow, goat and chicken). This kind of system accounted for more than 40% in this area. Farmers that grow only fruit trees including lychee, persimmon, longan, citrus accounted for 33%. Growing fruit trees and food crops (rice, corn, sweet potato) cultivation is the system that is currently used by about 20% of farmers. A small percent (3%) of farmers are growing lychee and at the same time doing small business such as fruit collector or grocery selling.

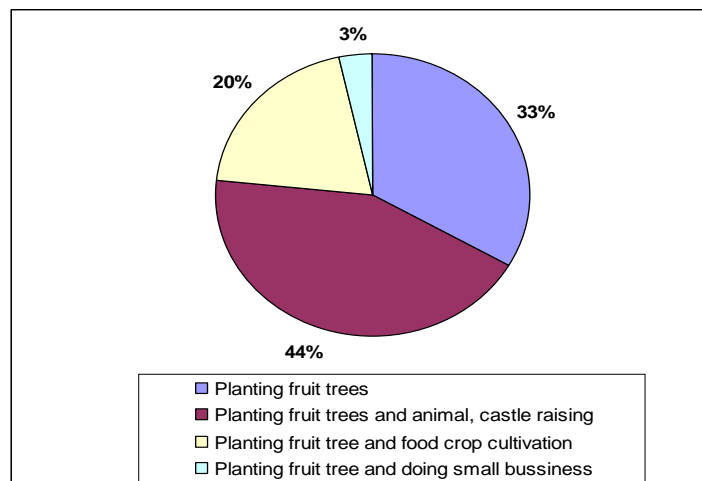


Figure 4. 1 Primary business type of surveyed farmers in Luc Ngan (N=30)

The survey results reveal that all of farmers at Luc Ngan district do have lychee production independently from their farm size. Three groups of farm size (large, medium and small) were distributed equally among samples. Of the surveyed producers 9 people have their farm smaller than 0.5ha; 11 have medium farm size (0.5-1ha) and the remaining 10 farmers are producing their fruit trees and raising animals/castles on the farms that are larger than 1ha.

It's observed that farmers who have more agricultural land or farm size larger than 1ha are more specialized in growing lychee and other fruit trees with animal/castle producing. In contrast, smaller farm sized farmers tend to grow other crops and doing small business rather than grow Thieu lychee solely. Farmer who has fruit trees and animal/castle raising seems to have advantages from this system. Surveyed results showed that they can use manure from animal/castle to fertilize their trees to minimize input and also to have more income from animal and castle production.

Thieu lychee production contributes differently to household's income from farm to farm. Figure 4.2 showed the frequency distribution in percent that lychee production contributes to economy of household. The contribution varies from 20 to more than

80 percent. According to survey, Thieu lychee production contributes significantly to the income of most of the farmers in this area. More than 80% of famers have lychee production contributed over 40% of their income. Among them, about 40% of farmer has lychee production contributed from 70-80% of their income. 23 percent of farmers have their income highly significant attributed by lychee production with more than 80%. Only one family (3% of the questioned farmers) has poor income from lychee cultivation.

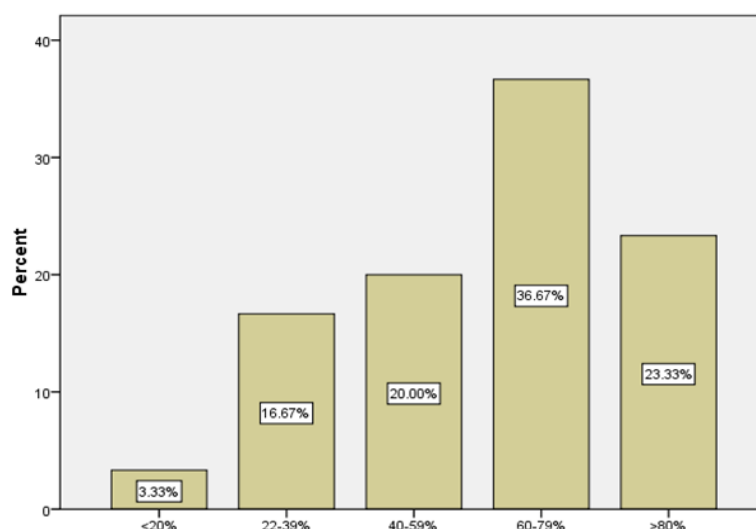


Figure. 4.2 Lychee production contribute to household income (N=30)

The amount that lychee production contributed to household's income seems not have clear relationship with the farm size (Table 4.1). Different fragment of contributions are found scattered frequently over the different farm size. The farmer that has large farm size even has high income from lychee production, excepts for 1 household who had lowest percent income contributed from lychee production. The highest percent of income from lychee productions (>80%) are found more from farmers that have small and large farm size this accounted for 36% of total surveyed farms who indicated lychee production are major income sources of their family economic. The medium farm sized groups seems to have more stable income percent from lychee production with 7 households have lychee production contributed 70-80% of family economy.

**Table 4.1 Relationship between farm size and the contribution of lychee production to the household's income of surveyed farmers in Luc Ngan**

		Contribution of lychee production to household's income					Total
		<20%	22-39%	40-59%	60-79%	>80%	
Farm size	<0,5 ha	0	3	2	1	3	9
	0,5-1ha	0	1	2	7	1	11
	>1ha	1	1	2	3	3	10
Total		1	5	6	11	7	30

#### 4.1.2 Farming management

**Standard cultivation methods:** The present cultivation methods were examined in Luc Ngan district and the result is shown Figure 4.3. This result reveals that the cultivation methods in Luc Ngan are still backward with almost 70% of farms are now managed by the traditional method. This method has no standard, it is based on farmer experiences inherited from generation to generation in the family or the experiences can be achieved through collecting information from adjacent farmers. Looking at all the management methods that currently available and being used in lychee orchards of Luc Ngan, one can realize that they have difficulty in commercial production for exportation. There are at least 5 or more management practices together existing here in Luc Ngan. Beside the traditional method that is mentioned above, there are some other methods that are considered newer and more advanced such as Safe production, IPM and VietGap. About 30 percent of farms surveyed stated that they are using advanced methods in managing their lychee orchards. Among these, 10 percent of farms are using Safe production methods that introduced by Institute of Agricultural Technology Science in Hanoi (IATS), Vietnam. Like that, about 13% of farms are now using VietGap which is newly introduced to this District from Ministry of Agriculture and Rural development (MARD) in 2007. Small amount are using IPM method (6.6%) that is introduced by IATS and there are about 3% of farmers indicated to use other methods that they may be introduced from private companies or other unknown sources.

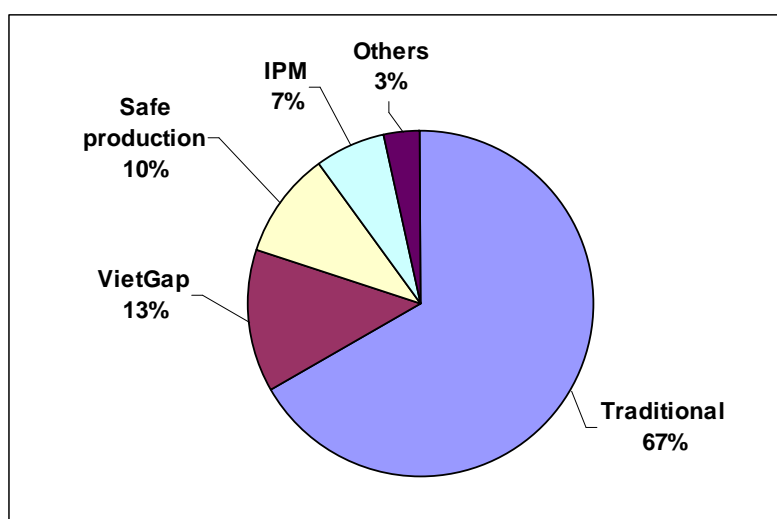


Figure 4.3 Distribution of cultivation method among surveyed farmers

**Input application methods:** How farmers manage their lychee orchards was further investigated. There are also diversity ways of applying fertilizer, growth regulation and pesticide/herbicide to lychee orchards in Luc Ngan district. The survey result showed that there are more than five ways of handling fertilizer and other input to the lychee orchards using by farmers.

For each kind of input, the different ways of application can be observed in every farmer surveyed in Luc Ngan (Table 4.2).

In terms of fertilizer application the major method used to apply fertilizer to the lychee orchard found in Luc Ngan district is based on the experience of the farmers (33%). There are only small number of farmer (6.7) have used or follow instruction from extension services. It is different from that in the way farmers applying growth regulation to control flowering time and prolong harvesting time, majority of farmers apply growth regulation using “others’ methods. The other methods were than

defined that these farmers using VietGap and other advanced method of farm managements. Growth regulation was applied to control the winter buds. Farmers that using VietGap have also used the monitoring book which is proposed by MARD to apply growth regulation. Once again, the role of local extension service is poor when only 6.7% of farmer has information from this office to control the growth of the trees. Instruction of application of herbicides/pesticides are likely available on the bags of the products therefore the large number of farmers using this kind of information to apply this input to control pests, diseases and weed of the lychee orchards. More number of farmers has used information from local extension service to control pests and diseases in their lychee orchards but this is still not significant since the percent is limited at 13%.

**Table 4.2 Methods of fertilizer, growth regulation and herbicide/pesticides application used by surveyed farms in Luc Ngan district**

Method	Fertilizer (%)	Growth regulation (%)	Herbicide/Pesticides (%)	Mean (%)
Instruction on the bag of the product	17	20	37	24
Base on performance of the tree	17	27	20	21
Family experience	33	13	13	20
From local extension office	7	6.7	13	9
Others	27	33	17	26

**Pruning and training:** Pruning and training the lychee orchards is applied by growers in Luc Ngan district. Up to 93% of survey farmers answered that they use this technique to manage their lychee farms and only 7% of farmers do not use training and pruning because of lacking labor and even the farm size of these farmer are small but they have more income from other sources such as small business. The pruning and training methods seem being an important technique to improve yield since the farmers have used this methods relatively have higher yield (Table 4.3). Even the number of farmers that have not used pruning and training to care of the lychee orchard is only 2 out of 30 surveyed farmers but the significant lower yield of these two farms is a strong evidence of the advantage of this technique.

**Table 4.3 Frequency of farmers that are applying pruning and training in relation to Thieu lychee yield**

Applying Pruning/training	Frequency	Percent	Valid Percent	Yield (tones/ha)
Yes	28	93.3	93.3	4.2
No	2	6.7	6.7	3.2
Total	30	100.0	100.0	

**Fruit preservation:** Three major kinds of methods to maintain fresh fruit were found using by farmers in Luc Ngan district. The majority of farms (almost 50%) are trying to maintain the lychee fruit stay fresh longer by keeping the fruit on tree. Some households growing lychee use a biological product to keep fruit on trees. They use this product 6 times from the period of female flowers blooming to 10-15 day prior to harvesting time. This method can postpone harvesting period for another 20-25 days and would increase the weight of fruit (25-30 fruits/kg) and the output. About 30% of surveyed farms are not using any kind of preservation since they always sell their fresh fruit immediately after harvesting. Another 20% of farmers using other methods this is introduced form private company or a trial of some individual research from

Agricultural institutions near by such as Hanoi University of Agriculture and Institute of Agriculture Technology Science in Hanoi. No farmer has been reported to use cold storage or cool room to maintain their fruits because these facilities are not widely available in this region yet (Figure 4.4).

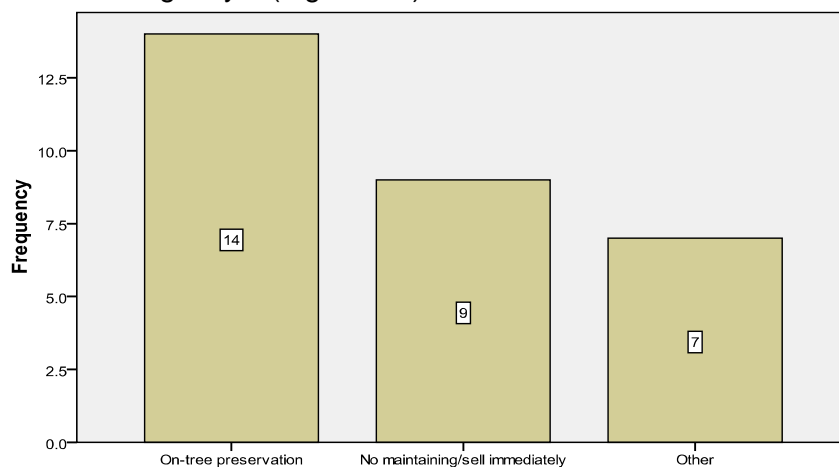


Figure 4.4 Frequency of grower using different method of fresh fruit preservation in Luc Ngan district (N=30)

The costs of the current method of preservation of fresh fruit lychee were also investigated. According to the survey, Farmer paid relatively small amount for lychee preservation by applying growth inhibitor to keep lychee on the tree to extend the harvest time for one to two weeks. They have no idea on how much if they invested high technology like cold storage or cool room because this kind of facility is not available in this region. The method for prolong harvest of the farmers is not monitored by the local authorities. Farmers have put the economic profit on top and did not care about the product safety and environment protection.

**Agronomical factor affecting fruit quality:** Factors influencing fruit quality were determined by in our survey. There was about 60% (17 farmers) agreed that practice management such as fertilizer and pruning are most important factors that strongly influence fruit quality. Almost 40% indicated other factors such as packaging and preservation that could contribute to fruit quality. This 40% also agreed that management practices are also important too. Only one farmer determined harvest time and harvest technique influence his fresh fruit quality.

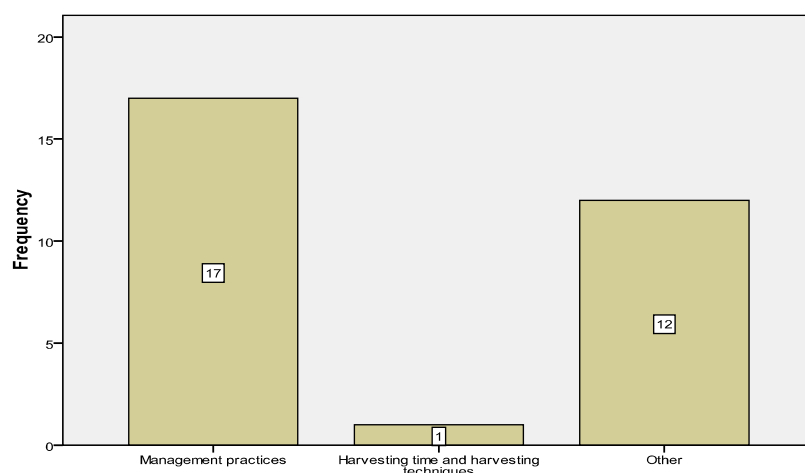


Figure 4.5 Frequency of factors influencing fruit quality determined by surveyed farmers in Luc Ngan district (N=30)

## 4.2 Harvest and Post harvest management

**Harvesting:** How farmer in Luc Ngan district decide harvesting their lychee fruit was surveyed in three villages. The majority of lychee farms are harvested based on the ripening level of the fruits and this method is currently used by almost 50% of farmers (Figure 4.6). About 30% of farmers (9 out of 30 surveyed farmers) determine that they are using “others” methods. This group consists of some farmer that applied VietGap or other management standards therefore they followed the guide of those methods. According to survey, when using these methods, growers must follow the safe period after chemical application. Twenty percent of surveyed farms were answered that they harvested their fruit base on the demand of the market and ignore the quality and yield of the fruit. According to them, the high demand of market could give them good price to compensate the lower yield and they did not care about the safe period after chemical application. Harvesting at high demand of market also has advantage to avoid risk of peak season when fruit is difficult to sale.

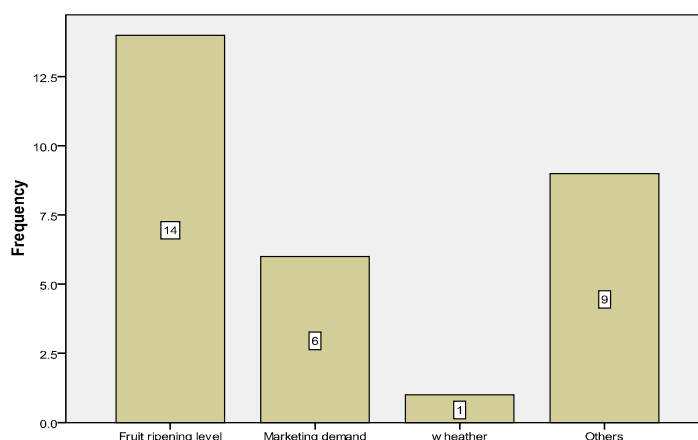


Figure 4.6 Growers frequency based on factors influence harvesting time (N=30)

**Sorting and grading:** Sorting and grading criteria were investigated on all the farmers surveyed. In Luc Ngan district, main criteria that farmers use to sort and grad their fresh fruit products is base on fruit morphology that are fruit color (1) and fruit size (2). However, more than 70% of surveyed farmers indicated to use both criteria (color and size of the fruit) and about 25% of surveyed farmers told that they determined the classes of fruit based only on color (Figure 4.7). The respondent also indicated the preferences on fruit morphology of different markets. The local markets prefer to buy green-red color (less ripening) fruit while trader that buys lychee to sell to Chinese markets like to buy red color fruit.

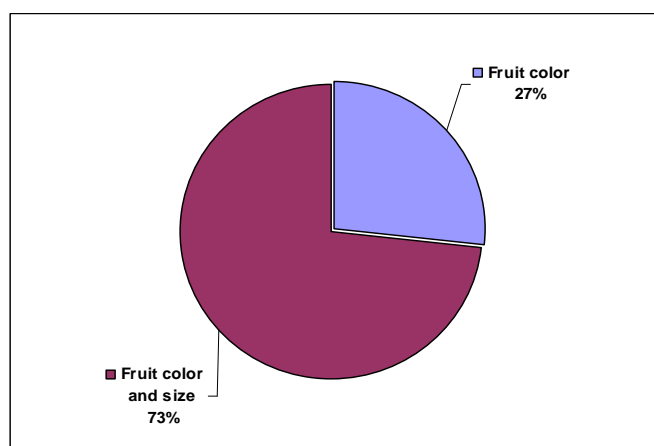


Figure 4.7 Criteria for sorting and grading of fresh lychee in Luc Ngan district (N=30)



**Packaging:** After sorting, producers plucked the branches and leaves and the fruits were fastened in to 1-2kg bundle. Bundling and packaging can be done by both growers and local collectors. The main method of packaging is to store the bundles in the wooden crate without cooling facility. This method accounted for about 66% of the farmers surveyed. About 30% of farmers are using other methods. "Other" was latterly described that the bundles were stored in the steel baskets that build on the bicycle and motorbike to travel to the market. This method is somewhat similar to that in the method using wooden crate. Only one farmers out of 30 surveyed use in the foam rubber with ice.

We observed often very rough handling of the Thieu lychee by the collectors and wholesalers at the farm gates and collecting points. Bags are unloaded on a cement floor on which they are bruised. The floor is also often very dirty whit speed up al kind of bacterial rotting processes.

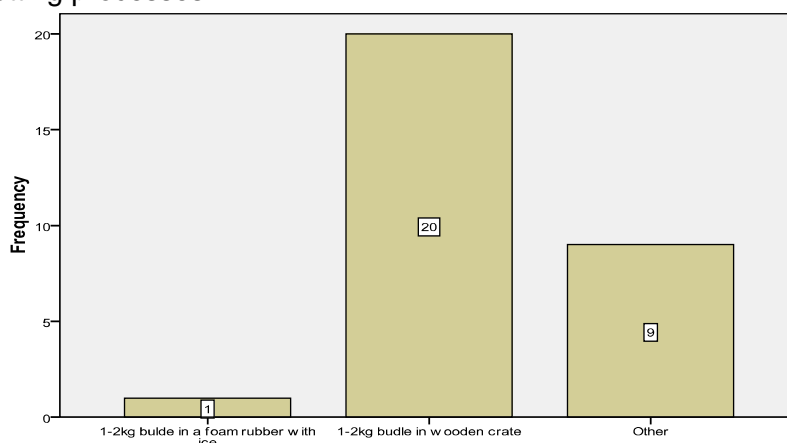


Figure 4.8 Packaging methods of fresh lychee in Luc Ngan by growers and collectors

### 4.3 Transportation situation

After packaging, Thieu lychee fruit is transported to the local market or collecting center in the district. The farmers dominantly use motorcycle to transport lychee to the markets or collecting points since this is convenient method in the local condition and most of farmer can afford a motorcycle. Number of farmers use motorcycle accounted for 66% of surveyed farms. Ten percent of surveyed farmers who own large farms can afford to transport their production using small truck with no cooling facility equipped. Still there, 4 percent of farmers using bicycle to transport Thieu lychee to the markets these farmers even could not afford a motorcycle. Some farms (13%) that have contracts with collectors do not have to transport their fruit to the market since collectors come to pick fruit at the farm gate. By this way, Thieu lychee can be transport to the wholesalers by big truck with cooling system.

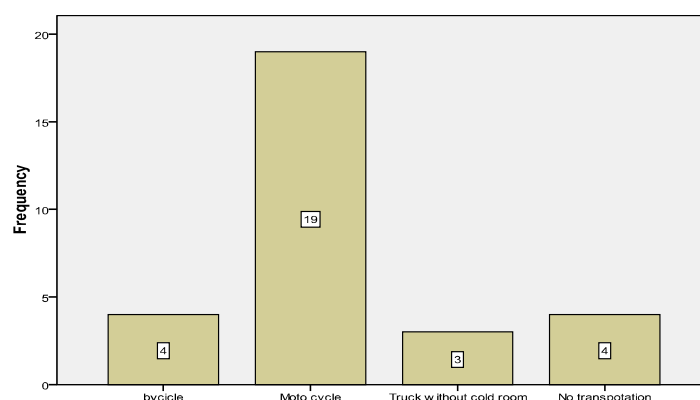


Figure 4.9 Means of transportation of fresh lychee in Luc Ngan district (N=30)

With the long transportation that carried by traders, wholesalers or importers, the main transport means are trucks which can carry between four to ten tons of lychee. But in the main season traders from other cities come with their own trucks and go especially to the district wholesalers to buy large volumes. Again the lychee is not taken well care of. It was reported that, buses with lychee (in bamboo baskets) on top of the roof, with little protection from sun, heat and rain. We even observed that a motorbike was put on top of the lychee. That bus had to go all the way to Ho Chi Minh (>28 hours), so one can imagine what happen with those lychee.

**Infrastructure situation:** The influence of infrastructure in the local on the Thieu lychee production and transportation was also accessed through survey. Survey result indicates that about 50% of farmer thinks that the transportation system has negative effect Thieu lychee quality and shelf life. This group is belonging to the Hong Giang village where the roads are degraded. The rest did not find any problem with transportation.

#### **4.4 Marketing channels and lychee chain map**

The information of marketing channels and the chain map were developed through our survey and from the discussion with Mr. Chu Van Bao, Head of Agricultural department and managing member of The Luc ngan Association for high quality Thieu lychee production and consumption.

The productivity of lychee in Luc Ngan was fluctuated since 2004. The largest production was observed in 2007 with total productivity exceed 100 thousands tones. The total productivity decreased in most recent three years with the total productivity is 85, 60 and 60 thousands tons in 2008, 2009 and 2010 respectively. The major reason for the reduction is the change in climate that leads to poor flowering and an adverse effect on fruit set.

Table 4.4 and figure 4.10 showed the different markets of lychee production in Luc Ngan. According to data given from Head of Agricultural office, every year comparatively 50% of fresh lychee is sold to Chinese markets.

The fresh Litchi sub sector sold through 2 main channels (Fig. 4.10):

- Domestic commodity channel to Hanoi, Ho Chi Minh and other Northern provinces Viet Nam: This channel consumes about 48% of total production. Besides the small traders in the whole sale markets in Ha Noi (Long bien market), the local traders as well as participate in this channel.
- Commodity channel to sell to neighboring country (China): This channel consumes 52% of total litchi production. The product of this channel is the first class litchi which has quality and appearance better than other places and the selling price from producers usually is higher about VND 3000 VND/kg to price of other places products.

Outside traders from Lao Cai province play an important role in the operation of this channel. They come to the trading carters and directly participate in the chain to select and buy lychee from the farm households or local collectors. Traders then transport fruit to wholesale markets in different provinces and fruits were sold there. These traders are the one who decide to buy which lychee types and have more power to control the price.

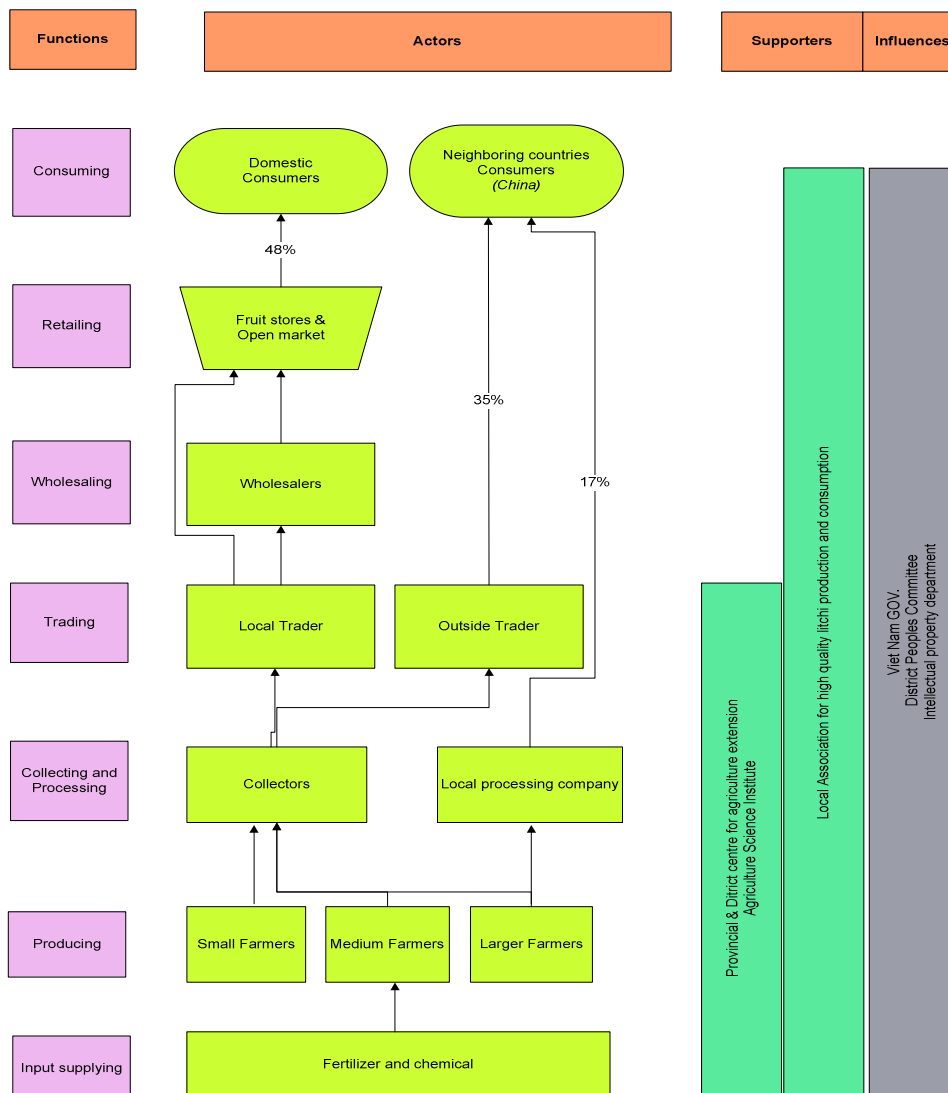


Figure 4.10 Current chain map of Fresh Lychee production in Luc ngan 2010

It can be seen from the chain map local processing companies serve only 17% of total output mainly for high quality. This is under the potential of the companies this is because the companies only look for quality products and there has been little contact between companies and growers. Local collector and outside traders are more mobility and they buy product in different quality.

Fresh Thieu lychee sector has several stakeholders including: Viet Nam Government, Provincial & District centre for Agriculture Extension and Agriculture Science Institute & University.

There are various roles played by the stakeholders in the development and sustainability of the Fresh Thieu lychee sector. The roles of the stakeholders are to provide advanced technology services, certify product brand name, policies to foster lychee commercialization.

Influencers include Vietnamese Government who creates policies to promote litchi production and trading. Local authorities involving management market and create favorable environment for development. Intellectual property Department give certifies to the quality products.

According to Mr. Chu Van Bao, Luc Ngan Thieu lychee Association was founded in October 2003 with the assistant of the Vietnam gardening Association and Luc ngan

district people committee. The objective of the Association is created the brand name for Luc Ngan specially Thieu lychee; found the stable markets for lychee of the farm households in order to increase economic efficiency for the Thieu lychee planting households. In order to achieve the objective the Thieu lychee production from different households should be in high and even quality. At the trial period, the Association has over 300 good production households as the members in 9 villages around production such as Hong Giang, Quy Son, Chu, Thanh Hai, Giap Son, Tan Quang, Tan Lap, Kim Son and Tru Huu. These households have large lychee area (in average 1 ha/household), have long experience on Thieu lychee planting and always have high quality Thieu lychee product.

In our discussion, the managing member of the Association let us know that the activities of the Association are that: Providing technique, instructing the household to farming as the common process, agreed that in 15 days before harvest, properly use of chemicals and water spraying for Thieu lychee. The Association organizes a group of households; each group includes 5-6 households to cross check each other on the technique practices. Besides the conduction of training and monitoring technique, the Association leaders also organize to contact for production consumption for the households. However it is not forced the household to sell their litchi for the partners whom the Association contacted. The households have a right to sell and to process their product in order to get better profit, but in case with the same profits then they prioritize to select the partners which the association contracted.

**Table 4.4 Different markets information of fresh fruit lychee in Luc Ngan**

Year	Domestic				China (%)
	Local Processing company (%)	Local markets (%)	Southern Vietnam (%)	Supermarket in Hanoi (%)	
2004	1.0	12.0	35.0	0.0	52.0
2006	1.0	10.0	39.0	0.0	50.0
2008	0.8	10.0	39.0	0.2	50.0
2010	0.5	9.5	37.5	0.5	52.0

*(Source: Agricultural Department office, Luc Ngan district 2010)*

According to survey data, there is a small percent (0.2-0.5%) of the product but it is consumed by an important channel is that growers that applied VietGap since 2007 up to now could sale their products to some supermarket in Hanoi. These supermarkets only bought products from Thanh Ha district, Hai Duong province before. But when farmers in Luc Ngan applied VietGap they could engage with supermarket in Hanoi to buy their good quality of lychee from them. The leader of Agricultural Department agreed that this is a good sight for growers in Luc Ngan. The price that farmers get when they sell lychee to supermarket is stable and 1.5 times higher than selling at local markets.

Why there was only a small percent (17%) of product is consumed via local processing company were examined through both interviews and also surveys. The producers were asked if they understand the reasons that company did not buy their fresh lychee. Of the producers surveyed 14 indicated that they were not interested to sale their product to the local processing companies because the companies often have too much requirements on product. There were 8 surveyed farmers not interested to sale their fruit to local processing company because they could have higher price with the local collector or trader. While 5 producers indicated that they have the contract with the local processing company but their product was denied by the company because not meeting the requirements on quality and quantity. The

remaining 3 growers also indicated that it is difficult have schedule for harvesting lychee therefore its more convenient to sale to local collector.

In an interview with Mr. Hoang Van Luu, sale manager of a local processing and exporting company (Agroport Bac Giang), we found out that the local processing companies are equipped with sufficient facilities such as cooling, cold storage room and post harvest procedures to handle lychee for exportation however, the business that the company is carrying on the lychee product is still behind its potential. The reason is that the company also finds difficulty to have stable contract with producers because they did not use safe production methods i.e the chemical residues is too high. Beside that, Mr. Hoang also indicated that in Vietnamese situation, the local traders and collectors are more mobility so that they could easily get contract with growers even the producers usually have disadvantage in terms of price when selling fruit to local collectors and traders. When being asked for the solution, Mr Hoang told us that, the company is now implementing a strategy to exploit its advantage of already availability post harvest facilities and that they are always ready to have a stable contract with producers if they could produce quality fruit. The company is also ready to invest in education for growers in terms of safe production.

Contacting an international exporter, Freshstudio Asia, who has been recently succeed in attempt to bring Vietnamese Avocado and Citrus to European and other international markets, the manager (Siebe van Wijk) let us know that, lychee is also a potential and interesting product for the company business purpose. But they have been busy working on many other projects since its foundation 7 years ago in Vietnam. The manager also showed an interest in investment in this area when they have chance.

#### 4.5 Linkages in information

The final part of the survey was to examine the existing linkages in information between chain *actors and stakeholders*. These linkages are paramount in producers' ability to make sound decisions for their businesses. The main supporter whose purpose it is to give farmers unbiased information about new crops, improved farming techniques, and aid them in analyzing new ventures and the wish of consumers.

In order to analyze the existing and missing linkages in information about fresh lychee, producers were surveyed about the source of information they have previously received and the information they still need. The knowledge of growers about international regulation of exportation was also investigated. Of the surveyed producers, 70 percent have received fairly enough or have never received any information about lychee production from other sources. Of the producers who have received information on lychee production, 30 percent have received information. In Figure 4.11 the information that producers have received the information of lychee production is presented.

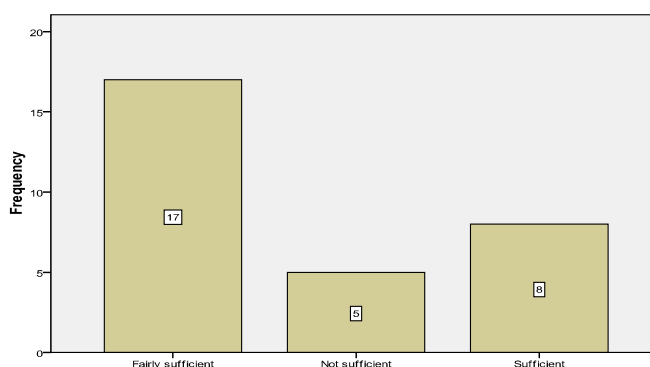


Figure. 4.11 Frequency of growers received information on lychee production

Surveyed producers were then asked about the additional information/sources of information they were interested in receiving to improve their fruit quality and yield. There are five options of information that farmers can choose including: (1) Advanced farming management, (2) marketing information, (3) International regulation for export/import fresh lychee; (4) 1+2 and (5) all the information above. In the surveys, the producers answered that they were interested in receiving additional information on new technology especially VietGap. Twenty three and twenty six percent were highly interested in receiving marketing information and all the available information respectively. Only 6.7 percent would want to receive international regulation about lychee exportation (Figure 4.12).

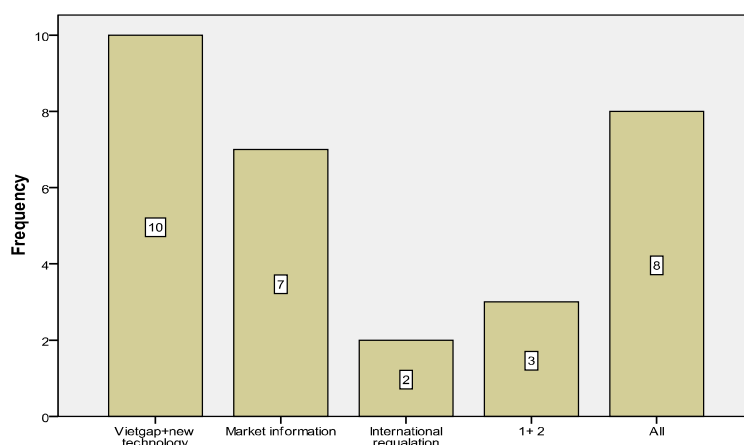


Figure 4.12 Information needed by growers in Luc Ngan district (N=30)

The surveyed was ended up with the question on the information arisen during the surveys that they are mostly interested to received VietGap to improve their fruit quality for higher marketing channels and exportation. The result showed that there is a clear strong interest of growers in Luc Ngan toward VietGap application. Of the producers, up to 83% indicated the willingness to apply VietGap to make a commercial production and to have higher income as they experienced from other farmers that have been applying VietGap since 2007. Only 16% indicated that they do not want to use VietGap because information is insufficient and they think it would be very difficult (Figure 4.13).

The farmers that used VietGap were then questioned for the advantages or disadvantages they experienced when applying this method. Survey result indicated that the different from traditional method is VietGap have a guidance booklet introduced from the Vietnam Academy of Agricultural Sciences, MARD. The management practices consist of three major parts differently from other cultivation methods including: guide to training and pruning method for the lychee orchard; fertilizer and regulation applied and harvest and chemical control at harvest. Applying VietGap is not expensive but need to stick to the method during the whole growing season. The clear importance of VietGap over the traditional method in lychee production in Luc Ngan is that VietGap could lead the growers to registration with management office; they will be equipped knowledge on safe use and chemical control. And finally their products would be registered or labeled.

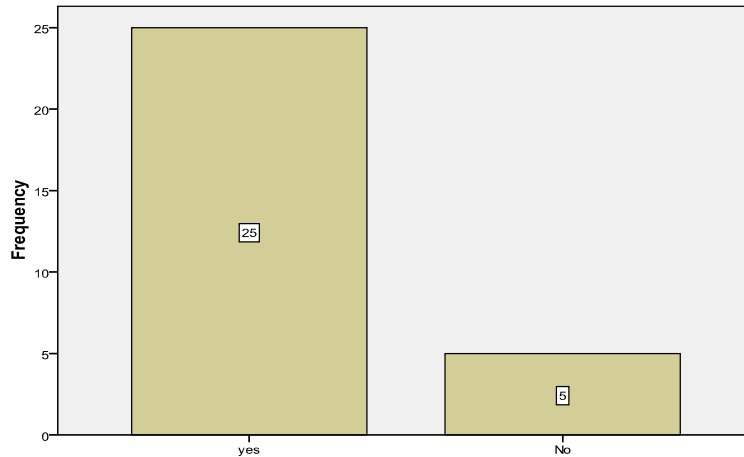


Figure 4.13 Frequency of growers that were interested in applying VietGap in Luc Ngan (N=30)

#### 4.6 Economic aspects

##### ***Selling price by actors***

The different selling prices were collected at different actor in the chain presented in the previous section including growers, local and outside collectors, local and outside traders and retailers. The selling price of fresh litchi, grower, collectors, trader, and retailer were recorded. The price was clear different from actor to actor as farmer sale their lychee with average at 11.000VND; collector get advantages from their jobs by selling lychee with about 4 thousands VND higher than what they bought from farmers (15.000VND), respectively. The traders sold the fresh lychee to the South or Chinese market at 20.000VND. It's also noticed that, the growers who applied VietGap and have the system to monitor the crops during their production process would be easily to get a contract with supermarket in Hanoi and the price is extremely higher than normal farmers do i.e. 18-22.000VND. The details of cost pricing, gross margin and profit of fresh lychee production of Luc Ngan are presented below.

##### ***Cost Pricing, Gross Margin and Profit of Thieu Lychee***

Operational costs for the production of lychee in Luc Ngan are calculated in Table 4.5. This calculation considers both preharvest and harvesting costs of production. Fertilizer costs are calculated based on the fertilizer rates using by growers for an expected yield of 4.22 tones/ha. The total production cost for 1 ha is about 2.2 millions VND (70 Euro).

A gross margin analysis was performed to examine the profitability of 1 hectare of production of lychee for Luc Ngan producers. From this analysis the total profit from lychee production of grower would be 32 million VND (1400 Euros) per hectare of production, see Table 4.5.

For the whole district, with the total lychee production area is 18.500 ha, the total output in 2010 is 60.170 tones and the average price of lychee sold by growers is 15.000 VND according to our survey, the total net margin of the district got from lychee production is about 504 billions VND (20 million Euros).

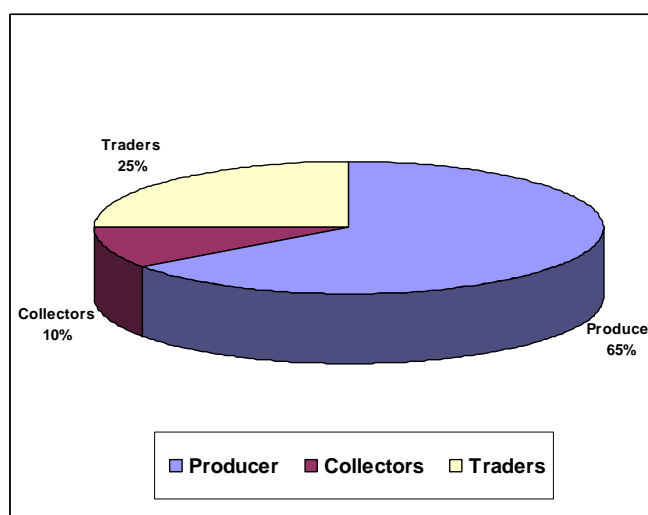
**Table 4.5 Cost Pricing, Gross Margin and Profit of Thieu Lychee**

<b>Criteria</b>	<b>(Unit: 1000VND/ha)</b>
Fertilizer cost	6945
Cost of Pest & Diseases	2778
Land tax	694.5
Other cost	2778
Labor cost	8334
<b>Total cost</b>	<b>21529.5</b>
Average yield (kg/ha)	4167
Average price	13
Revenues	54171
<b>Profit</b>	<b>32641.5</b>
The whole district production (tones)	60170000
<b>Gross output</b>	<b>902550000</b>
Var. Costs	20835
Total Var.Cost	385447500
<b>Gross Margin</b>	<b>517102500</b>
<b>Net profit</b>	<b>504254250</b>

*(Source: Agricultural Department office, Luc Ngan district 2010)*

**Value Share of the actors**

The value shares of fresh Thieu lychee actors in the chain are shown below. From this graph we can see that the largest share goes to the grower. The grower is also the actor which has the product for the longest time and adds the most value to the product (65%). The traders have the second largest value share at 25%. Growers have to pay production cost therefore they have higher value share. Trader pays much for transportation



*Figure 4.14 Value share by actor in the chain*



## Chapter 5 Discussion

### 5.1 Current situation of farming management

One of major objectives of this study is to find out the current situation of farming management and marketing channels existing in Thieu lychee production sector in Luc Ngan district. For higher income, fruit cultivation should be aimed at producing good quality fruits for export through a good understanding of the impact of fertiliser application and orchard management practices on fruit quality at harvest. Litchi fruit quality is determined by fruit size, weight, color, taste and flavour. Skin colour and sweetness are generally considered important quality attributes that determine fruit quality at harvest (Oosthuysen et al 2005). Sweetness and fruit pH affect the taste (sweet-sour) and flavour in many fruits (Auerwald et al 1999). The relationship between the nutrition of fruit trees and fruit quality indices has been well documented. The right nutrient balance is essential for maintaining fruit quality. Nutrients with the most notable influence on fruit quality are nitrogen, phosphorus, potassium and calcium. Thieu lychee nutrition management is based on monitoring leaf and soil nutrient levels and adjusting fertilizer practices according to the yields obtained (Menzel C, 2001). Fallahi and Simons (1999) have demonstrated that leaf analysis is a useful diagnostic tool for optimizing mineral nutrition in fruit trees and the differences in nutrition correlate well with fruit quality.

In terms of farming management method, our survey reveals that the cultivation methods in Luc Ngan are still behind with almost 70% of farms are now managed by the traditional method. This method has no standard, it is based on farmer experiences inherited from generation to generation in the family or the experiences can be achieved through collecting information from adjacent farmers (Table 4.3). In general, households have a habit of applying fertilizing after harvesting (encouraging autumn buds) so it is often 2-3 months late which discourages autumn buds to develop but encourages spring buds and this has a negative impact on the bloom in the following crop. Improper use of fertilizer in different litchi development period has been found. For example, in the period of encouraging fruits, households often use fertilizers N:P:K by a ratio of 1:2:0 This ratio is not good due to an abundance of nitrogen and phosphorus and an insufficiency of kali which can lead to brokering of litchi while harvesting, low possibility of keeping sugar content and litchi's vulnerability to diseases and even shelf life and taste. It has not been much fertilize applying to promote fruits, only once after fruits are born which leads to the insufficiency of protein for the development of fruits to its best and has a negative impact on litchi quality and autumn buds development.

The existence of various cultivation methods results in a large variation in lychee quality and therefore this situation can be one of the reasons that are preventing the lychee fresh fruit from reaching higher market segments. According to Sivakumar and Korsten (2008) in their study found that the different in practical management such as fertilizer application could lead to poor exportation because of the variation of production quality. Situation of management practices were further investigated in the details of input supply, chemical control, pruning and the harvest prolonging methods. The various ways were deployed by growers in Luc Ngan to apply chemical such as fertilizer, growth regulation to lychee in Luc Ngan. The role of extension service was rather poor according to the report by growers. Due to the lack of information for chemical control receiving by growers, they did not follow the safety period after chemical application and usually harvest the lychee based on fruit morphology and the markets demand but not do not care about the safe period after chemical application. This situation is dangerous for the farmer health, environment

and especially create the risk for the sector from seeking out the market in Europe and other countries.

In terms of pruning and training, up to 93% of surveyed farmers are applying this method in lychee production. The pruning and training methods seem being an important technique to improve yield since the farmers have used this methods relatively have higher yield (Table 4.3). Furthered communication of an expert from Agronomy faculty at HUA however showed that most of households don't know how to implement this technique in a good way and they have no experience in caring litchi so they often prune branches late (1-2 months after harvesting). This is not good for litchi trees because branches not only consume a lot of nutrition but are places for diseases to develop as well. Households usually prune branches once after harvesting so unnecessary branches have conditions to grow later which create favorable conditions for diseases to develop on litchi trees.

In summary, management practice was reported by 60% of growers that is main factor influence fruit quality. Improvement of the farming management methods could be a major factor enhancing fruit quality. Strong interest of growers in applying advanced farming management systems such as VietGap indicated that this method would be a way to put lychee production in Luc Ngan in to a right way becoming the high quality commercial production area for higher segment of markets

## **5.2 Harvest and post harvest management**

Harvest and post harvest management are the major factors that influencing lychee quality and yield (Lee et al., 2000; Jiang et al 2006 and Oosthuyse et al 2005.). Preharvest fertilizer application also determines fruit quality at harvest. Litchi fruits are hand harvested, sorted for defects due to diseases and damages and then pre-cooled. The storage life of the litchi fruit is limited due to browning and decay. Moisture loss is high after harvest, and during handling and transportation. This can cause loss of weight and flavor.

Harvesting of fresh lychee in Luc Ngan conducted by growers also showed a lot of problems. The beginning of the season is too early, the mid-and late season can reduce sugar content in litchi and make its appearance less attractive. In the mid-and late season, households often wait for higher price so they pick litchi late when fruits change into dark red and there is a high rate of litchi dropping (sometimes 50% of litchi). This is difficult for storing and long distant transportation, especially to the South and China. Therefore solving this problem is one of centre point to look for chance for higher segment markets.

Our survey result showed that fresh fruit preservation after harvest is a major problem of lychee production in Luc Ngan, most of growers do not access sufficient facilities for fruit preservation such as cooling room and cold storage. Therefore most of growers are using on-tree preservation. In this method, they use growth regulation to maintain fresh lychee fruit for about two weeks to wait for higher price at the market. This is probably negatively influence the fruit quality because this method has never been tested for its effect on quality of fruit as well as for chemical residual (fig. 4.5).

The current situation of post harvest management in Luc Ngan was examined. Simple sorting, grading and packaging methods are applied by growers and/or collector (Fig 4.7 and 4.8). Our survey also showed the problem under sorting and packaging, all steps are done by hands and bags are unloaded on a cement floor on which they are bruised. The floor is also often very dirty with speed up all kind of bacterial rotting processes. Moreover, fruits are not evaluated for chemical residues. These standards are composed through traditional experience of producers with the agreement of the collectors or traders. This also due to very poor quality management system here that has been discussed earlier. The reason is also due to

the preference of traders who focus only on the size and appearance of fruits and they rarely pay attention on the chemical residual of the fresh lychee. Besides, brix is not measured.

### **5.3 Logistic management**

Pre-cooling can provide a partial solution in overcoming the above mentioned fruit deterioration. Pre-cooling procedures help to remove field heat from the fruit and are known as critical precursors to low temperature management during subsequent storage or shipment (Tongdee, 1992). Room cooling, forced air cooling, hydro cooling and vacuum cooling are some commonly adopted cooling methods. Wang *et al.* (1996) found that immediate hydro cooling of litchi after harvest in iced-water (0–20°C) for 2–3 h provided satisfactory results. Hydrocooling is preferred over forced air cooling (Jiang *et al.*, 2006). Chen *et al.* (1986) reported that vacuum cooling of litchi fruit is rapid, but the water loss from the fruit and the incidence of browning associated with desiccation was high. In South Africa room cooling is practiced in most pack houses. After pre-cooling fruits are subjected to SO<sub>2</sub> in many litchi exporting countries.

There was no standard post harvest management method applied and intended quality such as pre-cooling, forced air cooling, hydro cooling and vacuum cooling as mentioned above. This poor post harvest management was resulted by lacking of investment of government and province to the production area and an inefficiency of local processing companies. The method that farmer is using at this moment is to store fresh litchi in the normal conditions within 4-5 days, post-storage loss is about 8-10% due to water evaporation and rotten fruits and 10% of litchi picked changes its color to brown. We found that the time between harvest until pre-cooling is 2 days for most growers, which most likely limits the shelf life with more than a week by enhancing respiration and transpiration. Besides, the sweetness will decrease.

Our surveys also indicated that there has been a strong need of investment in Infrastructure and transportation system varies in the district. Transportation from farms to the local markets was mainly done by growers by motor cycle.

### **5.4 Marketing channels and information linkages**

In order to analyze the marketing problem we have studied the markets for fresh lychee in Luc Ngan district (Table 4.4). We were able to make a chain map for lychee fruit (Fig. 4.10) to summarize the current situation of lychee production involving in the various actors. According to our result, the market channel is limited with two ways, domestic and to China. No product is exported to higher market segments in Europe or other international markets. This is a disadvantage of Luc Ngan lychee production as compared to the neighboring province where they have a percentage of lychee produced exported to Russia and France. For the domestic market, there is separate chain for supermarket that is still small but growing.

Information linkage analysis reveals the poor information system is available now in Luc Ngan. Of the surveyed producers, 70 percent have received fairly enough or have never received any information about lychee production and international standard requirements (Figure 4.11). These results reveal that the limitation of information flow would also a reason behind low quality and poor trading activity of lychee production in Luc Ngan.

There has been very limited information system in fresh litchi sub sector. The dominant one is from input suppliers who are small local stores. When they sell fertilizer and other chemical (pesticide and growth control) in addition to the information written on the covers of these substances, they may help explain the growers how to use. Beside this, there is lack of information when growers sell fruits to collectors and so on. There has been not much information on storages and

usages afterward. There is also no reverse flow information. Because the market is divided into different segments with different price and quality ratios are uncontrolled, financial limitations, little knowledge of the wishes of consumers, lack of market information systems, management capacity. In order to prevent further losses in the market and to gain new sections of the market for the lychee sector, it is essential to set targets in the field of improvement of information flow in this sector.

Our study result indicated that farmers are now mostly interested to receive information related to applying VietGap. According to growers and local authorities, this method would help farmer increase their fruit quality to seek out for the higher markets. The survey result showed that there is a clear strong interest of growers in Luc Ngan toward have VietGap application. Of the producers, up to 83% indicated their willingness to apply VietGap to make their production commercial and have to have better income as they experience from other growers that are applying VietGap since 2007 (Figure 4.13). However, it is obviously that not all of the growers that have willingness to apply VietGap are ready to adopt this new technology. There will be a need for the chain manager to select for growers to apply this new growing method.

### **5.5 Constraints in Thieu lychee production**

Second aim of this study is to find the constraints underlying low quality of fresh lychee production in Luc Ngan district from the surveyed results. Using value chain approach with the focusing on the root of production site and the marketing channels point of view, we could able to find different advantages and difficulties that influence growers and other actors from producing high quality fresh fruit lychee. Low quality of fresh fruit lychee in Luc Ngan district was attributed to several groups of factor such as: farming practice, information deficiency, marketing and transportation. From the literature (Evans, 2005) and the result from our discussions with Dr. Dao The Anh (CASRAD), Dr. Nguyen Quoc Vong (HUA) and Mr. Nguyen Van Loc (IPSARD), we found that there are many opportunities within the this sector such as favorable soil and climate condition, large area for production, long history and great passion of grower, low input kind of production to promote production for exportation. However, several important weaknesses such as farming management practices, limited market channels are now preventing growers from producing high quality product. Therefore, there is still no chance for the product to reach higher markets in Europe and Japan, for instant.

The SWOT analysis on the whole fresh lychee value chain allows us to look at both the positives and negatives internally and externally. The weaknesses mainly focus on marketing aspects, cultivation and post-harvest management and logistics.

<b>INTERNAL</b>	<b>STRENGTHS</b>	<b>WEAKNESS</b>
	<ul style="list-style-type: none"> <li>• Soil and climate favorable</li> <li>• Large area production</li> <li>• Traditional sector</li> <li>• Willingness of growers in applying new technology</li> <li>• Low labor cost</li> <li>• Low input requirement</li> <li>• Special product, Good tastes→ economically competitiveness than other crops</li> </ul>	<ul style="list-style-type: none"> <li>• Old plant→ low quality; Short harvest time</li> <li>• Unstable market; Limited marketing channels; Traders and collector controlling the price</li> <li>• Poor chain management of Government</li> <li>• Poor marketing information and standard production knowledge</li> <li>• Bad transportation of the product though the whole chain; High transport cost</li> <li>• Few financing opportunities for farmers</li> <li>• The product quality is negatively influenced by the lack of refrigeration facilities on the growers' premises and the lack of refrigerated transportation</li> <li>• There is insufficient monitoring in accordance with VIETGAP, as insufficient inspections, audits and certification take place</li> </ul>
<b>EXTERNAL</b>	<b>OPPORTUNITIES</b>	<b>THREATS</b>
	<ul style="list-style-type: none"> <li>• Vietgap is introduced</li> <li>• Commercial production</li> <li>• Exportation</li> <li>• Processing development</li> <li>• Specialized production area</li> <li>• There are many alternatives alongside fresh fruit, such as dried, juice and canned lychee.</li> <li>• High potential of domestic and regional market.</li> <li>• Successful stories of Avocado and citrus that recently exported to Europe though some international exporters.</li> </ul>	<ul style="list-style-type: none"> <li>• Declined production</li> <li>• Declined margins</li> <li>• Quality systems to be implemented are becoming ever more complex and therefore difficult to implement in the fresh lychee production</li> <li>• Competition from other province (Hai Duong) and other countries (China, Thailand, India....)</li> <li>• Vietnamese producers are at a disadvantage in terms of information, in contract with European customers.</li> <li>• Little access to high quality plant material.</li> </ul>

### 5.6 Propose a new lychee value chain

In this section we will discuss the whole supply chain approach to formulating the points for improvement base on the strength and weakness found above.

#### ***New value chain map***

Proposed solutions for the lychee production in Luc Ngan district to overcome the various problems underlying poor quality fresh fruit lychee as discussed above using value chain approach need to consider farming practices and marketing channels. Final aim of this study is to create a concrete steps to promote fruit quality to seek for

high market channels. In attempt to increase product quality to look for the higher segment of the market such as Southeast & East Asia markets. The product of these channels needs not only good appearance and better uniformity but also chemical residual free. There is a strong need to have to strengthen or change the role of actors as well as supporter to perfume in the chain.

In this section we have designed a value chain map that easily adopts the changes made to the fresh fruit lychee in Luc Ngan and at the same time a chain would enable actors (Association for production and consumption, local trading and processing companies and international importers/exporters) to perform its tasks effectively and efficiently as been shown in figure 5.1.

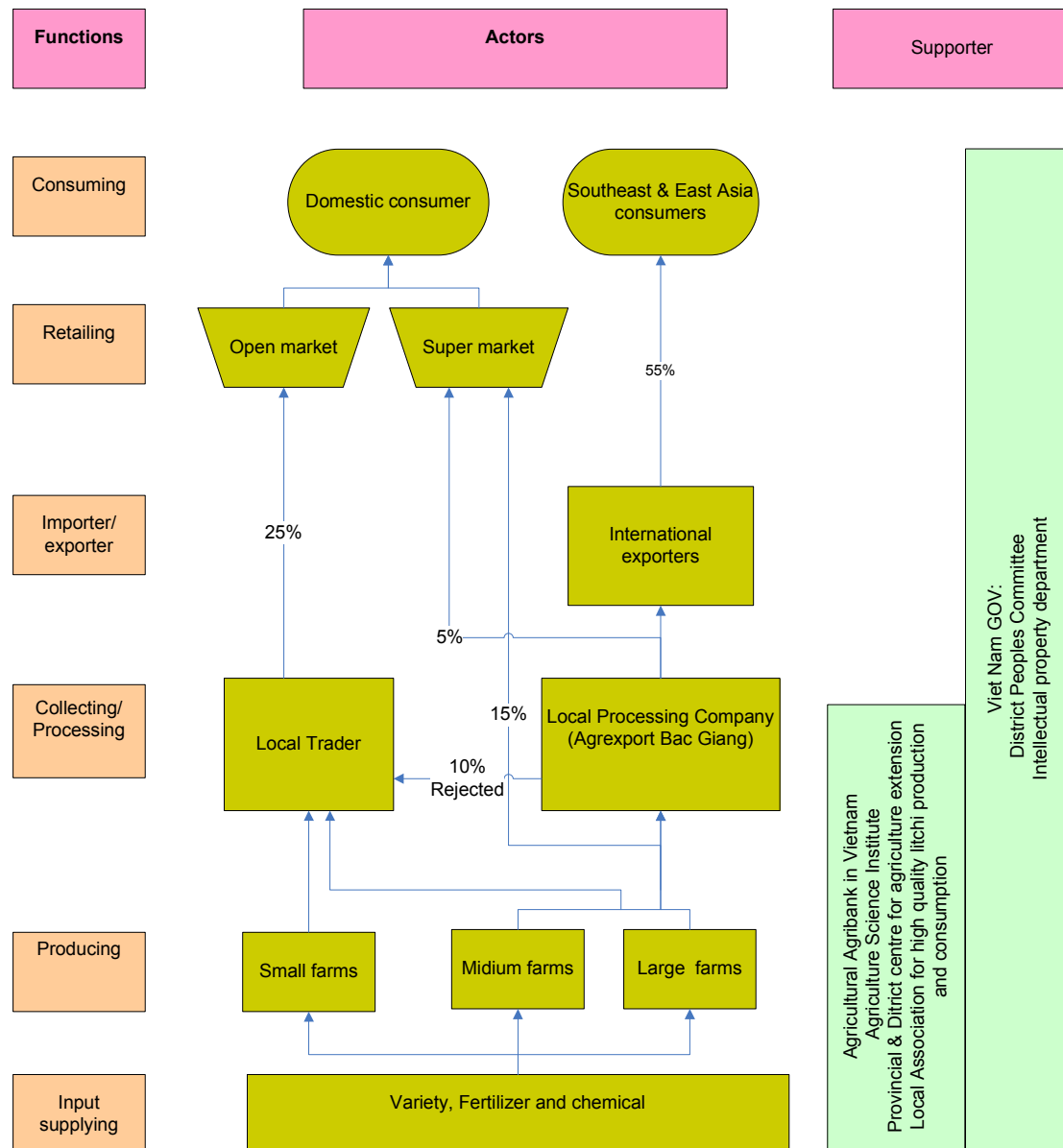


Figure 5.1 New lychee value chain map proposed for Luc Ngan based on this study

We can therefore note that the above value chain map correlates with the discussions we gave earlier. The new chain creates a close links with all actors in the chain that affect how well the value chain functions. The new chain allows a smooth flow of the whole fresh lychee, marketing information and logistic improvement. The new chain map was proposed also to promote information flow in already existing channel in lychee production in Luc Ngan.

### ***Cultivation and quality management***

As discussed above, Vietnam has recently released the Vietnamese Good Agricultural Practice (VietGap) to have better control on horticultural quality production and management to protect health of consumers but more importantly is to guide through producers how to produce plant product for high quality and healthy from growing until harvesting. The VietGap for production of fresh fruit and vegetable is aimed at preventing or minimizing the risk of hazards occurring during the production, harvesting and post harvest handling. The hazards covered in VietGap include food safety, produce quality, environmental impacts and health, safety and welfare for Vietnamese workers (Nguyen Quoc Vong, 2008). The proposed solution is to introduce VietGap to other farmers that are ready to apply this new technology. Therefore we will need more education and stronger support from scientific institutes and government to spread VietGap more widely and deeply to the different mountainous villages in Luc Ngan.

The small and medium scale farmers will have education on cultivation, post-harvest management from HUA and Association for production and consumption in Luc Ngan district. For large farms specialize in lychee production, they have direct contact with their customers or Chinese trader and as well as other companies in the chain. Thus they still have an important role controlling all the activities necessary for exporting. Moreover, they will have more investment from their own and loan to improve transportation infrastructure to have good quality during transportation.

### ***Post harvest and Logistics improvement***

There is lack of cold chain storage caused by the actors failure to invest in the facility resulting in high rate of fresh lychee perish ability (chapter 4). The fresh lychee sector is not well organized because it has not coordinated the stakeholders into establishing cold storage facilities. Infrastructure is still weak with old transportation facilities in Luc Ngan and the inadequate refrigeration facilities resulting in a lower quality product. The continuous demand is low, due to the poor product quality and the inadequate reliability of deliveries. Availability of cold chain storage of the harvested fresh lychee prolongs their shelf life and decreases the losses incurred by all actors with respect to money and quality, but this has to be accompanied with post harvest handling techniques. Concerning the cold chain storage of fresh lychee, we suggest that the value chain actors (public-private sector; supporting and influencing institutions) should invest into cold storage facilities at the port. Improving product quality, this should lead to higher export volumes, which in turn could lead to slightly lower freight costs. This problem could be solved if the local processing company aware about their advantages of the already available facility to have stable contract with producers to have better price.

In the new chain, the local companies run training courses to educate the various players on quality criteria for export lychee and the costs from the farm to customers. The companies therefore will rally firmly behind the leaders of the company by education more lychee farmers in their respective towns and villages to register with the company. These companies will help to improve the organizing degree of the new chain by create a tight relationship between members of the Luc Ngan lychee production and consumption association and lychee growers. With the joining of local processing company and education plans that company will implement to the farmers that have registration with them, the improvements at harvesting can therefore lead to a substantial increase in yield and quality. The dissemination of knowledge is the first step towards better cultivation methods and through the improvement of the post-harvest treatment, a distinction improvement can be made both the short-term and long-term manners.

### ***Old actors, new roles***

To serve Lychee growers in the Luc Ngan, the actors such as processing company, local and international importers/exporters are proposed to play a more important role in the new chain to solve the post harvest and marketing problem. Local company could reduce risk of growers may have from price controlled by local traders and collectors. To create a sustainable business by improving the end – quality of fresh fruit through better post-harvest treating, the local processing companies will buy fruit of growers and sell part of its lower quality output to local market, and also serve the growing demand for high quality lychee by selling direct to international importers/exporters. Local company will make the contract with the potential actors such as international exporters on required quality as well as quality so that they can together with producers apply to production process.

Beside improving the role of old actors in the chain and reducing the influences of local collector and traders, in this new chain, one of the important points that we proposed is to introduce the international companies such as Fresh studio (the Netherlands) or other like that to take part in the chain. Fresh Studio Innovations Asia is an international consulting which is new in Vietnam but has a lot of success in attempt to bring Vietnamese Avocado and citrus to the markets in Europe. They are passionate about the world of fresh produce and aim to be the most recognized initiator and developer of unique value chains, and accelerator of innovations adopted by the industry. Committed to re-imagine the fresh produce industry, the company collaborates with our clients and partners to fast-track innovations. We proposed that this company will have contracts with local trading and processing company to assist lychee exportation and finding available markets in the world. With the participation of Exporter, further losses in the market would be prevented and to gain new sections of the market for the Bac Giang lychee sector.

### ***Enhance the role of key supporters/influencers***

As mentioned in chapter 4, the local association for production and consumption was established in 2003 and has achieved early success in attempt to create the brand name for Luc Ngan specially litchi Thieu and find the stable markets for litchi of the farm households in order to increase economic efficiency for the litchi planting households. However, the area of coverage of the association was restricted in some villages and the production program that the association applied to its members is not always up to date. Therefore, strengthening the activities of this organization could be a solution for the chain improvement. Association could be together with science and research institutes to organize the education programs to group of households that are ready to apply VietGap. Besides the conduction of training and monitoring technique, the association leaders also assist the growers to find contract with local companies for production consumption. Association for production and consumption could also be a central point for information flow in the chain.

The supporters for this chain should include also several research institutions such as Hanoi University of Agriculture who introduces new practical methods and opens some training for producers. This also meets the need of current growers. This is important because from experience of about 30% farmers have been applied VietGap since 2007, they produced better quality of fresh lychee and obviously have a chance to access higher segment of market in Supermarket in Hanoi with a significant higher price. Therefore they could hope for a chance to reach higher markets in Europe or other international markets if they will stick still to VietGap and that the authority and supporter institutes will implement a good monitoring system.

To solve the problems within the lychee chain in Luc Ngan district, we also need stronger positive influences from Ministry of Agriculture and Rural development (MARD) and local authorities who make policies that affect the chain and provide the



better regulatory frame work for the industry in regards to the use of pesticides, certifications and export. The district people committee is the organization which directly manages through agricultural section and agriculture station to solve some difficulties at the organizing level, and to suggest some policies to support to impulse litchi product trading in the district. Agribank (Bank for agriculture and rural development) will play an important role in the new chain to support financial matter such as giving loan for growers and processing company to invest in post harvest facility.

## **Chapter 6 Conclusion and recommendation**

### **6.1 Conclusions**

Using value chain approach with the focusing on the farming management site and the marketing channels point of view, we could able to find different advantages and difficulties that influence growers and other actors from producing high quality fresh fruit lychee. Low quality of fresh fruit lychee in Luc Ngan district was attributed to several groups of factor such as: farming practice, quality management and post harvest handling. Low fruit quality has resulted to very limiting marketing channels and reduced the competence of lychee production in Luc Ngan.

From the study conducted, it is concluded that the problems can be solved using the value chain analysis approaches. Several solutions have been proposed to solve the agronomical and economical constraints in the lychee value chain. VietGap cultivation method has been chosen as a major solution to improve farming practices and quality management to improve fresh fruit quality. In order to do this, strengthening the role and activities of Lychee Association for production and consumption in Luc Ngan was strongly recommended. In cooperation with Hanoi University of Agriculture and other Science and research institutes, these organizations will act to promote VietGap application and implementation. Association for production and consumption will also help growers to have contract with local processing and trading companies.

To solve the marketing and post harvest handling problems, local processing and trading company were recommended to more actively participate in the chain. Once, growers could improve the quality of fresh lychee. The local trading and processing companies will buy fruit from growers and sale part of its output to local markets, and also serves the growing demand for high quality lychee by selling directly to international importers/exporters. In return, training on marketing demands and marketing information would be given to growers from the local companies.

The central point of the proposed solutions in this study is to introduce international exporters such as Freshstudio Asia and other companies like that to take part in the chain. This kind of company will have contract with local trading and processing companies to assist lychee exportation and finding available international markets. With the participant of exporter, further losses in the market would be prevented and to gain new sections of the market for the Bac Giang lychee sector.

Based on this study's results, a new chain map has been proposed for fresh lychee production. The new chain allows a smooth flow of the whole fresh lychee product, marketing information and improving logistic. And more importantly the new chain map could create the tight links between the existing actors and potential actors so that they can together act more efficiency and economically to improve fresh fruit quality for the higher segment of marketing channels.

## 6.2 Recommendations

Based on the results of this study, it is concluded that lychee production in Luc Ngan has potential to become a large production area for upper segment of markets. The proposed chain map has been shown that it could help solving problems underlying low product quality and limiting marketing channels. Therefore, this chain should be researched and developed further so that it can reach its potential. For the lychee production in Luc Ngan to develop, the following recommendations are made:

**To producers:** To have close link to the Association for production and consumption to have training and education program on VietGap production, safe use and international regulation on fresh lychee exportation. Currently it is advisable for producers to seek a guaranteed contract with local companies through Association for their product with higher price.

**Local companies:** To have closer cooperation with growers, provide necessary information on marketing demand, requirement for exportation and try to contact with exporters to have contract with them and to find other markets.

**International exporters:** To have contract with local processing company and stay in touch with the Association for production and consumption to provide international marketing information as well as standard requirements of production for exportation.

**To chain supporter:** Association for production and consumption to have close cooperation with science institutions to conduct education program for growers, serves as linkage point in the chain to maintain the smooth flow of information.

**To the Hanoi University of Agriculture:** Study showed that, with the demand for knowledge on new farming management technology such as VietGap increasingly, the role of University will be more and more important in terms of technology transfer. Variety and breeding for alternative varieties are also an important role of this institution in the new chain.

**Governmental and local authorities:** These organizations in Vietnam situation should hold the management possibility in the chain. It's a strong recommendation to facilitate discussing between all the potential actors including; representative of growers, local companies, science institutes, Agribank and international exporters to discuss on these problems in order to improve lychee quality for higher marketing channels.

## References

- Auerswald, H., D. Schwarz, C. Kornelson, A. Krumbein, and B. Brückner. 1999. Sensory analysis, sugar and acid content of tomato at different EC values of the nutrient solution. *Scientia Horticulturae* 82: 227–242.
- Menzel, C. 2002. The physiology of growth and cropping in lychee. *Abst. 1st Int. Symposium on litchi and longan*. Guangzhou, China, p. 37. Chien, T.M. 2003. On the Study of Critical Points in the Lychee Supply Chain. The Case of Bac Giang, Vietnam. Master of Science in Engineering in Agri-Chain Management, pp. 8-11.
- Chen F, Li YB and Chen MD. 1986. Production of ethylene by litchi fruits during storage and its control. *Acta Hort Sinica* 1986: 13: 151-156
- Christopher Menzel, 2002. *Lychee and Longan Botany, production and uses*. Cabi publishing, Cambridge, MA 02139 USA
- Dao The Anh, Vu Trong Binh, Dao Duc Huan, Bui Van Minh, Sautier Denis, 2009. Models of establishment of geographical indications for agricultural products in Vietnam: facts, difficulties and prospects
- Dao The Anh et al 2008. Constructing farming process oriented Asean GAP for Thieu Lychee. GAP Workshop in Binh Thuan, Vietnam 2008.
- Dao The Anh et al 2005. Commodity chain study for Thieu Litchi in Luc Ngan District Bac Giang Province. Final report of Agrarian System Department – Vietnam Agricultural Science Institute (VASI)
- DARD Bac Giang, Bac Giang Department of Agriculture and Rural Development 2008. Annual report of lychee production and consumption in Luc Ngan district (72 pages).
- Evans, E., R. Degner, and K. Morgan. 2004. Six ways to improve the profitability of growing lychee in South Florida. EDIS FE492, Dept. Food and Resource Econ., Univ. Fla., Gainesville. <http://edis.ifas.ufl.edu/FE497>, (accessed 20/07/2010)
- Edward A. Evans, 2005. Recent developments in world production and trade of lychee (*Litchi Chinensis*): implication for florida growers. *Proc. Fla. State Hort. Soc.* 118:247-249. 2005.
- Ha Minh Trung. 2000. Lychee Production in Viet Nam - prospects and problems. *Proc. 5th National Lychee Conf.*, Twin Waters, Australia, pp. 83-87.
- Hai, V.M., Dung, N.V. 2002. Lychee Production in Vietnam. In: PAPADEMETRIOU, M.K., DENT, F.J. (Ed.), *Lychee production in the Asia-Pacific region*. Food and Agriculture Organization of the United Nations, Regional Office for Asia and the Pacific, Bangkok, Thailand, pp. 114-119.
- Jiang et al 2006 (Jiang YM, Li J, Jiang W. 2005. Effects of chitosan coating on shelf life of cold-stored litchi fruit at ambient temperature. *Lebensmittel-Wissenschaft und Technologie* 38, 757-761
- Lai Q.Y. and Ao N.J., 1998. Advances in studies on postharvest physiology, pathology and preservation of litchi fruit. *J. Yunnan Tropical Crops Sci. Tech.* 21: 27-31.
- Li X.M., 1999. Preservative technology of litchi by truck transportation – foam plastic box with ice added. *South China Fruit*, 28: 21

- Lee SK et al 2000. Preharvest and postharvest factors influencing vitamin C content of horticultural crops. *Postharvest Biology and Technology* 2000: 20: 2007-220.
- Jianguo Li, Huibai Huang, Feifei Gao, Xuming Huang and Huicong Wang. 1999. An overview of litchi fruit cracking. *Proc. I Int. Symp. on Litchi & Longa. Acta Hort.* 558, ISHS 2001
- Li B., 1985. Project introduction of China Academy of Sciences taking part in The First S & T Achievement Trade in China. *Farming Information.* 12: 17.
- Menzel C.M (2001) The physiology of growth and cropping in lychee. *South Africa Litchi Grower's Association yearbook* 2001: 12-14
- S.K. Mitra, 2002, Litchi Production in the Asia-Pacific Region. *Proc. 3rd IS on Longan, Lychee & Other Fruit. Acta Hort.* 863, ISHS 2010
- S.K. Mitra and R.S.K. Dutta 2002. Advances in the Production and Research of Lychee in India. *Proc. 2nd IS on Lychee.*
- Nguyen Quoc Vong, 2008. General regulation of Good agricultural practices (GAP) for fresh vegetable and fruit producers in Vietnam-the progress. GAP conference, Binh Thuan, Vietnam, 2008
- Oosthuysen SA and Westcott DJ. Determination of harvest maturation stages appropriate for export of Madras litchi as identified by measurable fruit attributes. *South African Litchi Growers' Association Yearbook* 2005: 17: 29–33.
- Fallahi E and Simons BR(1999). Interrelations among leaf and fruit mineral nutrients and fruit quality in "Delicious" apples. *Journal of Tree Fruit Production* 1996: 1: 15-25
- FAO. Food and Agriculture Organization, 2002. Lychee production in the Asian-Pacific region. RAP Publ., Bangkok, Thailand.
- Ram B. Singh, 2002. Lychee production in the Asian-Pacific region. RAP Publ., Bangkok, Thailand
- Sivakumar and Korsten. 2008. Litchi quality in the postharvest horticulture chain. *An international journal for reviews in postharvest biology and technology.* Stewart Postharvest Solutions (UK) Ltd
- Tongdee, 1992. In Sulfur dioxide fumigation in postharvest handling of fresh longan and lychee for export. Champ BR, Highley H and Johnson GI (Eds.). *Postharvest handling of tropical fruits ACIAR conference Proc. Chang Mai, Thailand* 1993: 50: 186-195
- Vu Nhu Quynh, 2007. Upgrading litchi production and linking farmers to the end-users the approach by GIZ Vietnam. <http://www.value-chains.org/dyn/bds/docs/514/GTZ%20PPP%20Vietnam%20Lychee%202006.pdf> (accessed 120/07/2010)
- Vanderveer, 2000. Demand for area crop insurance among litchi producer in northern Vietnam. *Agricultural Economics.* 26 (2001) 173-184
- Wang SF, Cheng ZM and Li Y. 1996. Effect of postharvest treatments on physiology and quality of litchi and their economics. *Acta Horticulturae* 1996: 429: 503–507
- Zauberman G., Ronen R. and Akerman M., 1991. Post harvest retention of the red color of litchi fruit pericarp. *Sci. Hortic.* 7: 87-97.

- General Statistic office of Vietnam, 2007. Vietnam. [http://www.adb.org/Statistics/RLNAS/CW\\_CP\\_Vie.pdf](http://www.adb.org/Statistics/RLNAS/CW_CP_Vie.pdf), (accessed 20/07/2010)
- RIFAV. 2005. stands for Research Institute of Fruits and Vegetables (Hanoi, Vietnam) [www.acronymfinder.com/Research-Institute-of-Fruits-and-Vegetables-\(Hanoi,-Vietnam\)-\(RIFAV\).html](http://www.acronymfinder.com/Research-Institute-of-Fruits-and-Vegetables-(Hanoi,-Vietnam)-(RIFAV).html), (accessed 120/07/2010)

## Appendices

### Appendices 1: List of lychee cultivars cultivated in Viet Nam

No	Cultivars	Original area (Province)	No	Cultivars	Original area (Province)
1	Duongphen	Hatay	17	Thachbinh	Hanam
2	Hoahong	Hatay	18	Thieuthanhha	Haiduong
3	Banhtroui	Hatay	19	Thieu	Haiduong
4	Dua	Hatay	20	Laithanhha	Haiduong
5	Vanganh	Hatay	21	Hunglong	Phutho
6	Vatkhan	Hatay	22	Phudong	Phutho
7	Longvang	Hatay	23	Laihungyen	Quangninh
8	Luc	Hatay	24	Laibinhkhe	Quangninh
9	Ongthieu	Hatay	25	Phuchoa	Bacgiang
10	Moidai	Hatay	26	Laihuongson	Hoabinh
11	Nhono	Hatay	27	Lailienson	Hoabinh
12	Bieuquan	Hatay	28	Moga	From China
13	Bop	Hanam	29	Phi Tu Tieu	From China
14	Chintrang	Hanam	30	Sau Yue hong	From China
15	Laithuyxuyen	Hanam	31	Pai thang ing	From China
16	Laingocson	Hanam			

(Source: RIFAV, 2005)

**Appendices 2: Morphological characteristics of promising cultivars of lychee grown in Viet Nam**

<b>Cultivars</b>	<b>Fruit weight (g)</b>	<b>Percentage of edible part</b>	<b>Color of peed</b>	<b>Fruit shape</b>	<b>Characters of pulp</b>
Duongphen	23.61	65.35	bright red	heart shaped	light sweet, good flavor, soft
Hoahong	24.54	65.48	dark red	heart shaped	light sweet, soft
Hunglong	23.47	73.01	dark red	heart shaped	Sweet, firm and good flavour
Phudien	36.60	71.68	dark red	heart shaped with sharp bottom	Sweet, soft and good flavour
Phuchoa	23.08	71.88	pink	oblong	Sweet and good flavour
Laihungyen	30.10	73.18	yellowish red	heart shaped with flat bottom	Sweet and good flavor
Laibinhkhe	33.47	71.46	dark red	ovate	Sweet, soft
Thieuthanhha	20.70	75.48	bright red	sphere (round)	Sweet, good taste and flavour, firm

(Source: RIFAV, 2005 )



### Appendices 3: Characteristics of fruits of promising lychee cultivars

<b>Cultivars</b>	<b>Brix (%)</b>	<b>TSS (%)</b>	<b>VtC (mg%)</b>	<b>Total acidity (%)</b>	<b>Dry matter</b>
Duongphen	15.80	12.00	31.50	0.36	14.40
Hoahong	17.70	15.08	44.00	0.54	18.72
Hunglong	16.80	12.96	10.60	0.20	15.82
Phudien	17.50	12.31	12.50	0.17	16.20
Phuchoa	16.50	13.40	9.80	0.26	15.10
Laihungyen	17.50	13.75	17.09	0.57	14.50
Laibinhkhe	17.40	15.36	16.27	0.21	16.06
Thieuthanhha	20.50	16.24	24.00	0.28	18.20

(Source: RIFAV, 2005)

**Appendices 4: Total lychee production area and productivity of all villages  
in Luc Ngan district 2009**

No.	Village	Area (ha)	Production (tones)	No.	Village	Area (ha)	Production (tons)
1	Chu Town	80	256	17	Phongminh	180	576
2	Biendong	698	2.233	18	Phongvan	641	2.051
3	Bienson	908	2.903	19	Phunhuan	496	1.587
4	Camson	436	1.395	20	Phuong Son	679	2.172
5	Deogia	465	1.488	21	<b>Quyson</b>	<b>1.781</b>	<b>5.699</b>
6	Dongcoc	632	2.022	22	Saly	221	707
7	Giapson	734	2.348	23	Sonhai	400	1.280
8	Hodap	645	2.064	24	<b>Tanhoa</b>	<b>672</b>	<b>1.450</b>
<b>9</b>	<b>Honggiang</b>	<b>689</b>	<b>2.904</b>	25	Tanlap	866	2.771
10	Kienlao	653	2.089	26	Tanmoc	810	2.592
11	Kienthanh	917	2.934	27	Tanquang	872	2.790
12	Kimson	452	1.446	28	Thanhhai	805	2.576
13	Myan	423	1.353	29	Truhuu	580	1.856
14	Namduong	895	2.864	30	Tanson	670	2.144
15	Nghiaho	215	688		<b>Total</b>	<b>18.818</b>	
16	Phidien	295	944				

*Villages in bold highlighted were used in this study  
(Source: Agricultural office, Luc Ngan, 2009)*

## Appendices 5: Survey

### QUESTIONNAIRE FOR PRODUCER

Date: .....

Name of grower: .....

Name of interviewer: .....

1. What villages is your rank located in?.....
2. What is your age?
  - A. 39 or under
  - B. 40-49
  - C. 50-59
  - D. 60-69
3. How many hectare do you currently have in Thieu Litchi production? And How much for production/ha?
  - A. less than 0,5 hectare
  - B. 0,5 - 1 hectare
  - C. more than 1 hectare
4. To what type does your business belong?
  - A) Planting fruit trees
  - B) Planting fruit trees and animal, castle raising
  - C) Planting fruit tree and food crop cultivation
  - D) Planting fruit tree and doing small business
5. How many % of your income contribute Litchi production?
  - A. <20%
  - B. 21-39%
  - C. 40-59%
  - D. 60-79%
  - E. > 80%
6. What is the standard of the present cultivation method?
  - A. Traditional of family
  - B. IPM
  - C. Safe production
  - D. VietGap
  - E. Other: \_\_\_\_\_
7. Do you have registration to use one of the above methods?
  - A. Yes
  - B. No
8. How to apply fertilizer?
  - A. Base on recommendation on the labor
  - B. Base on the performance of tree in the field
  - C. Base on yearly experience

- D. Learn from neighboring growers
  - E. Other please describe.....
9. How to apply growth regulation?
- A. Base on recommendation on the labor
  - B. Base on the performance of tree in the field
  - C. Base on yearly experience
  - D. Learn from neighboring growers
  - E. Other please describe.....
10. How to apply herbicide, pesticide?
- A. Base on recommendation on the labor
  - B. Base on the performance of tree in the field
  - C. Base on yearly experience
  - D. Learn from neighboring growers
  - E. Other please describe.....
11. Do you do pruning?
- A. Yes
  - B. No
12. Do you apply a monitoring system?
- A. Yes
  - B. No
  - C. Other: such as self monitoring system please describe
13. What is the most important factor to decide harvest Lychee?
- A. Fruit ripening level
  - B. Marketing demand
  - C. Availability of family labor
  - D. Weather
  - E. Other \_\_\_\_\_
14. How do you maintain your fruit (keep the fruit stay fresh longer)?
- A. On – tree preservation
  - B. Cold preservation
  - C. No maintaining/sell immediately
  - D. Use of growth inhibitor
  - E. Other.....
15. How do you do sorting and grading?
- A. Base on fruit color
  - B. Base on fruit size
  - C. Both A and B
  - D. Other.....
16. How do you do packaging?
- A. Foam rubber with ice

- B. Wooden crate
- C. Other: .....

17. Who do you sell your fresh litchi? and How much for kg?

- A. Collector
- B. Local Trader
- C. Outside Trader
- D. Wholesaler
- E. Processing Company (please gives the name if possible:.....)

18.. How Litchi is transported from your farm to buyer?

- A. By bicycle
- B. By motor cycle
- C. By truck with cool room
- D. By truck without cool room
- E. No transpotation

19. Is post harvest technology is affordable?

- A. Very Cheap
- B. Cheap
- C. Expensive
- D. Very expensive
- E. Other.....

20. Is there any effect of climatic changes on quality and production of Litchi?

- A. 0 -19%
- B. 20 - 39%
- C. 40 - 59%
- D. 60 -79%
- E. >80%

21. Where is the major reason that company denied your product?

- A. Not sufficient to supply for them
- B. Insufficient quality
- C. Not punctual
- D. Sold at higher price at the local markets
- E. Other.....

22. Do you have any knowledge about international standards and regulations for export?

- A. Yes
- B. No
- C. Not sufficient

23. What do you think about current infrastructure available that influence litchi production and trading?

- A. Sufficient
- B. Insufficient

C. If insufficient please explain

24. Would you be interested in using VietGap?

A. Yes

B. No

C. If yes or no, please explain why?

25. What information have you already received from other actors and stakeholder?  
(amount, quality, quantity, wishes of customers...)

A. Fairly sufficient

B. Not sufficient

C. Sufficient

26. How do you prefer to receive information about Litchi production from Local extension office?

A. VIETGAP and New technology

B. Market information

C. International regulation

D. A and B

E. All

27. Do you have certificates for your products or geographical indicators?

A. Yes (when.....)

B. No (Why.....)

C. Other.....

28. How do you know about conditions to apply certificates of lychee quality production?

A. The difficulty of registration procedures

B. The difficulty to meet the standards and requirements set for the product of the state

C. Other comments.....

29. What is the most important factor to produce high quality Thieu Litchi?

A. Management practices

B. Harvesting time and harvesting technology

C. Packaging technology

D. Preservation technology

E. Other.....

**THANK YOU**