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THESIS

ECONOMIC AND TECHNICAL ASSESSMENT ON COMMERCIAL
SERICULTURAL PRODUCTION IN KHON KAEN PROVINCE,
NORTHEASTERN THAILAND

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Silk is one of the most popular natural fibers in the world due to its special characteristics as luster and softness. It has been regarded as the “Queen of textiles”. In Thailand, sericulture activities have developed as major occupation for income generation throughout the year. At present, modern technology and mechanization coupled with local wisdom have been used in commercial production both for domestic and international demand.

This investigation focused on assesses the economic and technical perspective. The main idea of the research was to provide a number of possible policy implications and recommendations towards commercial sericultural production. The benchmark survey in the form of interviewing schedule was obtained from 48 sericulture farmers in Hua Fai Village, PorDang subdistrict, Chonnabot district, Khon Kaen province through multistage sampling technique. An in-depth interview was obtained by collecting data from stakeholders. Descriptive statistics were frequencies, percentage, arithmetic means and standard deviation. Inferential statistics were employed by Cobb-Douglas production function, multiple linear regressions and Pearson product moment correlation coefficient to test hypothesis.

The findings revealed that positive factors affecting farmers’ knowledge, practice and attitude in commercial sericultural production were number of sericulture information perception, number of contact agency and frequency of group participation. On the other hand, negative factor affecting farmers’ attitude was sericulture production experiences. The main factors determining net earnings and net profit were number of contact agency, the opportunity cost of capital, cost of silk fabric weaving material and cost of mulberry leaf. The major factors determining yield were number of silkworm egg and mulberry leaf. The most important constraint was silkworm diseases.

Commercial sericultural production recommendation should focus on using skilled labor and appropriate technology in sericultural production, using the high yield variety of silkworm, producing silk product to meet the standard requirement, applying both technology and local wisdom. The strategic policy should focus on research and development in mulberry and silkworm diseases prevention, appropriate sericultural production patterns, main consumer demand assessment, setting marketing information center and empower more sericulture group networks. Innovations in terms of technology and local wisdom are in urgent need. Activities that should be continuously promote to farmers are mulberry planting, mulberry and silkworm disease prevention, weed control, silk yarn reeling, silk yarn dyeing and silk yarn preparation.

Student’s signature

Thesis Advisor’s signature

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LIST OF ABBREVIATIONS

ACFS	Thai Agricultural Commodity and Food Standards
ANOVA	Analysis of Variance
CDD	Community Development office
DOA	Department of Agricultural
DOAE	Department of Agricultural Extension
DIP	Department of Industrial promotion
FAO	Food and Agriculture Organization
GPP	Gross primary production
KAP	Knowledge, attitude, and practice
Max.	Maximum
Min.	Minimum
OAE	Office of agricultural economics
QSDOS	The Queen Sirikit Department of Sericulture
S.D.	Standard Deviation

CHAPTER I

INTRODUCTION

Statement of the Problems

Silk is one of the most popular natural fibers in the world. Due to its special characteristics of luster and softness, it is sometimes referred to as the “Queen of textiles”. Silk, therefore, is an important agricultural commodity for generating income of the countries in East, South, and Southeast Asia. World silk production has increased every year. From 2005-2009, the annual quantities of raw silk produced were 152,448, 163,774, 166,139, 164,850, and 164,971 tons respectively and China being the leading producer. In fact, in 2009, China produced around 126,001 tons of raw silk and accounted 73.49 % of world production. The remainder was accounted for by production in India, Viet Nam, Turkmenistan, Romania and Thailand that were 19,000, 7,367, 4,500, 2,100, and 1,600 tons per year, respectively (Food and Agriculture Organization [FAO], 2011). In 2011, the International Trade Center indicated that world silk product export values from 2006-2010 were 3,368.35, 3,307.62, 3,417.95, 2,786.66, and 2,954.92 million US\$ per year, respectively. The main exporters were China, Italy and India as the highest export values of silk fabric, raw silk, and silk yarn.

Sericulture has been practiced for a long time in Thailand at the household level and it has become a major income generating activity throughout the year. According to The Queen Sirikit Department of Sericulture data (QSDOS) in 2010, it revealed that there were around 94,633 sericulture households across the whole kingdom. Meanwhile, mulberry cropping areas accounted for around 106,106 rai (16,977 hectares). The silk varieties produced were either native, Thai hybrid, or foreign hybrid varieties. In order of importance, around 80% of silk production took place in the northeastern, northern, central, eastern and southern regions of Thailand, respectively. The capacity of silk yarn production was 1,600 tons per year including 1,150 tons handicraft production

and 450 tons industrial production while domestic demand was estimated to be at least 2,000 tons per year and 400 tons of silk yarn was also imported per year.

Thailand's exports of silk products from 2006-2010, accounted for 1,015.98, 881.71, 783.69, 471.52 and 390.11 million baht (where 1US\$ = BHT35), respectively. The main export markets were the United States, the European Union, and Japan. The highest export values were obtained from silk fabric, spun silk yarns, silk waste, silk yarns, and silk cocoons, respectively (Customs Department, 2011). Silk yarn products for the international markets have to certify by international standards. Meanwhile, exported silk handicrafts from Thailand also have to be certified by the Thai Agricultural Commodity and Food Standards (ACFS). At present, modern machines and various techniques have been used in sericulture for commercial production. However, there are many constraints in sericulture production and marketing including a lack of mulberry cultivation management, the low quantity and quality of products in rain fed areas, the low quality of autonomous silkworm eggs raised by farmers themselves, the instability of quality products, the lack of appropriate knowledge in sericultural production, the lack of water resources, disease and pest, the high cost when compared to that of foreign producers, the lack of grading of silk production, the small amount of marketing channels, the instability of prices, the lack of knowledge in silk fabric design, the inadequate advertising and marketing information. To reach international standard and increase silk production to meet domestic demand and international business standard, the development of silk production technologies is needed that include are appropriate production management to lower the cost, and to upgrade better quality products for both small scale entrepreneurs and commercial industries. Upgrading Thai silk brands to international standards is also needed to promote (Choopayoon, 2005).

Khon Kaen is one of the most important provinces for domestic and international Thai silk production. According to the 2008 data that gathered by the Queen Sirikit Sericulture Center in Khon Kaen, there were around 9,430 sericulture farmers in Khon Kaen and mulberry cropping was cultivated at approximately 5,327.50 rai (852.40 hectares). Native varieties accounting for 86.00 % while the rest

were Thai hybrids and foreign hybrids, accounting for 12.00% and 0.20 %, respectively. Silkworm rearing technologies are adapted from household level to commercial level. The majority of products were cocoon, silk yarn, and weaving materials.

Regarding the study site, Huafai village is in Pro Dang subdistrict, Chonabot district, Khon Khaen province, northeastern Thailand. It is a well-recognized village for silk fabric weaving. Sericulture farmers in the villages have practiced mulberry cultivation, silkworm rearing and silk fabric weaving for household use and for sale to the domestic market. These are the sources of income throughout the year. However, the silk producers have encountered many constraints including the instability of quality products, a lack of concern regarding product quality, and a lack of silk production management to reach quality and market standard requirements. In order to investigate an appropriate commercial sericultural production model and set a number of possible policies oriented and applied towards domestic and international demand for better income generation of target group and stakeholders, an economic and technical efficiency assessment of sericulture production of respondents is necessary.

Objectives of the Study

1. To determine the general background, socio-economic background, and socio-cultural background of sericulture farmers.
2. To describe the existing conditions in commercial sericultural production.
3. To determine the cost and income of sericultural practice and assess the knowledge, attitude, and practice in commercial sericultural production towards technical efficiency.
4. To find out an appropriate model in commercial sericultural production

5. To determine constraints and recommendations in order to improve commercial sericultural production.

Scope of the Study

This study focuses on economic and technical assessment in commercial sericultural production. The respondents are 48 sericulture farmers who have been engaged in commercial sericultural production in Huafai village, Por Dang Subdistrict, Chonnabot district, Khon Kaen province in 2010 and key stakeholder in sericulture supply chain. The contents of this study focus on characteristic of the study area, characteristic of respondents, commercial sericultural production, KAP assessment, cost and return analysis and constraints in commercial sericultural production. Collecting data was obtained during May - September 2011.

Expected Results

Expected results of the study are as follows:

1. An appropriate commercial sericultural production model that is applicable for improving target groups and relevant cases.
2. A policy oriented towards the implementation of a program of commercial silk production.

Operation Definitions

1. Stakeholder in commercial sericultural production supply chain refer to stakeholder in commercial sericultural supply chain divided into 3 groups including sericulture farmer in Huafai village, Por Dang subdistrict, Chonnabot district, Khon Kaen province, buyer and concerned government agency in Khon Kaen province

2. Commercial sericultural production refers to the best practice in sericulture production towards standardization that gathered from literature review, relevant agencies, sericulture experts, progressive and best practice farmers in sericulture supply chain in the study area. It comprises of 3 major items and 21 sub-items. These 3 major items are silkworm rearing, silk reeling and silk fabric weaving.

3. Silkworm rearing refers to the practice of sericulture farmers in research site towards commercial sericultural production. It comprises of 10 aspects including variety selection, rearing room and equipment preparation, disinfection, feeding, rearing area enlargement, bed cleaning, practice on molting and non molting period, collecting mature worms for mounting, cocoon harvesting and pest prevention.

4. Silk reeling refers to the practice of farmers in research site towards commercial sericultural production. It comprises of 7 aspects including silk reeling place preparation, equipment preparation, cocoon culling, cocoon degumming, reeling techniques, re-reeling techniques and silk yarn storage and packaging.

5. Silk fabric refers to the practice of farmers in research site towards commercial sericultural production. It comprises of 3 aspects including dyeing, yarn preparation, and weaving.

6. Standardization in silk production refers to silk standardization that gathered from literature review and relevant agencies, in particular the Agricultural Commodity and Food Standards and Industrial Standards Institute. It is comprised of 2 major items and 15 sub-items. These 2 major items are silk yarn standardization, and silk fabric standardization.

7. Silk yarn standardization refers to the pattern in silk yarn production towards standardization. It comprises of 7 aspects including type and quality, size, packaging, acceptable tolerance, label and marks and sampling and judgment.

8. Silk fabric standardization refers to the pattern in silk fabric production towards standardization. It comprises of 8 aspects including type, size, number of yarn, weight, required characteristics, packaging, marks and label, and sampling and judgment.

9. Economic assessment refers to assessment of cost and return in the commercial sericultural production of sericulture farmers in Huafaivillage.

10. Technical assessment refers to assessment of knowledge, attitude and practice of respondents in commercial sericultural production. It is comprised of 4 management aspects including production, marketing, accounting, and human resource management.

11. Silkworm rearing cycle refer to silkworm rearing in December in 2010. Normally, silkworm rearing condition in each cycle is similar.

12. Local wisdom in sericultural production refers to farmers' practice on sericultural production including mulberry cultivation, silkworm rearing, silk reeling, and silk fabric weaving that they learned from ancestors or learned by themselves.

13. Factors affecting cocoon yield refers to amount of input used in 1 cycle of silkworm rearing in year 2010 including total silkworm egg used, amount of mulberry leaves, amount of chemical disinfectant and total labor use.

14. Factors affecting income refers to agriculture production factors, biological factors, farmer's personal background factors, socio-economic factors, and institutional factors affecting sericulture income.

15. Factors affecting farmer' s KAP refers to the farmer's personal background factors, socio-economic factors, and institutional factors affecting the farmer's knowledge, attitude, and practice.

16. Agricultural production factors refers to the total cost of silkworm egg, mulberry leaves, chemical disinfectant, cocoon, silk yarn, dye, labor forces, material, equipment, silkworm rearing room, land use, opportunity cost of capital, and cost of depreciation.

17. Biological factors refer to the number of silkworm diseases in a cycle.

18. Farmer's personal background refers to age, sericulture experiences, level of education, and source of sericulture information.

19. Age refers to real age of sericulture farmers as of the date of interview on May 2011.

20. Sericulture experiences refers to the number of years that farmers have involved in sericulture production.

21. Level of education refers to number of years attended in formal education by the respondent including those who have never attended school.

22. Number of sericulture information refers to frequency of farmer's exposure to sericulture information including personal media, mass media and interactive media.

23. Socio-economic factors refers to labor, group belonging, and amount of group participation by farmer.

24. Labor refers to amount of labor used whether personal, family, or paid labor for sericulture production in 2010 .

25. Sericulture group belonging refers to number of sericulture group that farmer are member until date of interview on May 2011.

26. Frequency of group participation refers to the frequency of group participation of the respondents in 2010 .

27. Institutional factors refers to number of extension contacts.

28. Number of contact agency refers to number of agricultural extension agents from government and private agencies that have visited the respondents in 2010.

29. Cocoon yield refer to the total amount of cocoons that sericulture farmers harvested in 1 cycle.

30. Economic aspect refers to farm income including net earnings, and net profit.

31. Net earning refers to the total gross income generated from sericulture production subtracted by the total variable cash cost in 2010 .

32. Net profits is determined by deducting gross income of sericulture production from total production cost in 2010.

33. Break-even yield refers to the minimum yield of sericulture production a farmer needs in order to cover all costs at the price per unit. It will be computed by total costs divided by price ($BEY = TC / P$)

34. Break-even price refers to the minimum price per unit that is required to cover all costs at the sericulture yield. It will be computed by total costs divided by the total amount of silk product ($BEP = TC / Y$)

35. Social aspect refers to farmer's knowledge, attitude, and farmer's practice.

36. Farmers' knowledge refers to the level of accurate knowledge in commercial sericultural production.

37. Farmers' attitude refers to the general positive and negative views of farmers regarding commercial sericultural production.

38. Farmers' practice refers to the level of actual farmer's practice in commercial sericultural production

CHAPTER II

LITERATURE REVIEWS

Assessment

Concept of assessment

The term of assessment has many meanings in the world of work. It is associated with a variety of concepts, programs, and procedures. According to Rust (1999), Salvia and Ysseldyke (2001) and Hanauer *et al.* (2009), an assessment is some kind of evaluation or appraisal technique as a systematic process of gathering information, analyzing and identifying the strengths and weaknesses in some cases of working processes, and programs for making decisions. In addition, Selim and Pet-Armacost (2004) stated that the purpose of an assessment is to improve, inform, prove and support. The assessment process should provide feedback to determine how the work can be improved and inform other decision-makers of the contributions and impact of the program. It should encapsulate and demonstrate to the target audience and stakeholders what the program is accomplishing and support for decision-making activities such as program review and strategic planning, as well as external accountability activities such as accreditation. Furthermore, Wargo (2007) pointed out that the benefits of the systematic assessment process can be identifying strengths and weaknesses and to help make financial decisions based on unit priorities. Providing information to constituents on the quality of the services provided help to ensure continuous improvement of services and processes.

Type of assessment

There are many types of assessments which differ in both aims and approaches. The United States General Accounting office (GAO) (1998) and Preskill and Russ-Eft (2001) indicated that there are five types of assessment including developmental, formative, summative, impact assessment and cost-benefit analyses. Developmental

assessment positions, the assessor to be part of a program's design and development process. The assessor collects information and provides informal feedback to members of the design team and possibly organization members to help them perfect the program being designed before it is ready for beta or pilot testing.

Formative assessment is typically conducted for the purpose of improvement. It begins during work or program development and continues throughout the life of the program. Its intent is to assess ongoing program activities and provide information to monitor and improve the program.

Summative or outcome assessment is implemented for the purpose of determining the merit, worth, or value of the assessment in a way that leads to making a final evaluative judgment. It is usually conducted after a program's completion.

Impact assessment is a form of outcome assessment that assesses the net effect of a program by comparing program outcomes with an estimate of what would have happened in the absence of the program. This form of assessment is employed when external factors are known to influence the program's outcomes, in order to isolate the program's contribution to the achievement of its objectives.

Cost-benefit and cost-effectiveness analysis are analyses that compare a program's outputs or outcomes with the costs to produce them. When applied to existing programs, they are also considered a form of program assessment. Cost-effectiveness analysis assesses the cost of meeting a single goal or objective, and can be used to identify the least costly alternative to meet that goal. Cost-benefit analysis aims to identify all relevant costs and benefits.

Assessment techniques

Burton *et al* (1997), Jarmoszko *et al.* (2003) indicated that the assessment technique is used to guide the collection of quality evidence in the assessment process. It includes the instruments for collecting evidence, based on the selected assessment methods and the procedures to be followed in conducting the assessment.

The development of effective and relevant assessment techniques requires interpreting the evidence requirements of the specified competency standard for assessment, and analyzing the assessment context. It also involves identifying or confirming assessment methods which most effectively address the evidence requirements, then designing and developing the documentation to guide and support the collection of the required evidence through the designated assessment methods. The assessment techniques are explained under four categories were Individual techniques, group techniques, secondary sources and rapid rural appraisal.

1. Individual techniques

Individual techniques involve collecting data from people one at a time. The purpose of this technique is usually to collect specific information related to the individual. There are several techniques for collecting data such as face-to-face interviews, key informant interviews, In-depth interviews, questionnaires, and observations. Face-to-face interviews are appropriate when dealing with less literate audiences or complex issues about which there is little available information. Both structured and unstructured questions are appropriate for face-to-face interviews, depending on the issues involved and the time available for the interviews.

Key informant interviews are people who are considered experts in a given area because of their professional knowledge or their position of influence in the community or organization.

In-depth interviewing is a technique that involves conducting intensive individual interviews with a small number of respondents to explore their perspectives on a particular idea, program, or situation.

The questionnaire is a tool use to collect information from a large number of respondents. It can contain either forced-choice or open-ended questions. Forced-choice questions have a limited number of responses from which a respondent

may choose. An open-ended question does not require a respondent to choose from a set of possible responses. Instead, respondents are free to answer as they choose.

Observations are useful to gain an understand people's behaviors and activities. There are two forms including informal and formal observations. Informal observations are usually done when the respondents group has little knowledge and behaviour. Formal personal observations are based on using rating forms, checklists, or observation schedules for collecting information.

2. Group techniques

Group techniques allow participants to interact with one another during assessment activities such as Delphi, focus group interviews and the nominal group

The delphi technique is a way to obtain of experts without neccsserily bringing them together face to face. The advantage of this technique is expert opinions can be freely expressed to get reliable information. The disadvantage is if experts are selected who don't have knowledge of the field, the information won't be reliable.

The focus group interview is a technique in which a group of people who possess certain characteristics provide data of a qualitative nature in a focused discussion. Each interview involves a group of six to eight people who discuss a common topic for one to two hours under the direction of a moderator and assistant moderator.

The nominal group technique is a decision making method for used among groups of many sizes, who want to make their decision quickly, as by a vote, but want everyone's opinions taken into account.

3. Secondary sources

Secondary sources are information gathered for the purposes other than the immediate or first application. Secondary data sources include census reports, previous studies, and administrative records and reports.

4. Rapid rural appraisal

Rapid rural appraisal refers to the use of several data collection methods to gather practical information on development issues in local communities quickly. These might include interviewing key informants, reviewing secondary data sources, mapping exercises, and conducting semi-structured interviews with groups and individuals.

Assessment of knowledge, attitude, and practice

Eckman and Walker (2008) indicated that the knowledge, attitude, and practice (KAP) study are highly focused assessments that measure changes in human knowledge, attitude, and practice in response to a specific intervention, usually outreach, demonstration or education. KAP assessment tells what people know about certain things, how they feel, and how they be have.

In terms of knowledge, Jariya (2006) pointed out that the knowledge as the information and understanding that you have gained through learning or experience. There are many types of tools used in the test knowledge, in which each type is appropriate with different characteristics including oral test, practice test, and writing test. In term of factor affecting level of knowledge, the study by Perera *et al.* (2003) found that the extension communication activities and dominate role of personal were significantly related to farmer's knowledge. Kongdee (2005) also confirmed that age, occupation, membership years, length of experience and source of knowledge were found differences on the levels of knowledge. Tuentum (2005) and

Tongwon (2006) found that frequency of receiving agricultural information was significant relationship with knowledge level.

In terms of attitude, Ajzen (2005) indicated that an attitude is disposition to respond favorably or unfavorably to an objective, person, institution, and event. Vecchio (2002) and Poyoung (2007) also pointed out that a tool used in attitude measurement had several types, most of them are rating scales such as Thurstone scale, Guttman scale, Likert scale and Osgood scale. Thurston scale and Guttman scale are comparative method, in which subjects choose among a series of alternatives that have been previous calibrated by a separate criterion. The comparative methods require considerably more time to develop than Likert scale which is a direct estimation technique

Likert scale developed a type of scale that is easier to construct while yielding equally satisfactory reliability. The Likert's scale begins with a series of statements, each of which expresses an attitude that is either clearly favorable or clearly unfavorable. Items are selected on the basis of the responses of the person to whom they are administered in the process of test construction. The principal basis for item selection is internal consistency, although external criteria are also employed when available. Likert's scales call for a grade response to each statement. The response is usually expressed in items of the following five categories including strongly agree, agree, uncertain, disagree and strongly disagree. To score the scale, the response options are credited 5, 4, 3, 2, or 1 from favorable to unfavorable. Osgood scales are another useful attitude measure. These scales are for ratings based on a pair of adjectives that are opposite in meaning. Typically the scale is a seven point bipolar rating scale using adjectival opposites, although some studies have used five and six-point scales.

In terms of factor affecting attitude, the investigation by Kanchnasinith (2003) found that education and communication with the other farmer were relationship with farmer's attitude. In addition, Prathap and Ponusamy (2006) stated that family- type had a positive and significant relationship with attitude. Moreover, Khoram et al.

(2006) indicated that level of literacy, age and farm size influences the attitude of farmers. The study by Chizari and Noroozi (2008) found that the farmer's access of information sources and extent of extension contacts were significantly positive with farmers attitude. In the other hand farmer's experience were significantly negative with farmer's attitude. Moreover, Sadati *et al.* (2010) stated that participation in extension courses, access to extension communication channels, level of literacy and landholding were the effective factors on farmers' attitude.

In term of practice, Jariya (2005) and Poyoung (2007) indicated that practice is regular activity that human do in order to improve a silk or ability. The practice behavior of humans results from attitude, social norms, personality, and the expected outcome of a particular person. Practice assessment requires great observation, both in the process and the action outcome. The equipment used in the observation is a checklist, which is one of the standards for recording observational information. In terms of factor affecting farmer's practice, Kanchnasinith (2003) indicated that there were relationships between experiences of training with farmer's attitude. Moreover, Tongwon (2006) pointed out that age, education, farm experience, farm size and income training had effect on farmers' practices. In addition, Poyoung (2007) stated that education and training were significantly with farmer's practices. Monkaew (2008) stated that factor affecting farmer's practice were age, education, household labor, and social status.

Technical assessment

In terms of technical assessment, Trasys Company (2008) indicated that technical assessment is a discovery and planning process intended to guide decision makers in their investment planning for using technology within their business. In addition, Okongwu (1999) stated that technical assessment is foremost investigated to fully and effectively define the product and evaluates their relative merits. It also covers other areas such as manufacturing and production techniques to adopted, quality control considerations, production capacity, production sequence, and continued technical support for manufacture and maintenance during production.

Furthermore, Comprehensive Everglades Restoration Plan : CPRE (2006) pointed out that the technical assessment guidance strategy developed for assessing measurable change in system responses during and following implementation is a multi-step process consisting of monitoring design, data acquisition, data analysis, interpretation, assessment, and subsequent evaluation of system-wide performance

Agribusiness

The concept of agribusiness

Seperich *et al.* (2000) indicated that the important of agribusiness in all countries as the part of the world's economy by represents nearly one-fourth of total production and employs nearly one- half of the people on the planet. Agribusiness also plays a very big role in the economic development of most countries. Before economic growth can occur a country must first have an efficient and productive agriculture sector. This leads to the rise of the input sector, the process manufacturing, and therefore to the need for fewer people to grow crops. There are many different definitions of agribusiness. Some people interpret the word narrowly to mean only very large businesses within the agricultural industry.

According to Seperich *et al.* (2000), Ricketts and Rawlins (2001), GTZ. (2001), Becvarova (2005) and Louw, (2007), agribusiness is the sum total of all operations involved in the manufacture and distribution of farm supplies, production operations on the farm and the storage, processing, and distribution of farm commodities and items from them in the provision of services, such as extension and research. The agribusiness sector can be visualized as a vertical "slice" of an economy comprising many parts where consumers and producers of goods and services interact.

Modern agribusiness system

Ricketts and Rawlins (2001), Baker *et al.* (2002) and Hansra and Vijayaragavan (2003) pointed out that the agribusiness system is comprised of three sectors. These sectors, also known as the agricultural supply chain, included the input supply sectors, the farm sector, and the processing and distribution sector. The input supply sector is made up of those firms that supply inputs to be used in agricultural production. The major inputs used by producers include land, buildings, water, feed, seed livestock and poultry, fertilizer, pesticides, machinery, energy, labor, credit, and management information. The input used by a producer depends on the type of crop and production system. The input supply sector is responsible for much of the productivity gains in the food and fiber system. Increased yields due to improved genetics in the seed and livestock industries, more effective chemicals, more efficient machines, and better management information are some of the major factors contributing to the productivity improvements. The farm sector is increasingly characterized by two types of operations include the small producer, who earns most of the income off of the farm and the large commercial producer. The processing and distribution sector is a complex network of handlers, processors, shippers, warehouses, wholesalers, retailers, and foodservice establishments that are responsible for delivering food to the consumer for each product and the product may take multiple paths depending on its ultimate use.

Management in agribusiness

Erickson *et al.* (2002) and Ricketts and Ricketts (2009) stated that agribusiness management is the responsibility of a manager to make decisions, organize resources to implement decision, monitoring the implementation of decisions, and evaluate the effects of decisions on the overall success of the operation. The form and process by which farmer perform the tasks that are required to create and viable agribusiness, the practice of management can be broken down into four key functions including production and operations, marketing, financial, and human resources management.

Drummond and Goodwin (2004) summarized that production is a process in which factors of production are combined to produce a product or service. Many of the inputs involved in a particular production process will be intermediate goods that are a result of previous production processes. In addition, Penson *et al.* (2002) pointed out that there were four factors of production or input required to achieve an output, or in other words necessary ingredients for the making of things. These were land, labor, capital and management. Land includes natural resources use in the creation of production such as minerals, forests, groundwater and other resources given by nature. Labor includes all labor services used in production with the exception of managerial activities. In crop production, labor includes seed bed preparation, planting, irrigation, chemical applications, and harvesting. Capital is the input used in production. It refers to manufactured goods such as fuel, chemicals, tractors, trucks, and building that provide productive services to their users. Management functions are varied and are easier to conceptualize than to measure like the leader of farmers and agribusiness must make decisions as to how, when, and what to produce when organizing their input, when how to market the business's output, how large to grow and how to finance business expansion. Furthermore Erickson *et al.* (2002) mentioned that operations and logistics management, operations management focuses on the direction and the control of the processes used to produce the goods and service it involves the strategic use and movement of resources.

Marketing management involves understanding customer needs and effectively positioning and selling products and services in the market place. It is the function of management that is most closely focused on the end user. It is focused on the planned execution of what products to produce, what service to offer, what information to provide, what price to charge, who sells a product or service and to whom it is sold. Decisions here include how to promote the product, and how to distribute the product.

In addition, Baker *et al.* (2002) and Ricketts and Rawlins (2001) stated that the agribusiness marketing management decisions can be classified in four categories including product, price, place and promotion. They are the variables that marketing managers can control in order to best satisfy customers in the target market. The

product is the physical product or service offered to the consumer. Product decisions begin with the development of customers in the firm's target market. The product offering is one of the principal ways that a company can differentiate its offerings from those of competitors. It may include function, appearance, packaging, service and warranty. Pricing decisions should take into account profit margins and the probable pricing response of competitors. Pricing includes discounts and financing. Place are those associated with channels of distribution that serve as the means for getting the product to the target customers. The distribution system performs transactional, logistical, and facilitating functions. Promotion decisions are those related to communicating and selling to potential consumers. Promotion decisions involve advertising, public relations and media types.

Financial management is the diver for agribusiness as it works to generate the greatest possible returns from their resources. Successful achievement of this objective means making good decisions, using the tools of finance to analyze alternatives, and managing the assets and liabilities, and the owner's investment in the firm. In addition, Lasher (2003) stated that financial management means the management and control of money and money- related operation within a business. These activities include keeping records, paying employee and vendors, receiving payments from customers, borrowing purchasing assets, selling stock, paying dividends, and number of others. The function of financial management is often divided into three functions including financial planning, financial control and financial decision making financial planning, financial planning.

Financial planning, it is the duty of management to ensure the adequate funds are available to meet the needs of the business. In the short term, funds are required to pay the employers or to invest in stocks. In the middle and long term funds are required to make additions to the productive capacity of the business.

Financial control, financial control helps the business to ensure that it is meeting its goals. Through financial control the firm decides how much to invest in short term assets and how to raise the required funds.

Financial decision making, three primary aspects of financial decision making are investment, financing and dividends. Investment must be financed in some way for which various alternatives are available. A financing decision is to retain the profits earned by the business or should it should be distributed among the shareholders via dividends.

Human resources management includes finding the right people, motivating them by providing incentives in an ideal environment and evaluation them. In addition, Baker *et al.* (2002) pointed out that human resource management encompasses managing two areas include the mechanics of personnel administration and the finer points of motivating people to offer and contribute their maximum potential. The functions of human resource management are finding the right people for the right jobs, and then providing for their continued productivity and development. Human resource management begins with determining employment need. This usually requires defining the job and developing job descriptions so that the right person can be recited. Recruiting involves searching for qualified candidates, interviewing, and assisting in the selection of best person. And, once a new person in on the job, it is a human function to see that he or she gets off to a good start with proper orientation, training, and follow-up. Another human resource function is the development and administration of employee benefit programs. Insurance, retirement, health care, safety, continuing education, and related programs are designed to increase the welfare and productivity of employee. And, a well- designed benefits program represents a significant investment of both time and money by management. In most agribusiness, the human resource function also includes regular evaluation of employee performance and ensuring continued professional growth through ongoing training and development program. Training may consist of informal, on-the-job training or formal seminars, but regardless of source, the goal is greater productivity, and more satisfied employee.

Moreover, Baker *et al.* (2002), Erickson *et al.* (2002) and Ricketts and Rawlins (2009) mentioned that agribusiness management process is often divided into five major area of activity include planning, organizing, leading, staffing and controlling.

Planning is determining a course of action to accomplish that stated goals. Planning involves determining the present status of the business, surveying the environment, setting objectives, forecasting future situations, starting necessary actions and resources, evaluating proposed actions, revising plans in response to changing conditions and communicating effectively.

Organizing is the grouping together of activities people and other resources to implement a plan. Organizing involves coordinating activities and obtaining and coordinating resources so that the objective of the business can be met.

Leading consists of providing instruction and guidance to employees. It is primary concerned with relationship between leaders and employees. Leading involves influencing, teaching and guiding people to carry out their assigned tasks to meet the goals that have been set.

Staffing includes all activities involved in the recruitment, selection, training and retention of personal. Good staff makes the workflow through the agribusiness go smoothly. Staffing responsibilities involves determining human resource needs, recruiting excellent employee candidates, selecting excellent employee from those recruited, training and developing employees and revising the number of employees according to changing conditions of the agribusiness.

Controlling involves setting standards for work and solving problems that prevent the completion of tasks according to these standards. Controlling also involves evaluation or monitoring the activities of employees and the procedures employee use in reaching these goals. Controlling responsibilities involves establishing standards, monitoring results and comparing them to standards, correcting deviation from standards, revising and adjusting methods in response to changes in the agribusiness experiences, on an ongoing basis and communicating necessary changes throughout the organization.

Factor affecting agribusiness

From the investigation of Baker (2003) found that key success factors in the agribusiness in Latin America cases were technical upgrading of artisan as well as industrial technologies, high levels of education and training, solid and expanding domestic markets in which remunerative price permit the development of innovations and new skills, explicit public and private co-operation policies. Furthermore Soiphab (2004) stated that the factors that affect community business is the struggle honest, the sacrifice of leaders, the study visit, staging exchange learning, leadership training, unity of members and financial resources.

Clover and Darroch (2005a) also indicated that factors affecting agribusiness were strong energizer behaviors, more business experience expansion and policies. In addition, Clover and Darroch (2005b) identify factors such as insufficient public and private sector support, capital, training, labor, tax legislation, business experience, entrepreneurial quality, the development of appropriate infrastructure, innovative loan products, and policies to reduce the cost of compliance affecting agribusiness. Moreover, Malang (2008) stated that the factors affecting the development of community enterprises are the leader of enterprises, participation of committee and members, capital, product unique, community role organizations support and satisfaction in products and services.

Constraints in agribusiness

In terms of constraints in agribusiness, the study of Baker (2003) found that constraints affecting development of agribusiness linkages were lack of direct linkages between the co-operatives and the sources of technological and organizational innovation, poverty which prevent wealth accumulation and investment, absence of dynamic interactions between the public and private sectors, prevalence of informal activities with private agents, vulnerability and crises due to unstable international markets.

In addition, Clover and Darroch (2005b) studied on owners' perceptions of factors that constrain the survival and growth of small, medium and micro agribusiness in Kwazulu-natal, South Africa. The studied identified eight dimensions of constraints including lack of access to services, funding constraints at start-up, lack of management capacity in the enterprise, access to tender contracts, compliance costs associated with VAT and labor legislation, liquidity stress, lack of collateral, and lack of institutional support.

Moreover, GTZ (2005) stated that the constraints in agribusiness including poor public infrastructure in many rural areas, posing great difficulties for transport and post harvest handling. The institutional set up and organization of markets is insufficient, leading to high transaction costs for small producers and unfair trade practices. Economic regulations are often heavy for entrepreneurs and may include abusive practices. There is a lack of technology, market information and business knowledge. The shortcomings in the supply of the indispensable public goods are aggravated by the conditions of poverty under which small-sized farms and entrepreneurs operate. They are significantly disadvantaged in competition because of their lack of capital, insecure tenure status and hence lack of collaterals for obtaining loans, and the resulting difficulty in procuring essential inputs and services. Furthermore,

Louw (2008) found that the main constraint in the agribusiness sector in includes poor product quality, limited market access due to barriers to trade, restricted marketing opportunities due to problems with pricing, limited margins and inadequate promotion strategies, weak human capital development, high costs of doing business, high transaction costs resulting from weaknesses in provision of relevant information and lack of co-ordination in infrastructure development.

Economic Assessment: Production Function Analysis

Ricketts and Ricketts (2009) pointed out that production economics plays an important role within society and is particularly important for today's farm managers and producers. Effective farm manager must take a wide variety of factors into account when planning for the success of their farm. Production economic provides the tools to achieve this success. Production economic basics, knowledge of different market sectors of the economy and the understanding of how the production and cost function operate are all important to the manager and producer. A foundational component of production economic theory is the production function. The concept of production function presented by James and Eberle (2000), Drummond and Goodwin (2004) and Kay *et al.* (2004), it could state the production function is a basic concept in the economic systemic way to show the relationship between units of a variable input and units of output.

It is a technical, or physical, relationship that is determined by the particular technology which is used in the production process. Agriculture products are the result of combining factor inputs. For example, corn seed is planted in tilled soil that is kept free of excess weeds, fertilized and watered produces additional corn. The inputs are the factors of production. The product is the output. Different inputs produce different products, and the amount of output is related to the level of inputs used. These input-output relationships can be placed in mathematical terms for clarity and general applications as follows: $Y = f(X_1, X_2, X_3, \dots, X_n)$ where Y is output of any product, X is any input required by Y for its production, and f is function relationship of X to Y .

In addition, Davies and Lam (2001) indicated that one of the most useful and best known is the CobbDouglas production function, which is written: $Q = AK^aL^b$ where A mean a constant a, b are positive fractions. The production function is assumed to have a number of properties. In the first place, both K and L are assumed to be infinitely divisible and independently variable and the function is continuous, so that output increases smoothly as either the capital input, the labour input, or both, are increased. If the level of one input, capital for instance, is kept constant and the level

of the other input (labor) is altered, the rate at which output changes is known as the marginal product of labour. In addition, Keat and Young (2003) also pointed out that the important properties of Cobb-Douglas production function are as following:

First, to make this equation useful, both inputs must exist for Q to be a positive number. This makes sense because total product is a result of combining two or more factors.

Second, the function can exhibit increasing, or constant returns. Originally, Cobb and Douglas assumed returns to scale are constant. The function was constructed in such a way that the exponents summed to $b + 1 - b = 1$. However, in later studies, they relaxed this requirement and rewrote the equation as follows: $Q = aL^bK^c$. Under this construction, if $b + c > 1$, returns to scale are increasing and if $b + c < 1$, returns decreasing Constant returns exist when $b + c = 1$.

Third, the function permits us to investigate the marginal product for any factor while holding all others constant. Thus it is also useful in the analysis of short-run production functions. In the two- factor model discussed here, the marginal product of labor turns out to be $MP_L = b Q / L$ and the marginal product of capital is $MP_K = cQ / K$. Each coefficient will usually be less than 1, and this will mean that each of them exhibit diminishing marginal returns. Thus, production takes place in stage II, which is the relevant area of production

Fourth, in the Cobb-Douglas function, the elasticity of the factors are equal to their exponents, in this case b and c . Thus, the elasticity of labor and capital are constants. As a power function can be converted to a linear function by using logarithms, it can be estimated by linear regression analysis, which makes for a relatively easy calculation with any software package. Although, we limit our discussion to just two input variables (L and K) Cobb-Douglas can accommodate any number of independent variables, as follows:

$$Q = aX_1^b X_2^c X_3^d X_4^e \dots X_n^n$$

However, the Cobb-Douglas function has shortcomings are that it cannot show the marginal product going through all three stages of production in one specification. A cubic function would be necessary to achieve this. Similarly, it cannot show a firm passing through increasing constant and decreasing returns to scale. There are also important problems with specification of data to be used in empirical estimates. These problems are discussed next.

Inputs of production

McGuigan *et al.* (2005) and Ricketts and Ricketts (2009) indicated that inputs are important in the production function. An input is a material or good used in creating a final product. Input helps to determine the fixed and variable costs associated with the production of good and services. As with other agribusiness concepts, there are both fixed and variable inputs. A fixed input is defined as one required in the production process but whose quantity employed in the process is constant over a given period of time regardless of the quantity of output produced. The cost of a fixed input must be incurred regardless of whether the production process is operated at a high or a low level. A variable input is defined as one whose quantity employed in the process changes, depending on the desired quantity of output to be produced.

Production equation

McGuigan *et al.* (2005), Kay *et al.* (2004) and Ricketts and Ricketts (2009) stated that severally key components work together to mathematically describe production relationships. The following are some of the fundamental relationships used in production equations.

Total product (TP) is the level of output produced within the production process corresponding to the amount of the variable input added. Overall, TP illustrates the relationship between a variable input and output.

Average product (AP), describes the amount of output produced by each individual unit of the variable input in the production process. This amount of input units corresponds to the level of production. Average product is calculated by the formula:

$$AP = \frac{\text{total product}}{\text{Input level}}$$

Marginal product (MP) is defined as the increments in total output that can be obtained from the use of one more unit of an input in the production process. Marginal product is calculated as:

$$MP = \frac{\Delta \text{ total physical product}}{\Delta \text{ input level}}$$

The numerator is the change in TP caused by a change in the variable input and the denominator is the actual amount of a change in the input. Marginal product can be positive or negative. It can also be zero if the change of the input level causes no change in TP. A negative MP indicates that too much variable input is being used relative to the fixed input, and this combination causes TP to decline.

Three stages of production

Keat and Young (2003), Kay *et al.* (2004) and Ricketts and Ricketts (2009) pointed out that a production and its corresponding MP, shown in Figure 2, illustrates several important relationships between TP, AP, and MP. Notice that as long as TP is increasing at an increasing rate, MP is increasing along with AP. At the point where TP changes from increasing at an increasing rate to increasing at a decreasing rate, MP reaches a maximum and then declines continuously, having a value of zero where TP reaches its maximum. Where TPP is at its maximum, a very small change in the level neither increases nor decreases output, and therefore MPP is zero.

Average physical product increases over a slightly longer range than MPP before beginning to decline which serves to illustrate an interesting relationship

between APP and MPP. Notice that wherever MPP is above APP, APP will be increasing and vice versa. This can be explained by remembering that to rise (lower) and average value, the additional or marginal value used in calculating the new average must be above (below) the old average.

The relationship between TPP, APP, and MPP are often to divide this particular type of production function into three stages, as show in Figure 2. Stage I the process begins with there being relatively low levels of input use but the output rises at an increasing rate. This stage is considered the irrational stage of production uses more of the variable input, resulting in more output being produced. The APP continues to increase as more variable input units are added. Production does not take place during this stage, as the level of maximum input efficiency has not yet been reached- production always begins at the point of maximum input efficiency in the production process. Stage I begins where zero units of the variable input are added and extends to the point where the AP curve its maximum. It is at this point that the marginal product curve intersects the average production curve. Individually, the AP curve first increases at an increasing rate; it then increases at decreasing rate. The AP curve increases throughout this stage until it reaches its maximum point; the marginal product curve first increases to its peak, then begins to decreasing marginal returns are realized throughout this stage.

Stage II begins once the maximum point of the AP curve is reached. This is considered the rational stage of production, the stage where production always occurs. During this stage, the producer decides how much of the variable input to add in order to maximize profitability. Stage II begins where the MP and AP curves intersect and culminates where the marginal product curve equals zero and the TP curve is at its maximum. The total product curve itself continues increasing though at a decreasing rate, until it reaches its maximum level. AP decreases throughout all of stage II and MP also declines throughout this stage, until it reaches zero. An important side note MP equals zero at the same point where TP is at its highest point within the production process. Decreasing marginal returns are realized within this stage.

Stage III is final stage. Even though more units of input may be added, the output (TP) has reached its maximum level and begins to decrease. Therefore, there is no benefit to adding additional input units. This is also considered an irrational stage of production as TP is decreasing and MP is actually negative. This stage begins where the MP curve is zero and becomes negative and the TP curve peaks and begins decreasing. AP also continues to decline. Net returns within the production process can never be maximized during this stage even if the input is completely free.

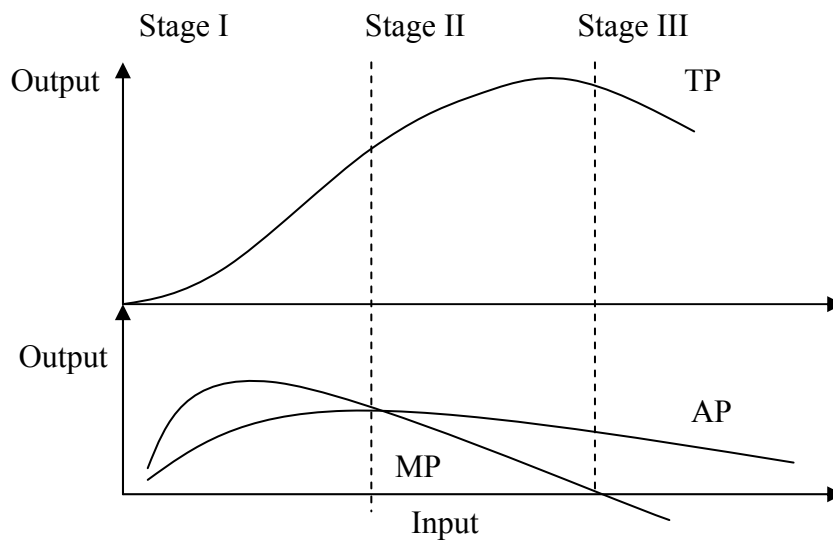


Figure 1 Diagram illustrates the three stages of a production function
Source: Ricketts and Ricketts (2009)

Law of diminishing marginal return

According to Keat and Young (2003) , Drummond and Goodwin (2004), Kay *et al.* (2004) and Ricketts and Ricketts (2009), the law of diminishing marginal return is additional units of variable input are combined with a fixed input, at some point the additional output starts to diminish. In terms of diminishing marginal returns, it is used to describe what happens to MP as additional input is used. The law of diminishing returns states that, as additional units of a variable input are used in combination with one or more fixed inputs, marginal product will eventually begin to decline. Notice that this law is expressed in terms of marginal product and not average or total

production. Three properties of this law and its definition need to be emphasized. First, for diminishing returns to exist, one or more fixed inputs must be used in the production process in addition to the variable input. One acre of land or one head of livestock is often the fixed input used to define the production function and therefore to illustrate diminishing marginal returns. Second, the definition does not preclude diminishing marginal returns from beginning with the first unit of the variable input. This is often the case in agricultural applications of this law. Third, this law is based on the biological processes found in agricultural production. It results from the inability of plants and animals to provide the same response indefinitely to successive increases in nutrients or some other input.

Numerous examples of diminishing returns exist in agricultural production. As additional units of seed, fertilizer, or irrigation water are applied to a fixed acreage of some crop, the additional output or MP will eventually begin to decline. The MP gets smaller and smaller as the crop nears its biological capacity to utilize the input.

Sericulture Production in Thailand

According to Department of agricultural extension: DOAE (2002), sericulture has been practiced in Thailand for a long time, but not as a main occupation. Generally, farmers reel their cocoons and weave silk fabric for household consumption. By the turn of the century, the demand for silk increased to a level where Thailand had to import a lot of raw silk and various kinds of silk fabric. In 1901, the Thai government realized the necessity of producing enough silk for domestic demand to decrease silk products imports. Therefore, sericulture production was promoted by the government to improve productivity and quality of sericulture production to meet the domestic demand.

In term of sericulture policies, Boonchoo (2006) indicated that the Thai government makes policies and strategies including increasing the standard of quality, promoting the development of a stronger and diversified domestic market and encouraging outward expansion for international markets, forming silk supply chains

as silk clusters, developing of designs and new products, and promoting and strengthening the Thai silk handcraft cottage industry. In order to maintain the Thai silk products in the international market, the Thai silk handicraft industry should concentrate on producing unique Thai products, which show the country's image nationwide, with high quality products to be the alternative products in the market.

In term of sericulture production, DOAE (2002), Pongsrihadulchai (2005) and Meesin (2008) identified 2 types of sericulture production in Thailand which are silk handicraft and silk industry. Silk handicraft is produced on the farms using relatively simple equipment. The silkworm varieties are native silkworm varieties and Thai hybrid varieties that are reared 6-8 cycles a year. Farmers may sell their hand-reeled yarn to middleman, local silk reeling factories, the Queen Project or weave it themselves to produced silk fabric in traditional styles. In the silk industry, the farmers produce and sell cocoons and the yarn is reeled in factories. The silkworms are foreign hybrids which are highly productive but require higher levels of skill and care than native varieties and Thai hybrid varieties. In general, farmers hold memberships with silk factories where they receive mulberry varieties silkworm eggs and production factors from silk reeling factories. They sell their white silk output to the factory wherein prices depend upon silk quality.

The silk product can be classified into 3 types including cocoons, silk yarn and fabric. A cocoon is a product of sericulture. It provides filament for raw silk. The cocoons from native silk worms look yellow, while those from cross-bred silkworms usually look white. The cocoons from cross-bred silk worms have a better yield than those of native ones, but raising the former is more difficult than the latter. Cocoon production is an important branch in the silk industry. It is related to mulberry production and silkworm rising. Silk yarn is a product reeled from filament of cocoons both by hand-reeled and machine- reeled. It is usually classified into “weft” and “warp”. The weft is the silk yarn used for beaming, while the warp is that running parallel along the length of the fabrics. The native silk yarns which are hand-reeled from the native cocoons are usually used as weft classified into 3 grades including 1st, 2nd and 3rd grade. The warp are silk yarns reeled by automatic reeling machine from

cocoons of cross-bred silkworms. In silk fabric is the woven cloth made of silk yarn as warp and weft. Silk fabric may be classified into 7 types including Mud-mee, Khit, Yok, Chok, Phrae wa, plain silk and batic

In term of supply and demand, Boonchoo (2006) stated that in 2005 there were around 127,017 farm families who are engaged in sericulture. Mulberry trees are grown in the area of 22,237 hectares which can produce around 1,500 tons per year of silk yarn including 1,050 tons of handicraft production and 450 tons of industrial production. Domestic demand was estimated to be at least 2,000 tons and imported raw silk was around 500 tons per year. The main countries importing silk yarn to Thailand were China, India and Italy.

Table 1 Sericulture farmer and mulberry areas in Thailand 2001-2009

Year	Sericulture farmer	Mulberry areas
2001	159,743	190,000
2002	161,868	185,670
2003	148,650	169,040
2004	136,405	161,430
2005	136,884	155,510
2006	127,017	138,984
2007	-	-
2008	69,866	65,472
2009	94,633	106,106

Source: The Queen Sirikit Department of Sericulture (2011)

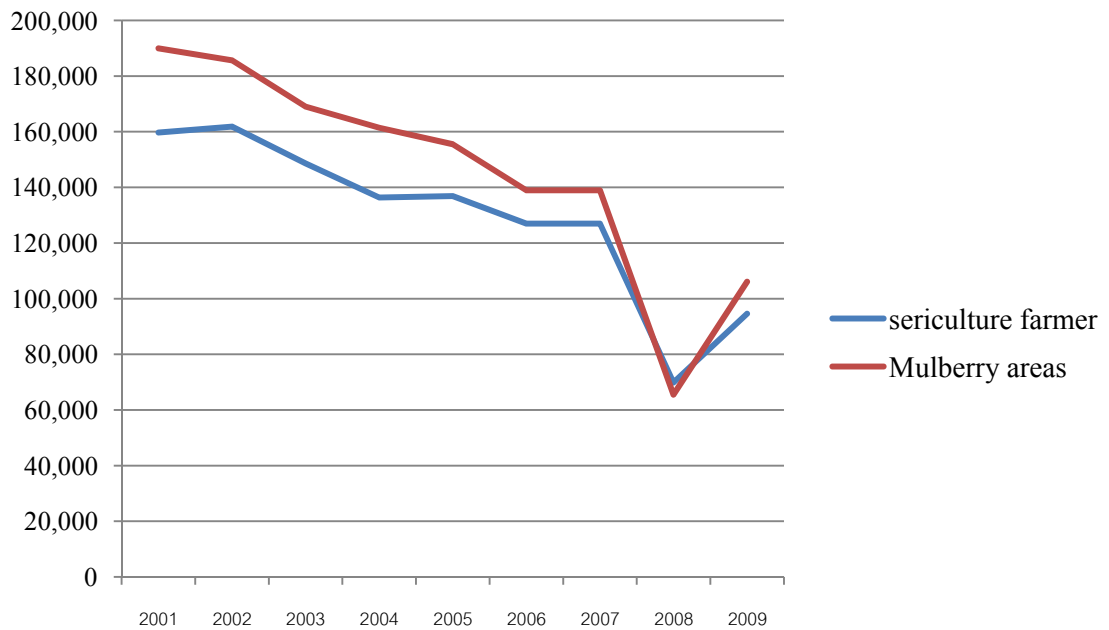


Figure 2 Sericulture farmer and mulberry areas in Thailand 2001-2009

Source: The Queen Sirikit Department of Sericulture (2011)

In term of marketing, Boonchoo (2006) identified 2 types of Thai silk markets including the domestic market and international market. In domestic marketing, there are two channels of markets are wholesale and retail markets. Wholesale market, this market channel, producers can sell their products directly to informal-contact customers who are traders, silk processing shops, and exporters. Retail markets, the total amount of silk fabrics is sold as retail trade is about 60% of the total volume. The Main retail markets are the tourists, department stores, and OTOP shops, accounting for 35 % of total production and it seem to be more beneficial for the Thai economy. In the International Market, Thailand is a small player in a highly concentrated international market of raw silk. Thailand was the fifth largest producer of silk yarn in 2005, producing 1,500 tones, equal to about one percent of world production. However, Thai silk and products have a market share of about 5 % of the world silk trade, while China has a market share of 40 %, followed by India which has a market share of 26 %. The other silk producers have a market share of 29 %. The main export markets for all types of Thai silk fabrics and products are The U.S.A,

accounting for 30 %, The EU, accounting for 23 %, Japan, accounting for 7 %, and other countries accounting for 40 % of total exports.

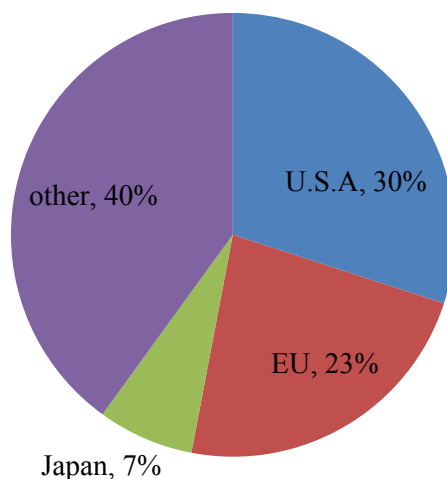


Figure 3 Main export marketing of silk products

Source: Boonchoo (2006)

Silkworm rearing

Sericulture or silk farming is the rearing of silkworms for the production of raw silk and silk fabric weaving. Although there are several commercial species of silkworms, *Bombyx mori* is the most widely used. The larva life of silkworm is divided into five stages. 1st – 3rd instar are young silkworms and 4th – 5th instar are late age. In Thailand, Chul Thai Silk Company Limited (2000), DOAE (1995), Department of Agriculture : DOA (2004), Tayutivuttikul (2004), and Chooprayoon (2008) indicated that the season of silkworm rearing is between May to February. The best temperature for young silkworm range is from 25-28 C° and humidity at 90%. The temperature for late age range is from 24-30 C° and humidity of 70-75%. silkworm rearing practice start from variety selection, rearing room and equipment preparation, disinfection, feeding, area for silkworm rearing, enlargement of rearing area, bed cleaning, practice while silkworms are sleeping and awake mounting, collecting mature worms for mounting, cocoon harvesting and elimination disease and pest.

1. Variety selection

The major varieties of silkworm are reared in Thailand including native, Thai hybrids, and hybrids varieties. The native varieties are the traditionally produced varieties, based on silk egg bred by the farmers or bought from their neighbor. Native varieties produce small, yellow cocoons such as “NANGNOI”, “SOMRONG” and “NANGLAI”. Thai hybrids are bred from native and foreign parents. They produce yellow cocoons of medium size that are usually reeled by the farmers but can be reeled in factories such as “DOAE2”, “DOAE6” and “DOKBAU”. Sericulture farmers receive silkworm egg from government office. Hybrids varieties are bred from foreign parents. They produce large, white cocoons that are suitable for factory reeling such as K1× K8, UB3×UB6, Chul1, Chul5, JT2 and JT4. There are four varieties which are promoted by government agencies including “DOKBAU” and “SAKONNAKHON” due to easy to rearing and high yield. “UDONTHANI” is resistance to grassery disease.

2. Rearing room and equipment preparation

The rearing room should be far away from chemical usage and constructed in an East to West direction, well provided in air ventilation, and the silkworms must be protected from its enemies. Perennial plants should be grown around the rearing room, reducing the heat and sunlight. The roof should be made from materials which can regulate the heat in the rearing room and water. The height should be about 50 cm and covered with nylon nets from the ceiling. In the room, equipment necessary for rearing the silk larva should be adequately prepared in line with the number of silkworm including rearing shelves or tables, baskets, knife, chopping board, weighing, sieve, net for removing larvae excrement, chopsticks, 3% formalin and newspaper. Before rear silkworm, the rearing room and all equipments should be exposed to sun light or incubated in 3% formalin at the ratio of 1 liter / square meter for at least 2 days. Subsequently, the rearing room should be opened for 1 day for air ventilation.

3. Disinfection

Disinfection is a process of destructing the disease casual organisms. There is a possibility of carrying the pathogens or disease through the rearing equipment if there is any disease attack in the previous crop. Before taking up rearing all the rearing equipment including the rearing house, can be disinfected thoroughly. There are various methods of disinfection, both physical and chemical. Physical disinfections are sun drying and steaming. In chemical disinfection, all the rearing equipment as well as the rearing house should be thoroughly disinfected with 2% formalin and dried.

4. Feeding

In silkworm feeding, not only nutritive value but also the number of feeds in each instar plays a major role in the cocoon built. Usually, 20,000 eggs or one box of silkworm eggs require 300-400 kg of mulberry leaves per cycle. Mulberry leaves harvesting for silkworms should suitable for the age of the silkworm. In young silkworm can be give tender leaves grown near the top of a branch and chopped leaves to cut leaves into small pieces. Size of cut pieces is suggested as a square with a side of 0.5- 1.0 cm for the 1st instar, 1.5- 2.0 cm for the 2nd instar and 2.5-3 cm for the 3rd instar. In late age can be give whole leaves or twigs until they are fully grown. The silkworms should be fed at least 3 times a day, depending on farming facilities, that is, first time at 6.00 am – 7.00 am, second time at 11.00 am – 12.00 am, and the last time at 4.00 pm – 5.00 pm.

5. Enlargement of rearing area

Laval growth will be very fast in the silkworms during the early stages. Too much crowd in the rearing bed results in increase in humidity, heat, fermentation of litter which results in unhygienic conditions, wastage of leaf and under development of silkworm. The number of bed and area require for each instar will increase. In a case of Thai hybrid, the areas for rearing silkworm in 1st- 5th instar are required at 20,000,

10,000, 5,000, 1,700 and 1,200 silkworm per m², respectively. The area should be given simultaneously at the time of bed cleaning or feeding.

6. Bed cleaning

Bed cleaning in the silkworm rearing is indispensable for the maintenance of a healthy and hygienic microclimate in the rearing bed. There are various methods include using husk or net. In 1st instar- once, preferably on the third day after brushing when the larvae settle for the first moult. In 2nd instar – twice, the first just after the first moult at the time of the first feeding and the second before the larvae enter the second moult. In 3rd instar thrice, first after the second moult, the second in the middle of the instar and the third just before the third moult. During 4th and 5th instars once in a day in case of shelf rearing.

7. Practice on molting and non molting period

When the silkworms are molting, burnt rice rind or lime should be sprinkled to reduce humidity in the winnowing baskets or shelves. Care must be taken to avoid any impact on the silkworm. Once the silkworms are awake, sprinkle 3% of paraformaldehyde on them to kill disease that pest a risk for infecting their skin. Wait for 15-30 minutes then laid a net on the larvae bodies and scatter good quality mulberry leaves chopped in squares on the net over the silkworm. Wait 2-3 hours then lift the net under which the silkworm are non molting to be fed in the tray prepared for the feeding

8. Collecting mature worms for mounting

After 6 to 7 days from the silkworms' 5th instar, the silkworms develop to the mature stage and find a place for mounting. The method of collecting mature worms for mounting includes picking by hand or nets to transfer them on to a mountage and using a net spread out on the mountage after feeding. Mature worms always crawl up onto the net which is then taken out and shook over paper, and the

worm is then mounted. There are usually spreads of 1,000 silkworms per bamboo mountage. During mounting, the temperature in the rearing room should oscillate between 23-25 °C. The relative humidity must be around 70-75% and even lighting with good ventilation in the room.

9. Cocoon harvesting

Cocoon harvest method can be done after silkworms have gone to cocoon for 5 days. When collecting cocoons for trading, the best quality should be selected and packed in a well-ventilated package. Collecting cocoons for reeling yarns, they should be exposed to the sun and the cocoons incubated. When transporting fresh cocoons, the cocoons should be packed in cloth or nylon bags.

10. Prevention and elimination disease and pest

The disease prevention practices are cleaning rearing room and equipment by using 3 % of formalin or 0.6 % of Chlorine before and after rearing. Using disinfection powder with destroy disease. During the silkworm rearing, infected, dead larvae and infected materials should be removed, burned and buried in the soil. In a case of pest prevention, the windows of the rearing rooms must have hardware cloth in order to prevent entrance of insects and mice in the rearing rooms. For ants can be controlled by intercept the ant's passage with water or oil and hang the rearing bed above the floor.

Silk reeling

According to DOAE (2002), Tayutivuttikul (2004), Agricultural Commodity and Food Standards (2007), and Chooprayoon (2008), silk reeling is simply the unwinding of filaments from a group of cocoons in hot water bath on to a reel. The silk reeling method begin with place preparation for silk reeling, equipment preparation, cocoon culling, cocoon cooking, reeling techniques and re-reeling techniques and storage and packaging.

1. Place preparation for silk reeling

The place for silk reeling should be far away from any communities, good ventilation, separated area for each silk yarn production process, sufficient light and clean water for operation, and provide a good sewage management system.

2. Equipment preparation

Equipments shall be adequate for operation, kept orderly for convenient use and cleaned before and after each operation. Do not use reeling tools and equipments for degumming and dyeing as stains left on the equipment may deform silk yarn color. Maintain the machines, tools and equipments in good function

3. Cocoon culling

Before reeling, cocoons are culled for good and bad cocoons to be used appropriately for each type of yarn. Cocoon culling is based on 11 types of bad cocoons including double cocoon, pierced cocoon, inside soiled cocoon, out-side soiled cocoon, thin shell cocoon, loose shell cocoon, thin-end cocoon, malformed cocoon, cocoon with prints of cocooning frame, crushed cocoon, and musty cocoon.

4. Cocoon degumming

It is necessary that water used for cocoon cooking be clear and tasteless water such as distilled water or rain water. The best pH ratio is at 6 to 7 and the water should be changed when its color has changed. In terms of cocoon cooking method, the cocoons are cook in the cocoon cooking pot and separate the fresh and dried cocoons. Over-turn the cocoons so that they are thoroughly cooked. If the cocoons are properly cooked, the cocoon shell shall appear soaked all over. After cooked, reduce the water temperature to around 60°C to 70°C to reel the silk yarn

5. Reeling Techniques

The reeling techniques need a controlled temperature of 60 to 70 °C. Higher temperatures will lead to knots on the silk yarn, while lower temperatures will cause difficulties in reeling. This depends very much on the types of cocoons; fresh or dried. Refill the cocoons in order to keep an approximate number at the beginning. Keep pulling tension at one level while reeling the silk yarn and refill the water if the level drops from the top of the pot. Change the water when it turns darker or becomes dirty, to control the quality of silk yarn color.

6. Re-reeling technique

The final step is the re-reeling process. Re-reel the silk yarn to become silk skeins of a circumference 135 cm to 155 cm with the weight of 80 g to 100 g per skein. If kept in small reels and the yarn gets dry, soak it in warm water to soften the silk gum before re-reeling. Then, re-reel the yarn to a diamond cross pattern. Prepare silk plies for at least six intervals to prevent the silk yarn clots when degumming or dyeing. After plying, allow the silk skeins to air-dry before storage. In this procedure, 200-gram of silk yarn is produced per day per person or within approximately 5 days, silk will be produced at about 1 kilogram.

7. Storage and packaging

In term of silk yarn storage, storage rooms shall be dry and clean and free of insects, rats, as well as the control of environment, e.g. sunlight, temperature, humidity in order to prevent the silk yarn getting deteriorated. Silk yarn is kept by type and sizes. Packaging materials shall be of good quality, able to prevent moisture and damages from insects, durable for transportation, free of odors and other contaminants which will affect the quality of silk yarn. Be able to prevent any damages which may occur during transportation.

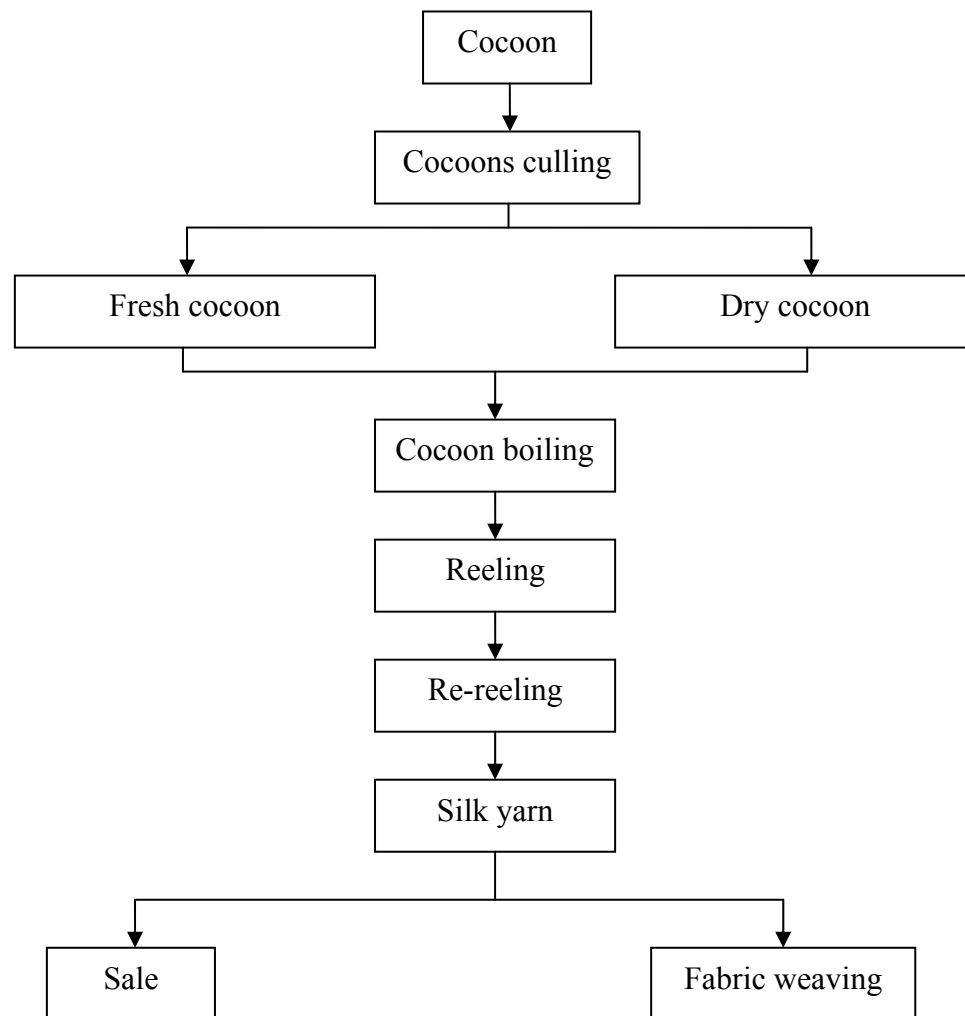


Figure 4 Silk yarn reeling process

Source: Department of Agricultural Extension (2002)

Silk fabric weaving

Silk weaving is a beautiful handicraft with artistic value. Created from a collection of experience in agreement with Thai traditions and culture, Thai silk weaving production methods represent local intelligence inherited from one generation to the next. Chuprayoon (2008), and Tonghoon, (2007) stated that the silk fabric weaving method start from dyeing, yarn preparation, and weaving.

1. Dyeing

Silk yarn needs to undergo bleaching before dyeing. There are 2 methods for bleaching that are bleaching with natural substances such as spiny amaranth, leaf sheaf of banana tree, Cassod tree, Palmyra palm panicles, leaves of broken bone tree by drying them and burning them to obtain ashes. Next, the ashes are boiled at a temperature of 90 C° and the silk yarns are boiled for approximately 60 minutes. On the other hand, silk bleaching can be performed by using chemical substances by boiling silk yarns with soda ash, synthetic soap and silk bleaching substances used exclusively for bleaching Thai silk for approximately 60 minutes at the temperature of 90 C° then washing the silk strands with hot water 2-3 times and washing them once with cool water and drying them. The silk strands obtained will be silk yarn that can be dyed in any desired color. There are two types of dye color include natural and chemical color. At present, natural colors is popular. Natural colors dyeing method can do by extracting colors from materials acquired from plants or animals such flower, core, bark, and leaf. Then mix these with clean water in order to acquire the desired pigment concentration. Next, the silk yarns to be dyed are placed into the dye water and the dye water is rubbed into the silk strands by hand, then left in the dyeing pot on the stove as the heat is increased until the dye water reaches the temperature of 95°C. The dyeing will require approximately 1-1.30 hours. The dyed yarns are then rinsed clean with water, wrung out and hung to dry. Other than the use of natural dyestuff in dyeing silk yarns, there are also synthesized dyestuffs. Most of the chemical The process of using chemical dyestuffs to dye silk yarns should begin with preparing the dyestuff by correctly calculating the ratio between the dyestuff, yarn weight and amount of water to be used, weighing the dyestuff that will be used and melting it with prepared hot water then stirring to mix it together and placing the silk yarn to be dyed into the water so the strands will be evenly dyed. Next, lift the pot onto the stove and gradually increase the temperature to approximately 90-95°C. While boiling, the yarns will have to be turned continually in order to prevent fading following the dyeing. Add acetic acid into the pot after assuring that the yarns have already absorbed the dyestuff. In order help for the yarns to absorb better, lift the yarns up from dye water and then add acetic acid whenever the dye water is observed to be clear the color will be clear, stir and then put the silk yarns back into the dye water again and continue to boil for

10-15 minutes. Lastly, rinse the dyed silk yarns clean in clear water, wring them out and hang them to dry. Then use the yarns for weaving.

2. Yarn preparation

After finishing the dyeing stage, the strings are then untied and the yarn is wound on small spools. The Dyed yarn winding is also an important stage since the correct sequence must be followed, otherwise, the woven material will be flawed, and then pattern will be out of alignment, discontinued or changed into an altogether different design. The small spool is put into shuttle one by one as in order at the final stage of weft yarn preparation. Warp yarn is produced with a simple device. The yarns used for warp are wound on a wooden board with knobs around which yarns are led so that a length of warp can be obtained without tangles. The number of warp yarns is related to the specific beater to be used in the weaving. The next step, the warp yarn is removed from the frame. Each yarn is subsequently passed through the string heddles by twisting it together with warp end left from the previous weaving.

3. Weaving

Typical hand looms are used to weave “MUDMEE” which has complicated designs. After inserting the weft, weaver has to adjust by hand the position of tied and dyed weft in order to making clear pattern in the design. This kind of loom gives production of silk fabrics about 1.5 – 2 yards (1.35 – 1.8 meters) / day (8 hrs).

Standardization in Silk Production

Silk yarn standard

According to ACFS (2005), Thai silk yarn is an important agricultural commodity used as a raw material for many kinds of Thai silk products. Recognition to the silk yarn's special characteristics, the Thai silk products have brought worldwide reputation to Thailand. Nevertheless, commercial Thai silk production still faces

obstacles particularly on quality aspects of silk yarn; evenness, the lack of standard. Thus, silk products come in a wide range of quality, which sometimes the production goes without meeting the demands of farmers, producers and customers. Thai silk yarn standard has comprised of six aspect including types and quality, size, packaging, acceptable tolerance, label and marks, and sampling and judgment.

1. Types and quality

There are 3 types of Thai silk yarn as following:

1st grade is the silk yarn reeled from the inner layers of the cocoon shell. The silk yarn is even in structure, size and color, round, clean and free from adulterated materials. This grade could be sub-divided based on their testable characteristics into 3 quality levels; Premium grade, First level grade and Second level grade. The sericin level is $\leq 30\%$.

2nd grade is the silk yarn reeled from a combination of the inner and outer layers of cocoon shell. The silk yarn is not even in structure, but is even in size and color, round, clean and free from adulterated materials. This grade could be sub-divided based on their testable characteristics into 2 quality levels; First level grade and Second level grade. The sericin level is $\leq 30\%$.

3rd grade is the silk yarn reeled from the outer layer of the cocoon shell with the addition of the floss or from the innermost layer. the silk yarn may contain some knots. It is round, even in size and color, clean and free from adulterated materials. This grade could be sub-divided based on their testable characteristics into 2 quality levels; First level grade and Second level grade. The sericin level is $\leq 40\%$.

2. Sizes

The size of the Thai silk yarn is classified by its utilization. Yarn classifications, average size calculation of the silk yarn are following

Table 2 Classifications of 1st grade of silk yarn

Group	Size (Denier)
Group 1	≤ 120
Group 2	121 – 150
Group 3	151 – 200
Group 4	201 – 250
Group 5	≥ 251

Source: Agricultural Commodity and Food Standards (2005)

Table 3 Classifications of 2nd grade of silk yarn

Group	Size (Denier)
Group 1	≤ 150
Group 2	151 – 200
Group 3	201 – 250
Group 4	251 – 300
Group 5	≥ 301

Source: Agricultural Commodity and Food Standards (2005)

Table 4 Classifications of 3rd grade of silk yarn

Group	Size (Denier)
Group 1	≤ 250
Group 2	251 – 350
Group 3	351 – 450
Group 4	≥ 451

Source: Agricultural Commodity and Food Standards (2005)

3. Packaging

The Thai silk yarn skein is orderly packed in a package. Each package must be even in quality and size. Each package contains 1 or 2 kg of Thai silk yarn. Packaging materials must be of good quality, which shall well-protect the products from humidity and insect contamination, and tolerate the transportation operations. They must be free from odor and adulterated materials which may affect the yarn quality. The visible part of the Thai silk yarn must represent all Thai silk yarn as clearly labeled.

4. Acceptable tolerance

The Thai silk yarn contained in each package is subjected to an acceptable level of tolerance as follows;

4.1 Acceptable tolerance for the diameter of silk skein not more than 3% of that specified on the label.

4.2 Acceptable tolerance for the quality aspect

4.2.1 Premium Grade

Not more than 5% of deviation from the criteria set for Premium Grade quality, but meet those of First level grade.

4.2.2 First Level Grade

Not more than 10% of deviation from the criteria set for first level grade quality, but meet those of second level grade.

4.2.3 Second Level Grade

Not more than 10% of deviation from the criteria set for Second Level Grade quality.

4.3 Deviation criterion for the size aspect not more than 10% of that specified on the label.

5. Label and marks

Each unit of the Thai silk yarn package must contain at least number, alphabet, mark, and statement, clearly visible without any counterfeit that details the following;

5.1 The term Thai silk yarn and silkworm variety or silkworm race.

5.2 Type, size and diameter of skein

5.3 Number of skeins and net weight of the package

5.4 Date–month–year of production

5.5 Name of producer / group and location

In case a foreign language is used, the label must carry the Thai meanings as set above.

6. Sampling and judgment

6.1 For each lot of the Thai silk yarn, take 1–1.5% in weight a sample that well represents the product contained therein.

6.2 After the testing process, each sample of Thai silk yarn must meet the criteria in Section 2, 3, 4 and 7 should be qualified under this standard.

Silk fabric standards

Wannawalee (2000) indicated that aside from the exquisite beauty of silk due to its qualities as a large fibrous protein that make silk flame resistant, and the high degree of safety offered by silk used for interior decorations, which reflects consumer demand in other countries mainly regarding quality, exported silk must be made to meet the import standards and regulates of competitor countries. Importing countries have different standards and methods for inspecting diverse qualities, such as silk burning or resistance to flames, light, tearing, stains and wrinkles; seals of guarantee and silk fabric components or special fabric qualities. Silk quality depends upon the basic needs of customers. In general, basic qualities in other countries require silk fabric that has already passed treatment, so it can be washed or dry cleaned without wrinkling, shrinking or fading.

In addition, Office of Small and Medium Enterprises Promotion : OSMEP (2010) stated that the process of producing silk fabric for export to EU and Italy , standards have been set forth, so the merchandise or product meets set criteria. Most criteria are set by agencies that are central or government organizations with the objective of providing coverage for consumers and making consumers clearly aware of the quality and qualifications of merchandise. The standards set by competitive countries include the origins of woven products, labor employment standards and environmental standards. Some countries even set standards requiring some products to have technical certificates. Moreover, Ngrmchanakijja (2003) indicated that in UK, the government always focuses of the consumer right. Imported products must be approved by the relevant department before entering the country. Additionally, products must be packed and indicate properly in term of product types, manufacturing date, weight, ingredient and manufacturer. Therefore, in order to certify Thai silk quality, domestically and internationally accepted standards have been obtained and become a symbol of quality for consumers.

In addition, The QTHAISILK (2008) indicated that Her Majesty graciously granted permission for the 'peacock' to be used as the brand or logo of quality assurance for four types of Thai silk. The logo, designed for domestic and international recognition, is also meant to commercially address the issue of Thai silk standards as opposed to fake 'Thai silk', and to create a sense of trust in consumers. To be accorded the logo, Thai silk is judged on the attributes of the raw materials and the production process. There are 4 types as follows:

Gold Peacock, the term refers to the type of Thai silk that is hand-woven vertically and horizontally using indigenous Thai silk yarn picked by hands on traditional handlooms. Either natural or chemical dyes are used, but the latter must be environmentally friendly. The silk must be produced in Thailand exclusively.

Silver Peacock, this refers to the style of Thai silk that is hand-woven vertically and horizontally using either indigenous or adaptive Thai silk yarn picked by hands on traditional handlooms. Either natural or chemical dyes are used, but, again, the later must be environmentally friendly. The silk must be produced in Thailand exclusively.

Blue Peacock, this silk is the product of traditional processes that are adapted for practicality and commercial viability. Only pure silk yarn is used in this kind of silk, which is woven vertically (weft) and horizontally (warp) on any kind of loom. Either natural or chemical dyes are used, but the latter must be environmentally friendly. However, the silk must be produced in Thailand.

Green Peacock, for this kind of silk, pure silk thread is the main component, supplemented by other fibers as a secondary raw material. Any kind of loom can be used but details of fiber components must be clearly identified. Either natural or chemical dye is used. The silk must be produced in Thailand.

Moreover, Thai Industrial Standards Institute (1997) set standard for fabric product which is consisted of six aspects including types, size, number of yarn,

weight, required characteristics, packaging, label and marks, and sampling and judgment .

1. Types

1.1 Silk fabric is classified into 4 types according to its weight:

1.1.1 Light weight silk: weigh not more than 90 grams/cm²

1.1.2 Medium weight silk: weigh from 91 -120 grams/ cm²

1.1.3 Heavy weight silk: weigh from 121 – 160 grams/ cm²

1.1.4 Extra heavy weight silk: weigh more than 160grams/cm²

2. Size

2.1 The width has to be as indicated in the label with deviation + 3%

2.2 The length has to be not less than the value indicated in the label.

3. Number of yarn

Number of yarn per 25.4 mm must be as indicated in the label with deviation + 2%

4. Weight

Weight per area unit, must be as indicated in the label with deviation + 2%

5. Required characteristics

5.1 All kinds of the silk fabric shall be neat in appearance, free from stains and damage including splitting yarn, hole, and uniform in color characteristic of silk through out the length.

5.2 Characteristics of pure silk

The silk must possess not less than 2 of the following characteristics.

5.2.1 When we look at the strand by its length through a microscope, if it is degummed silk, we will see smooth single strand with no construction. If it is raw silk, the single yarn will contain dark strand in the middle which can be absent in some part of the yarn. If we look at the strand by its width, degummed silk will show triangle with round points while raw silk will construct 2-line triangle with round points covered with adhering thin tissue that the tissue might be absent in some parts of the triangle.

5.2.2 When tested with burning method, authentic silk will be high flammable except black or dark silk. The flame will be extinguished with a smell of burnt feather when bringing the silk out of blaze. Ashes hold a fragile lump; however; the burnt thicker silk stays its shape but shrink into smaller size.

5.2.3 When tested the authentic silk solubility of with sodium hypochlorite solution, and sulfuric acid at + 20C° for 20 minutes

5.2.4 When tested with dyeing, the silk color will become brown

5.2.5 The resistant to light (xenon arc light), must not less than 5 level blue scale.

5.2.6 The resistant to dried-clean bleach, must not less than 4 level gray scale, both for the color change and the stain.

5.2.7 The resistant to sweat (pH Value), must not less than 4 level gray scale, both for the color change and the stain.

6. Packaging

The silk fabric shall be tidily and securely packed and wrapped with clean and adequately durable material to protect the product form any damage.

7. Marking and Label

Each silk fabric bale must shall bear at least number, letter, or mark indicating clearly and legibly the following information.

7.1 Product name

7.2 Type of fabric by type of weaving

7.3 Width and length in meters

7.4 Dye type (natural or chemical dye)

7.5 Number of yarns in each row

7.6 Weight in grams per square meters

7.7 Recommended care and maintenance

7.8 The name of the manufacturer or factory, address or registered Trademark

In cases a foreign language is used, the meaning shall correspond to that in Thai.

8. Sampling and judgment method

8.1 Sampling and acceptance for ordinary testing, width, length, packaging, trademark and labeling: sampling from the same lot by random in the amount set forth in the table 5

Table 5 Sampling and acceptance for ordinary testing

Lot Size (Number of Pieces, or Folds, or Bolts)	Sample Size (Number of Pieces, or Folds, or Bolts)	Amount Allowed Failure to Meet Criteria
No More Than 30	2	0
Over 30	8	1

Source: Thai Industrial Standards Institute (1997),

Sampling and acceptance for testing pure of silk, number of yarns, color and light durability: select two piece, or fold, or bolt samples at random from the same lot and randomly cut each piece, or fold, or bolt at a length of no less than 20 centimeters for the whole width of the fabric.

8.2 Judgment

Silk fabric samples must meet acceptable criteria for that particular lot of silk fabric to be deemed as having met silk manufacturing standards. In cases where specific pieces of fabric are being considered, the length must be no less than 5 meters.

Factors affecting sericulture production

The Department of Agriculture (1995) indicated that today Thailand has developed the household sericulture practices into commercial enterprises, and therefore there is a need to develop sericulture techniques which can be performed efficiently. As a result, sericulture farmers can get the maximum return from the lowest investment. The decision-making process regarding sericulture production must consider various factors such as mulberry cultivation management, environments in silkworm rearing, silkworm variety, labor, capital, and marketing.

The study by Santiworawat (2000) found that factors affecting silk production were education, the number of weavers, association memberships, and income. In addition, critical factors affecting silk marketing included education levels, association memberships, years of membership, and income. In addition, Siribulpipattana (2003) indicated that education level and income from mulberry planting were significantly positively correlated with the amount of silk production. Age, however, was significantly negatively correlated with the amount of silk production.

Moreover, Srinivasa *et al.* (2004) also indicated that the variables like education level, family size, and extension contact and extension participation of the farmers were found to have a significant influence in the cocoon yield or income in sericulture production. The study by Kaewhom (2005) showed that factors that were important to the success of silk production included biological, physical, and socio-economic factors. Biological factors included silk diseases, and silk variety. Physical factors were temperatures suitable for silk, relative humidity, landscape of silkworm rearing room, and light intensity. Socio-economic factors included experience, attitudes, farm size, return in labor and extension of the government and private agencies.

The Investigation by Srinivas *et al.* (2006) found that agricultural land holding and adoption of innovative methods were significantly correlated with income in sericulture production.

In addition, Chantrasena (2006) stated that experience and knowledge in silk production were significantly related to silk production expectations. On the other hand, group unity and group working supposition did not significantly influence silk production development expectations.

Moreover, Arkanit (2006) pointed out that factors affecting profit in silk weaving included the production cost and the sale units, good financial management, technical know-how, strength in member's cooperation, benefits, dividends, participation of the leaders in various activities, attempts on new approaches, and fullest attention to the production.

The Limunggura and Boonchoo (2007) study on Sericulture Technology of Farmer Network under Community Reeling Factory the results between farmer network from Khon Kaen and Maharakarm provinces showed that there were highly significant differences in term of farmer age, land occupation, and sericulture experience.

In terms of management factors, the study by Weangsreoanaval (2000) found that the number of labors, amount of mulberry leaves, and chemical agents were significantly positively correlated with cocoon production, while the numbers of labors and chemical agents were significantly negatively correlated with income. In addition, Guoda *et al.* (2001) indicated that the importance of factors affecting the cocoon output per box were the culture area of mulberry field, the egg amount raised per unit area of mulberry field, popularization of new mulberry varieties, rearing techniques and productive varieties.

The investigation by Pandit *et al.* (2005) also found that factors such as the spacing of silkworms, the method of rearing house disinfection, and leaf productivity were found to have significant influence on cocoon productivity. Vijayakumari and Rajan (2005) studied an economic analysis of factors influencing income from commercial chawhi rearing centers in Karnataka found that positive factors influence income such as mulberry acreage, the number of disease free layings (dfls) brushed per

annum and the costs related to disinfection, and Chawki transportation. In addition, Srinivasa *et al.* (2008) stated that the variables such as disinfectant and leaf quantity depicted a positive and significant relationship with the cocoon output.

Constraints in sericulture production

Even though Thai silk is well known and has a good image among consumers, it still has many weak points that need to be solved in order to strengthen the Thai silk handcraft cottage industry to compete in the world markets. According to Santiworawat (2000), Weangsreoanaval (2000), Nupak (2002), Jantawan (2003) Siribulpipattana (2003) Kaewhom (2005), Leepayakun (2005), Arkanit (2006), Boonchoo (2006), and Chantrasena (2006), the constraints in sericulture were: less techniques and knowledge in silkworm breeding, insufficiency of good silkworm eggs, management in mulberry cultivation, disease and pests, insufficient mulberry leaves for silkworm rearing in the dry season, lack of water resources in rain fed areas, lack of appropriate knowledge and practices in silk variety selection under appropriate production conditions and rearing area expansion before mulberry leaf feeding, less concern for product quality, instability of product quality, high costs of production, lack of labor in silkworm rearing, lack of new products and designs to meet market's needs, most of sericulture farmer are small scale with the small production levels and poor management, low investment and technology, lack of negotiating power, uncertain marketing channels, low competitive power, decreases in price, lack of marketing channels and opportunities for expansion, lack of marketing advertising and information, competition from other fabrics, weak sericulture farmer groups, poor management in organizations, and less member participation.

Recommendations for sericulture production

In order to increase silk production to meet the domestic demand and international marketing requirements Santiworawat (2000), Weangsreoanaval (2000), Nupak (2002), Jantawan (2003) Siribulpipattana (2003) Kaewhom (2005), Leepayakun (2005), Arkanit (2006), and Chantrasena (2006) recommended that the sericulture

farmers should attempt to acquire knowledge and skill of mulberry managing, silkworm rearing, reeling, degumming, dying, fabric designing, and marketing. Moreover, they should cooperate with government and private organizations in order to be provided knowledge and technology and to promote the products to public. In addition, they should probably establish marketing systems to support their silk products, which will lead to stable increased income. They should be concerned about hygienic practices for the silkworm culture house and culture equipments as well as the proper use of disinfectants. In fact, the government should support input, knowledge, marketing management, and clear policy on sericulture extension. In addition, good silkworm eggs, high yield of mulberry and silkworm varieties, capital and financial source, marketing and processing know-how should be provided. Promotion of appropriate knowledge and practices in silk production is highly required. Particularly, the promotion of silk production and group working through learning process is required. Meanwhile, the government playing a more active role in silk production, marketing and product processing is likely to address the problems and constraints.

Hypothesis

The testing hypothesis of study will involve commercial sericultural production in the study areas. From the relevant research papers, many independent variables had statistical significantly relationships with dependent variables. Then, in this investigation the research hypotheses are as follows:

1. There are statistical significantly relationships between agricultural productions with cocoon yield.

2. There are statistical significantly relationships between agricultural production, biological, personal background, socio-economic, and institutional factors with net earning.

3. There are statistical significantly relationships between agricultural production, biological, personal background, socio-economic, and institutional factors with net profit.

4. There are statistical significantly relationships between personal background, socio-economic, and institutional factors with farmer's knowledge in commercial sericultural production.

5. There are statistical significantly relationships between personal background, socio-economic, and institutional factors with farmer's attitude in commercial sericultural production.

6. There are statistical significantly relationships between personal background, socio-economic, and institutional factors with farmer's practice in commercial sericultural production.

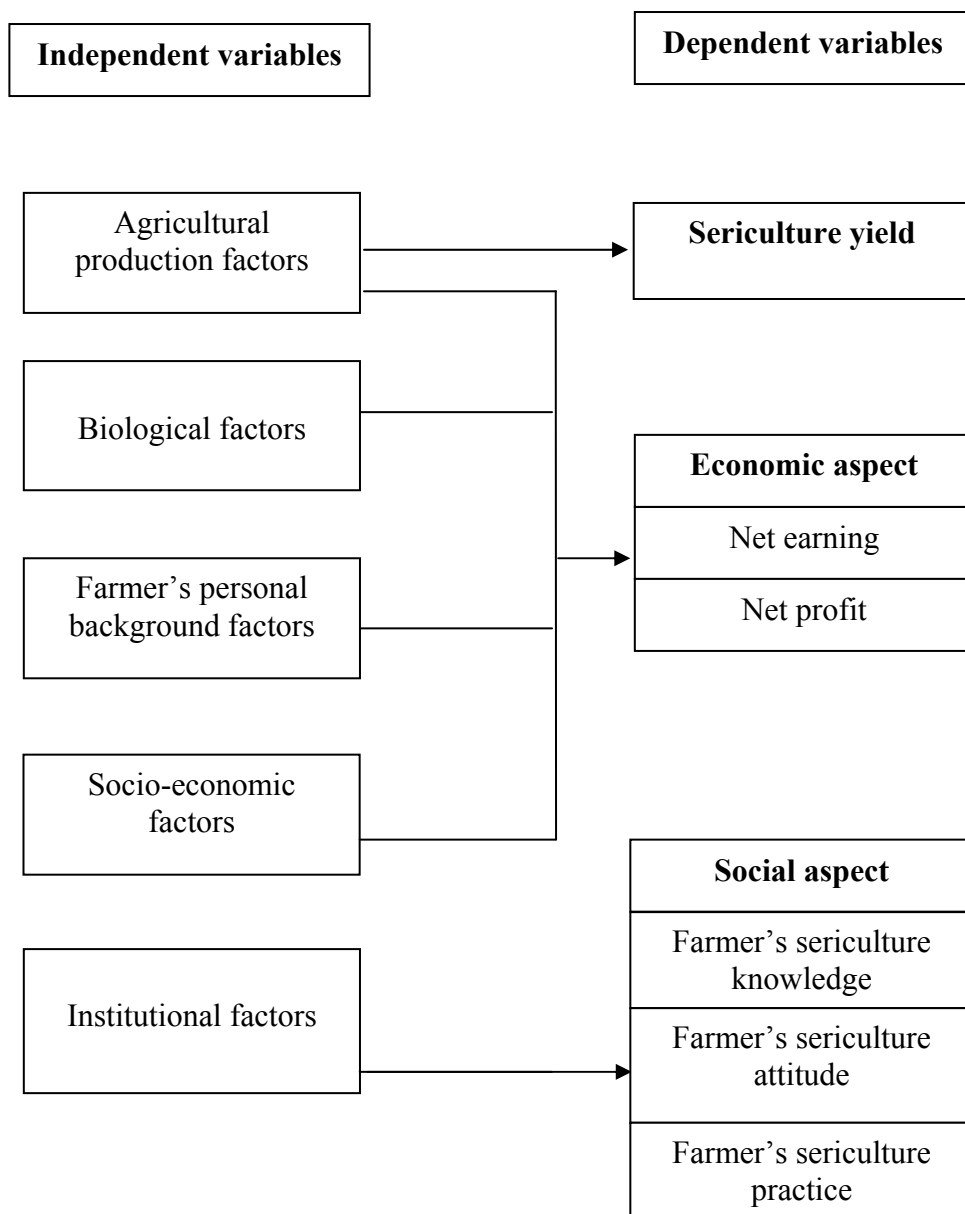


Figure 5 Structure of testing hypothesis

CHAPTER III

RESEARCH METHODOLOGY

To test the hypotheses both primary and secondary data were utilized. This section presents the types of necessary data, the method of data collection, and the data analysis proposed to be employed in this study.

Population

Population were stakeholders in commercial sericultural supply chain divided into 2 groups

1. Sericulture farmer

145 Sericulture farmers in Huafai village, Por Dang subdistrict, Chonnabot district, Khon Kaen province in 2010.

2. Key stakeholder in commercial sericultural supply chain

Key stakeholder in commercial sericultural supply chain include concerned government agencies and buyer in Khon Kaen province.

Sampling Technique

1. Sericulture farmer

The samples was 48 sericulture farmers in Huafai village through technique multistage sampling methods including systematic sampling techniques and snowball sampling. The number of sample size was determined by Arkin's (1974) formula as follows:

$$N = \frac{p(1-p)}{\left(\frac{SE}{t}\right)^2 + \frac{p(1-p)}{N}}$$

Where:

n	=	Sample size
SE	=	Standard error = 0.05
N	=	Total population
P	=	Percent of occurrence in the population (95%)
t	=	Confident level factor = 1.96

Based on the calculation, the number of sample size is:

$$N = \frac{0.95(1-0.95)}{\left(\frac{0.05}{1.96}\right)^2 + \frac{0.95(1-0.95)}{145}}$$

$$n = 48$$

2. Key stakeholder in commercial sericultural supply chain

Concerned government agencies and buyer in Khon Kaen province were selected through purposive sampling technique.

Data Collection

The research concept used in this investigation is based basically on the strategic planning methodology approaches. It involves diagnosis of the existing situation in the study area to identify the developmental issues, socio-economic conditions and the relationship between farmers and their social, economic and environmental factors affecting commercial sericultural production. To address this complex interaction, data were collected according the following consequential steps:

1. Review of related literature

A review of various literatures that were relevant and significant to the study in different aspects were undertaken, specifically, strategy to increase efficiency in terms of technical production in the study area for sericulture production, sericultural practice and their constraints. Application of ICT as a search engine to find some relevant research papers were conducted in addition to the library studies.

2. Field work stage

This stage focuses on information gathering from secondary and primary data collections in order to fulfill the objectives of study and to answer the research questions. The field work stage was divided into three categories which are secondary data collection, primary data collection and in-depth case study.

2.1 Secondary data collection

Secondary data concerning on sericultural production statistic, silk production technology, silk standard, sericulture policy, extension program and silk marketing were obtained from relevant concerned agencies, stakeholders including sericulture expertise, group leader, middleman, and extension officer. Data and information were gathered through documentation review.

2.2 Primary data collection

The primary data for socio-economic analysis were collected from respondents by using survey items. Four types of information will be collected as follows:

2.2.1 Farmers' personal and socio-economic background

The collecting data include general information of farmers and household members the data are information on age, sericulture experiences, level of education, and their source of sericulture information. The details of farmer's socio-economic background include agricultural land holdings, labor in sericulture production, income of household, group belonging and number of group participation by farmer extension support, and number of extension contracts.

2.2.2 Existing sericulture production and activities

The data of sericultural production related in 2010 were discussed. Details of mulberry cultivation, silkworm rearing, silk yarn reeling and silk fabric weaving will be examined. The cost of inputs, yield and income generate from farm activities will be recorded.

2.2.3 Farmers' knowledge, attitude and practice on commercial sericultural production

The physiological data about the farmers' knowledge, attitude and practice on commercial sericultural production were examined. The respondents were asked by open and closed answer questions. Knowledge testing comprises of 4 multiple choice items for which only one answer is correct. Therefore, the score for correct is 1 and the wrong answer is 0. The total scores had been counted for each individual. In attitude measurement, the Likert scale had been used to measure levels of attitude scales which were ranked from strongly agree =5, agree =4, uncertain = 3, disagree = 2, and strongly disagree =1. For the farmers' practice, the marking of score are always = 1 and never= 0.

2.2.4 Constraints and recommendations

In this category, the study examine the details of constraints concern in the aspect of agricultural production factors, biological factors, farmers' personal background factors, socio-economic factors, and institutional factors. The recommendation for improvement current situation will be asked by close and open questions.

2.3. In-depth interview

In order to support and verify some primary and secondary data especially in term of sericulture cultivation technique, general background, and resources available in the study area, in-depth case interview were conducted concerning stakeholders including sericulture expertise and best practices farmer.

Tryout, Reliability and Validity of Survey Items

Before gathering data, the survey items were tried out with 30 commercial sericulture farmers who resided in Khon Kaen province. Testing the reliability of knowledge and practices in commercial sericultural production were obtained through the KR-20 with the reliability of 0.86. The reliability of attitude on commercial sericultural production was by Conbrach's alpha coefficient at 0.89. For KAP question, item-objective congruence index (IOC) was employed checking by 3 expertise.

Analytical Method

Both descriptive and quantitative analytical methods were used to investigate the related problems and constraints depending on the objectives and the nature of the data collected. The different methods of analysis proposed to be employed are described below.

1. Descriptive statistical analysis

Data collected from respondents were analyzed using appropriate statistical packages. Descriptive statistic tools including percentage, arithmetic means, frequency and also standard deviation were used to describe the background of sericulture farmer, household information, sericulture production and activities, knowledge, attitude and practice of farmers in commercial sericultural, their constraints and recommendations to technical efficiency in commercial sericultural.

2. Cost and return analysis

The cost and return analysis of sericultural production were analyzed in order to indicate cost function and relative cocoon production, silk yarn production and silk fabric weaving in the study area. The method of analysis was utilized from improved calculation method by Aungsuratana (2000), Agricultural Information Center, Agricultural Economic Office (AEO), MOAC, Thailand as follows:

2.1 Production cost analysis

2.1.1 Analysis of mulberry cultivation cost: production cost consists of two mains components as follows:

1) Total variable cost (TVC)

Total variable cost includes cost of mulberry cutting, fertilizer, labor input, opportunity cost of capital, and other, such as gasoline for farm engines, electricity.

2) Total fixed cost (TFC)

Total fixed cost consists of cost of land use (rental, land tax etc.) and depreciation cost of farm housing and equipment.

3) Total cost of production (TC)

Total cost will be determined by total variable cost (TVC) plus total fixed cost (TFC) for both cash and non cash expense:

$$TC = TVC + TFC$$

Cost of mulberry cutting: The cost of mulberry cutting is that farmers produce and buy from government agency or neighbors, which can be categorized into cash and non-cash expenses.

Cost of fertilizer: The farmers used both chemical and organic fertilizer for mulberry cultivation. The farmers bought chemical fertilizers, from the middleman. For the organic fertilizers, the farmers bought some of them and produced some from residual agricultural products on farm. Cost of fertilizer was cash expenses.

Cost of soil conditioner: Cost of soil conditioner was expenses consisted of lime , dolomite and etc.

Cost of labor input: Labor cost consisted of both cash and non cash expenses. The farmer was paid to hire labor while the latter was imputed for family labor. The minimum wages rate in the study area is 150 baht per day. In terms of labor input survey items are determined by the priority detail of farm activities, devoted first to as watering, pruning, weeding, fertilizing, and harvesting. This is measured and calculated by number of days and number of man per day for each activity. Labor cost is determined by the number of working hours multiplied by the minimum wage rate per day and divided by 8 hours per day.

$$\text{Man labor cost} = \frac{\text{Number of working hour} \times \text{Wage rate/day}}{8 \text{ hours/day}}$$

$Man - day = (Number\ of\ working\ day/day \times number\ of\ working\ hour/day / one\ person \times number\ of\ day) \div 8\ hour/day$

Depreciation Cost: Depreciation is a non cash expense that reflects a loss in value of a building due to age, wear, and obsolescence. The straight line method is applied to calculate their depreciation according to Agricultural International Center. AEO, MOAC, Thailand, under the conditions that:

- i. A four wheel tractor with 15-60 H.P., the working life span is 10 year;
- ii. A two wheel tractor with 7-15 H.P., the working life span is 8 years;
- iii. A plough machine, the working life span is 10 years;
- iv. A diesel engine, the working life span is 7 years;
- v. A gasoline engine, the working life span is 5 years;
- vi. An irrigation pump, the working life span is 6 years
- ;
- vii. A sprayer engine, the working life span is 6 years;
- viii. A combine machine, the working life span is 10 years;

Depreciation of each farm machine cost per year is determined price at first bought subtracted by the current price divided by number of operating years and multiplied by percentage of operating period.

$$Depreciation\ cost = \frac{First\ buying\ value - Current\ value}{Number\ of\ operated\ year} \times (\%Operated\ period)$$

Cost of land used: Cost of land use is a non cash expense calculated from the total cultivated area farmers' use for sericulture production in 2010 under rented land rate and production in the study area. Theoretically, the suitable method to determine cost of land used is divided into 2 categories. First, cost of rented land (which comes from number of rented land multiplied by rented land rate), and another one is cost of land tax.

$$\text{Cost of land used} = (\text{Total cultivated area} \times \text{Rented land rate}) + \text{Cost of land tax}$$

Opportunity cost of capital: Opportunity cost of capital consists of the opportunity cost of non cash and cash expenses. Non cash expenses are determined by total variable non cash costs multiplied by savings interest rate.

$$\text{Opportunity cost of non cash expenses} = (\text{Total variable non cash cost} \times \text{Savings interest rate})$$

$$\text{Opportunity cost of cash expenses} = (\text{Total variable non cash cost} \times \text{Loan interest rate})$$

Other costs: Many types of expenses are also included in terms of variable cost. The data consisted of petrol and diesel, as well as electricity and maintenance.

2.1.2. Analysis of silkworm rearing cost: Cost of production consists of two main components as follows:

1) Total variable cost (TVC)

Total variable cost includes cost of mulberry leaf, silkworm egg, disinfectant, labor input, opportunity cost of capital, and other, such as gasoline for farm engines, electricity.

2) Total fixed cost (TFC)

Total fixed cost consists of cost depreciation cost of farm housing and equipment.

3) Total cost of production (TC) Total cost will be determined by total variable cost (TVC) plus total fixed cost (TFC) of both cash and non cash expense:

$$TC = TVC + TFC$$

Cost of mulberry leaf: The cost of mulberry leaves that farmers produce for their own use and buy from neighbors, which can be categorized into cash and non-cash expenses.

Cost of silkworm egg: Most farmers receive support for silkworm egg from the Queen Sirikit Sericulture Center. Farmers also produce silkworm eggs by themselves or buy from neighbors, which constitutes both cash and non-cash expenditures.

Cost of disinfectant: Cost of disinfectant is cash expenses consisting of agriculture chemicals for disinfecting rearing room and silkworm.

Cost of labor input: Labor cost consisted of both cash and non - cash expenses. The farmer was paid to hire labor while the later was imputed for family labor. The minimum wages rate in the study area is 150 baht per day. In term of

labor input survey items determined by the priority detail of farm activities, devoted first to as rearing room preparation, feeding, bed cleaning, disease control, mounting management, and harvesting. This is measured and calculated by the number of days and the number of men per day for each activity. Labor cost is determine by number of working hours multiplied by minimum wage rate per day and divided by 8 hours per day.

$$\text{Man labor cost} = \frac{\text{Number of working hour} \times \text{Wage rate/day}}{8 \text{ hours/day}}$$

$$\text{Man - day} = (\text{Number of warking may/day} \times (\text{numberofworking hour / day/one person} \times \text{number of day}) \div 8 \text{ hour/day}$$

Depreciation cost: Depreciation is a non cash expense that reflects a loss in value of a building due to age, wear, and obsolescence. The straight line method is applied to calculate their depreciation according to Agricultural International Center. AEO, MOAC, Thailand, under the condition that:

- i. Silkworm rearing rooms have a working life span of 10 years;
- ii. Equipment for silkworm rearing such as trimming scissors, knives, baskets, bamboo trays, rearing shelves, chopping blocks, bamboo mountages, etc, have a working life span of 5 years;

Depreciation of each farm housing and equipment cost per year is determined by the value of the first bought price subtracted by the value of the last operated price divided by number of operating years and multiplied by the percentage of operating period.

$$\text{Depreciation cost} = \frac{\text{First buying value} - \text{Current value}}{\text{Number of operated year}} \times (\% \text{Operated period})$$

Opportunity cost of capital: This consists of the opportunity cost of non cash and cash expenses. Non cash expenses are determined by the total variable non cash cost multiplied by the savings interest rate.

Opportunity cost of non cash expenses = (Total variable non cash cost × Savings interest rate)

Opportunity cost of cash expenses = (Total variable non cash cost × Loan interest rate)

Other costs: Many types of expenses are also included in terms of variable cost. The data consisted of electricity and maintenance.

2.1.3 Production cost of silk yarn analysis: Cost of production consists of two main components as follows:

1) Total variable cost (TVC)

Total variable cost includes the cost of cocoon, cost of labor input, opportunity cost of capital, and others, such as electricity.

2) Total fixed cost (TFC)

Total fixed cost consists of the depreciation cost of farm equipments.

3) Total cost of production (TC)

Total cost will be determined by the total variable cost (TVC) plus the total fixed cost (TFC) for both cash and non cash expense:

$$TC = TVC + TFC$$

Cost of cocoon: Is the cost of cocoon that farmers who produce cocoon for their own use and buy from neighbors and middleman, which can be categorized into cash and non-cash expenses.

Cost of labor input: Labor cost consisted of both cash and non cash expenses. The farmer was paid to hire labor while the latter was imputed for family labor. The minimum wages rate in the study area is 150 baht per day. In term of labor input survey items are determined by the priority detail of farm activities, devoted first to as select cocoon, equipment preparation, cooking, reeling, re-reeling and finally packing. The measures are calculated by number of days and number of man per day for each activity. Labor cost is determined by the number of working hours multiply by the minimum wage rate per day and divided by 8 hours per day

$$\text{Man labor cost} = \frac{\text{Number of working hour} \times \text{Wage rate/day}}{8 \text{ hours/day}}$$

$$\text{Man - day} = (\text{Number of working day/day} \times \text{Number of working hour/day/one person} \times \text{number of day}) \div 8 \text{ hour/day}$$

Depreciation cost: Depreciation is a non cash expense that reflects a loss in value of building due to age, wear, and obsolescence. The straight line method is applied to calculate their depreciation according to the comptroller General's Department and Agricultural International Center. AEO, MOAC, Thailand, under the condition that:

Equipment for silk reeling such as cooking pot, stove, basin, basket, silk reel winders, hand reeling apparatus, etc, have a working life span of 5 years;

Depreciation of each farm machine cost per year is determined by the value of the first operated price subtracted by the value of the last operated price divided by the number of operating years and multiplied by the percentage of operated period.

$$\text{Depreciation Cost} = \left\{ \left(\text{First Buying Value} - \text{Current Value} \right) \div \left(\text{Number of operated year} \right) \right\} \times (\% \text{ Operated period})$$

Opportunity cost of capital: This consists of the opportunity cost of non cash and cash expenses. For non cash expenses determine by total variable non cash cost multiplied by savings interest rate.

$$\text{Opportunity cost of non cash expenses} = (\text{Total variable non cash cost} \times \text{Savings interest rate})$$

$$\text{Opportunity cost of cash expenses} = (\text{Total variable non cash cost} \times \text{Loan interest rate})$$

Other costs: Many types of expenses are also included in term of variable cost. The data consisted of electricity and maintenance.

2.1.4 Analysis of silk fabric weaving cost analysis: Cost of production consists of two mains components as follows:

1) Total variable cost (TVC)

Total variable cost includes the cost of silk yarn, cost of dye color, cost of material, cost of labor input, opportunity cost of capital, and others, such as electricity.

2) Total fixed cost (TFC)

Total fixed cost consists of depreciation cost of farm equipment.

3) Total cost of production (TC)

The total costs were determined by the total variable cost (TVC) plus the total fixed cost (TFC) by both cash and non cash expense:

$$TC = TVC + TFC$$

Cost of silk yarn: This is the cost of silk yarn that expenses incurred with warp and weft silk yarn, both produced by the farmers and buy from middleman, sericulture group and neighbors, which can be categorized into cash and non-cash expenses.

Cost of material input: Material input that farmers use in dyeing method in silk fabric weaving consists of bleaching substances, dye color, glue, rope, bleaching solutions, tapioca starch, vinegar, salt, shampoo, and alkali water.

Cost of labor input: labor cost consisted of both cash and non cash expenses. The farmer was paid to hire labor while the latter was imputed for family labor. The minimum wage rate in the study area is 150 baht per day. In term of labor input survey items determined by the priority detail of farm activities, devoted first to as dyeing, powdering, winding onto a reel, stretching the warp yarn, combing the warp yarn, separating the warp from weft in weaving, keeping and binding down the heddle, reed insertion, and getting loom ready for silk weaving. This is measured and calculated by the number of days and number of men per day for each activity. Labor cost is determined by the number of working hours multiplied by the minimum wage rate per day and divided by 8 hours per day.

$$\text{Man labor cost} = \frac{\text{number of working hour} \times \text{wage rate/day}}{8 \text{ hours/day}}$$

$$\text{Man - day} = (\text{number of working day/day} \times \text{Number of working hour/day/one person} \times \text{number of day}) \div 8 \text{ hour/day}$$

Depreciation cost: Depreciation is a non cash expense that reflects a loss in value of building due to age, wear, and obsolescence. The straight line

method is applied to calculate their depreciation according to Agricultural International Center. AEO, MOAC, Thailand, under the condition that

- i. Looms have a working life span of 10 years;
- ii. Equipment for weaving such as heddle, shuttle, silk yarn hanging rails and boiling pots, etc, have working life spans of 5 years;

Depreciation of each farm machine cost per year is determined by the value of the first bought price subtracted by the value of the last operated price divided by the number of operated years and multiplied by percentage of operated period.

$$\text{Depreciation Cost} = \{(\text{First Buying Value} - \text{Current Value}) \div (\text{Number of operated year})\} \times (\% \text{ Operated period})$$

Opportunity cost of capital: This consists of the opportunity cost of non cash and cash expenses. Non cash expenses are determined by total variable non cash cost multiplied by savings interest rate.

$$\text{Opportunity cost of non cash expenses} = (\text{Total variable non cash cost} \times \text{Savings interest rate})$$

$$\text{Opportunity cost of cash expenses} = (\text{Total variable non cash cost} \times \text{Loan interest rate})$$

Other costs: Many types of expenses are also included in term of variable cost. The data consisted of electricity and maintenance.

2.2 Return analysis

In terms of return analysis, productivity, income generation and profitability of commercial sericultural production were utilized from yield, gross income, net farm earnings, and net profit.

2.2.1 Gross enterprise income: The gross income of silk enterprise is defined as the value of the total output of each silk product in 2010, whether the output is sold or not. The gross enterprise income is determined by total product multiplied by price sold to market.

$$\text{Gross enterprise income} = \text{Total product} \times \text{Selling price}$$

$$\text{GI} = \text{TP} \times \text{P}$$

2.2.2 Net earnings: Net farm earning is defined as the total reward in each enterprise production including the lack of the investment opportunity of total variable cash cost. Net farm earnings are determined by gross enterprise income subtracted by total variable cash cost.

$$\text{Net earnings} = \text{Gross enterprise income} - \text{Total variable cash cost}$$

$$\text{NE} = \text{GI} - \text{TVC (cash cost)}$$

2.2.3 Net Profits: Net profit of sericulture enterprise is defined as the return of silk enterprise production in 2010. The net profit is determined by gross enterprise income subtracting by total cost.

$$\text{Net profit} = \text{Gross enterprise income} - \text{Total cost}$$

$$\text{NP} = \text{GR} - \text{TC}$$

2.2.4 Break-even yield is defined as the minimum yield required to cover all costs at the price. It will be determined by total costs divided by price:

$$\text{Break-even yield} = \frac{\text{Total cost}}{\text{Price}}$$

2.2.5 Break-even price is defined as the minimum price required to cover all costs at yield. It will be determined by total costs divided by the volume of product :

$$\text{Break-even price} = \frac{\text{Total cost}}{\text{Yield}}$$

Technical Efficiency and Its determinants

To confirm the level of technical efficiency and its determinants an econometric and socio-econometric analysis will be employed in this study. Technical Efficiency here means both yields and income. Yield is refers to cocoon yield, silk yarn yield and silk fabric yield. Income refers to net earnings and net profits of sericulture production activities in study areas in 2010. The Cobb-Douglas production function and multiple regression models will be selected to try for investigation the suitable model of technical efficiency in production function.

Analytical Framework and Model specification

1 . Efficiency input use analysis

An analysis of input use efficiency in cocoon production, The Cobb-Douglas production function model was employed to obtain parameters for the measurement of input use factors determinants cocoon yield. The form of Cobb-Douglas production function proposed as follows:

$$Y_i = \beta X_1^{b_1} X_2^{b_2} X_3 \dots X_k^{b_k} e^u$$

This form Cobb-Douglas function estimates by using ordinary least square (OLS) approaches after converting it into log linear form. The estimable form of the equation is given below:

$$\ln Y = \ln \beta + b_1 \ln X_1 + b_2 \ln X_2 + b_3 \ln X_3 + b_4 \ln X_4 + e^u$$

Where

Y = Total cocoon from silkworm production (Kg)

β = Constant

X_1 = Total silkworm egg used (sheet)

X_2 = Amount of mulberry leaves (kg)

X_3 = Total of chemical disinfectant (Kg)

X_4 = Total labor used (man day)

e^u = Random-error

2. Farm income and its determinants analysis

Income here refers to the net earnings and net profits. The relationship between dependent and independent variables through a multiple linear regression model will be specified as:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 \dots + \beta_k X_k + \mathcal{E}$$

Dependent variables: The dependent variable was the economic aspects including net earnings and net profit.

Independent variables: The independent variables include 5 main items as follows:

Agricultural production factors

X_1 = Total cost of silkworm egg used (baht)

X_2 = Total cost of mulberry leaf (baht)

X_3 = Total cost of Chemical disinfectant (baht)

X_4 = Total cost of cocoon used (baht)

X_5 = Total cost of silk yarn used (baht)

X_6 = Total cost of labor forces (baht)

X_7 = Total cost of weaving material (baht)

X_8 = Opportunity cost of capital (baht)

X_9 = Cost of depreciation (baht)

Biological factors

X_{10} = Number of silkworm diseases

Farmers' personal background factors

X_{11} = Age

X_{12} = Sericulture production experiences

X_{13} = Level of education

X_{14} = Source of sericulture information

Socio-economic factors

X_{15} = Labor

X_{16} = Group belonging

X_{17} = Frequency of group participation by farmer

Institutional factors

X_{18} = Number of contact agency

3. KAP assessment

KAP assessment means knowledge and practices analysis of sericulture farmer in commercial sericultural production in 2010. Pearson product moment correlation coefficient has been used. The variables will be explained.

Dependent variables: The dependent variable were knowledge, attitude and practice of farmer

Independent variables: The independent variables include 3 main items as follows:

Farmers' personal background factors

X_1 = Age

X_2 = Sericulture production experiences

X_3 = Level of education

X_4 = Number of sericulture information perception

Socio-economic factors

X_5 = Number of labor

X_6 = Group belonging

X_7 = Frequency of group participation of farmer

Institutional factors

X_8 = Number of contact agency

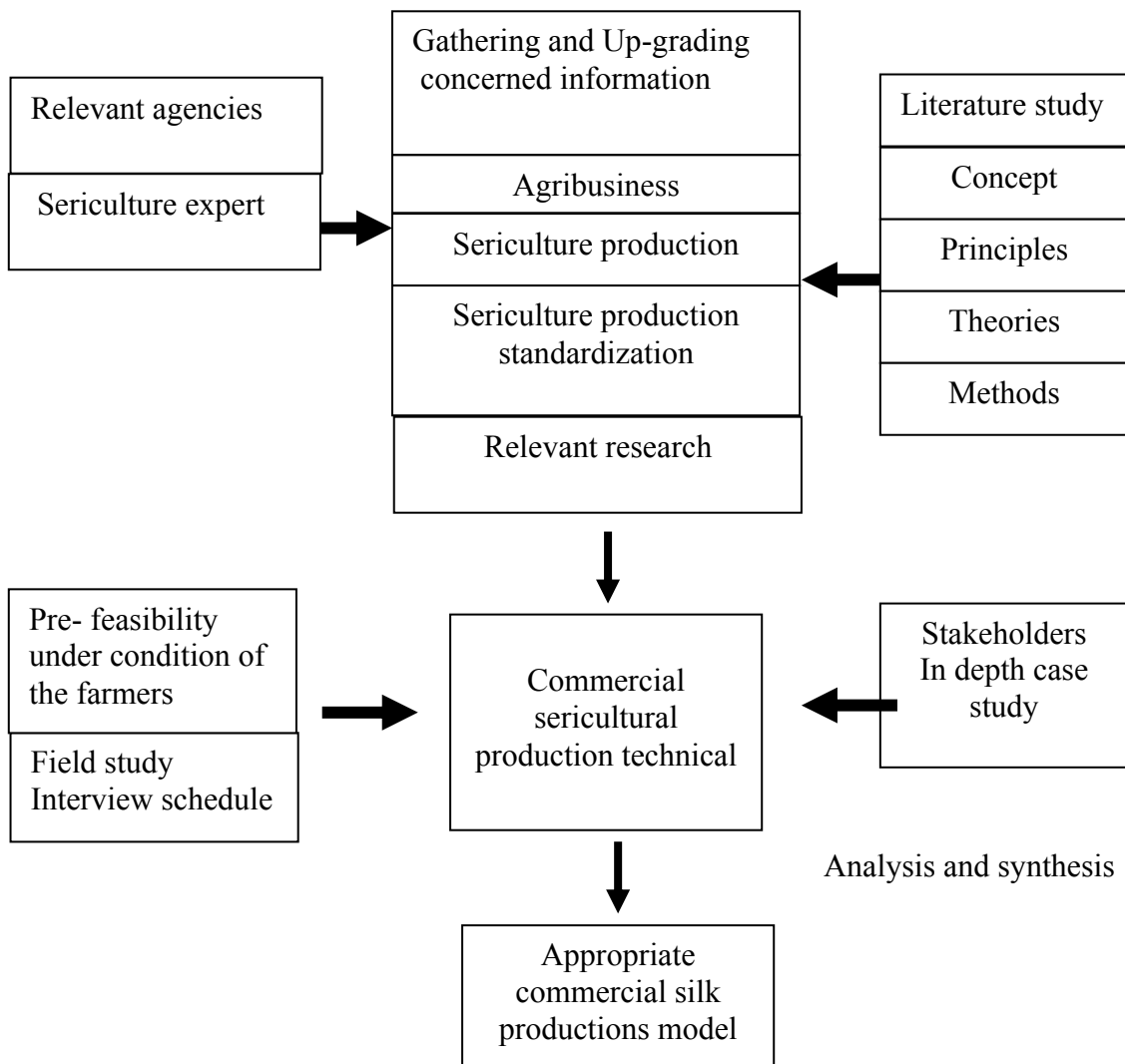


Figure 6 Conceptual frame work

CHAPTER IV

RESULTS AND DISCUSSION

Part 1 Characteristic of the Study Area

This part provides general information of the study area. It explains the history, location and accessibility, topography, climate, soil characteristics and land suitable, water resources irrigation system, infrastructure and public service facility, population, occupation and income in the study areas.

History

Huafai village, the study area, is a part of Por Dang subdistrict, Chonnabot district, Khon Kaen province in the northeastern Thailand. According to Po Dang Subdistrict Administrative Organization (2011), Huafai village was established in 1912. This village was moved from Por Dang village to the weir area because of it is convenient to engage in farming. Then, the village was named “Huafai” as water resource areas. This village is situated in the south of the Chonnabot district with a distance of approximately 21 km. according to the highway of Chonnabot district - Waeng Yai district, Khon Kaen province. This village is a well known for silk fabric weaving.

Location and accessibility

Huafai Village is 1 of the 10 villages in Por Dang subdistrict, located on Chonnabot district, Khon Kaen province in the northeastern Thailand at 16° 16'N 102° 46'E .This village is located around 80 km. south of Khon Kaen province as shown in Figure 5.

Huafai village is located under the control of Pordang Sub-district Administrative Organization. The village is administered based on decentralization by having 7 communities. Each community has its leader and committee.

Besides, there are woman development committee of the village and community development volunteers under the supervision of the village committee and Pordaeng subdistrict headman.

Topography

Huafai village area is mostly flat with some undulating land and elevation ranges from 226 meters above sea level in the west part of the subdrastic.

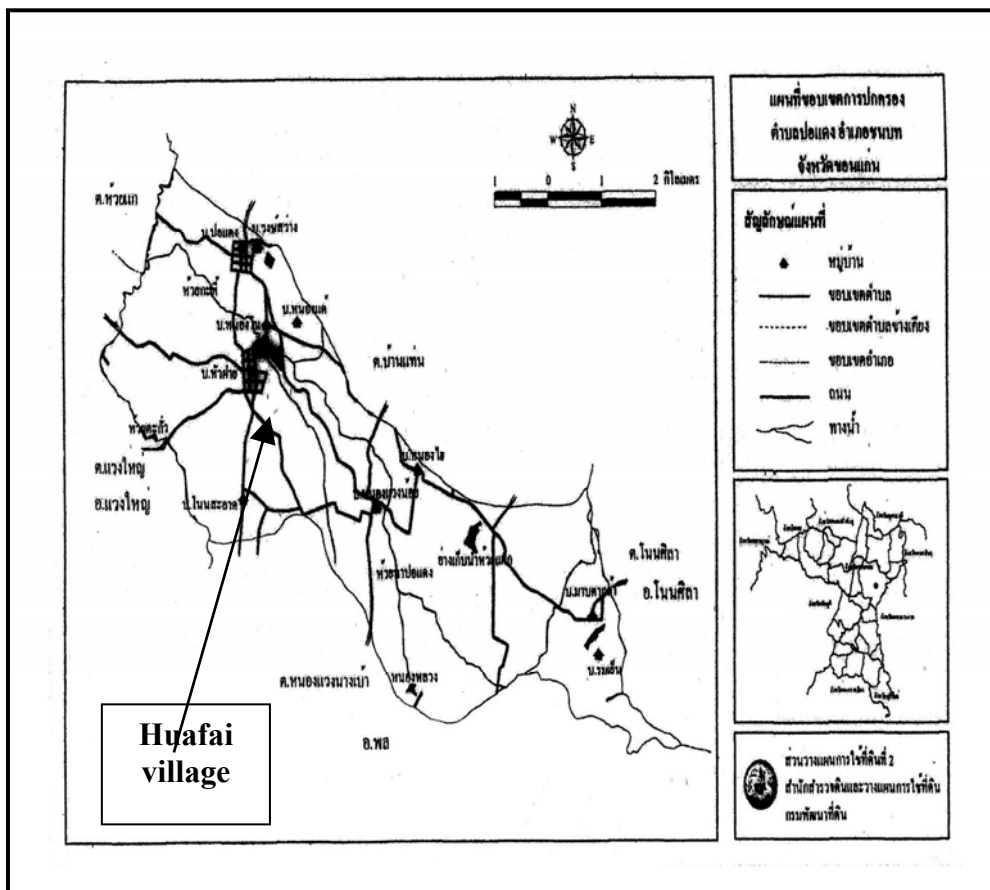


Figure 7 Location of Huafai village
 Source: Land Development Department (2011)

Climate

The climatic condition in the study area is tropical savannah. Based on meteorological data during the last 30 years (1980–2011) at the nearest station of the study area, namely Chonnabot station Khon Khon province as shown in Table 6 and Figure 8, the average annual rainfall was 1,239.7 mm. Average number of rainy days was 88 days. The rainy season lasted from May to October. The average maximum monthly precipitation was 269.4 mm. in September. The minimum was 8.2 mm. in January. The average annual relative humidity (RH) was 69.1 %. The average maximum RH was 79.5 % in September. The minimum was 58.5% in March. The average temperature was 27.2 °C. The average maximum temperature was 30.4°C in April and minimum was 23.0°C in December.

Table 6 The average temperature and rainfall pattern in study area within 30 years (1981–2011)

Month	Temperature (°C)			Relative humidity (%)			Rainfall	
	Maximum	Minimum	Average	Maximum	Minimum	Average	Rainfall (Days)	Average (mm)
January	30.30	16.20	23.20	86	41	63.50	3	8.20
February	32.70	19.30	26.00	83	39	61.00	2	25.40
March	35.20	22.30	28.70	79	38	58.50	3	41.90
April	36.40	24.50	30.40	81	43	62.00	5	88.30
May	34.50	24.80	29.60	89	53	71.00	11	147.80
June	33.20	24.80	29.00	90	57	73.50	10	122.50
July	32.70	24.40	28.50	90	59	74.50	12	143.60
August	32.00	24.20	28.10	92	62	77.00	13	179.90
September	31.60	23.70	27.60	95	64	79.50	14	269.40
October	31.40	22.50	26.90	92	58	75.00	10	130.90
November	30.70	19.60	25.10	89	49	69.00	3	34.70
December	29.70	16.40	23.00	87	42	64.50	2	9.20
Annual	32.50	21.90	27.20	87.70	50.40	69.10	88	1,239.70

Note: Data collected at meteorology station, Chonnabot district

Source: Meteorological Department (201

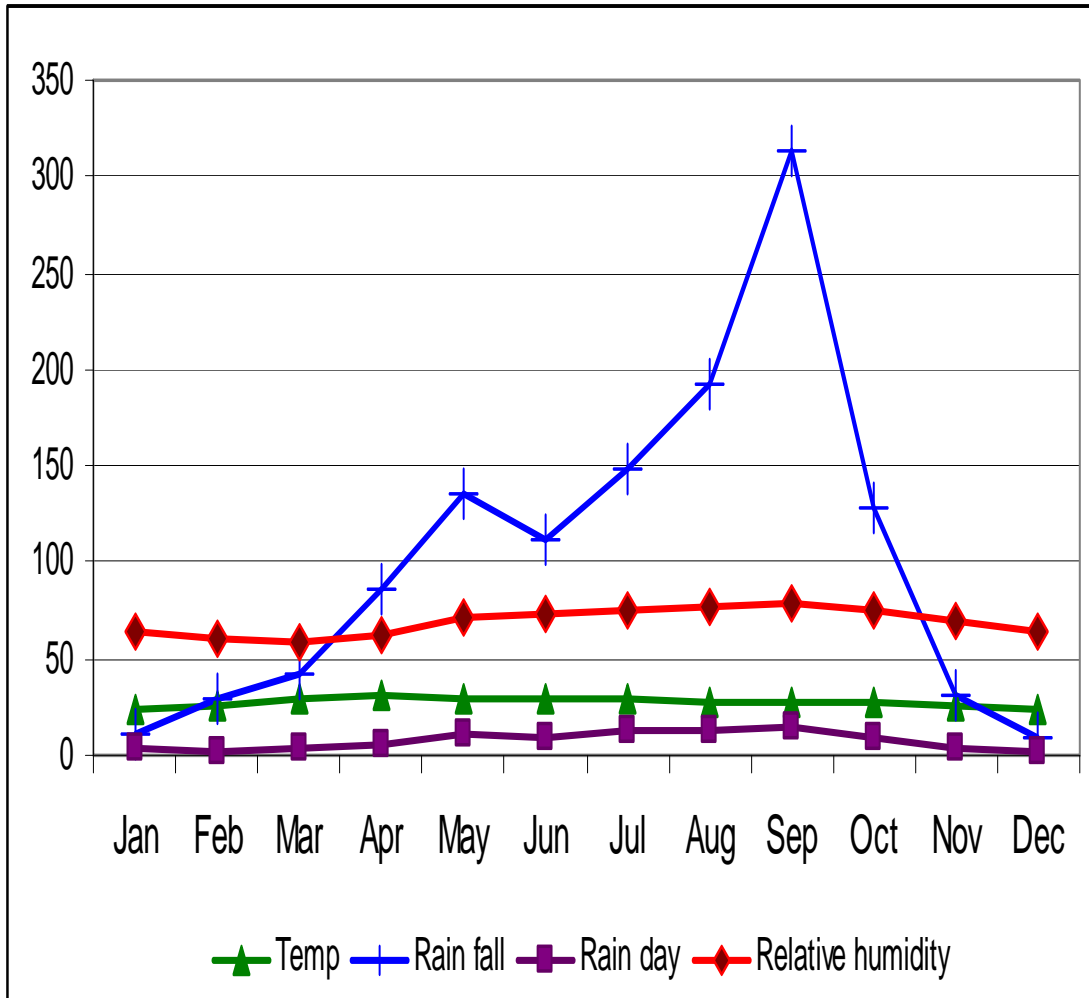


Figure 8 Average rainfall, temperature relative humidity and rainfall pattern (1981-2010)

Source: Estimated with the data of Meteorological Department (2011)

Soil characteristics and land suitable requirement

The major soil types in the study area are clay loam soil, sandy loam, and sandy soil. The majority of soil is mapping unit number 44 as shown in Figure 9. According to the land suitability requirement report, soil mapping unit number 44 is sandy loam and color profiles are gray or light brown. The slope range is less than 20% with highly drained characteristic in the rainy season. Soil fertility is rather poor with pH reaction 5.5-7.0. Land use and land cover classes are suitable to cultivate field crops such as cassava, pineapple and sugarcane.

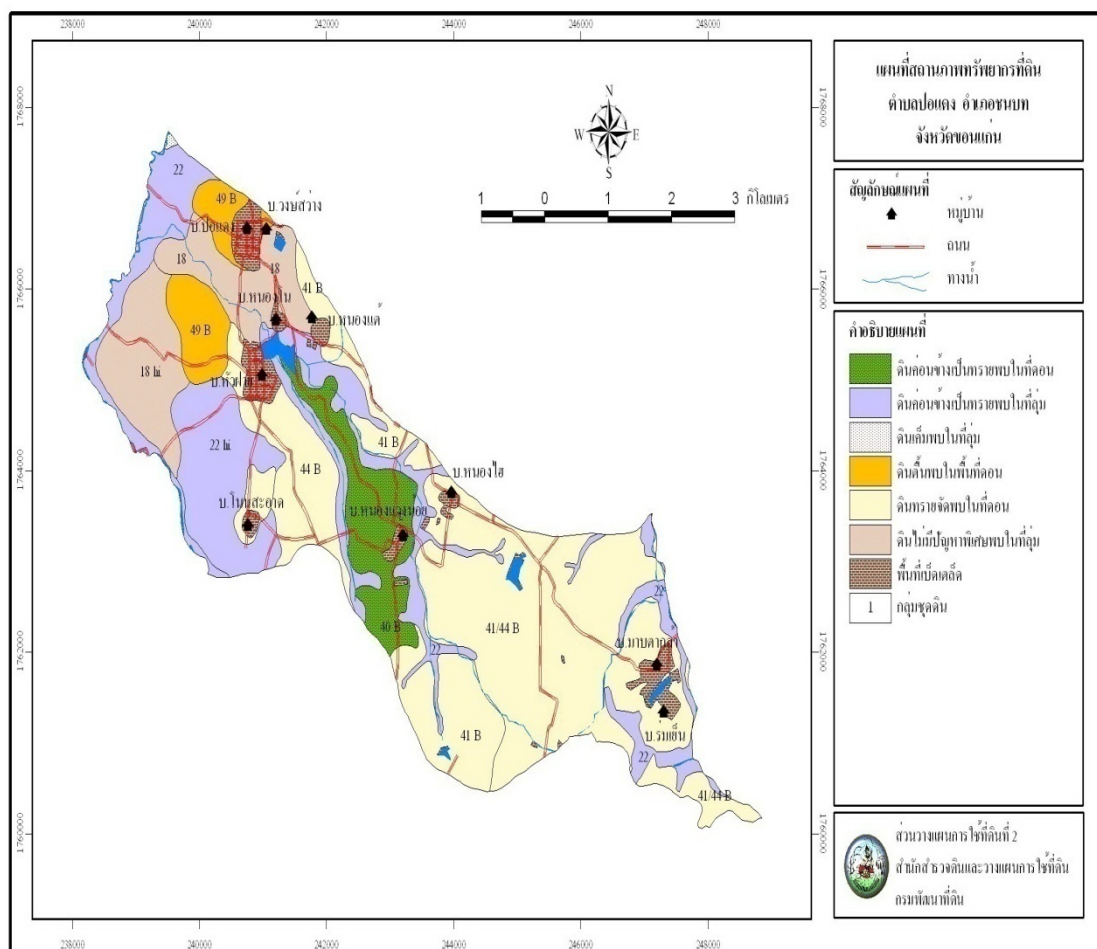


Figure 9 Land suitability classification of Huafai village

Source: Land development Department (2011)

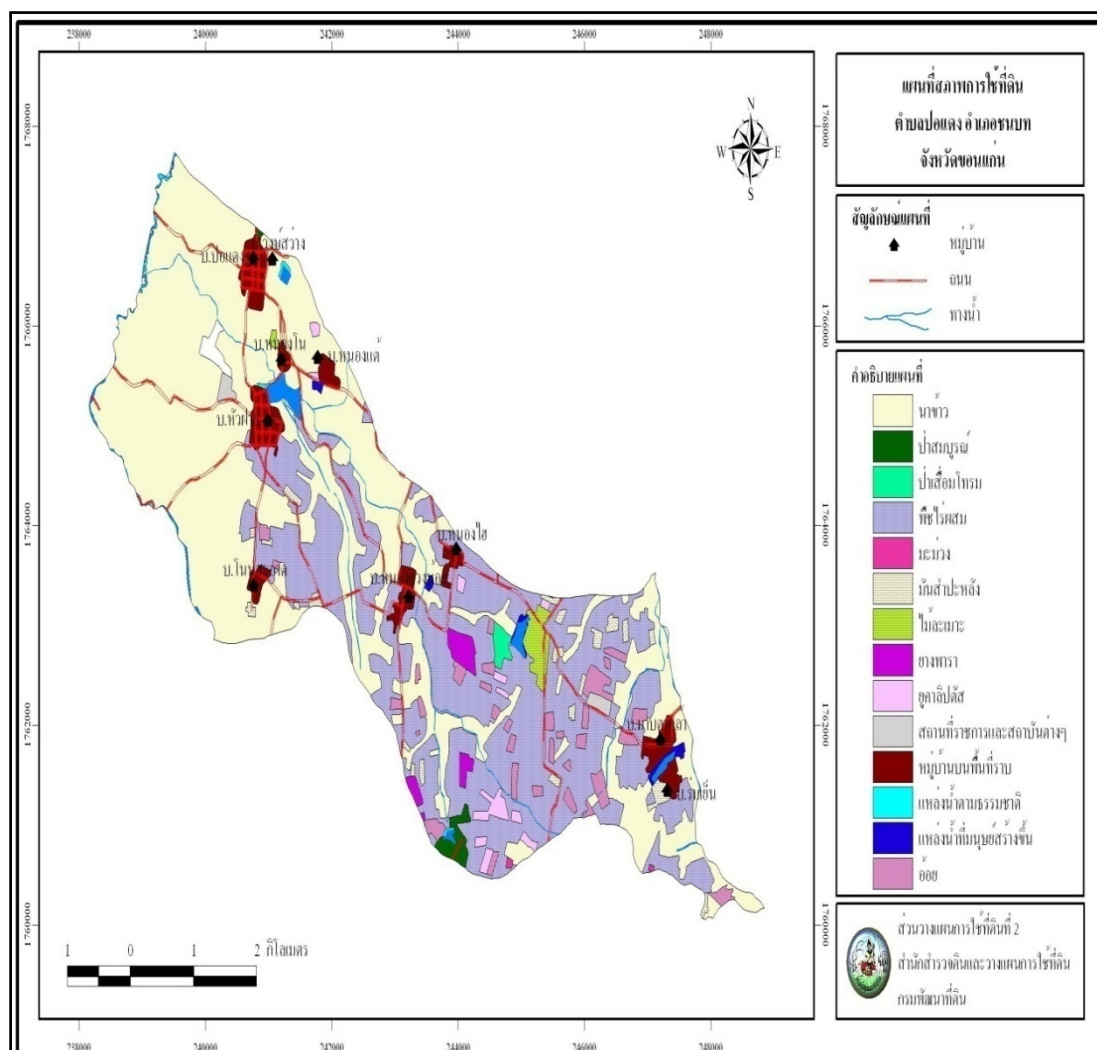


Figure 10 Land use of Huafai village

Source: Land development Department (2011)

Farming system activity

Based on land use data as shown in Figure 10, 65.6 % of total land are used for agricultural activities. The major crop grown in Huafai village is rice farming, accounting for 49.3 %. Second is field crop such as cassava and sugar cane, accounting for 14.1 %. The rest, 2.1 % is mulberry cultivation. Sericulture production plays an important role in farming system in this area. Formerly, farmers practiced sericulture production as a hobby when they have time from farm activities. The purpose of main sericulture production is for household use.

In 1983 Huafai village silk fabric weaving group was established to improve quality of silk production in order to gain power for price negotiation with the merchants and also increase production capacity of the village. In 2000, the government agency, DOAE provided funds for demonstration rearing houses construction, provided high yield silkworm variety, and also mulberry variety. Sericulture technology to improve productivity was also provided. Furthermore, modern machines and various techniques have been continuity recommended. Nowadays, the sericulture production have developed as a major occupation to generate income to farmers in this village throughout the year.

In terms of livestock, a few farmers are also involved in livestock and fisheries. Generally, these are cattle, chickens and swine for household consumption and for sale at local markets. A few farmers also have fish raising ponds either for their own consumption or for sale at local markets.

Water resources and irrigation system

As shown in Table 7, there are various sources of water in the study area including rain, ground water (wells, ponds), reservoirs, natural streams and irrigation canals. The majority of villagers have used natural streams for agriculture and daily life consumption. In terms of irrigation, canals are mainly used for agriculture.

Table 7 Water resources and irrigation system in Huafai village

Type of water resource	No.	Name of water resource
Reservoir	1	Huafai reservoir
Natural stream	3	Takua creek, Nong eel lai creek, Kra pee creek
Irrigation canal	1	Isan khiew canal

Source: Podang Subdistrict Administrative Organization (2011)

Infrastructure and public service facility

Based on survey data from Po Dang Subdistrict Administrative Organization as shown in Table 8, Huafai village have basic equipped facilities as common public services in any villages. All household are provided with tap water supply and electricity. Public telephone and road are also available in the villages. Moreover, there are a primary school, temple, public meeting center, village newspaper services, postbox, playground, radio broadcasting center and also grocery in the community.

Table 8 Public services and facilities in Huafai village

Public services and facilities	No.
Tap water supply	All household
Electricity supply	All household
Public telephone	3
Village road	4 kg
Primary school	1
Temple	2
public meeting center	1
Village newspaper services	1
Radio broadcasting center	1
Postbox	1
Playground	1
Grocery	1

Source: Podang Subdistrict Administrative Organization (2011)

Population

The farmers in the study area were mainly form Podang subdistrict and the other subdistrict in Chonnabot province. The settlement pattern of the majority was clustered and located nearby water resources and main road. The main reason that people came to this area was to find new farm lands. Their main languages were Thai

and dialect (“ESAN”). Composition of population by sex and age as shown in Table 9, total population were 1,107 persons with female 50.05 % and male 49.95%. The majority of age, accounting for 68.29 % was labor force (more than 15 to 64 year old). Buddhism was main religion.

Table 9 Composition of population in Huafai village

Age	Male	Female	Total
Less than 1	6	8	14
1-15	96	82	178
16-30	116	110	226
31-45	158	159	317
46-60	104	109	213
61-75	58	67	125
More than 75	15	19	34

Note: Data collected at July 2011, Podang Subdistrict Health Promoting Hospital

Source: Podang Subdistrict Health Promoting Hospital (2011)

Occupation and income

Major occupational in Huafai village, accounting for 87.71 % was agriculture mainly including sericulture production, rice, cassava and sugar cane cultivation. Second was employee, accounting for 5.06 %. The rests were government officer and trader, accounting for 4.34% and 2.89 %, respectively. In term of income, the majority of people in village had an income between 30,001-50,000 baht/year, accounting for 68.02 %. Second group of income was less than 30,000 baht/year, accounting for 24.03 %. The rest was more than 50,000 baht/year, accounting for 7.95 % as shown in Table 10.

Table 10 Major occupation and income distribution in Huafai village

Item	No	(%)
Major occupation		
Agriculture	802	87.71
Employee	46	5.06
Government officer	40	4.34
Trader	27	2.89
Total	915	100.00
Income distribution (baht/year)		
Less than 30,000	220	24.03
30,001-50,000	622	68.02
More than 50,000	73	7.95
Total	915	100.00

Source: .Compiled from Podang Subdistrict Administrative Organization (2011)

Part 2 Characteristic of Respondents

The 48 respondents were selected from sericulture farmers in Huafai village, Por Dang subdistrict, Chonnabot district, Khon Kaen province. This part will describe the characteristic of respondents including personal and socio-economic background.

Personal background

1. Age distribution

As shown in Table 11, the majority of age were between 46-55 years old, accounting for 41.67 %. The rests were 56-65 years, more than 65 years and less than 45 years, accounting for 35.42 %, 14.58 % and 8.33 %, respectively. The oldest was 70 years old. The youngest was 41 years old. The average age was 55.96 years old.

The result indicated that most of farmers were aged person because most of the young generations were in schools. Some went out to other areas to find higher earning jobs and sometime returned back to work in their household. This caused farm labor force limitation.

Table 11 Distribution of age

Age ^{1/} (year)	No.	%
Less than 45	4	8.33
46-55	20	41.67
56-65	17	35.42
More than 65	7	14.58
Total	48	100.00

Note: 1/: Min = 41 years, Max = 70 years, \bar{x} = 55.96 years, S.D. = 12.48

Source: Survey (2011)

2. Level of education and schooling year

In terms of level of education as shown in Table 12, the study revealed that the majority of respondent finished primary school, accounting for 75.00 %. The rests finished secondary school, high school or vocational certificate accounting for 16.67 % and 8.33 % respectively. The maximum educational level was high vocational certificate. The minimum level was grade 4. All farmers attended compulsory education. Therefore, they were able to write and read.

In terms of school year, the majority of respondent attained years of school in between 1-4 years, accounting for 47.92 % followed by 5-8 years and 9-12 years, respectively. The maximum year of schooling was 12 years. The minimum was 4 years. The average was 6.08 years. The findings revealed that farmers attended at least a compulsory education as commonly found in rural area in Thailand.

Table 12 Level of education

Items	No.	%
Education level		
Primary school	36	75.00
Secondary school	8	16.67
High school/vocational certificate	4	8.33
Total	48	100.00
Number of schooling year^{1/} (year)		
1-4	23	47.92
5-8	13	27.08
9-12	12	25.00
Total	48	100.00

Note: 1/: Min = 4 years, Max = 12 years, \bar{x} = 6.08 years, S.D. = 2.56

Source: Survey (2011)

3. Number of household members and family structure

In regards to number of household member as shown in Table 13, the majority of respondent had household member 4-6 persons, accounting for 66.67 %. The rests were 1-3 persons and more than 6 persons, respectively. The maximum number of household member was 8 persons. The minimum was 1 person. The average was 4.50 persons.

The study revealed that the average number of household members in the study area was similar to the average number of family member at the national level that was 4.01 persons/ household in 2011 (OAE, 2011).

In terms of number of household member in labor force, the majority of respondent had member 3-4 person, accounting for 54.17 %. The rests were more than 4 persons and 1-2 persons, accounting for 27.08 %, and 16.67 % respectively. There were also 2.08 % that did not have member. The maximum number of household member in labor force was 6 persons. The minimum was 1 person. The average was 3.90 persons.

On the other hand, the number of dependency member (less than 15 years old and age more than 65 years old) had 1-2 family members, accounting for 56.25 %. The rest were 3-4 persons and more than 4 persons, respectively. There were 39.59 % did not have dependency member. The maximum number of dependency member was 6 persons. The minimum was 1 person. The average was 1.3 persons. It indicated that the majority of family structure is extended family that they are living together with grandparent and grandchild.

Table 13 Distribution of household member

Items	No.	%
Number of household members^{1/}		
(person/ household)		
1-3	9	18.75
4-6	32	66.67
More than 6	7	14.58
Total	48	100.00
Number of household member in labor force		
(15-64 year) ^{2/}		
(person/ household)		
None	1	2.08
1-2	8	16.67
3-4	26	54.17
More than 4	13	27.08
Total	48	100.00
Number of dependency (< 15 & > 65 year) ^{3/}		
(person/ household)		
None	19	39.59
1-2	27	56.25
3-4	1	2.08
More than 4	1	2.08
Total	48	100.00

Note: 1/: Min = 1 person, Max = 8 persons, \bar{x} = 4.50 persons, S.D. = 1.51

2/: Min = 1 person, Max = 6 persons, \bar{x} = 3.90 persons, S.D. = 1.18

3/: Min = 1 person, Max = 6 persons, \bar{x} = 1.30 persons, S.D. = 1.01

Source: Survey (2011)

Socio-economic background

1. Labor force in agriculture

According to Table 14, the majority of respondent had number of labor force between 6-10 persons, accounting for 56.25 %. The rests were 1-5 persons and more than 10 persons, respectively. The maximum number of labor force was 13 persons. The minimum was 1 person. The average was 6.40 persons.

In terms of number of family labor force, most respondent had number of family labor force between 3-4 persons, accounting for 45.83 %. The rests were 1-2 persons, and more than 4 persons, accounting for 41.67 % and 12.50 %, respectively. The maximum number of family labor force was 7 persons. The minimum was 1 person. The average was 3.08 persons.

The result was similar to the average number of family labor at the national level that was 2.89 persons per household in 2011 (OAE, 2011). Most household farm labor forces are father, mother, and children who are capable of working in farm.

In terms of type of labor force, the majority of respondent used household labor and hired labor in agriculture activities, accounting for 93.75 %. A few of them used only household labor, accounting for 6.25 %. It revealed that most farmers used household labor force as the main work source in farm activities. Hired labor force was used to fulfill some activities such as bleaching, dyeing and tying silk yarn. Most of hired labors forces were in their own community. The hired labor force rate was around 130-150 baht per day.

Table 14 Labor force in agriculture

Items	No.	%
Number of labor force^{1/}		
(person/ family)		
1-5	18	37.50
6-10	27	56.25
More than 10	3	6.25
Total	48	100.0
Number of family labor force^{2/}		
(person/ family)		
1-2	20	41.67
3-4	22	45.83
More than 4	6	12.50
Total	48	100.0
Type of labor		
Household and hire labor	45	93.75
Household labor	3	6.25
Total	48	100.00

Note: 1/: Min = 1 person, Max = 13 persons, \bar{x} = 6.40 persons, S.D. = 2.61

2/: Min = 1 person, Max = 7 persons, \bar{x} = 3.08 persons, S.D. = 1.35

Source: Survey (2011)

2. Land tenure status

In regard to land tenure status, as shown in Table 15, most respondents had household land tenure between 1-15 rai, accounting for 43.75 %. The rest were 15.1-30 rai, 31.1-55 rai and more than 55 rai, respectively. The maximum land tenure was 67.30 rai. The minimum was 5.30 rai. The average was 21.90 rai. The result was similar to the average amount of land tenure at the national level that was 22.44 rai in 2011 (OAE, 2011). The findings revealed that major land used in the study area were rice cultivation, field crop, mulberry cultivation, and residences, respectively.

In terms of land tenure status, most farmers had their own farms. The finding revealed that most of land was the heritage from their ancestors. The farmers did not rent the land because they cannot afford to use the land due to family labor force limitation.

Table 15 Land tenure status

Items	No.	%
Number of land tenure ^{1/} (rai / household)		
1-15	21	43.75
15.1-30	20	41.67
31.1-55	4	8.33
More than 55	3	6.25
Total	48	100.00

Note: 1/: Min = 5.30 rai, Max = 67.30 rai, \bar{x} = 21.90 rai, S.D. = 13.51

2/: All respondents had their own land tenure

Source: Survey (2011)

3. Major and minor occupation

In concerning with major and minor occupation of farmer the results as shown in Figure 11 revealed that sericulture production was a major occupation of respondents, accounting for 60.42 %. The rest were rice cultivation, filed crop farming and trader.

The finding indicated that sericulture production in study area was inherited from the ancestors. Farmers can rear silkworm throughout the year. The duration of silkworm rearing per cycle is only 20-24 days. The farmers can rear silkworm 4-6 cycles a year. Moreover, they were able to weave the silk fabric for sale after crop season. This generates income for farmers throughout the year. So the sericulture production has become the main occupation in the study area.

The minor occupation, around 56.25 %, engaged in rice farming. The rest were sericulture production and field crop farming. Farmers cultivated rice as their minor occupation for sale and their own consumption.

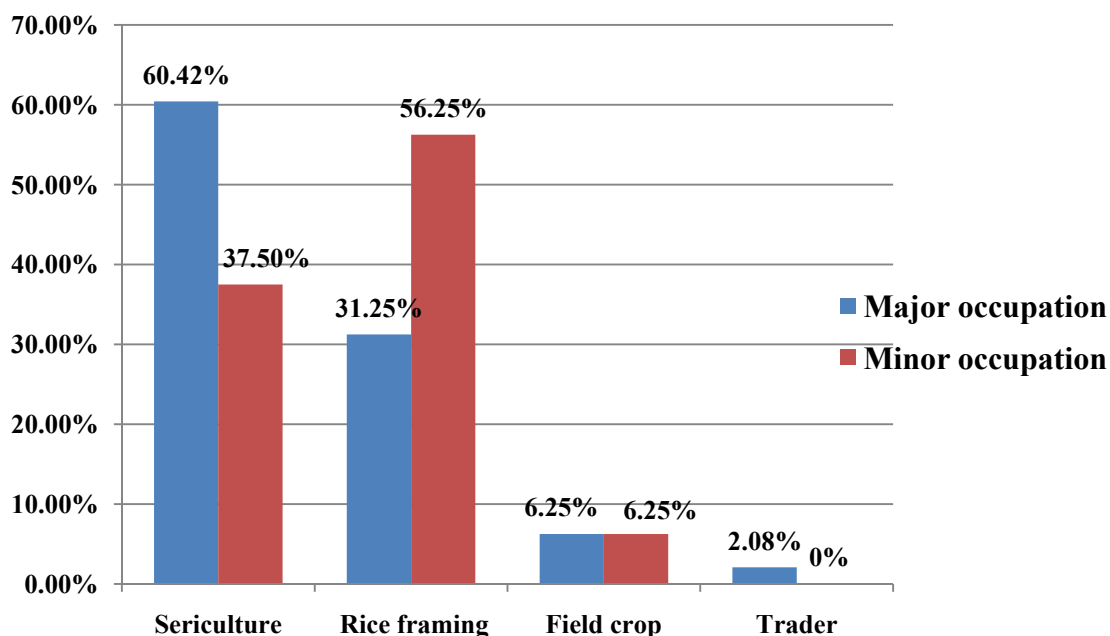


Figure 11 Major and minor occupation of farmer

Source: Survey (2011)

4. Farmers' income

Farmer income as shown in Table 16, revealed that 35.42 % of respondents had annual farm income between 50,001-80,000 baht. The rest were less than 50,000 baht, 80,001-110,000 baht and more than 110,000 baht, respectively. The maximum farm income was 220,720 baht per year because the farmer had various occupations. The minimum was 15,020 baht per year because their income only came from sericulture production. The average was 76,113.00 baht per year. Farm income without expenditures seemed to be high when compared with national and regional levels that were 58,632 baht per year and 21,424 baht per year, respectively in 2011 (OAE, 2011). Because of this, most farmers get more income from many sources, particularly sericulture production, rice planting, field crops, and livestock.

In terms of non farm income, the majority of respondent had income less than 20,000 baht per year, accounting for 54.17 %. The rest were 20,001-40,000, 40,001-60,000, 60,001-80,000 and more than 80,000 baht per year, respectively. There were 33.33% who did not have non farm income. The maximum non farm income was 210,000 baht per year because this farmer engaged in trading. The minimum was 1,000 baht per year from family member supporting. The average was 12,092.00 baht per year.

Non farm income without expenditures seemed to be low when compared with national and regional level that was 87,945 baht per year and 90,923 baht per year, respectively in 2011 (OAE, 2011). The findings revealed that the majority of non farm incomes came from hired work in the farm activity, trading and from family member who worked in Bangkok or Khon Kaen province.

In terms of total income includes both from farm and non farm, most respondents had total income between 50,001-80,000 baht per year, accounting for 31.25 %. The rests were 80,001-110,000 baht, less than 50,000 baht, more than 140,000 baht, and 110,001-140,000 baht, accounting for 27.08 %, 22.92 %, 14.58 %, and 4.17 %, respectively. The maximum total income was 401,500 baht per year. The minimum was 15,020 baht per year. The average was 88,486.90 baht per year.

Total income without expenditures seemed to be low when compared with the national and regional level that were 146,577 baht per year and 112,347 baht per year, respectively in 2011 (OAE, 2011). The majority of the farmers' income came from farm sector, which mainly includes sericulture production, rice production, cassava production and also vegetables. In addition, some farmers could get income as hired labor force in their own community. Therefore, their incomes were lower than national level. Some farmers also did not have any non farm income.

In terms of income from sericulture production, 54.17 % of respondent had income between 20,001-40,000 baht. The rest were 40,001-60,000 baht, less than 20,000 baht, 60,001-80,000 baht, and more than 80,000 baht, respectively. The

maximum income from silk production was 102,192 baht. The minimum was 12,860 baht. The average was 37,311.00 baht. Income from sericulture came from silk yarn production and silk fabric weaving.

Table 16 Farmers' income

Income	No.	%
Farm income ^{1/}		
(baht/ year)		
< 50,000	13	27.08
50,001-80,000	17	35.42
80,001-110,000	10	20.83
More than 110,000	8	16.67
Total	48	100.00
Non farm income ^{2/}		
(baht/ year)		
None	16	33.33
< 20,000	26	54.17
20,001-40,000	2	4.17
40,001-60,000	2	4.17
60,001-80,000	1	2.08
More than 80,000	1	2.08
Total	48	100.00
Total income ^{3/}		
(baht/ year)		
< 50,000	11	22.92
50,001-80,000	15	31.25
80,001-110,000	13	27.08
110,001-140,000	2	4.17
More than 140,000	7	14.58
Total	48	100.00

Table 16 (Continued)

Income	No.	%
Income from sericulture ^{4/}		
(baht/ year)		
< 20,000	7	14.58
20,001-40,000	26	54.17
40,001-60,000	10	20.83
60,001-80,000	3	6.25
More than 80,000	2	4.17
Total	48	100.00

Note: 1/: Min= 15,020 Baht, Max = 220,720 Baht, \bar{x} = 76,113 Baht,
S.D. = 44532.86

2/: Min = 1,000.0 Baht, Max = 210,000 Baht, \bar{x} = 12,092 Baht,
S.D. = 33,020.21

3/: Min= 15,020 Baht, Maximum= 401,500 Baht, \bar{x} = 88,486.90 Baht,
S.D. = 64,220.

4/: Min = 102,192 Baht, Max =12,860 Baht, \bar{x} = 37,311 Baht
S.D. =33,020.21

Source: Survey (2011)

5. Loans accessibility

Based on survey data as shown in Table 17, the most respondents obtained credit less than 50,000 baht per year, accounting for 31.25 %. The rest were more than 150,000 baht and 10,000-150,000 baht per year, accounting for 25.00 %, 16.67 %, and 8.33 %, respectively. There were 18.75 % did not obtain credit. The maximum credit was 738,000 baht per year. The minimum credit was 3,800 baht per year. The average was 91,906.25 baht per year.

In terms of credit sources as shown in Figure 12, most respondents obtained credit from Agricultural Cooperatives, accounting for 45.83 %. The rests were Bank for

Agriculture and Cooperatives (BAAC), village fund, The Government Savings Bank, silk production groups, Government Housing Bank, savings groups, farmer groups, and the village council, respectively. The majority of respondent spent their credit in farm production, accounting for 66.67 %. The rest spent on household living and non farm enterprise, respectively.

Agricultural Cooperatives and BAAC play important roles in farm sector in Thailand. Some farmers got credit for their agricultural activities, either from Agricultural Cooperative or BAAC. In the research site, officers came to the field to check their activities due to the fact that there were no land titles deeds for collateral. The disadvantage of this system is that landless farmers have difficulty in obtaining credit. The findings indicated that the majority of farmers used money for farm capital, machineries maintenance, house construction and for other personal usage.

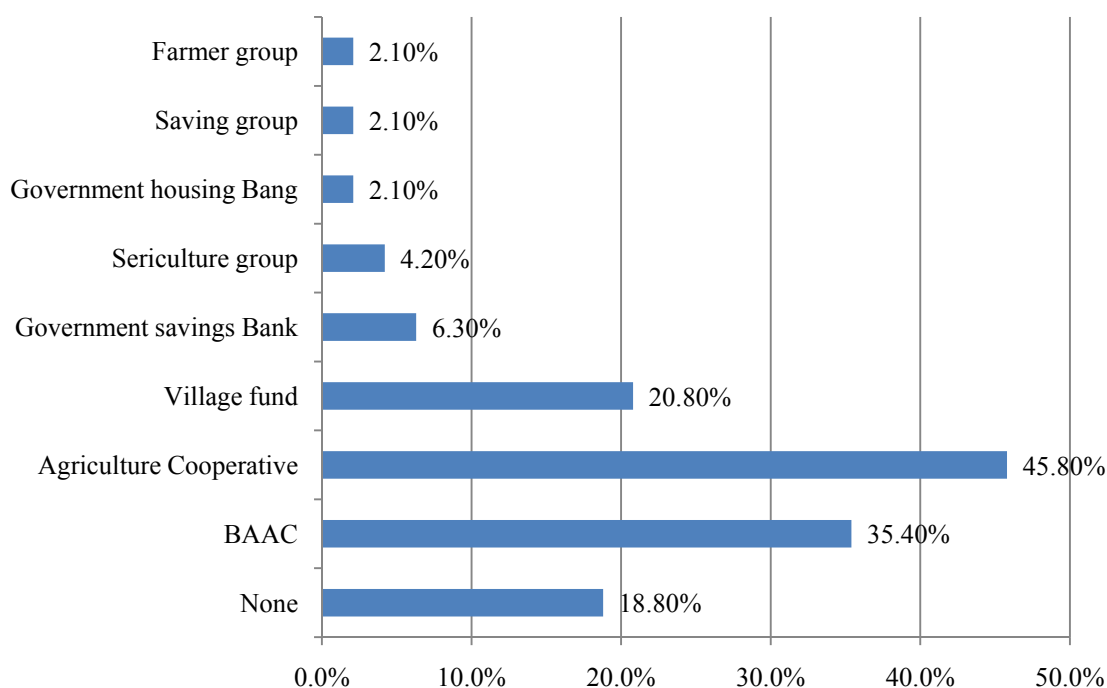


Figure 12 Source of loans

Source: Survey (2011)

Table 17 Loans accessibility

Items	No.	%
Number of loans^{1/}		
(baht / year)		
Non credit	9	18.75
< 50,000	15	31.25
50,000-100.0,000	12	25.00
10,000-150,000	4	8.33
More than 150,000	8	16.67
Total	48	100.00
Loans spending (n=39)		
Farm production	26	66.67
Household living	8	20.83
Non farm enterprise	5	12.50
Total	39	100.00

Note: 1/: Min = 3,800 Baht, Max = 738,000 Baht, \bar{x} = 91,906.25, S.D.= 14,547.2

2/: One respondent can have more than one source of credit

Source: Survey (2011)

6. Local group membership

Regarding the local group membership as shown in Table 18, it revealed that all respondents were belonging to group member. The majority of respondent were member of a sericulture production group, accounting for 93.75 %. The rests were saving group, farmer housewife group, community enterprise group, agricultural cooperatives group, village funding and BAAC, respectively. It is because they wanted to improve the quality of sericulture production in order to gain power for price negotiation with the merchants and expand the production capacity of the village.

Moreover, the benefit that the farmers received from these groups were some input supporting such as silkworm rearing rooms, silkworm eggs, materials for silk

rearing and equipments for silk reeling. In addition, they also had opportunity to attend training courses and visit progressive sericulture farmer groups.

In terms of sericulture group belonging duration, the majority of respondent were group member less than 10 years, accounting for 45.8 %. The rest were 11-20 years and more than 20 years, accounting for 35.42 % and 12.5%, respectively. There were 6.25 % did not join in any local group. The maximum period of group belonging was 28 years. The minimum was 3 years. The average was 13.89 years.

Regarding group activities participation, the majority of respondent had participation in the activities between 11-20 times per year, accounting for 50.00 %. The rests were more than 20 times per year and less or 10 times per year, respectively. The maximum participation was 26 times. The minimum was 5 times. The average was 17.04 times. It is because they could get information regarding sericulture production and marketing. The activities that farmers often participated were group meeting and training such as silkworm rearing, bleaching, silk yarn dyeing and silk fabric weaving. Farm visited also their participated activities.

Table 18 Local group membership

Items	No.	%
Group belonging^{1/}		
Sericulture group	45	93.75
Saving group	42	87.50
Farmer housewives group	33	68.75
Community enterprise group	32	66.67
Agriculture Cooperative	31	64.58
Farmers group	30	62.50
Village funding	28	58.33
The Bank for Agriculture and Cooperatives	17	35.42

Table 18 (Continued)

Items	No.	%
Number of sericulture group belonging^{2/}		
(years)		
None	3	6.25
10 or less	22	45.83
11-20	17	35.42
More than 20	6	12.50
Total	48	100.00
Number of group participation^{3/}		
(times / year)		
10 or less	7	14.58
11-20	24	50.00
More than 20	17	35.42
Total	48	100.00

Note: 1/: One respondent can member more than one group

2/: Min = 3 year, Max = 28 year, \bar{x} = 13.89 year, S.D. = 7.29

3/: Min = 5 times, Max = 26 times, \bar{x} = 17.04 times, S.D. 6.01

Source: Survey (2011)

Part 3 Commercial Sericultural Production

This part further discusses commercial sericultural production in the study area. It reviewed on existing data of farmers background in sericulture production, condition of mulberry cultivation, condition on silkworm rearing, condition on silk reeling, condition on silk fabric and farmer's practice towards silk products standard.

Farmer background in sericulture production

1. Sericulture experiences

In terms of sericulture experience as shown in Table 19, the results revealed that the majority of respondent had experience between 1-20 years, accounting for 29.17 %. The rests were 31-40 years, 21-30, 41-50 and more than 50 years, respectively. The maximum experience was 60 years. The minimum was 6 years. The average was 32.60 years. The study revealed that the most of farmers in study area were familiar with sericulture production. Because it is the occupation of their ancestors and they had learned sericulture production since they were young.

Table 19 Sericulture experience

Sericulture experience ^{1/} (years)	No.	%
1-20	14	29.17
21-30	9	18.75
31-40	13	27.08
41-50	9	18.75
More than 50	3	6.25
Total	48	100.0

Note: 1/ : Min = 6 year, Max = 60 year, \bar{x} = 32.60 , S.D. = 14.45

Source: Survey (2011)

2. Media perception in sericulture

Regarding source of sericulture media perception as shown in Table 20, the most popular media was personal media. The majority of respondent received information from group leader, accounting for 95.8%. The rests were neighbors, village leaders, government officer, cousin and private officer, respectively. The findings revealed that the group leaders regularly received information regarding sericulture production from concern organizations such as The Queen Sirikit Department of Sericulture (QSDS), The Department of Industrial Promotion (DIP) and Agriculture Department of Extension Office (DOAE). They also transfer knowledge to their members.

In terms of mass media, the majority of respondent always received information from village broadcasting, accounting for 70.8 %. The rests were television, radio, newspapers and internet, respectively. The findings also revealed that village broadcasting can broadcast news to farmers throughout the entire village. When the village leaders received information from concern agencies, they always informed it via the village broadcasting as well.

In terms of interactive media, the majority of the respondent always attained training by government agencies, accounting for 54.2 %. The rest were through government demonstration, farm visit by government, , private training, private farm visit and private demonstration.

The findings revealed that most of farmer had opportunity to attended training courses from concern agencies. Based on information from the QSDS and DIP, they organized the training in villages because it is convenience for farmer. Farm visit was also conducted in order to give an opportunity to farmers to share and exchange their experiences among themselves, and also progressive farmer and expertise.

Table 20 Media perception in sericulture

Items	Frequency of information perception								\bar{x}
	Rarely (< 3 time)		Sometimes (3-4 time)		Always (> 4 time)		Total		
	No	%	No	%	No	%	No	%	
Personal media									
Neighbor	3	6.25	6	12.50	39	81.25	48	100.00	2.75
Cousin	10	20.83	12	25.00	26	54.17	48	100.00	2.33
Group leader	1	2.08	1	2.08	46	95.83	48	100.00	2.94
Village leader	5	10.42	5	10.42	38	79.17	48	100.00	2.69
Government officer	5	10.42	14	29.17	29	60.42	48	100.00	2.50
Private officer	28	58.33	9	18.75	11	22.92	48	100.00	1.65
Mass media									
Radio	14	29.17	13	27.08	21	43.75	48	100.00	2.15
Television	8	16.67	13	27.08	27	56.25	48	100.00	2.40
Newspapers	34	70.83	9	18.75	5	10.42	48	100.00	1.40
Village broadcast	7	14.58	7	14.58	34	70.83	48	100.00	2.56
Internet	45	93.75	1	2.08	4	4.17	48	100.00	1.10
Interactive media									
Government training	11	22.92	11	22.92	26	54.16	48	100.00	2.31
Private training	34	70.83	8	16.67	6	12.50	48	100.00	1.42
Government farm visit	20	41.67	15	31.25	13	27.08	48	100.00	1.85
Private farm visit	36	75.00	6	12.50	6	12.50	48	100.00	1.38
Govt. demonstration	17	35.42	14	29.16	17	35.42	48	100.00	2.00
Private demonstration	36	75.00	9	18.75	3	6.25	48	100.00	1.31

Note: The average score of perception level

Always = 2.34-3.00

Sometimes = 1.67-2.33

Rarely = 1.00- 1.66.

Source: Survey (2011)

3. Supporting agency in sericulture production

Regarding the number of agencies that supported in sericulture production as shown in Table 21, the number of farmer's agencies supporting were 1-2 agencies, accounting for 75.00 %, followed by 3-4, and more than 4 agencies. The maximum number of agency was 5 agencies. The minimum was 1 agency. The average was 1.70 agencies. Most of supporting agency was QSDS, accounting for 95.83 %. The rests were DOAE, The Department of Industrial Promotion, private sectors (DIP), The Community Development Office (CDD) and Sub-district Administration Organizations, respectively. The findings revealed that QSDS was the most supporting agencies because it takes important roles as Royal Queen Project that was initiated in 2011.

Table 21 Supporting agency in sericulture production

Items	No.	%
Number of supporting agency ^{1/}		
1-2	36	75.00
3-4	10	20.83
More than 4	2	4.17
Total	48	100.00
Supporting Agency ^{2/}		
The Queen Sirikit Department of Sericulture	46	95.83
The Department of Industrial Promotion	11	22.92
The Department of Agricultural Extension	8	16.67
Private agency	7	14.58
The community development department	4	8.33
Subdistrict Administration Organization	2	4.17

Note: 1/: Min = 1, Max = 5, \bar{x} = 1.70, S.D = 1.15

2/: One respondent is supported more than one agency

Source: Survey (2011)

4. The Supporting activities in sericulture production

Regarding the support activities in sericulture production as shown in Table 22, in terms of training, it revealed that the majority of respondent attended training in silk yarn dyeing, accounting for 91.67 %. The rests were sericulture production, silk fabric design, silk fabric weaving, silk yarn reeling, sericulture marketing and silk processing, respectively.

The finding revealed that almost all farmers attended training in silk yarn dyeing because silk yarn dyeing process is the most important for silk production. If the silk yarn dyeing is not properly done, the silk yarn color is uneven or fading thus lower quality of silk yarn.

In terms of farm visit, it revealed that the majority of respondent attended farm visit in of the silk yarn dyeing, accounting for 72.92 %. The rests were silk reeling and silk pattern design, sericulture production, silk weaving, marketing, and the processing of silk products, respectively.

Regarding input supporting, all respondents gained silkworm eggs from government agencies. The rest of supporting input were mulberry variety, rearing rooms, chemical disinfection materials for silkworms, investment, cleaning chemicals for silkworms rearing room and equipments, and equipments for silk reeling and weaving, respectively. Most inputs were provided from government agencies to improve silk productivity in study area.

Table 22 Supporting activities in sericulture production

Items	Support		Non support	
	No.	%	No.	%
Training ^{1/}				
Silk yarn dyeing	44	91.67	4	8.33
Sericulture production	40	83.33	8	16.67
Silk fabric design	40	83.33	8	16.67
Silk fabric weaving	39	81.25	9	18.75
Silk yarn reeling	38	79.17	10	20.83
Silk marketing	32	66.67	16	33.33
Silk processing	3	6.25	45	93.75
Farm visit ^{2/}				
Silk yarn dyeing	35	72.92	13	27.08
Silk yarn reeling	33	68.75	15	31.25
Silk fabric design	33	68.75	15	31.25
Sericulture production	32	66.67	16	33.33
Silk fabric weaving	32	66.67	16	33.33
Marketing	24	50.00	24	50.00
Input support^{3/}				
Silkworm egg	48	100.00	0	0.00
Mulberry variety	44	91.67	4	8.33
Silkworm rearing room	38	79.17	10	20.83
Disinfection materials	36	75.00	12	25.00
Investment	30	62.50	18	37.50
Disease protect chemical	26	54.17	22	45.83
Silk reeling equipment	22	45.83	26	54.17
Silk weaving equipment	22	45.83	26	54.17

Note 1/: One respondent attended more than one source

2/: One respondent attended more than one source

3/: One respondent attended more than one source

Source: Survey (2011)

Existing condition of mulberry cultivation

1. Mulberry cultivation area

Based on data survey presented in Table 23, all respondents had their own areas for mulberry cultivation. The majority of respondent had 0.5 - 1 rai of land for mulberry cultivation, accounting for 50.00 %. The rests were 0.25-0.5 rai and more than 1 rai, accounting for 43.75 % and 6.25 %, respectively. The maximum mulberry cultivation area was 2 rai. The minimum was 0.25 rai. The average was 0.76 rai. Actually, from QSDS recommendation (2011), the land of 0.25-2 rai was appropriate for Thai hybrid silkworm variety of 4-5 cycles per year or silkworm native variety of 5-6 cycles per year. From field observation, it revealed that the majority of them had household mulberry cultivation area and also silkworm rearing cycle similar to the recommendation.

Table 23 Mulberry cultivation area

Number of mulberry area (rai/ household)	No.	%
0.25-0.5	21	43.75
0.51-1	24	50.00
More than 1	3	6.25
Total	48	100.00

Note: 1/: Min = 0.25, Max = 2 , \bar{x} = 0.76 , S.D. = 0.428

2/: All respondents had their own mulberry cultivation area

Source: Survey (2011)

2. Mulberry variety

Regarding the mulberry variety as shown in Table 24, the majority of respondent cultivated “BURIRAM 60”, accounting for 97.92 %. The rest cultivated “NOI”, accounting for 2.08 %. The study revealed that most of respondents cultivated

“BURIRAM 60” variety because it was recommended by the agencies. The farmers received mulberry variety from the QSDS. This kind of mulberry variety has high yield and thick leaves. The leaf yield is 4,300 kg /rai /year.

Table 24 Mulberry variety

Mulberry variety	No.	%
“BURIRAM 60”	47	97.92
“NOI”	1	2.08
Total	48	100.0

Source: Survey (2011)



Figure 13 “BURIRAM 60” variety

3. Water sources in mulberry cultivation

As shown in Figure 14, the majority of mulberry cultivation depended on rain, accounting for 56.25%. The rests were ground water, ponds, and artificial water supply, respectively. The data from the OAE (2011) indicated that most of farming areas in Thailand, particularly in the northeast had insufficient irrigation. Almost all

farm areas depend on rain only. Moreover, farmers have insufficient investment to drill wells, therefore their main supply of water is rain.

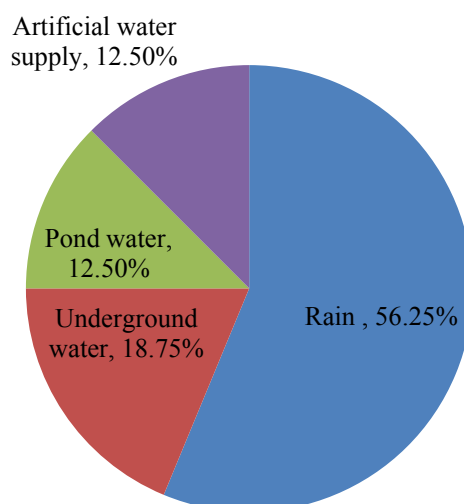


Figure 14 Water resource in mulberry cultivation

Source: Survey (2011)

4. Local wisdom and technology application in mulberry cultivation

As shown in Table 25, only a few of respondent applied local wisdom in mulberry cultivation, accounting for 2.08 %.. A few of them always applied local wisdom in diseases prevention by water pouring from rice cleaning mixed with salt on the root of mulberry plants. They also applied fertilizers in the furrow to prevent termites. There were 97.92 % did not apply local wisdom in mulberry cultivation

The finding revealed that few sericulture farmers applied local wisdom in mulberry cultivation because they used to cultivate by following recommended technology from extension officer as their common practice.

Regarding technology application, most of respondents applied technology in their mulberry cultivation areas, accounting for 56.25 %. There were 43.75 % did not apply recommendation technology. The findings indicated that respondents applied

recommended technology includes watering, weed control, and mulberry planting, respectively.

Farmers used sprinklers and also watering their mulberry trees by furrows technique following extension officer recommendation. They also used steel plowing to save time and labor in controlling the weed. A few of them planted mulberry by putting the mulberry branch in a hold and covered by rice husks under shady trees. The plants were watered for 5-7 days until the knots appear and were ready for planting. In this way, the growth rate of the mulberry plant was enhanced.

Table 25 Local wisdom and technology application in mulberry cultivation

Items	No.	%
Local wisdom application		
Do not applied local wisdom	47	97.92
Applied local wisdom	1	2.08
Total	48	100.00
Applied local wisdom^{1/} (n=1)		
Disease prevention	1	100
Technology application		
Do not applied technology	21	43.75
Applied technology	27	56.25
Total	48	100.0
Applied technology application^{2/} (n= 27)		
Watering	21	77.78
Weed control	12	44.44
Mulberry planting	1	3.70

Note: 1/: One respondent can apply more than one local wisdom, (Total = 1)

2/: One respondent can apply more than one technology, (Total = 34)

Source: Survey (2011)

Existing condition on silkworm rearing

1. Number of silkworm rearing cycle per year

Regarding the number of silkworm rearing cycle per year as shown in Table 26, the majority of respondent reared silkworm between 6-10 cycles per years, accounting for 87.50 %. The rest were 5 or less and more than 10, accounting for 10.42 % and 2.08 %, respectively. In one case the maximum number of silkworm rearing cycle was 15 cycles because she has 2 silkworm rearing room. The minimum was 3 cycles. The average was 7.10 cycles.

According to QSDS (2011), the average capability for silkworm rearing was at 8-10 cycles annually. The best time for rearing silkworms is late of May due to abundant mulberry leaves in the rainy season. The farmers continue rearing until February of the next year. The weather during this time is suitable for the mulberry growing.

Table 26 Number of silkworm rearing cycle per year

Number of silkworm rearing (cycle/years)	No.	%
5 or less	5	10.42
6-10	42	87.50
More than 10	1	2.08
Total	48	100.00

Note: Min= 3 cycle, Max = 15 cycle, \bar{x} = 7.10, S.D. = 1.96

Source: Survey (2011)

2. Characteristic of silkworm rearing

As shown in Table 27, the majority of respondent reared silkworm throughout the year with breaks for cleaning rearing room, accounting for 64.58 %. The rest reared silkworm after rice harvesting, accounting for 18.75 %. Rearing silkworms all year-round without a break was accounted for 16.67 %. The study revealed that the farmers take a break for cleaning and maintenance rooms and equipments. According to QSDS recommendation, after silkworm rearing completion, the rooms and equipments have to be cleaned to eliminate disease before using in next cycle.

Table 27 Characteristic of silkworm rearing

Characteristic of silkworm rearing	No.	%
Rearing though out the year with breaks for cleaning rearing room	31	64.58
Rearing all year-round without a break	8	16.67
Rearing after rice harvesting	9	18.75
Total	48	100.00

Source: Survey (2011)

3. Type of silkworm rearing room

As shown in Table 28, the majority of respondent had low cost silkworm rearing rooms that located inside their houses, accounting for 58.33 %. The rests were low cost rearing rooms separated from their house, and standard rearing rooms, accounting for 31.25 % and 10.42 % respectively. To save the cost, farmers built their rearing rooms by themselves.

Table 28 Type of silkworm rearing room

Type of silkworm rearing room	No.	%
Low cost silkworm rearing room located inside their houses	28	58.33
Low cost silkworm rearing room separated from their house	15	31.25
Standard silkworm rearing room	5	10.42
Total	48	100.00

Source: Survey (2011)

4. Silkworm rearing record

Regarding silkworm rearing record as shown in Table 29, most of respondents did not keep their silkworm rearing record, accounting for 83.33 %. Only a few of them kept a record, accounting for 16.67 %. The most recorded items were molting and after molting stage. The rests were mulberry leaves weight, the annual plan for rearing silkworms, time spent in silkworm rearing cycle, the silkworm disease, mounting period, silkworm rearing problems, cocoon yield and temperature and humidity in silkworm rearing, respectively.

The study revealed that only few farmers kept a record because they did not have time for recording. Moreover, they did not realize the importance of information recording. They rely on their memory and experience to manage each stage. In fact, records are important for farmers.

According to the Department of Agriculture (DOA), production document is a record of information on work procedures which can be a format of simple table on a notebook. The recorded data can be further used for considerations related to forecasting events in the coming years. The rearing record should include the following items: the optimal time to start rearing, the amount of leaves, silkworm disease, temperature and humidity, after molting and molting times, the use of chemical,

mounting period, yields, and problems in silkworm rearing and other related rearing activities.

Table 29 Silkworm rearing record

Silkworm rearing record	No.	%
No recording	40	83.33
Record	8	16.67
Total	48	100.00
Silkworm rearing record		
Molting and after molting	8	100.00
Weight of the mulberry leaves	7	75.00
Annual plan for rearing silkworms	6	75.00
Time spent in silkworm rearing cycle	6	62.50
Silkworm disease	5	62.50
Mounting period	5	62.50
Silkworm rearing problem	5	62.50
Cocoon yield	4	50.00
Temperature and humidity in silkworm rearing	3	37.50

Note: One respondent keeps record more than one information

Source: Survey (2011)

5. Silkworm variety

Regarding the silkworm variety as shown in Figure 15, the majority of respondent reared “DOKBUA” variety, accounting for 50.00%. The rests were “DOKKUN”, “NANGNOISRESAKET”, “NANGTUI”, “NANGLAI”, “NANG LUEANG” and “NANGSIW”, respectively. The finding revealed that most farmers were rearing “DOKBUA” variety due to extension officer recommendations. This variety produces a high yield with an average yield of 15-18 kg cocoons per box. Most farmers received the silkworm eggs from QSDS.

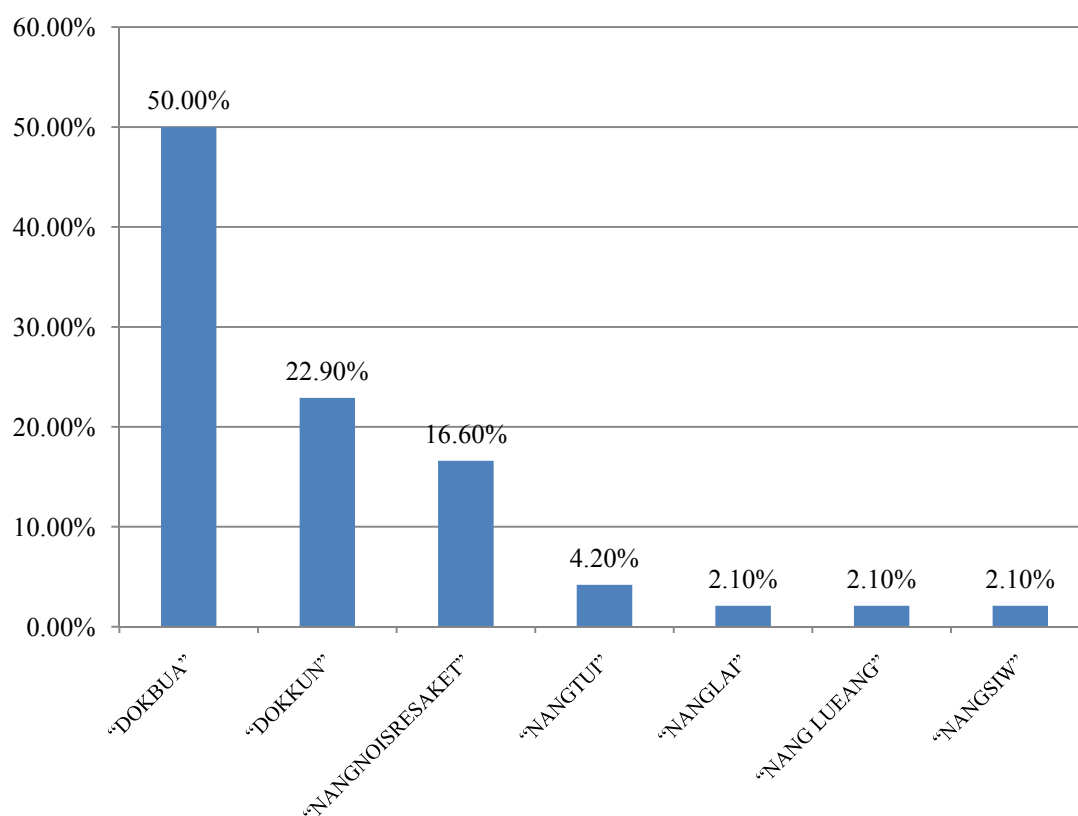


Figure 15 Silkworm variety

Source: Survey (2011)

6. Reason in silkworm rearing

Regarding reason in silkworm rearing as shown in Table 30, the reason that all of respondent reared silkworm were to produce silk yarn and fabric weaving. The findings revealed that most farmers reeled silk yarn by themselves and kept silk yarn for weaving and sale to the middleman in local and province markets.

Table 30 Reason in silkworm rearing

Reason in silkworm rearing	No.	%
Silk yarn sale	48	100.00
Silk fabric weaving	48	100.00
Cocoon sale	1	2.08

Note: One respondent can have more than one reason

Source: Survey (2011)

7. Appropriate silkworm variety for commercial production

In terms of appropriate silkworm variety for commercial production as shown in Table 31, the majority of respondent selected “DOKBUA” variety, accounting for 68.75 %. The rest selection was “DOKKUN”, accounting for 31.25 %. Both varieties are recommended by QSDS due to its high yield. These varieties have an average cocoon yield of 15-18 kg per box and percent of cocoon shell are 15-18 % per cocoon.

Table 31 Appropriate silkworm variety for commercial production

Silkworm variety	No.	%
DOKBUA	33	68.75
DOKKUN	15	31.25
Total	48	100.0

Source: Survey (2011)

8. Amount of silkworm eggs sheet per cycle

As show in Table 32, the majority of respondent, accounting for 83.33 %, reared 1 silkworm egg sheet per cycle. The rests were more than 1 sheet and 0.5 or less, accounting for 12.50 % and 4.17 %, respectively. The maximum amount of silkworm

egg was 2 sheets. The minimum was 0.5 sheets. The average was 1.10 sheets. It is because most farmers had the low cost rearing room which can rear silkworm at only 1 sheet per cycle. Moreover, they cannot afford to rear silkworm due to labor force limitation.

Table 32 Amount of silkworm egg sheet per cycle

Amount of silkworm egg ^{1/} (sheet/ cycle)	No.	%
0.5 or less	2	4.17
0.51-1	40	83.33
More than 1	6	12.50
Total	48	100.00

Note: 1/: Min= 0.5 sheet, Max = 2 sheet, \bar{x} = 1.10, S.D. = 0.35

Source: Survey (2011)

9. Mulberry leaves used for feeding silkworm

As shown in Table 33, the majority of respondent had sufficient mulberry leaf to feed their silkworm, accounting for 68.75 % because they had the good plan and management in mulberry cultivation. The rest, 31.25 % had insufficient mulberry leaves to feed the silkworm because sometimes they had more silkworm than expected over 4-5 instar of silkworm.

Table 33 Mulberry leaves used for feeding silkworm

Mulberry leaves used for feeding silkworm	No.	%
Sufficient	33	68.75
Insufficient	15	31.25
Total	48	100.00

Source: Survey (2011)

10. Silkworm diseases

In terms of silkworm diseases, as shown in Table 34, there were four kinds of silkworm disease in the study area including Grasserie , Mycoses, Flacherie and Pebrine disease, accounting for 87.08 %, 56.25 %, 31.25 % and 14.58 %, respectively. The most common diseases were Grasserie disease and Mycoses case because the silkworm are unhealthy or in the bad condition. Some casuals, the disease comes from outside over the rearing.

The findings revealed that the majority of farmers prevented silkworm diseases by removing and burning the infected silkworms in order to eliminate disease and prevent them from spreading it to other silkworms. In addition, they observed their silkworm. When farmer found abnormal silkworms, they immediately eliminated silkworm and cleaned rearing tools in silkworm rearing rooms in order to prevent the outbreak of diseases.

Table 34 Silkworm diseases

Items	Damage			% of damage					
	Free	Infected	Total	0	1-25	26-50	51-75	76-100	Total
	No (%)	No (%)	No (%)	No (%)	No (%)	No (%)	No (%)	No (%)	No (%)
Grassery	11 (22.92)	37 (87.08)	48 (100.00)	11 (22.92)	33 (68.75)	4 (8.33)	0 (0.00)	0 (0.00)	48 (100.00)
Mycoses	21 (43.75)	27 (56.25)	48 (100.00)	21 (43.75)	27 (56.25)	0 (0.00)	0 (0.00)	0 (0.00)	48 (100.00)
Flacherie	33 (68.75)	15 (31.25)	48 (100.00)	33 (68.75)	14 (29.17)	0 (0.00)	1 (2.10)	0 (0.00)	48 (100.00)
Pebrine	41 (85.42)	7 (14.58)	48 (100.00)	41 (85.42)	7 (14.58)	0 (0.00)	0 (0.00)	0 (0.00)	48 (100.00)

Note: One respondents may infected with more than one diseases damages

Source: Survey (2011)

11. Silkworm pest

In terms of silkworm pest, as shown in Table 35, five kinds of silkworm pests were found in the study area including Tachinid fly, accounting for 89.58 %. The rest were ants, lizards, mice, rat and geckos, accounting for 47.92 %, 37.50 %, 35.42 % and 10.42 %, respectively.

The study revealed that farmers prevented silkworm pests by rearing silkworms in the rearing room that were protected by metal or plastic nets with no holes. Farmers also eliminated pests immediately when finding them in the rearing room. Furthermore, the farmers kept maintaining and fixing any damage to the rearing rooms in order to prevent pests from entering the rooms and destroying silkworms.

Table 35 Silkworm pest

Items	Damage			% of damage					
	Free	infected	Total	0	1-25	26-50	51-75	76-100	Total
	No (%)	No (%)	No (%)	No (%)	No (%)	No (%)	No (%)	No (%)	No (%)
Fly	5 (10.42)	43 (89.58)	48 (100.00)	5 (10.42)	43 (89.58)	0 (0.00)	0 (0.00)	0 (0.00)	48 (100.00)
Ants	25 (52.08)	23 (47.92)	48 (100.00)	25 (52.08)	23 (47.92)	0 (0.00)	0 (0.00)	0 (0.00)	48 (100.00)
Lizard	30 (62.50)	18 (37.50)	48 (100.00)	30 (62.50)	18 (37.50)	0 (0.00)	0 (0.00)	0 (0.00)	48 (100.00)
Rat	31 (64.58)	17 (35.42)	48 (100.00)	31 (64.58)	17 (35.42)	0 (0.00)	0 (0.00)	0 (0.00)	48 (100.00)
Gecko	43 (89.58)	5 (10.42)	48 (100.00)	43 (89.58)	5 (10.42)	0 (0.00)	0 (0.00)	0 (0.00)	48 (100.00)

Note: One respondents may infested with more than one infestation damages

Source: Survey (2011)

12. Local wisdom and technology application in silkworm rearing

As shown in Table 36, most respondents applied local wisdom in sericulture production, accounting for 62.50 %. There were 37.50 % who did not apply local wisdom.

In terms of method of local wisdom application, there were 4 methods including disease prevention, newly hatched larva rearing, silkworm selecting and collecting mature worms for mounting, accounting for 83.33 %, 16.67 %, 6.67 % and 3.33 %, respectively.

Regarding prevention of silkworm diseases, farmers sprayed baby powder on silkworms after the molting stage to reduce humidity and prevented diseases. They also put banana leaves on the bottom of the rearing bed to increase humidity and prevented silkworms from getting dry. A few of them used rice to scatter on silkworms and when feeding mulberry leaves so that the silkworms will not stick together. In addition, they poured hot water from silk reeling around the silkworm rearing rooms to prevent ants.

In terms of local wisdom application in newly hatched larva rearing, farmers used various methods namely “TUM JAI” medicine and “TUM JAI” medicine mixed with chopped young tamarind leaves to scatter on newly hatched larva. They also scattered baby powder on newly hatched larva in order to make them strong and reduce the humidity in the rearing bed. Moreover, some of them used rectangular leave sheath of banana tree to enclose the newly hatched larva to increase humidity.

In terms of selecting silkworm variety, farmers selected silkworm variety by shaking cocoons. If there is a loud, hard sound inside, it means the cocoons are good quality and can be used in breeding.

For collecting mature worms for mounting, a few farmers put a plastic sheet on the bottom of the baskets to prevent silkworm from spilling their fiber. After that, they collected mature worm for mounting.

In terms of technology application in silkworm rearing, the majority of respondent applied recommendation technology in silkworm rearing, accounting for % 77.08 %. The rest, 2.08 % did not apply recommendation technology. The study indicated that farmers applied recommendation technology in newly hatched larva raring, disease and pest prevention and bed cleaning, respectively. Most farmers scattered lime and “PEBSOL” on newly hatched larva and silkworms after the molting stage to reduce humidity and prevented diseases. A few of them used a bed cleaning net to remove waste manure, which is convenient, fast and also helps to save time in rearing silkworms.

Table 36 Local wisdom and technology application in silkworm rearing

Items	No.	%
Local wisdom application		
Applied local wisdom	30	62.50
Do not applied local wisdom	18	37.50
Total	48	100.0
Applied local wisdom ^{1/} (n= 30)		
Prevention of silkworm diseases and pests	25	83.33
Rearing of newly hatched larva	5	16.67
Silkworm variety selecting	2	6.67
Collecting mature worms for mounting	1	3.33
Technology application		
Applied technology	37	77.08
Do not applied technology	11	22.92
Total	48	100.0

Table 36 (Continued)

Items	No.	%
Applied technology ^{2/} (n = 37)		
Rearing of newly hatched larva	37	100.00
Prevention of silkworm diseases	37	100.00
Bed cleaning	1	2.70

Note: 1/: One respondent can apply more than one local wisdom

2/: One respondent can apply more than one technology

Source: Survey (2011)

13. Cocoons yield per cycle

Regarding cocoon yield per cycle as shown in Table 37, the majority of respondent produced cocoon between 11-20 kg, accounting for 58.34 %. The rest were less than 10 kg, 21-30 kg, more than 30 kg, respectively. The maximum amount of cocoon yield was 40 kg. The minimum was 4.5 kg. The average was 17.09 kg. The findings revealed that most sericulture farmers reared “DOKBUA” variety. This variety can produce cocoons for 13-18 kg per sheet per cycle.

Table 37 Cocoon yield per cycle

Cocoon yield (kg/ cycle)	No.	%
10 or less	10	20.83
11-20	28	58.34
21-30	9	18.75
More than 30	1	2.08
Total	48	100.00

Note: 1/: Min = 4.5 kg, Max = 40 kg, \bar{x} = 17.09 kg, S.D. = 6.89

Source: Survey (2011)

Existing conditions of silk yarn reeling

1. Cocoon culling

As for cocoon culling as shown in Table 38, the majority of respondent culled cocoon before reeling, accounting for 91.67 %. The rest, 8.33 % did not cull them. The study indicated that most farmers culled cocoons before reeling to separate poor cocoon, so that they could get good silk yarn. If they did not separate the good and the bad cocoons, the mixed is the poor quality grade.

Table 38 Cocoon culling

Cocoon culling	No.	%
Culling	44	91.67
un-culling	4	8.33
Total	48	100.00

Source: Survey (2011)

2. Silk yarn yield per cycle

In terms of type of silk yarn reeling apparatus, all of respondents used developed hand reeling apparatus because they could produce more silk yarn in the short time and save cost. The developed hand reeling apparatus was recommended by extension officers. It could increase the efficiency of silk yarn production more than the traditional hand reeling apparatus by 5-10 times or 1-1.5 kg. It also makes more to ability to control silk yarn quality.

In terms of silk yarn yield per cycle as shown in Table 39, the majority of respondent produced silk yarn between 1.1 - 2 kg per cycle, accounting for 58.33 %. The rests were 1 kg or less, 2.1 – 3, more than 4 and 3.1 – 4 kg per cycle, respectively. The maximum silk yarn yield was 6 kg per cycle because they reared 2 sheets per

cycle. The minimum was 0.45 kg per cycle because they reared 0.5 sheets per cycle. The average was 1.98 kg per cycle.

The findings revealed that farmers reel silk yarn themselves by hand-reeled apparatus which is similar to common practice of 8 - 10 kg of cocoon can producing 1 kg silk yarn.

Table 39 Silk yarn yield per cycle

Silk yarn yield per cycle (kg/ cycle)	No.	%
1 or less	9	18.75
1.1 - 2	28	58.33
2.1 – 3	5	10.42
3.1 – 4	2	4.17
More than 4	4	8.33
Total	48	100.00

Note: 1/: Min = 0.45, Max = 6, \bar{x} = 1.98 kg, S.D. = 1.14

2/: Average silk yarn yield per cycle = 1-2 kg

Source: Survey (2011)

3. Type of silk yarn

Regarding type of silk yarn as shown in Table 40, the majority of respondent, produced 2nd grade, accounting for 97.92 %. The findings revealed that most farmers produce 2nd grade silk yarn because they used a weft yarn for weaving. In addition, the rest, 2.1% produced 1st grade silk yarn because this farmer had high potential to produce the best quality of silk fabric brand name.

Table 40 Type of silk yarn

Type of silk yarn	Practice	Non practice	Total
	No (%)	No (%)	No (%)
1 st grade	1 (2.08)	47 (97.92)	48 (100.0)
2 nd grade	48 (100.0)	0 (0.0)	48 (100.0)

Note: 1/: One respondent can reply more than one type

2/: 1st grade refer to the silk yarn reeled from the inner layers of the cocoon shell. The silk yarn is even in structure, size and color, round, clean and free from adulterated materials. The sericin level is $\leq 30\%$.

2nd grade is the silk yarn reeled from a combination of the inner and outer layers of cocoon shell. The silk yarn is not even in structure, but is even in size and color, round, clean and free from adulterated materials. The sericin level is $\leq 30\%$.

Source: Survey (2011)

4. Silk yarn application

As shown in Table 41, the majority of respondents produced silk yarn for sale and weaving, accounting for 91.67%. The rest, 8.33% produced silk yarn only for weaving. In terms of silk yarn production, the majority farmers who reared silkworm at least 1 sheet per cycle sold their products in the form of both silk yarn and silk yarn weaving. Because they have plenty silk yarn for more channels of income.

On the contrary, the rests who sold only silk yarn weaving are small scale silkworm rearing. Then they have a few silk yarn products. So, they try to sale in the form of silk yarn weaving that they can get more income rather than in the form of silk yarn. The findings also revealed that farmers sold their hand-reeled yarn or weaved it themselves to produce silk fabric in traditional styles.

Table 41 Silk yarn application

Silk yarn used	No.	%
Weaving and sale	44	91.67
Weaving	4	8.33
Total	48	100.00

Source: Survey (2011)

5. Local wisdom and technology application in silk yarn reeling

Regarding local wisdom application in silk yarn reeling as shown in Table 42, a few respondents applied local wisdom in silk yarn reeling, accounting for 27.08 %. There were 72.92 % did not use local wisdom. The local wisdom that farmers applied local wisdom for re-reeling is soaking silk yarn in water after reeling to prevent drying so they can easily re-reel.

Regarding technology application in silk reeling, all of respondents applied recommendation technology in silk yarn reeling. The finding revealed that all of them used developed silk yarn apparatus in silk yarn reeling. This method can help farmers to produce a lot of silk yarn in a short time.

They also used developed re-reeling apparatus in silk yarn re-reeling which had been received from the QSSD. This apparatus can help produce the spread of silk yarn during re-reeling that fits to the standard the silk skein. They also used clothes dryers to dry silk yarn which saves time and is more convenience.

Table 42 Local wisdom and technology application in silk yarn reeling

Items	No.	%
Local wisdom application		
Do not applied local wisdom	35	72.92
Applied local wisdom in re-reeling	13	27.08
Total	48	100.00
Technology application^{1/}		
Applied technology	48	100.00
Silk reeling	48	100.00
Re-reeling	13	27.08
Silk yarn drying	1	2.08

Note: 1/: One respondent can apply more than one technology

Source: Survey (2011)

Exiting conditions on silk fabric weaving

1. Silk fabric Type

Regarding the silk fabric type as shown in Table 43, there were 5 kinds of silk fabric including “MUD MEE”, plain fabric, shawl, “PHAKAOMA” and “SARONG”. The majority of respondent produced “MUDMEE”, accounting for 91.67 %. The rests were plain fabric, shawl, “PHAKAOMA” and “SARONG”, accounting for 39.58 %, 20.83 %, 18.75 %, and 18.75 %, respectively.

“MUDMEE” silk fabric is one of famous local fabrics in the northeastern of Thailand. Farmers have learnt how to produce “MUDMEE” products from their ancestors. In addition, they always have the opportunity to improve more style and quality continuity from concern agencies in particular QSSD and DIP. In addition, all respondents used a native loom for weaving because silk fabric which are woven from a native loom are delicate, tight, good quality with beautiful design and texture.

Table 43 Type of silk fabric

Type of silk fabric ^{1/}	No.	%
“MUDMEE”	44	91.67
Plain fabric	19	39.58
Shawl	10	20.83
“PHAKAOMA”	9	18.75
“SARONG”	9	18.75

Note: One respondent can weave fabric more than one type

Source: Survey (2011)

2. Amount of silk fabric per year

As shown in Table 44, the majority of respondent weaved silk fabric between 21-40 meters, accounting for 27.08 %. The rest were 61-80 meters, less than 20 meters, 41-60 meters and more than 80 meters, respectively. The maximum amount of silk fabric was 160 m. The minimum was 12 meters. The average was 57.39 m.

The findings revealed that farmers weaved silk fabric when they were free from farm activity. They spend 3-4 days to weave one cloth of 2 meters and they stopped weaving during rice farming season.

Table 44 Amount of silk fabric per year

Amount of silk fabric ^{1/} (meters/ year)	No.	%
1-20	9	18.75
21-40	13	27.08
41-60	8	16.67
61-80	10	20.83
More than 80	8	16.67
Total	48	100.00

Note: 1/: Min = 12 meters, Max = 160 meters, \bar{x} = 57.39 kg, S.D. =33.25

Source: Survey (2011)

3. Local wisdom and technology application in fabric weaving

Regarding local wisdom and technology application in fabric weaving as shown in Table 45, the majority of respondent applied local wisdom, accounting for 72.92 %. All of them applied local wisdom in weaving process. They used water from washing rice for silk combing in order to make the silk yarn slide and not separate when they weaved the fabric. There were 27.08 % did not applied local wisdom.

Moreover, they made the equipment for weaving by themselves for example; they smashed mature coconut peel instead of silk yarn combing. They also used a tree branch cut into pieces instead of a spool to save production costs.

In terms of technology for weaving, the majority of respondent applied technology, accounting for 68.75 %. There were 31.25 % who did not use technology.

Most respondents applied recommendation technology in dyeing by using olive oil or vinegar for dyeing a wrap yarn. This technique is to prevent spots and to absorb colors efficiently. In addition, they used some drops of dish washing liquid

mixed with color for dyeing. This technique is to get a beautiful color and to keep the silk yarn from separating.

Moreover, they used hair conditioner for silk combing so that silk yarns are soft and easily for weaving. Some farmers used a clothes dryer to dry silk yarn after bleaching instead of drying. This technique is quick and convenience.

The respondents applied the technology in silk yarn preparation, accounting for 12.6%. Their techniques are be applied electric warping board to save time and labor for silk yarn preparation.

Table 45 Local wisdom and technology in silk fabric weaving

Items	No.	%
Local wisdom application		
Do not applied	13	27.08
Applied local wisdom	35	72.92
Weaving	35	72.92
Technology application		
Applied technology	33	68.75
Do not applied	15	31.25
Total	48	100.0
Applied technology ^{1/} (n=33)		
Dyeing	33	100.00
Silk yarn preparation	6	18.18

Note: 1/: One respondent can apply more than one technology

Source: Survey (2011)

Silk product marketing channel

Regarding silk product marketing channel as shown in Table 46, there were 3 silk products in study areas including cocoon, silk yarn and silk fabric. In terms of cocoons, a few of respondent sold cocoon to neighbor, accounting for 20.83 %. The

findings revealed that most of respondents did not sell cocoon because main purpose on silkworm rearing was to produce silk yarn.

In terms of silk yarns, the majority of respondent sold silk yarn to sericulture group, accounting for 81.25 %. The rests were sold to middlemen and local markets, respectively.

The study indicated that farmers sold silk yarn through sericulture groups. One of the reasons why they preferred this channel was because it was familiar and helped to sell silk yarn at market prices. The groups gathered silk yarn for distribution to buyers, consisting of silk production networks and middlemen. In addition, people from other villages were also their customers.

In terms of silk fabric, the majority of respondent sold silk fabric to sericulture groups, accounting for 81.25 %. The rest were middlemen, local markets and markets in other provinces, respectively. The findings revealed that farmers sold silk fabric to sericulture groups because they could sell silk fabric with high prices. The sericulture groups gathered silk fabric and checked quality before distribution by group committees. They distributed silk fabric to OTOP shops, local silk shops and middlemen with silk requirement specification, such as type, color and size.

Table 46 Silk product marketing channel

Marketing channel	Cocoon		Silk yarn		Silk fabric	
	No.	%	No.	%	No.	%
Sericulture group	0	0.00	39	81.25	39	81.25
Middleman	0	0.00	10	20.83	6	12.50
Local market	0	0.00	10	20.83	2	4.17
Other province	0	0.00	0	0.00	2	4.17
Neighbor	10	20.83	0	0.00	0	0.00

Note: One respondent can sell more than one channel

Source: Survey (2011)

Farmers' practice towards silk production standard

1. Farmers' practice towards silk yarn production standard

In terms of silk yarn quality as shown in Table 47, the majority of respondent produced smooth and clean silk of the same size and color, accounting for 62.50 % because they wanted to produce the highest quality of silk yarn for the maximum price.

In terms of packaging, the majority of respondent preferred to show certain part of silk yarn in a package to represent all labeled silk yarn, accounting for 66.67 %. The rest were packaged with 1 or 2 kg of silk yarn, accounting for 47.92 %. The silk yarn packages were free from odor and adulterated materials, which may affect the silk yarn quality, accounting for 35.42 %. Packaging materials were good quality with effectively protects the products from humidity, insect contamination and damage caused by transportation, accounting for 31.25 %. Each package was even in quality and size, accounting for 22.92 %, respectively.

The result indicated that there was only one item the farmers could reach the set standard more than 50%. Practically, the farmers keep all silk yarn in a bag. When sale their silk yarn. Then, the silk yarns were packed in packages by the sericulture group committee.

In terms of acceptable tolerance, the level of tolerance that the majority of respondent could produce the first silk yarn level grade that they do not deviate more than 10% from criteria set of the first level grade quality. They also produced second level that the quality do not more than 10% from the criteria set of second grade quality. They could complete the criteria for the size aspect, with deviated not more than 10%, accounting for 83.33 %. The rest had acceptable tolerance for the diameter of silk skein that was not more than 3% of specified label.

The study revealed that generally, farmers could meet the standard demand more than 50% in any aspect because farmers were supported by silk reeling apparatus. So they could produce a greater amount of silk yarn with accepted quality. Therefore, farmers were supported to perform the current practice in silk yarn reeling as they used these tools together with their local ways.

In terms of labels and markings, the majority of respondent identified date–month–year of production on the package, accounting for 93.75 %. The rests identified type, size and diameter of skein, the common term of Thai silk yarn and silkworm variety or silkworm race, identifying name of producer and location, and identifying number of skeins and net weight of the package respectively.

The result revealed that farmers could meet the standard demand more than 50% in any aspect because farmer recorded silk details every time after they finished their production that was based on silk production group suggestion.

Table 47 Farmers’ practice towards silk yarn standard

Items	Farmers’ practices					
	Done		Never		Total	
	No.	%	No.	%	No.	%
Silk yarn quality						
The silk yarn is even in structure, size and color, round, clean and free from adulterated materials.	30	62.50	18	37.50	48	100.00
Packaging						
The visible part of the Thai silk yarn represents all Thai silk yarn as labeled.	32	66.67	16	33.33	48	100.00
Each package contains 1 or 2 kg of Thai silk yarn	23	47.92	25	52.08	48	100.00
The silk yarn package are free from odor and adulterated materials, which may affect the yarn quality.	17	35.42	31	64.58	48	100.00

Table 47 (continue)

Items	Farmers' practices					
	Done		Never		Total	
	No.	%	No.	%	No.	%
Packaging materials are of good quality, which is well protecting the products from humidity, insect contamination and tolerate transportation.	15	31.25	33	68.75	48	100.00
Each package is even in quality and size	11	22.92	37	77.08	48	100.00
Acceptable tolerance						
Acceptable tolerance for the first level grade quality do not deviate more than 10% of from the criteria set for first level grade quality.	40	83.33	8	16.67	48	100.00
Acceptable tolerance for the second level grade quality do not deviate more than 10% from the criteria set for second level grade quality.	40	83.33	8	16.67	48	100.00
Deviation criterion for the size aspect not more than 10% of that specified on the label.	40	83.3	8	16.70	48	100.00
Acceptable tolerance for the diameter of silk skein is not more than 3% of that specified on the label.	36	75.0	12	25.00	48	100.00
Deviation criterion for the size aspect not more than 10% of that specified on the label.	40	83.3	8	16.70	48	100.00
Label and markings						
Identifying date–month–year of production	45	93.75	3	6.25	48	100.0
Identifying type, size and diameter of skein	44	91.67	4	8.33	48	100.0
Identifying the term Thai silk yarn and silkworm variety or silkworm race	42	87.50	6	12.50	48	100.0
Identifying name of producer and location	39	81.25	9	18.75	48	100.0
Identifying number of skeins and net weight of the package	38	79.17	10	20.83	48	100.0

Source: Survey (2011)

2. Farmers' practice towards silk fabric production standard

As shown in Table 48, in terms of silk fabric type, the majority of respondent weaved heavy weight silk with a weight with approximately 121-160 g. per square meter, accounting for 66.67 %. The rest were medium weight silk with a weight approximately 91-120 g. per square meter, accounting for 45.83 %, light weight silk with a weight of less than 90 grams per square meter, accounting for 41.67 %, and extra heavy weight silk with a weight approximately 160 grams per square meter, accounting for 37.50 %, respectively. Farmers produced the heavy weight silk in order to fulfill market demand.

In terms of size, most respondents produced silk fabric with a length not less than the value indicated in the label, accounting for 66.67 %. The rest were width as indicated in the label with deviation $\pm 3\%$, accounting for 60.42 %.

In terms of number of silk yarns, the majority of respondent produced silk fabric with a number of yarns per 25.4 mm as indicated in the label with deviation $\pm 2\%$, accounting for 54.17 %

In terms of weight, the majority of respondent produced silk fabric with a weight per area unit is as indicated in the label with deviation $\pm 2\%$, accounting for 52.08 %.

The possible reason is that farmers made on order of the vender and the products were matched to the specifications listed on the labels.

In terms of required characteristics, all of respondents used authentic silk yarn for silk fabric weaving. The rest produced silk fabric without stains and damage including splitting yarn, hole, and uniform in color characteristic of silk through out the length, accounting for 97.92 %. Producing silk fabric resistant to light was not less than 5 level blue scales, accounting for 70.83 %.

The findings revealed that most farmers choose authentic silk yarn and weave the neat fabric without any flaws in order to get the standard certificate. Additionally, the sericulture production group or the venders also inspected the quality of silk fabric before purchasing it because the silk fabric price is set on the quality and pattern.

In terms of packaging, most respondents packed and wrapped silk fabric with clean and adequately durable material to protect the product from any damage, accounting for 95.83 %. The study indicated that most farmers used clean plastic bags or cotton bags to cover the silk fabric in order to prevent insect damage.

In terms of marking and labeling, the majority of respondent identified their product name on their covering material, accounting for 43.75 %. The rests identified weight in grams per square meter, number of silk yarns in each row, hand-woven or machine-woven cloth and suggestions for laundering, width and length in centimeters or meter, kind of dyeing, and country of origin, respectively.

The study revealed that most farmers had practiced this standard less than 50% because after farmers finished fabric weaving, the sericulture group committee dose support for marking and labeling.

Table 48 Farmers' practice towards silk fabric production standard

Items	Farmers' practices					
	Done		Never		Total	
	No.	%	No.	%	No.	%
Types						
Heavy weight silk: weigh from 121–160 grams/square meter	32	66.67	16	33.33	48	100.00
Medium weight silk: weigh from 91-120 grams/square meter	22	45.83	26	54.17	48	100.00
Light weight silk: weigh not more than 90 grams/square meter	20	41.67	28	58.33	48	100.00
Extra heavy weight silk: weigh more than 160 grams per square meter	18	37.50	30	62.50	48	100.00
Size						
The length is not less than the value indicated in the label	32	66.67	16	33.33	48	100.00
The width is as indicated in the label with deviation $\pm 3\%$	29	60.42	19	39.58	48	100.00
Number of yarn						
Number of yarn per 25.4 mm is as indicated in the label with deviation $\pm 2\%$	26	54.17	22	45.83	48	100.00
Weight						
Weight per area unit is as indicated in the label with deviation $\pm 2\%$	25	52.08	23	47.92	48	100.00
Required Characteristics						
The silk is authentic	48	100.00	0	0.00	48	100.00
All kinds of the silk fabric are neat in appearance, free from stains and damage including splitting yarn, hole, and uniform in color characteristic of silk through out the length.	47	97.92	1	2.1	48	100.00
The resistant to light (xenon arc light) is not less than 5 level blue scales.	34	70.83	14	29.17	48	100.00

Table 48 (continue)

Items	Farmers' practices					
	Done		Never		Total	
	No.	%	No.	%	No.	%
Packaging						
The silk fabric is tidily and securely packed and wrapped with clean and adequately durable material to protect the product form any damage.	46	95.83	2	4.17	48	100.00
Marking and Label						
Identifying product name	21	43.75	27	56.25	48	100.00
Identifying weight in grams per square meters	16	33.33	32	67.67	48	100.00
Identifying number of yarns in each row	15	31.25	33	68.75	48	100.00
Identifying type of fabric by type of weaving	14	29.17	34	70.83	48	100.00
Identifying recommended care and maintenance	13	27.08	35	72.92	48	100.00
Identifying width and length in meters	13	27.08	35	72.92	48	100.00
Identifying dye type (natural or chemical dye)	12	25.00	36	75.00	48	100.00
Identifying the name of the manufacturer or factory, address or registered trademark	12	25.00	36	75.00	48	100.00

Source: Survey (2011)

Part 4 Knowledge, Attitude and Practice Assessment

This part is present the farmers' knowledge, attitude and practice assessment towards commercial sericultural production.

Knowledge towards commercial sericultural production

1. Level of farmers' knowledge in commercial sericultural production

The level of farmers' knowledge on commercial sericultural production was assessed by using the developed question. The question was designed as multiple choices with 35 choices. All questions were divided into 7 categories based on commercial sericultural production consisting of silkworm rearing management, mounting management, silkworm disease and pest management, production of silk products, marketing management, accountant management and human resource management.

Regarding the T-score formula that was used to analyze the level of farmers' capability by based on their scores on question as shown in Table 49. The result revealed that the majority of respondent knowledge was in the moderate level, accounting for 58.33 %. The rests were in the high level and lower level, accounting for 22.91 % and 18.76 %, respectively.

The result indicated that the majority of farmer had high ability to understand the concept and principle of commercial sericultural production. This is because they had been trained towards intervention programs in sericulture commercial production that provided by concern agencies.

Table 49 Level of farmer knowledge in commercial sericultural

Raw score	Frequency	Cf	Percentile	Normalized T	Level
33	1	48	98.96	73.11	
31	1	47	96.88	68.63	
30	2	46	93.75	65.34	High
29	1	44	90.63	63.18	(22.91%)
28	1	43	88.54	62.03	
27	5	42	82.29	59.27	
26	4	37	72.92	56.10	
25	5	33	63.54	53.46	
24	3	28	55.21	51.31	
23	1	25	51.04	50.26	Moderate
21	1	24	48.96	49.74	(58.33%)
19	1	23	46.88	49.22	
17	3	22	42.71	48.16	
15	1	19	38.54	47.09	
14	4	18	33.33	45.69	
13	5	14	23.96	42.92	
12	2	9	16.67	40.33	
11	4	7	10.42	37.42	Lower
10	2	3	4.17	32.68	(18.76 %)
8	1	1	1.04	26.89	

Note: Steps to calculate level of farmers' knowledge in commercial sericultural production

1. Find out the range of score by max-min of T($73.11-26.89=46.22$)
2. Classified by 3 level by find out the interval score ($46.22/3=15.40$)
3. Lower level Min of T –score + interval score ($26.89+15.40=42.29$)
4. Moderate level($42.29+15.40=73.09$)
5. High level($57.69+15.40=57.69$)

Source: Survey (2011)

2. Knowledge towards commercial sericultural

The farmers' knowledge in commercial sericultural production category as shown in Table 50, it revealed that in silkworm rearing management, the majority of respondent had corrected answer more than 50 % in harvesting mulberry leave for young silkworm, accounting for 79.2 %. The rests were feeding mulberry leave to young silkworm, method for enlarging silkworm rearing area, time for bed cleaning, practice for silkworm molting and practice for silkworm after molting, respectively.

In terms of mounting management, the majority of respondent had corrected answer more than 50 % in time for cleaning mountage, accounting for 72.92 %. The rests were method for harvesting cocoon from mountage, suitable place for mounting and characteristic of good cocoon, respectively.

In terms of silkworm disease and pest management, the majority of respondent had corrected answer more than 50% in method of eliminating unhealthy or infected silkworm, accounting for 79.17 %.

In addition, regarding production of silk product aspect, the majority of respondent had corrected answer more than 50% in appropriate amount of cocoon to be boiled to ensure good quality of silk yarn, accounting for 60.42 %. The rests were method in maintain reeling equipment, type of water used to boil cocoon, and using substance for fix color in dyeing method, respectively.

Moreover, the majority of respondent had corrected answer more than 50% relating to marketing management in method of making silk product well known in market, accounting for 62.50 %. The rests were method for getting product to be accepted by the market, method for preparing raw material to produce good product quality that meet market requirement and, method for producing quality product to be sold at high price, respectively.

In accounting management, the majority of respondent had corrected answer more than 50% in accounting management after selling, accounting for 70.83 % and followed by Method for making efficiency in accounting management, method for determining in silk production cost, efficiency investment making decision, and providing investment in sericulture production, respectively.

In terms of human resource management, they also had corrected answer more than 50% concerning method for group working to produce good quality product and to encourage group working among member accounting 72.92 %. The rest were and method in enhance strength and unity for group members.

The findings indicated that most farmers had corrected answer. This may have resulted from the trainings and promotion program that provided by concerned agencies and from attending in group meeting every month,

However, the farmers still lack of knowledge in commercial sericultural production involved on using substance to reduce humidity when the silkworm are molting, suitable time to harvest cocoon, preventing ant from damaging silkworm, using chemical to spray in the room and equipment for rearing silkworm before rearing silkworm and using chemical to sprinkle over newly hatched silk worm.

The likely reasons behind these may be that they still do not understand that using chemical substance is dangerous for themselves and silkworm. Consequently, the farmers also failed to answer the given questions. They also have limited knowledge in how to produce silk product to meet market requirement and to set product price. As silk marketing has operated by group committees only, this may be the due reason why farmers failed to have corrected answer for this kind of questions.

Table 50 Distribution of knowledge towards commercial sericultural production

Items	Correct	Wrong	Total
	No.	No.	No.
	%	%	%
Silkworm rearing management			
Harvesting mulberry leaf for young silkworm	38 (79.17)	10 (20.83)	48 (100.00)
Feeding mulberry leaf to young silkworm	37 (77.08)	11 (22.9)	48 (100.00)
Method for enlarging silkworm rearing area	30 (62.50)	18 (37.50)	48 (100.00)
Time for bed cleaning	25 (52.08)	23 (47.92)	48 (100.00)
Practice for silkworm molting	25 (52.08)	23 (47.92)	48 (100.00)
Practice for silkworm after molting	25 (52.08)	23 (47.92)	48 (100.00)
Using substance to reduce humidity when the silkworm is molting	23 (47.92)	25 (52.08)	48 (100.00)
Mounting management			
Time for cleaning moutage	35 (72.92)	13 (27.08)	48 (100.00)
Method for harvesting cocoon from moutage	30 (62.50)	18 (37.50)	48 (100.00)
Suitable place for mounting	25 (52.08)	23 (47.92)	48 (100.0)
Characteristics of good cocoon	25 (52.08)	23 (47.92)	48 (100.00)
Suitable time to harvest cocoon	21 (43.75)	27 (56.25)	48 (100.00)

Table 50 (continue)

Items	Correct	Wrong	Total
	No.	No.	No.
	%	%	%
Silkworm disease management			
Method for eliminating unhealthy or infected silk worm	38 (79.17)	10 (20.83)	48 (100.00)
Preventing ant from damaging silkworm	20 (41.67)	28 (58.33)	48 (100.00)
Using chemical to spray in the room and equipment for rearing silkworm before rearing silk worm	19 (39.58)	29 (60.42)	48 (100.00)
Using chemical to sprinkle over newly hatched silkworm	10 (20.83)	38 (79.17)	48 (100.00)
Production of silk product			
Appropriate amount of cocoon to be boiled to ensure good quality of silk yarn	29 (60.42)	19 (39.58)	48 (100.00)
Method in maintain reeling equipment	25 (52.08)	23 (47.92)	48 (100.00)
Type of water used to boil cocoon	25 (52.08)	23 (47.92)	48 (100.00)
Using substance for fix color in dyeing method	25 (52.08)	23 (47.92)	48 (100.00)
Marketing management			
Method for making silk product well known in the market	30 (62.50)	18 (37.50)	48 (100.00)
Method for getting product to be accepted by market	29 (60.42)	19 (39.58)	48 (100.00)
Method for preparing raw materials to produce good quality product that meet market requirement	25 (52.08)	23 (47.92)	48 (100.00)

Table 50 (continue)

Items	Correct	Wrong	Total
	No.	No.	No.
	%	%	%
Method for producing quality product to be sold at high price	25 (52.08)	23 (47.92)	48 (100.00)
Method for producing silk product to meet market requirement	23 (47.92)	25 (52.08)	48 (100.00)
Method for setting price according to target group	23 (47.92)	25 (52.08)	48 (100.00)
Method for setting price according to silk quality	23 (47.92)	25 (52.08)	48 (100.00)
Accounting management			
Accounting management after sale	34 (70.83)	14 (29.17)	48 (100.00)
Method for making efficiency in accounting management	32 (66.67)	16 (33.33)	48 (100.00)
Method for determining in silk production cost	32 (66.67)	16 (33.33)	48 (100.00)
Efficiency investment making decision	32 (66.67)	16 (33.33)	48 (100.00)
Providing investment in sericulture production	31 (64.58)	17 (35.42)	48 (100.00)
Human Resource Management			
Method for group working to produce good quality product	35 (72.92)	13 (27.08)	48 (100.00)
Encourage group working among member	35 (72.92)	13 (27.08)	48 (100.00)
Method in enhance strength and unity for group member	30 (62.50)	18 (37.50)	48 (100.00)

Source: Survey (2011)

Attitude towards commercial sericultural production

The attitude towards commercial sericultural production as shown in Table 51 and Table 52, it found that the majority of respondent had extremely positive attitude, accounting for 58.33 %. The rest had positive attitude, accounting for 41.67 %. All respondents had extremely positive attitudes towards commercial sericultural production with an average score of 4.29.

The respondents had extremely positive attitudes towards commercial sericultural production concerning human resource management, marketing management, accounting management and mounting management with average score of 4.68, 4.42, 4.31 and 4.23, respectively.

In addition, the majority of respondent had positive attitude towards the production of silk product with average scores of 4.21. The rest were silkworm rearing management and disease and pest management with average score of 4.19 and 4.05, respectively.

In terms of silkworm rearing management, the majority of respondent had good attitude on the aspect of feeding mulberry leaf to young silkworm by chopping mulberry leaf in appropriate size at an average score of 4.71. Farmers believed that proper size and enough of mulberry leaf depend on the age of silk worm. These practices make good growth and healthy silkworms.

In terms of mounting management, respondents had also a good attitude on the aspect of culling firm cocoon with tight cocoon, no twin or thin cocoon that are not clean inside and outside and no defect at an average score of 4.63. They also had correctly perceived that good silk yarn quality comes from the good quality cocoon spun. Therefore, bad silk cocoon should be culled out.

In terms of disease and pest management, the majority of respondent had the good attitude to the topic of eliminating unhealthy and infected silkworms by using

formalin by 3% at an average score of 4.23. The reason is that farmers do recognize that elimination of unhealthy and infected silkworms in formalin solutions can prevent the spread of diseases.

Regarding the production of silk product, the majority of respondent had the good attitude to the topic of cleaning reeling equipment before and after using it at an average score of 4.48. This is because all reeling equipment requires good treatment and proper maintenance for clean silk yarn.

In terms of marketing management, respondents had the good attitude to produce silk products according to market's requirement with an average score of 4.60. This may be because producing silk products to meet market requirement, farmers can get high price and more income.

In addition, accounting management aspect, the respondents had the good attitude to the topic of providing capital in advance for silk production at an average score of 4.42. This because farmers required capital as one of the efficiency factor to run production

Regarding human resource management, respondents had also the good attitude to participate in group activities at an average score of 4.71. It was recognized by farmers that all activities and also leaning process can increase their sericulture production.

In addition, farmers received knowledge, news and information regarding silk production from such participation in the aforementioned activities. Furthermore farmers can take such opportunities to have more networks from their business.

Table 51 Attitude levels in commercial sericultural production

Attitude levels	Average score	No.	%
Extremely positive	4.21-5.00	28	58.33
Positive	3.41-4.20	20	41.67
Neutral	2.61-3.40	0	0.00
Negative	1.81-2.60	0	0.00
Extremely negative	1.00-1.80	0	0.00
Total		48	100.0

Source: Survey (2011)

Table 52 Attitude in commercial sericultural production

Items	Opinions level												\bar{x}
	Strongly agree		Agree		Uncertain		Disagree		Strongly disagree		Total		
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	
Silkworm rearing management													
Feeding mulberry leaf to young silkworm by chopping mulberry leaf into the appropriate size for silkworm	34	70.83	14	29.17	0	0.00	0	0.00	0	0.00	48	100.00	4.71
Harvesting the young mulberry leaf from the 2 ^{sd} – 3 rd leaf from the top for feeding young silkworm	24	50.00	24	50.00	0	0.00	0	0.00	0	0.00	48	100.00	4.50
Enlarge the silkworm rearing area before feeding	22	45.83	22	45.83	3	6.26	1	2.08	0	0.00	48	100.00	4.35
Using lime or rice husk to reduce humidity while silkworms are molting	22	45.83	21	43.75	3	6.26	2	4.16	0	0.00	48	100.00	4.31
Bed cleaning every time before feeding	23	47.92	17	35.41	3	6.26	5	10.41	0	0.0	48	100.00	4.21
Sprinkling “PEBSOL” on silkworms once before they come out from their molting state every time	15	31.25	15	31.25	11	22.92	7	14.58	0	0.0	48	100.00	3.79
Culling un-molting silkworm form molting silkworm during molting silkworm	10	20.83	16	33.33	8	16.67	14	29.17	0	0.0	48	100.00	3.46
Average													4.19

Table 52 (continue)

Items	Opinions level										Total	\bar{x}	
	Strongly agree		Agree		Uncertain		Disagree		Strongly disagree				
	No.	%	No.	%	No.	%	No.	%	No.	%			
Mounting management													
Culling firm cocoon with tight cocoon, no twin or thin cocoon that are not clean inside and outside, and no defects	30	62.50	18	37.50	0	0.00	0	0.00	0	0.00	48	100.00	4.63
Select a well ventilated place for mounting	24	50.00	24	50.00	0	0.00	0	0.00	0	0.00	48	100.00	4.50
Cleaning mountage before putting cocoon into mountage and after bringing cocoon out of mountage	18	37.50	25	52.08	4	8.34	1	2.08	0	0.00	48	100.00	4.25
Collecting silk cocoon softly from mountage to prevent pupa body breakage or death	24	50.00	14	29.16	5	10.42	5	10.42	0	0.00	48	100.00	4.19
Harvesting cocoon 4-5 days after silkworm mounting	10	20.83	23	47.92	4	8.34	11	22.91	0	0.00	48	100.00	3.67
Average											48	100.00	4.23

Table 52 (continue)

Items	Opinions level												\bar{x}
	Strongly agree		Agree		Uncertain		Disagree		Strongly disagree		Total		
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	
Silkworm disease and pest management													
Eliminate unhealthy and infected silkworm by using formalin 3%	22	45.83	18	37.50	5	10.42	3	6.5	0	0.00	48	100.00	4.23
Preventing ants from damaging silkworm by digging a ditch around silkworm raring room	19	39.58	21	43.75	5	10.42	3	6.25	0	0.00	48	100.0	4.17
Sprinkling “PEBSOL” on newly hatched silkworm every time	24	50.00	13	27.08	5	10.42	6	12.50	0	0.00	48	100.0	4.15
Spraying or fumigating the silkworm rearing room and equipment with formalin 3% every time before silkworm rearing	17	35.42	11	22.91	3	6.25	17	35.42	0	0.00	48	100.0	3.58
Average													4.05

Table 52 (continue)

Items	Opinions level												\bar{x}
	Strongly agree		Agree		Uncertain		Disagree		Strongly disagree		Total		
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	
Production of silk product	25	52.08	21	43.75	2	4.17	0	0.00	0	0.00	48	100.00	4.48
Cleaning reeling equipment before and after use													
Using clean water for boiling cocoon every time	22	45.83	18	37.50	5	10.42	3	6.25	0	0.00	48	100.00	4.23
Using vinegar to fix color in dyeing method	22	45.83	19	39.58	6	12.50	1	2.08	0	0.00	48	100.00	4.29
Using 80-100 cocoon/time in every boiling pot for drawing the silk from the cocoon in order to get good quality silk yarn	19	39.59	13	27.08	6	12.50	10	20.8	0	0.00	48	100.00	3.85
Average													4.21

Table 52 (continue)

Items	Opinions level												\bar{x}
	Strongly agree		Agree		Uncertain		Disagree		Strongly disagree		Total		
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	
Marketing management													
Producing silk product according to market's requirement	31	64.59	16	33.33	0	0.00	1	2.08	0	0.00	48	100.0	4.60
Determine silk product quality before selling	26	54.17	21	43.75	1	2.08	0	0.00	0	0.00	48	100.0	4.52
Setting price according to silk quality, design and color	24	50.00	22	45.83	2	4.17	0	0.00	0	0.00	48	100.0	4.46
Consistently using quality raw materials in silk production every time	23	47.92	24	50.00	1	2.08	0	0.00	0	0.00	48	100.0	4.44
Advertising silk product through various media channels	23	47.92	20	41.66	5	10.42	0	0.00	0	0.00	48	100.0	4.38
Setting price according to target groups	22	45.83	21	43.75	3	6.25	2	4.17	0	0.00	48	100.0	4.31
Producing silk product towards quality certification.	21	43.75	19	39.58	7	14.59	1	2.08	0	0.00	48	100.0	4.25
Average													4.42

Table 52 (continue)

Items	Opinions level												\bar{x}
	Strongly agree		Agree		Uncertain		Disagree		Strongly disagree		Total		
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	
Accounting management													
Providing capital in advance for sericulture production	23	47.92	23	47.92	1	2.08	1	2.08	0	0.00	48	100.00	4.42
Planning expenditure in sericulture production	13	27.08	31	64.59	3	6.25	1	2.08	0	0.00	48	100.00	4.17
Analyzing return in sericulture production	21	43.75	24	50.0	3	6.25	0	0.00	0	0.00	48	100.00	4.38
Earning as capital in further production	20	41.67	25	50.0	3	6.25	0	0.00	0	0.00	48	100.00	4.35
Providing accounting records in sericulture production	18	37.50	24	50.0	6	12.50	0	0.00	0	0.00	48	100.00	4.25
Average													4.31

Table 52 (continue)

Items	Opinions level												\bar{x}
	Strongly agree		Agree		Uncertain		Disagree		Strongly disagree		Total		
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	
Human resource management													
Participation in group activity	34	70.83	14	29.17	0	0.0	0	0.00	0	0.00	48	100.00	4.71
Participation in all group learning process	34	70.83	14	29.17	0	0.0	0	0.00	0	0.00	48	100.00	4.71
Participation in group benefit	31	64.59	16	33.33	1	2.08	0	0.00	0	0.00	48	100.00	4.63
Average												4.68	
Total average												4.29	

Note: Average score between 4.21- 5.00 refers to extremely positive attitude

Average score between 3.41- 4.20 refers to positive attitude

Average score between 2.61- 3.40 refers to average attitude

Average score between 1.81- 2.60 refers to negative attitude

Average score between 1.00-1.80 refers to extremely negative attitude

Source: Survey (2011)

The farmers' practice in commercial silk production

According to analysis on farmers' practice by using average and standard deviation as criteria to identify farmers' level of practice, it can be divided into 3 levels including the good, moderate, and poor level as shown in Table 53 and Table 54.

The findings revealed that the majority of respondent had practice scores in moderate level, accounting for 68.75 %. The rests were in poor and good level, accounting for 18.75 % and 12.5 %, respectively.

In terms of silkworm rearing management aspect, the majority of respondent corrected practice on harvesting young mulberry leaf from the 2nd – 3rd leaf from the top for feeding young and feed leaf to young silkworms by chopping mulberry leaves into the appropriate size for silkworms, accounting for 79.17 %.

The study indicated that the most corrected practice in harvesting mulberry leaf for young silkworm by the suitable kind and number of mulberry for rearing in each age is the key stage to contribute sufficient food for silkworm to grow faster and stronger.

However, a limited number of respondents enlarged silkworm rearing area every time before feeding. They also did not practice on sprinkle "PEBSOL" on silkworm once before they come out from their molting state, using lime or rice husks to reduce humidity while silkworms are molting, culling un-molting silkworm from molting during molting silkworm and also cleaning silkworm excrement before feeding.

Moreover, the lowest corrected practice was bed cleaning before feeding. This is because farmers clean silkworm excrement one time a day only as the silkworms do not have many dropping. So, the feces do not have to be removed every time before feeding. This mistake practiced affecting unhealthy silkworm and damage.

For mounting management, the majority of respondent corrected practice in collecting silk cocoons softly from mountage to prevent pupa body breakage or death, accounting for 72.92 %. The rest were involved in cleaning mountage before putting cocoon into mountage, and after bringing cocoon out of mountage, accounting for 64.58 %.

The findings showed that the majority of respondent corrected practice in collecting silk cocoon softly from mountage to prevent pupa body breakage or death. They also want good cocoon to produce good quality silk yarn. Nevertheless, a few of them selected a well ventilated place for mounting and harvesting cocoons 4-5 days after silkworm mounting. The study revealed that the lower corrected practice is collecting the cocoons after 4-5 day - mounting by their observation. In fact, if the farmers gathered the cocoons later than the appropriate time, the silkworms become butterfly.

In disease and pest management, the majority of respondent corrected practice in eliminating unhealthy and infected silkworms by using 3% formalin. It was found that most farmers removed correctly in disease infected cocoons to destroy in the 3% formalin every time.

The lowest corrected practice was to sprinkle "PEBSOL" on the newly hatched silkworm. Because "PEBSOL", a smelly chemical substance is rarely found in the market, so the farmers sometimes use lime instead.

In production of silk product, it was found that most respondents corrected practice on using 80-100 cocoons per time in every boiling pot for drawing the silk from the cocoon in order to get good quality silk yarn. This because of farmers wanted to get the good quality silk yarn that meet market requirement and can sale at high price. The lowest corrected practice was cleaning reeling equipment before and after use.

In terms of marketing management, most respondents corrected practice in advertising silk product through various media channels. This is because farmers need their products to be recognized as well as to increase sales volumes.

The lowest corrected practice were producing silk products that met market requirement, checking silk product quality before selling, setting price according to silk quality, design and color, and setting price according to target group because farmers usually set the price by themselves. In addition, actually the silk fabric price always fluctuates depending on market demand and time.

Regarding accounting management, most respondents corrected practice in providing capital in advance for sericulture production. This is because the farmers can access loans from local financial institutes and occupational groups in the village. However, the lowest corrected practice was providing accounting record in sericulture production. The problem was caused by their limited time to implement.

In terms of human resource management, most respondents corrected practice in every aspect. In fact, they had been trained by the sericulture group. However, the farmers still need some financial support to improve more on their production.

Table 53 Farmers' practice level in commercial sericultural production

Practice levels	No	%
Good	6	12.50
Moderate	33	68.75
Poor	9	18.75
Total	48	100.0

Note 1/: Min= 7 point, Max = 31, \bar{x} = 18.21, SD= 6.69

2/: The practice levels are as follows :

Good = more than 25.4 ($18.21+6.69 = 24.9$)

Moderate level = between 11.52-24.9

($18.21+ 6.69 = 24.9$ to $18.21 - 6.69 = 11.52$)

Poor = less than 11.52 ($18.21 - 6.69 = 12.85$)

Table 54 Farmers' practice in commercial silk production

Items	Always	Never	Total
	No. (%)	No. (%)	No. (%)
Silkworm rearing management			
Feeding mulberry leaf to young silkworm by chopping mulberry leaf into the appropriate size for silkworm	38 (79.17)	10 (20.83)	48 (100.0)
Harvesting the young mulberry leaf from the 2 nd – 3 rd leaf from the top for feeding young silkworm	37 (77.08)	11 (22.92)	48 (100.0)
Enlarge the silkworm rearing area before feeding	24 (50.00)	24 (50.00)	48 (100.0)
Sprinkling “PEBSOL” on silkworms once before they come out from their molting state	24 (50.00)	24 (50.00)	48 (100.0)
Using lime or rice husk to reduce humidity while silkworms are molting	24 (50.00)	24 (50.00)	48 (100.0)
Culling un-molting silkworm form molting silkworm every time during molting silkworm	22 (45.83)	26 (54.17)	48 (100.0)

Table 54 (Continued)

Items	Always	Never	Total
	No. (%)	No. (%)	No. (%)
Bed cleaning before feeding	18 (37.50)	30 (62.50)	48 (100.0)
Mounting management			
Collecting silk cocoon softly from mountage to prevent pupa body breakage or death	35 (72.92)	13 (27.08)	48 (100.0)
Cleaning mountage before putting cocoon into mountage and after bringing cocoon out of mountage	31 (64.58)	17 (35.42)	48 (100.0)
Select a well ventilated place for mounting every time	23 (47.92)	25 (52.08)	48 (100.0)
Culling firm cocoon with tight cocoon, no twin or thin cocoon that are not clean inside and outside, and no defect	23 (47.92)	25 (52.08)	48 (100.0)
Harvesting cocoon 4-5 days after silkworm mounting	21 (43.75)	27 (56.25)	48 (100.0)
Silkworm disease and pest management			
Eliminate unhealthy and infected silkworm by using 3 % formalin	38 (79.17)	10 (20.83)	48 (100.0)
Spraying or fumigating the silkworm rearing room and equipment with 3% formalin every time before silkworm rearing	15 (31.25)	33 (68.75)	48 (100.0)
Preventing ant from damaging silkworm by digging a ditch around silkworm rearing room	13 (27.08)	35 (72.92)	48 (100.0)
Sprinkling “PEBSOL” on newly hatched silkworm every time	3 (6.25)	45 (93.75)	48 (100.0)
Production of silk products			
Using 80-100 cocoon/time in every boiling pot for drawing the silk from the cocoon in order to get good quality silk yarn	29 (60.42)	19 (39.58)	48 (100.0)
Using clean water for boiling cocoon every time	25 (52.08)	23 (47.92)	48 (100.0)
Using vinegar to fix color in dyeing method	25 (52.08)	23 (47.92)	48 (100.0)
Cleaning reeling equipment before and after use	24 (50.00)	24 (50.00)	48 (100.0)

Table 54 (Continued)

Items	Always No. (%)	Never No. (%)	Total No. (%)
Marketing management			
Advertising silk product through various media channels	31 (64.58)	17 (35.42)	48 (100.0)
Producing silk product towards quality certification	29 (60.42)	19 (39.58)	48 (100.0)
Consistently using quality raw materials in silk production every time	24 (50.00)	24 (50.00)	48 (100.0)
Producing silk product that meet marketing requirement	23 (47.92)	25 (52.08)	48 (100.0)
Determine silk product quality before selling	23 (47.92)	25 (52.08)	48 (100.0)
Setting price according to silk quality, design and color	23 (47.92)	25 (52.08)	48 (100.0)
Setting price according to target groups	23 (47.92)	25 (52.08)	48 (100.0)
Accounting management			
Providing capital in advance for sericulture production	33 (68.75)	15 (31.25)	48 (100.0)
Planning expenditure in sericulture production	32 (66.67)	16 (33.33)	48 (100.0)
Earning as capital in further production	31 (64.58)	17 (35.42)	48 (100.0)
Analyzing return in sericulture production	21 (43.72)	27 (56.25)	48 (100.0)
Providing accounting records in sericulture production	18 (37.50)	30 (62.50)	48 (100.0)
Human resource management			
Participation in group benefit	36 (75.00)	12 (25.00)	48 (100.0)

Table 54 (Continued)

Items	Always	Never	Total
	No. (%)	No. (%)	No. (%)
Participation in all group learning process	31 (64.58)	7 (35.42)	48 (100.0)
Participation in group activity	25 (52.08)	23 (47.92)	48 (100.0)

Source: Survey (2011)

Comparison between knowledge and practice in commercial sericultural production

Comparison between knowledge and practice in commercial silk production by the criterion of corrected knowledge and practice more than 50% are presented in Table 55. They are divided into 3 aspects. First, farmers actually had corrected both in knowledge and practiced. The items are 1) harvesting mulberry leaf for young silkworm 2) feeding mulberry leaf to young silkworm 3) time for cleaning moutage by cleaning moutage before putting cocoon into moutage and after bringing cocoon out of moutage 4) method for harvesting cocoons from moutage by collecting silk cocoons softly from moutage to prevent pupa body breakage or death 5) method for eliminating unhealthy or infected silkworm during rearing 6) Type of water used for boiling cocoon by using clean water 7) Appropriate amount of cocoon to be boiled to ensure good quality of silk yarn by using 80-100 cocoon/time in every boiling pot for reeling the silk yarn from the cocoon in order to acquire good quality silk yarn 8) using vinegar for fix color in dyeing method 9) method for making silk product well know in the market 10) method for getting product accepted by market 11) method for making efficiency accounting management 12) efficiency investment making decision 13) method for determining silk production cost 14) Method for determining in silk production cost 14) method in enhance strength and unity for group member 15)

method for group working to produce good quality product and also 16) encourage group among members.

Second, farmers actually had corrected knowledge but they did not practice. The items are 1) enlarging silkworm rearing area before feeding 2) bed cleaning before feeding 3) culling un-molting silkworm from molting silkworm during molting silkworm 4) sprinkling “PEBSOL” on silkworm once before they come out from their molting state 5) the suitable place for mounting 6) characteristic of good cocoon and 7) method in maintain reeling equipment.

The last, farmers had less knowledge and they did not practice it. The items are 1) substance used to reduce humidity when the silkworm is molting 2) suitable time to harvest cocoon 3) chemical used to sprinkle over newly hatched silk worm 4) chemical used to spray in the room and equipment for rearing silkworm before rearing silk worm 5) preventing ant from damaging silkworm 6) method for producing silk product that meet market requirement 7) method for setting price according to target group and 8) methods for setting price according to silk quality.

From the investigation, it can point out that the urgent recommendations in terms of corrected knowledge and practice towards intervention programs that should be promoted continuously by concern agencies are 1) using substance to reduce humidity when the silkworm is molting 2) suitable time to harvest cocoon 3) using chemical to sprinkle over newly hatched silkworm 4) using chemical to spray in the room and equipment for rearing silkworm before rearing silk worm 5) preventing ant from damaging silkworm 6) method for producing silk product that meet market requirement, 7) method for setting price according to target group and also 8) method for setting price according to silk quality.

Furthermore, the common practices that should be promoted under the process of learning by doing are 1) enlarging silkworm rearing area before feeding 2) bed cleaning before feeding 3) culling un-molting silkworm from molting silkworm during molting silkworm 4) sprinkling “PEBSOL” on silkworm once before they come out

from their molting state 5) the suitable place for mounting 6) characteristic of good cocoon and also 7) method in maintain reeling equipment as well.

Table 55 Distribution of knowledge towards commercial sericultural production

Items	Knowledge	Practice
Silkworm rearing management		
Harvesting mulberry leaf for young silkworm	/	/
Feeding mulberry leaf to young silkworm	/	/
Method for enlarging silkworms rearing area	/	×
Time for bed cleaning	/	×
Practice for silkworms molting	/	×
Practice for silkworm after molting	/	×
Using substance to reduce humidity when the silkworm is molting	×	×
Mounting management		
Times for cleaning mountage	/	/
Suitable place for mounting	/	×
Suitable time to harvest cocoon	×	×
Method for harvesting cocoon from mountage	/	/
Characteristic of good cocoon	/	×
Silkworm disease and pest management		
Using chemical to sprinkle over newly hatched silkworm	×	×
Using chemicals to spray in the rooms and equipment for rearing silkworms before rearing silk worms	×	×
Methods for eliminating unhealthy or infected silk worms	/	/
Preventing ant from damaging silkworm	×	×
Production of silk products		
Method in maintain reeling equipment	/	×
Type of water used to boil cocoons	/	/
Appropriate amounts of cocoons to be boiled to ensure good quality of silk yarn	/	/

Table 55 (continue)

Items	Knowledge	Practice
	No. %	No. (%)
Using substance for fix color in dyeing method	/	/
Marketing management		
Method for producing silk product that meet market requirement	×	×
Method for preparing raw material to producing good product quality meet market requirement	/	×
Method for producing quality product to be sold at high price	/	×
Method for setting price according to target group	×	×
Method for setting price according to silk quality	×	×
Method for making silk product well known in the market	/	/
Method for getting product accepted by the market	/	/
Accounting management		
Method for making efficiency accounting management	/	/
Efficiency investment making decision	/	/
Method for determining silk production cost	/	/
Providing investment in sericulture production	/	×
Accounting management after selling	/	×
Human Resource Management		
Method in enhance strength and unity for group member	/	/
Method for group working to produce good quality product	/	/
Encourage group working among member	/	/

Note: / refers to either corrected knowledge or corrected practice more than 50%

× refers to either corrected knowledge or corrected practice less than 50%

Factors affecting farmers' perception

To examine factors determinant farmers' perception of sericulture production in the study area, Pearson product moment correlation coefficient has been used. Before discussion of the results, the variables will be explained.

1. Dependent variables

The dependent variable was knowledge, attitude and practice of farmer

2. Independent variables

The independent variables include 3 main items as follows:

Farmers' personal background factors

X_1 = Age

X_2 = Sericulture production experiences

X_3 = Level of education

X_4 = Number of sericulture information perception

Socio-economic factors

X_5 = number of labor

X_6 = Group belonging

X_7 = Frequency of group participation

Institutional factors

X_8 = Number of contact agency

From statistical analysis, the finding is shown in Table 56. There were 3 factors included number of sericulture information perception, number of contacted agency and frequency of group participation had positive significant with farmers' knowledge in commercial sericultural production at statistically significant level of 0.01. The correlation coefficients were at 0.776, 0.766 and 0.433, respectively.

It means that if famers had more number of sericulture information perception, number of contacted agency, and frequency of group participation, they have more knowledge in commercial sericultural production. This is because farmers can gain knowledge in sericulture production from various sources for example, leader group, farm visit and training course. Moreover, they can exchange their knowledge from group members and got a new technology from various concern agencies. Thus, they had more knowledge in sericulture production.

In addition, the findings indicated that there were 3 factors included number of sericulture information perception, number of contacted agency and frequency of group participation had positive significant with farmers' practice in commercial sericultural production at statistically significant level of 0.01. The correlation coefficients were at 0.767, 0.764 and 0.427, respectively.

It means that if famers had more number of sericulture information perception, number of contacted agency, and frequency of group participation, they have more practice in commercial sericultural production. It is because farmers can gain new information from various sources to apply in sericulture production. They also exchange techniques in sericulture production from group members and got a new technology from various concern agencies. Thus, they had more good practice in sericulture production.

Furthermore, the findings indicated that sericulture production experiences had negative significant at statistically significant level of 0.01 with attitude in commercial sericultural production. The correlation coefficient was at -0.438.

It means that if farmers have more sericulture production experiences, they have less agree opinion in commercial sericultural production. It is because almost of them are aged farmers who are familiar to their own practice that they have learnt from ancestors. Then, when they contacted agencies came to recommend them for the new technology that is quite different from their common practice, they always never agree to the recommendation.

Moreover, the findings indicated that there were positive significant between number of contacted agency at statistically significant level of 0.01 with attitude in commercial sericultural production. The correlation coefficient was at 0.323. It is because farmers who have more contact with extension agencies. They had opportunity to get new information and gained new knowledge from various concern agencies. Moreover, they also realized that if their sericulture production follows agencies concern recommendation, they can produce better quality product to reach marketing requirement.

Table 56 Relationship between some factors and perception in commercial sericulture production

Some factors of farmers	Farmers' perception		
	Knowledge	Practices	Attitude
Age	-0.004	-0.022	-0.103
Sericulture production experiences	0.054	0.360	-0.438**
Level of education	0.171	0.151	0.217
Number of sericulture information perception	0.776**	0.764**	0.171
Number of labor	0.184	0.182	0.156
Group belonging	0.890	.0640	-0.011
Frequency of group participation	0.433**	0.427**	0.204
Number of agency contact	0.766**	0.767**	0.323*

Note: **, * statistical significant relation at .01 and .05, respectively

Part 5 Cost and Return Analysis

The cost and return of sericulture production were analyzed by using cost and return and break-even analysis in order to indicate cost function and relative mulberry cultivation, cocoon production, silk yarn production and silk fabric production in the study areas.

Production cost analysis

The cost in sericulture production is related with mulberry cultivation, silkworm rearing, silk yarn production and silk fabric weaving.

1. Mulberry cultivation cost

Mulberry cultivation cost consisted of fixed cost and variable cost. Fixed costs were land and depreciation cost. Variable costs were labor, fertilizer, soil conditioner, opportunity cost of capital, and other cost. In this calculation, the production cost is in form of both cash and non cash cost.

The mulberry cultivation cost per rai as shown in Table 57, total cost was 7,595.06 baht. Variable cost was 5,664.29 baht, accounting for 74.58 %. Fixed cost was 1,930.77 baht, accounting for 25.42 %. Total cash cost was 1,347.99 baht. Total non cash cost was 6,247.07 baht.

In terms of variable cost, labor cost was highest, accounting for 44.78 %. The rests were fertilizer cost, opportunity cost of capital, other cost, and soil conditioner cost, accounting for 24.77 %, 2.52 %, 1.85 %, and 0.66 %, respectively. For the fixed cost, land cost was the highest, accounting for 23.68 %. The rests were depreciation cost, accounting for 1.74 %. The study revealed that most farmers used labor force in mulberry cultivation such as fertilizer applying, weed control, watering, pruning and harvesting.

In terms of cash cost, the majority of cash cost was paid for fertilizer. The rest was soil conditioner such as dolomites and lime. Most farmers used fertilizer to increase yield of mulberry leaves.

Meanwhile, the majority of non cash cost was spent on labor cost. Almost labor cost is permanent for weeding and harvesting. The amount of labor force is 150 baht/day. The rest were cost of land use, for example land rent, fertilizer because they use their own manures, opportunity cost of capital, other cost such as electricity and water and depreciation cost, respectively. Most farmers used household labor force as main source in mulberry cultivation.

Table 57 Mulberry cultivation cost

Items	Mulberry production cost (baht/ rai)			
	Cash cost	Non cash cost	Total	%
Fixed cost				
Land	0.00	1,798.57	1,798.57	23.68
Depreciation	0.00	132.20	132.20	1.74
Total fixed cost	0.00	1,930.77	1,930.77	25.42
Variable cost				
Fertilizer	1,297.79	583.33	1,881.12	24.77
Soil conditioner	50.20	0.00	50.20	0.66
Labor	0.00	3,400.97	3,400.97	44.78
Opportunity cost of capital	0.00	191.55	191.55	2.52
Others ^{2/}	0.00	140.45	140.45	1.85
Total variable cost	1,347.99	4,316.30	5,664.29	74.58
Total cost	1,347.99	6,247.07	7,595.06	100.00

Note: 1/: Others cost refers to petrol and diesel, electricity and maintenance.

Source: Survey (2011)

2 Silkworm rearing cost

Silkworm rearing cost consists of fixed cost and variable cost. Fixed cost was depreciation cost. Variable costs were silkworm egg, mulberry leaf, disinfectant, labor, opportunity cost of capital, and others cost. In this calculation, the production cost is divided into cash and non cash cost.

The silkworm rearing cost per sheet per cycle as shown in Table 58, total cost of silkworm was 2,984.52 baht. Variable cost was 2,963.86 baht, accounting for 99.31 % baht and fixed cost was 20.66 baht, accounting for 0.69 %. Total cash cost was 348.49 baht. Total non cash cost was 2,636.01 baht.

In terms of variable cost, labor cost was the highest expense, accounting for 56.95 %. The rests were mulberry leaf cost, opportunity cost of capital, other cost, silkworm egg, and disinfectant cost, accounting for 29.02 %, 4.71 %, 4.45 %, 3.36 %, and 0.82 % respectively. For the fixed cost, depreciation cost was 0.69 %.

The results indicated that most of production cost was spent on labor cost because farmers used labor force in silkworm rearing activities such as silkworm rearing room preparation, silkworm feeding, enlarging silkworm rearing area, collecting mature worms for mounting and cocoon harvesting. The amount of labor force is 150 baht/day.

In terms of cash cost, the majority of cash costs were paid for other costs such as electricity and water. The rests were mulberry leaf, silkworm egg, and disinfectant cost. The results indicated that most farmers used tap water for silkworm rearing room cleaning before and after silkworm rearing. Meanwhile, the majority of non cash cost was labor cost. The rests were mulberry leaf, opportunity cost of capital, silkworm egg and depreciation cost, respectively. All farmers used only household labor force in silkworm rearing activities. Because it is delicate work that need intensive care for better quality of products.

Regarding total cost in silkworm rearing in the research site that was 2,984.52 baht per cycle. When compares to the province level in year 2010 that is 2,794.10 baht per cycle, it reveals that farmers spent more than the average cost because silkworm rearing is delicate and take time to raring. In addition, they realize sufficient mulberry leaf to feed silkworm in each age can make good growth and healthy silkworm. Therefore, they spent more in labor force and mulberry leaf cost.

Table 58 Silkworm rearing cost

Item	Silkworm rearing cost (baht/sheet/cycle)			
	Cash cost	Non cash cost	Total	%
Fixed cost				
Depreciation cost	0.0	20.66	20.66	0.69
Total fixed cost	0.0	20.66	20.66	0.69
Variable costs				
Silkworm egg	51.45	81.25	132.70	4.45
Mulberry leaf	132.00	734.20	866.20	29.02
Disinfectant	24.59	0.00	24.59	0.82
Labor cost	0.0	1,699.67	1,699.69	56.95
Opportunity cost of capital	0.0	100.23	100.23	3.36
Others ^{1/}	140.45	0.00	140.45	4.71
Total variable cost	348.49	2,615.35	2,963.86	99.31
Total cost	348.49	2,636.01.61	2,984.52	100.00

Note : 1/ Others cost refers to electricity and maintenance

2/ Cost of silkworm rearing at province level was 2,794.10 baht per cycle by calculated from Goss primary production (GPP)

Source: Survey (2011)

3. Silk yarn production cost

Silk yarn production cost consists of fixed cost and variable cost. Fixed cost was depreciation cost of equipment. Variable cost consists of cocoon, labor, opportunity cost of capital, and others cost. In this calculation, the production cost is divided into cash and non cash.

The silk yarn production cost per year is shown in Table 59. Total cost was 18,515.59 baht. Variable cost was 18,347.09 baht, accounting for 99.09 % and fixed cost was 168.50 baht, accounting for 0.91 %. Total cash cost was 1,005.17 baht. Total non cash cost was 17,511.38 baht.

In terms of variable cost, cocoon cost was the highest, accounting for 79.54 %. The rests were labor cost and opportunity cost of capital, accounting for 16.20 % and 3.35 %, respectively. Fixed cost was depreciation cost, accounting for 0.91 %. The results indicated that the majority of production cost was cocoon cost as it was the main material for producing silk yarn. The majority of cocoons come from silkworm eggs that farmers get from concern agencies in northeastern such as QSDS.

In terms of cash cost, labor cost was highest. Farmers hired labor for cocoon culling. Meanwhile, the majority of non cash cost was cocoon cost. The rests were labor, opportunity cost of capital, and depreciation cost, respectively. The results indicated that farmers produced cocoon by themselves for silk yarn reeling. A few of them sold cocoons to neighboring who want to keep the good quality of cocoons for the next rearing. The price is only 90-100 baht/ 1 kg of cocoon.

Regarding total cost in silk yarn reeling in the research site that was 1,259.1 baht per kg. When compares to the province level in year 2010 that is 1,421.60 baht per kg, it reveals that farmers spent less than the average cost because they use developed hand reeling apparatus that can produce more silk yarn in short time.

Table 59 Silk yarn production cost

Item	Silk yarn production cost (baht/ year)			
	Cash cost	Non cash cost	Total	%
Fixed cost				
Depreciation	0.00	168.50	168.50	0.91
Total fixed cost	0.00	168.50	168.50	0.91
Variable cost				
Cocoon	0.00	14,727.96	14,727.0	79.54
Labor	1,005.17	1,994.49	2,999.66	16.20
Opportunity cost of capital	0.00	620.43	620.43	3.35
Others ^{1/}	0.00	0.00	0.00	0.00
Total variable cost	1,005.17	17,342.88	18,347.09	99.09
Total cost	1,005.17	17,511.38	18,515.59	100.00

Note : 1/ Others cost refers to electricity and maintenance

2/ Average cost of silkworm was 1421.60 baht per kg by calculated from

Gross primary production (GPP)

Source: Survey (2011)

4. Silk fabric production cost

The production costs in this part is the cost of silk fabrics includes plain silk fabrics, “MUDMEE”, “PHAKAOMA”, “SARONG”, and shawls are shown in Table 60 -64.

4.1 Plain silk fabrics production cost

Plain silk fabrics production cost consists of fixed cost and variable cost. Fixed cost was depreciation cost. Variable costs were silk yarn, material, labor, opportunity cost of capital, and others costs. In this calculation, the production cost is divided into cash and non cash.

In terms of Plain silk fabrics production cost per year is shown in Table 60. Total cost was 6,307.05 baht. Variable cost was 6,270.60 baht, accounting for 99.42 % and fixed cost was 36.45 baht, accounting for 0.58 %. Total cash cost was 1,597.45 baht. Total non cash cost was 4,709.60 baht.

In terms of variable cost, silk yarn cost was the highest, accounting for 77.75 %. The rests were labor, opportunity cost of capital, and material cost, accounting for 18.22 %, 3.36 % and 0.09 % respectively. Fixed cost was depreciation cost, accounting for 0.58 %.

In terms of cash cost, the majority of cash cost was paid for silk yarn cost. The rests were labor, and material cost. Most non cash cost was paid for silk yarn cost. The rest were labor, opportunity cost of capital and depreciation cost, respectively. Silk yarn includes warp yarn and weft yarn comes from factory and their own. All of weft yarn is produced by farmers. On the other hand almost of warp yarn farmers buy from local shop in their own community. The price is around 1,400 baht per kg.

Table 60 Plain silk fabrics production cost

Item	Plain silk fabrics production cost (baht/ year)			
	Cash cost	Non cash cost	Total	%
Fixed cost				
Depreciation	0.00	36.45	36.45	0.58
Total fixed cost	0.00	36.45	36.45	0.58
Variable cost				
Silk yarn	1,331.82	3,571.76	4,903.58	77.75
Material	5.63	0.00	5.63	0.09
Labor	260.00	889.34	1,149.34	18.22
Opportunity cost of capital	0.00	212.05	212.05	3.36
Other cost ^{1/}	0.00	0.00	0.00	0.00
Total variable cost	1,597.45	4,673.15	6,270.60	99.42
Total cost	1,597.45	4,709.60	6,307.05	100.00

Note: 1/: Others cost refers to electricity and maintenance

Source: Survey (2011)

4.2 “MUDMEE” silk fabric production cost

“MUDMEE” silk fabrics production cost includes fixed cost and variable cost. Fixed cost is determined by depreciation cost only. Variable cost consists of silk yarn, material, labor, opportunity cost of capital, and others cost. In this calculation, the production cost is divided into cash and non cash cost.

“MUDMEE” silk fabric production cost per year is shown in Table 61. The total cost was 9,334.81 baht. Variable cost was 8,436.72 baht, accounting for 90.38 % and fixed cost was 898.09 baht, accounting for 9.62 %. Cash cost was 2,300.56 baht. Total non cash cost was 7,034.25 baht.

In terms of variable cost, silk yarn cost was highest, accounting for 65.14 %. The rests were labor, opportunity cost of capital, and material cost accounting

for 20.17 %, 3.06 %, and 2.01 % respectively. Fixed cost was depreciation cost, accounting for 9.62 %. The study revealed that most farmers used silk yarn as the main material in silk fabric weaving.

In terms of cash cost, the majority of cash cost was paid for silk yarn cost. The rests were labor and material cost. The majority of non cash cost was silk yarn cost, the rest were labor, depreciation cost and opportunity cost of capital, respectively.

When compare between “MUDMEE silk fabric production cost and plain silk fabric production cost, “MUDMEE” silk fabric production cost was 9,357.28 baht/ year. The plain silk fabric cost was 6,281.86 baht/year.

From the investigation, it can point out that “MUDMEE” silk fabric production cost is rather high than plain silk fabric cost in particular the terms of silk yarn and labor cost because the process is more delicate and take time to produce.

Table 61 “MUDMEE” silk fabric production cost

Item	“MUDMEE” silk fabric production cost (baht/ year)			
	Cash cost	Non cash cost	Total	%
Fixed cost				
Depreciation	0.00	898.09	898.09	9.62
Total fixed cost	0.00	898.09	898.09	9.62
Variable cost				
Silk yarn	1,390.31	4,690.91	6,081.22	65.14
Material	187.58	0.00	187.58	2.01
Labor	722.67	1,159.95	1,882.62	20.17
Opportunity cost of capital	0.00	285.30	285.30	3.06
Others ^{1/}	0.00	0.00	0.0	0.00
Total variable cost	2,300.56	6,136.16	8,436.72	90.38
Total cost	2,300.56	7,034.25	9,334.81	100.00

Note: 1/ Others cost refers to electricity and maintenance

Source: Survey (2011)

4.3 “PHAKAOMA” production cost

“PHAKAOMA” production cost consists of fixed cost and variable cost. Fixed cost was only depreciation cost. Variable cost consists of silk yarn, material, labor, opportunity cost of capital, and other costs. In this calculation, the production cost is divided into cash and non cash cost.

“PHAKAOMA” production cost per year is shown in Table 62. The total cost was 4,467.05 baht. Variable cost was 3,343.05 baht, accounting for 74.84 %. Fixed cost was 1,124.00 baht, accounting for 25.16 %. Total cash cost was 111.00 baht. Total non cash cost was 4,356.05 baht.

In terms of variable cost, silk yarn was the highest, accounting for 60.44 %. The rests were labor, opportunity cost of capital, and accounting for 9.38 %, 2.53 %, and 2.49 %, respectively. Fixed cost was depreciation cost, accounting for 25.16 %.

In terms of cash cost, the majority of cash cost was paid for material cost. The majority of non cash cost was silk yarn cost, the rests were depreciation cost, labor cost, and opportunity cost of, respectively.

From the investigation it point out that farmers produce this kind of product by using their own of silk yarn because they use the low quality of silk yarn to produce.

Table 62 “PHAKAOMA” production cost

Item	“PHAKAOMA” production cost (baht/ year)			
	Cash cost	Non cash cost	Total	%
Fixed cost				
Depreciation cost	0.00	1,124.00	1,124.00	25.16
Total fixed cost	0.00	1,124.00	1,124.00	25.16
Variable				
Silk yarn cost	0.00	2,700.00	2,700.00	60.44
Material cost	111.00	0.00	111.00	2.49
Labor cost	0.00	419.00	419.00	9.38
Opportunity cost of capital	0.00	113.05	113.05	2.53
Other cost ^{1/}	0.00	0.00	0.00	0.00
Total variable cost	111.00	3,232.05	3,343.05	74.84
Total cost	111.00	4,356.05	4,467.05	100.00

Note: 1/ Others cost refers to electricity and maintenance

Source: Survey (2011)

4.4. “SARONG” production cost

“SARONG” silk fabric production cost includes both fixed cost and variable cost. Fixed cost comprises only depreciation cost. Variable cost covers that of silk yarn cost, material, labor, opportunity cost of capital, and other costs. In this calculation, the production cost is divided into cash and non cash expense.

“SARONG” silk fabrics production cost per year as shown in Table 63, total cost was 7,082.19 baht. Variable cost was 5,831.19 baht, accounting for 82.34 %. Fixed cost was 1,251.00 baht, accounting for 17.66 % Total cash cost was 1,056.00 baht. Total non cash cost was 6,026.19 baht.

In terms of variable cost, silk yarn cost was highest, accounting for 66.93 %. The rest were labor, opportunity cost of capital, and material cost accounting for 10.99 %, 2.78 %, and 1.64 %, respectively. Fixed cost was depreciation cost, accounting for 17.66 %.

In terms of cash cost, the majority of cash cost was silk yarn cost. The rest was material cost. The majority of non cash cost was silk yarn expense. The rest were depreciation cost labor and opportunity cost of capital, respectively.

“SARONG” silk fabric cost is rather high because it takes time for producing with high quality of silk yarn. Farmer will make this kind of fabric when they got special order from the shops.

Table 63 “SARONG” silk fabrics production cost

Item	“SARONG” production cost (baht/ year)			
	Cash cost	Non cash cost	Total	%
Fixed cost				
Depreciation	0.00	1,251.00	1,251.00	17.66
Total fixed cost	0.00	1,251.00	1,251.00	17.66
Variable				
Silk yarn	940.00	3,800.00	4,740.00	66.93
Material	116.00	0.00	116.00	1.64
Labor	0.00	778.00	778.00	10.99
Opportunity cost of capital	0.00	197.19	197.19	2.78
Others ^{1/}	0.00	0.00	0.00	0.00
Total variable cost	1,056.00	4,775.19	5,831.19	82.34
Total cost	1,056.00	6,026.19	7,082.19	100.00

Note: 1/ Others cost refers to electricity and maintenance

Source: Survey (2011)

4.5 Shawls production cost

Shawls production cost constitutes fixed cost and variable cost. Fixed cost consists of depreciation cost. Variable cost consists of silk yarn, material, labor, opportunity cost of capital, and other costs. In this calculation, the production cost is divided into cash and non cash expenses.

Shawls silk fabric production cost per year is shown in Table 64. The total cost was 5,049.77 baht, Variable cost was 4,221.77 baht, accounting for 83.60 % and the fixed cost was 828.00 baht, accounting for 16.40 %. Total cash cost was 1,040.00 baht. Total non cash cost was 4,009.77 baht.

In terms of variable cost, silk yarn cost was highest, accounting for 67.44 %. The rests were labor, opportunity cost of capital, and material cost accounting for 10.95 %, 2.83 %, and 2.38 %, respectively. The fixed cost covered depreciation cost, accounting for 16.40 %.

In terms of cash cost, the majority of cash cost was silk yarn cost. The rest was material cost. The majority of non cash cost was silk yarn expense. The rests were depreciation cost labor and opportunity cost of capital, respectively.

Regarding shawl production cost, farmers produced this kind of fabric because they got a better price under the condition that they did not to use a lot of silk yarn and when they got special order from the shops.

Table 64 Shawl production cost

Item	Shawls production cost (baht/ year)			
	Cash cost	Non cash cost	Total	%
Fixed cost				
Depreciation	0.00	828.00	828.00	16.40
Total fixed cost	0.00	828.00	828.00	16.40
Variable				
Silk yarn	920.00	2,486.00	3,406.00	67.44
Material	120.00	0.00	120.00	2.38
Labor	0.00	553.00	553.00	10.95
Opportunity cost of capital	0.00	142.77	142.77	2.83
Others ^{1/}	0.00	0.00	0.00	0.00
Total variable cost	1,040.00	3,181.77	4,221.77	83.60
Total cost	1,040.00	4009.77	5,049.77	100.00

Note: 1/ Others cost refers to electricity and maintenance

Source: Survey (2011)

Sericulture production returns analysis

1. Analysis of break-even point in sericulture production

Breakeven analysis methods were used to calculate the level of a variable needed to obtain a desired level of profit in sericulture production in 2010 divided to break-even yield analysis and break-even price analysis as shown in Table 65.

In terms of mulberry cultivation, the respondents had break-even yield 2,531.93 kg per rai and break-even price at 2.08 baht per kg. The study indicated that farmers had mulberry leaf yield higher than the break-even yield at 1,113.31 kg. They also sold mulberry leaf higher than break-even price at 3 baht per kg. Thus, they earned the profit at 0.92 baht per kg.

In terms of silkworm rearing, the farmers had break-even yield 29.85 kg per cycle per sheet. They had break-even price at 170.54 baht per kg. The study indicated that farmers produced cocoons lower than the break-even yield at 12.35 kg. They sold cocoons at 100.00 baht per kg that was lower than the break-even price. This results in profit loss approximately at 70.54 baht.

In terms of silk yarn reeling, the farmers had break-even yield at 15.43 kg per year and they had break-even price at 1,259.56 baht per kg. The finding revealed the farmers produced silk yarn lower than the break-even yield at 0.73 kg. They sold cocoons at 1,200.00 baht per kg. Their sold price was lower than the break-even price. This causes the farmers profit loss approximately at 59.56 baht.

In terms of silk fabric weaving, the break-even yield in Plain, "MUDMEE", "PHAKAOMA", "SARONG", and shawl were 20.54, 13.65, 16.75, 12.50 and 18.70 meter per year, respectively. The study indicated that farmers produced Plain, "MUDMEE", "PHAKAOMA", "SARONG", and shawl at 27.40, 32.60, 24.00, 18.60, and 25.20 meter per year respectively, that is higher than the break-even yield at 6.86, 18.95, 7.25, 6.55, and 6.50 meter per year, respectively.

They also had break-even price at 230.18, 286.34, 156.13, 380.76 and 200.39 baht per meter, respectively. They sold Plain, “MUDMEE”, “PHAKAOMA” “SARONG”, and shawl at 307.00, 684.10, 266.70, 566.70 and 270.00 baht per meter, respectively. They sold higher than the break-even price. Thus, they earned the profit at 76.82, 397.76, 80.57, 185.94 and 69.61, respectively.

Table 65 Analysis of break-even yield and break-even price in sericulture production

Items	Break-even yield		Break-even price	
	Actual	Break-even Point	Actual	Break-even Point
Mulberry cultivation	3,645.00	2,531.69	3.00	2.08
Silkworm rearing	17.50	29.85	100.00	170.54
Silk yarn reeling	14.70	15.43	1,200.00	1,259.56
Plain silk fabric	27.40	20.54	307.00	230.18
“MUDMEE”	32.60	13.65	684.10	286.34
“PHAKAOMA”	24.00	16.75	266.70	186.13
“SARONG”	18.60	12.50	566.70	380.76
Shawl	25.20	18.70	270.00	200.39

Source: Survey (2011)

2 Cost and return in mulberry cultivation

Cost and return in mulberry cultivation per rai as shown in Table 66, it found that mulberry yield was 3,645.00 kg per rai. The price was 3.0 baht per kg. The cost per kg was 2.08 baht per kg.

In terms of the break-even yield, it is 2,531.69 kg. The actual yield is 3,645.00 kg. It means that the farmers in the study area can get better yield because they had a good practice in mulberry cultivation. They gained knowledge and new technique from participating in training courses and farm visited, so they can get high yield.

In terms of the break-even price, it is 2.08 baht. The actual price is 3.0 baht. It revealed that framer could get a better price.

Regarding rate of return, income was 10,935.00 baht per rai. Net profit was 3,339.94 baht per rai. It indicated that the rate of return that the farmers got was quite high. However, most farmers grow mulberry leaves to reared silkworms. Only a few of farmers sold some of mulberry leaf to their neighbor in case of they have sufficient.

Table 66 Cost and return in mulberry cultivation

Items	Baht/ rai
Total cost (baht/ rai)	7,595.06
Fixed cost (baht/rai)	1,930.77
Variable cost (baht/rai)	5,664.29
Cash cost (baht/rai)	1,347.99
Non cash cost (baht/rai)	6,247.07
Cost per kg (baht/kg)	2.08
Yield (kg)	3,645.00
Price (baht per kg.)	3.00
Income (baht per rai)	10,935.00
Net profit (baht per rai)	3,339.94
Break- even yield (kg per rai)	2,531.69
Break -even price (baht per kg)	2.08

Source: Survey (2011)

3. Cost and return in silkworm rearing

Cost and return in silkworm rearing per cycle per sheet is shown in Table 67. It found that the cocoon yield was 17.50 kg per rai. The price was 100.00 baht per kg. The cost per kg was 170.54 baht per kg.

In terms of the break even yield, it is 29.85 kg. The actual yield is 17.50 kg. It means that the farmers in the study areas got low yield because they rear Thai hybrid silkworm that give yields averaging 15-18 kg per cycle per sheet.

In terms of the break- even price, it is 170.54 baht. The actual price is 100.00 baht. It revealed that farmer got a low price because they sale cocoon based on the local market price at 100 baht per kg.

In rate of return, income was 1,750.00 baht. Net profit was -1,234.52 baht. It indicated that the return that farmers could generate was low because the cost in silkworm rearing was in the form of non-cash, such as labor cost from their household. In addition, the most farmers reared silkworm for produced silk yarn and silk fabric weaving.

Table 67 Cost and return in silkworm rearing

Items	Baht/ sheet/ cycle
Total cost (baht/ sheet/cycle)	2,984.52
Fixed cost (baht/ sheet/cycle)	20.66
Variable cost (baht/ sheet/cycle)	2,963.86
Cash cost (baht/ sheet/cycle)	348.49
Non cash cost (baht/ sheet/cycle)	2,636.01
Cost per kg (baht)	170.54
Yield (kg /sheet /cycle)	17.50
Price (baht per kg.)	100.00
Income (baht/ sheet/cycle)	1,750.00
Net profit (baht/ sheet/cycle)	-1,326.04
Break-even yield (baht per kg.)	29.85
Break-even price (baht per kg)	170.54

Source: Survey (2011)

4. Cost and return in silk yarn production

Cost and return in silk yarn production per year is shown in Table 68. The silk yarn yield was 14.70 kg. The price was 1,200.00 baht per kg. The cost per kg was 1,259.10 baht per kg.

In terms of the break even yield, it is 15.43 kg. The actual yield is 14.70 kg, it means that the farmers in the study areas got low yield. In terms of the break- even price, it is baht. The actual price is 1,259.56 baht. It revealed that framer got low price because they produce 2nd grade silk yarn. The silk yarn price was between 1,200–1,400 baht per kg.

In rate of return, income was 17,640.00 baht. Net profit was -875.59 baht. It indicated that rate of return farmers could get was low because most of the cost in silk yarn reeling was in non-cash, such as labor cost from their household.

Table 68 Cost and return in silk yarn reeling

Items	Baht/ year
Total cost(baht/year)	18,515.59
Fixed cost(baht/year)	168.50
Variable cost(baht/year)	18,347.09
Cash cost(baht/year)	1,005.17
Non cash cost(baht/year)	17,511.38
Cost per kg(baht)	1,259.10
Yield (kg per year)	14.70
Price (baht per kg.)	1,200.00
Income (baht per year)	17,640.00
Net profit (baht per year)	-875.59
Break-even yield	15.43
Break-even price	1,259.56

Source: Survey (2011)

5. Cost and return in silk fabric weaving

Cost and return in silk fabric weaving per year included Plain fabric, “MUDMEE” “PHAKAOMA” “SARONG” and shawl as shown in Table 69.

In terms of Plain fabric, farmers produced Plain fabric 27.40 meters per year. The price was 307 baht per meter. The cost per meter was 229.50 baht per meter. The break even yield, it is 20.54 meters. The actual yield is 27.40 meter, it means that the farmers in the study areas got better yield. The break- even price, it is 230.18 baht per meter. The actual price is 307.00 baht per meter. It revealed that framer got better price. Income was 8,411.80 baht per year. Net profit was 2,104.75 baht.

In terms of “MUDMEE” fabric, farmers produced “MUDMEE” 32.60 meters per year. The price was 684.10 baht per meter. The break even yield, it is 13.65

meters. The actual yield is 32.60 meters, it means that the farmers in the study areas got better yield. The break- even price, it is 286.34 baht per meter. The actual price is 684.10 baht per meter. It revealed that framer got better price. Income was 22,301.66 baht per year. Net profit was 12,966.85 baht.

Regarding “PHAKAOMA”, farmers produced this fabric 24.00 meters per year. The price was 266.70 baht per meters. The break even yield, it is 16.75 meters. The actual yield is 24.00 meters, it means that the farmers in the study areas got better yield. The break- even price, it is 186.13 baht per meter. The actual price is 266.70 baht per meter. It revealed that framer got better price. Income was 6,400.80 baht per year. Net profit was 1,933.75 baht.

In terms of “SARONG”, farmer produced “SARONG” silk fabric 18.57 meters per year. The price was 566.70 baht per meter. The break even yield, it is 12.50 meters. The actual yield is 18.57 meters, it means that the farmers in the study area got better yield. The break- even price, it is 380.76 baht per meter. The actual price is 566.70 baht per meter. It revealed that framer got better price. Income was 10,523.61 baht per year. Net profit was 3,441.42 baht.

In terms of shawl, farmers produced shawl 25.20 meters per year. The price is 270.00 baht per meter. The break even yield, it is 18.70 meters. The actual yield is 25.20 meters, it means that the farmers in the study area got better yield. The break-even price, it is 200.39 baht per meter. The actual price is 270.00 baht per meter. It revealed that framer got better price. Income was 6,804.00 baht per year. Net profit was 1,754.23 baht. It indicated that the rate of return the farmers could generate was quite high because most of them bought ready-to-use weft yarns from shops and hired labors to weave in some processes such as dying to save time and reduce labor cost. In addition, they produce good quality silk under market requirement so they can get a good price.

Table 69 Cost and return in silk fabric weaving

Items	Plain fabric	“MUDMEE”	“PHAKAOMA”	“SARONG”	Shawl
Total cost(baht per year)	6,307.05	9,334.81	4,467.05	7,082.91	5,049.77
Fixed cost(baht per year)	36.45	898.09	1,124.00	1,251.000	828.00
Variable cost(baht per year)	6,270.60	8,436.72	3,343.05	5,851.19	4,221.77
Cash cost(baht per year)	1,597.45	2,300.56	111.00	1,056.00	1,040.00
Non cash cost(baht per year)	4,709.60	7034.25	4,356.05	6,026.19	4,009.77
Cost per meter(baht per meter)	229.50	286.70	186.80	382.50	184.10
Yield (meter/year)	27.40	32.60	24.00	18.57	25.20
Price (baht/meter)	307.00	684.10	266.70	566.70	270.00
Income (baht per year)	8,411.80	22,301.66	6,400.80	10,523.61	6,804.00
Net profit (baht/ year)	2,104.75	12,966.85	1,933.75	3,441.42	1,754.23
Break-even yield (meter per year)	20.54	13.65	16.75	12.50	18.70
Break-even price (baht per meter)	230.18	286.34	186.13	380.76	200.39

Source: Survey (2011)

Factor determinant yield

The Cobb - Douglas production function was applied to analyze factors affecting yield. The form of Cobb - Douglas production function is shown below:

$$Y_i = a X_1^{\beta_1} X_2^{\beta_2} X_3^{\beta_3} X_4^{\beta_4} \dots \dots \dots (1)$$

Where,

Y_i = cocoons yield (kg)

X_1 = silk eggs used (sheet)

X_2 = mulberry leaf used (kg)

X_3 = disinfectant used (kg)

X_4 = labor used (man day)

D = silkworm variety

$D = 0$ = native variety, $D = 1$ = recommendation variety

This form Cobb - Douglas production function was estimated by using ordinary least square (OLS) approaches after converting it into log linear form using E-View analysis program. The estimable form the equation used was shown below:

$$\ln Y = \ln a + \beta_1 \ln X_1 + \beta_2 \ln X_2 + \beta_3 \ln X_3 + \beta_4 \ln X_4 + D + u_i \dots \dots \dots (2)$$

$$\ln Y = 0.224 + 0.403 \ln X_1 + 0.400 \ln X_2 \dots \dots \dots (3)$$

(6.015)** (6.460)**

$$Y = 1.2510 X_1^{0.403} X_2^{0.400} \dots \dots \dots (4)$$

$$R^2 = 0.629$$

$$\text{Adjusted } R^2 = 0.585$$

$$\text{F-value} = 14.235$$

In equation 3, the coefficient of determination (R^2) was 0.629. It indicated that silkworm egg and mulberry leaf could explain some change of cocoon yield at 60.29%.

Base on result of ordinary least square (OLS) analysis as shown in Table 70, the factor of silkworm egg and mulberry leaf had positive statistically significant effect on yield at the .001.

Base on Cobb - Douglas production function analysis, the results revealed that the coefficient of silkworm egg was 0.403 indicated that if silkworm egg more are 1%, the cocoon yield is expected to increase by 0.403%. The coefficient of mulberry leaf was 0.400 indicated that further increase 1.0 % of mulberry leaf, the cocoon yield is expected to increase by 0.400%.

The results revealed that the cocoon yield will increase if combinations of increasing in silkworm egg and mulberry leaf use are employ.

In terms of silkworm egg, recommended by QSDS (2011) farmers have to pay attention that their silkworms are healthy from the silkworm egg stage right through to the stage when the newborn silkworms hatch.

Even though at the moment they bring the silkworm eggs from the silk breeding center, as it these eggs that are healthy and have a high chance of hatching, they still have to plan carefully before ordering so that they will have appropriate numbers of mulberry leaves to rear their silkworm.

Actually, from QSDS recommendation (2011), mulberry leaf is an important food for silkworms. To grow well, silkworm must eat fresh and good quality mulberry

leaf because they contain all necessary nutrients for silkworm growth. Therefore, the farmers should be aware of the quality of mulberry leaf and use more mulberry leaf to feed silkworm. As a result, the silkworm will be healthy and can produce silk in high volumes.

Table 70 Factor determinant yield based on OLS analysis

Variable	Coefficient	Std. Error	t-statistic	Prob.
Constant	0.224	0.412	0.543	0.590
Silkworm egg	0.403	0.067	6.015	0.000***
Mulberry leaves	0.400	0.062	6.460	0.000***
Disinfectant	0.009	0.141	1.366	0.179
Labor	-0.114	0.259	-1.907	0.063
Silkworm variety	0.142	0.119	1.194	0.239

Notes: *** statistical significant relation at .001

Factor determinant farm income

To examine factors determinant farm income of sericulture production in the study area, an econometric analysis has been used. Before discussion of the results estimation, the variables and model used will be explained.

1. Dependent variables

The dependent variable was net earnings (Y_1)

2. Independent variables

The independent variables include 5 main items as follows:

Agricultural production factors

X_1 = Total cost of silkworm egg used (baht)

X_2 = Total cost of mulberry leaf (baht)

X_3 = Total cost of disinfectant (baht)

X_4 = Total cost of cocoon used (baht)

X_5 = Total cost of silk yarn used (baht)

X_6 = Total cost of labor forces (baht)

X_7 = Total cost of silk weaving material (baht)

X_8 = Opportunity cost of capital (baht)

X_9 = Cost of depreciation (baht)

Farmers' personal background factors

X_{10} = Age

X_{11} = Sericulture production experiences

X_{12} = Level of education

X_{13} = number of sericulture information

Biological factors

X_{14} = Number of silkworm diseases

Socio-economic factors

X_{15} = number of labor

X_{16} = Group belonging

X_{17} = Frequency of group participation by farmer

Institutional factors

X_{18} = Number of contact agency

3. Model

The relationship between independent and dependent variable was estimated by using multi stepwise regression model to find out an appropriate model based on the principle of regression equation least independent variable determine the best variation of dependents variables. The empirical from the mentioned study can be specified as:

$$\ln Y_i = \beta_0 + \beta_1 \ln X_1 + \beta_2 \ln X_2 + \beta_3 \ln X_3 \dots + \beta_{20} \ln X_{20} + \varepsilon_i$$

The estimated results of farm income function of sericulture production in the study areas was conducted by stepwise procedure of multiple linear reassign (MLR) analysis.

The model was specified by the criterion of β -beta, R-square, Adjusted R-square, R-square change, F-value, F-sig and t-value.

4. Net earning function

Based on result of study as shown in Table 71, 3 models of net earning function have been formed as follows:

$$NE = 3816.467 + 16273.512(X_{18}) \dots \dots \dots (1)$$

$$NE = -1814.881 + 10854.662(X_{18}) + 0.466(X_8) \dots \dots \dots (2)$$

$$NE = -8340.854 + 10001.242(X_{18}) + 0.446(X_8) + 32.436(X_7) \dots \dots \dots (3)$$

The equation above revealed that the first factor determinant net earnings was the number of contact agency (X_{18}). In equation 1, the result of R- square (R^2) was 0.731. It indicated that the factor of number of contact agency had positive significant relationship with variation of net earnings up 73.10 % ($F = 125.107$, $P = 0.000$) it can be pointed out that the more number of contacted agency, the more net earnings is.

In equation 2, the opportunity cost of capital (X_8) becomes as second factor to determine net earnings. It contributes 11.50 % to the variation of net earnings (R^2 change = 0.115) with positive significant relationship. The result of R^2 for second equation was 0.846. It indicated that two factors included the number of contact agency and opportunity cost of capital had work well in explaining the variation of net earning up to 84.60 % ($F = 123.966$, $P = 0.000$) It can be pointed out that the more number of contacted agency and also the more opportunity cost of capital, the more net earnings is.

In equation 3, cost of silk fabric weaving material (X_7) becomes as third factor to determine net earnings. It contributes 4.00 % to the variation of net earnings (R^2 change = 0.040) with positive significant relationship. The result of R^2 for third equation was 0.886. It indicated that three factors included the number of contacted agency, opportunity cost of capital and silk fabric weaving material cost had work well

in explaining the variation of net earning up to 88.60 % ($F = 113.845$, $P = 0.000$). It can be pointed out that more number of contacted agency, the more opportunity cost of capital and also the more silk fabric weaving material cost, the more net earnings is.

In term of relationship among independent variable with dependent variable of net earnings, the finding showed that number of contacted agency, opportunity cost of capital and cost of silk fabric weaving material were positive significant relationship to the variation of net earnings. It can be indicated that more number of contacted agency extension, opportunity cost of capital and also cost of silk fabric weaving material, the more net earnings is.

From the findings, it revealed that under the existing condition, it can point out that the farmers who keep more contact with agency have the more opportunity to gain more net earnings. This is because farmers can increase their knowledge and experiences from those agencies to improve productivity and silk product quality that can meets market requirement.

In addition, the farmers who have higher potential in capital, they can have more opportunity to invest in sericulture production business. So they have more opportunity to gain more net earnings as well.

From this investigation, it also can point out that the larger scale around 7-10 cycles per year of sericulture business has the more opportunity to gain net earnings.

Table 71 Parameter estimate results of net earning function

Equation model	Unstandardized		T	Sig.	R ²	Adjusted R ²	R ² change	ANOVA	
	Coefficients							F	Sig.
	B	Std. Error							
1 (Constant)	3816.467	3600.755	1.060	0.295	0.731	0.725		125.107	0.000***
Number of contact agency	16273.512	1454.925	11.185	0.000					
2 (Constant)	-1814.881	2917.693	-6.22	0.537	0.846	0.840	0.115	123.966	0.000***
Number of contact agency	10854.662	1451.371	7.479	0.000					
Opportunity cost of capital	0.466	0.080	5.810	0.000					
3(Constant)	-8340.857	3043.911	-2.740	0.009	0.886	0.878	0.040	113.845	0.000***
Number of extension contact	10001.242	1283.883	7.790	0.000					
Opportunity cost of capital	0.446	0.70	6.372	0.000					
Silk fabric weaving material cost	32.436	8.313	3.902	0.001					

Notes: *** statistical significant relation at .001

Factor determine net profit

To investigate factors determinant of net profit of sericulture production in the study area, the socio-econometric analysis has been employed. Before discussion the result of estimation, the variable and model used will be explained.

1. Dependent variables

The dependent variable was net profit (Y_2)

2. Independent variables

The independent variables were 5 main categories divided into 18 items same as presented in paragraph 2

Based on result of study as shown in Table 72, 2 models of net profit function have been formed as follows:

$$NP = -13767.903 + 11448.053(X_{18}) \dots \dots \dots (1)$$

$$NP = -11448.053 + 9658.200(X_{18}) + 0.354(X_2) \dots \dots \dots (2)$$

The equation above revealed that the first factor determinant net profit was the number of agency contact (X_{18}). In equation 1, the result of R- square (R^2) was 0.631. It indicated that the factor of number of contact agency had positive significant relationship with variation of net profit up 63.10% ($F = 78.819$, $P = 0.000$) it can be pointed out that the more number of contacted agency, the more net profit is.

In equation 2, the cost of mulberry leaf (X_2) becomes as second factor to determine the net profit. It contributes 7.30 % to the variation of net profit (R^2 change = 0.073) with positive significant relationship. The result of R^2 for second equation was 0.704. It indicated that two factors include the number of contacted agency and the cost

of mulberry leaf had work well in explaining the variation of net profit up to 70.40 % (F = 53.499, P = 0.000) It can be pointed out that the more number of contacted agency and the more cost of mulberry leaf, the more net profit is.

In term of relationship among independent variable with dependent variable of net profit, the finding showed that number of contacted agency and cost of mulberry leaves were positive significant relationship to the variation net profit. It can be indicated that the more number of contacted agency and the cost of mulberry leaf, the more net profit is.

Farmer who had more opportunity to contact with extension agencies are able to access information and knowledge from various sources. Therefore, farmers can improve their productivity and get higher profit.

Regarding the amount of mulberry leaf that is non cash cost, proper size and enough of mulberry leaf for silkworm at different ages can makes them healthy and good growth. Then, the farmers can get a high quality cocoon to produce a good silk yarn quality at the higher price. This result is the same direction of table 70 that the more mulberry leaves the famer can get higher yield for more profit.

Table 72 Parameter estimate results of net profit function

Equation model	Un standardized		T	Sig.	R ²	Adjusted R ²	R ² change	ANOVA	
	Coefficients							F	Sig.
	B	Std. Error							
1 (Constant)	-13767.903	3191.302	-4.314	0.000	0.631	0.623	78.819	0.000***	
Number of contact agency	11448.053	1289.481	8.878	0.000					
2 (Constant)	-12671.561	2910.747	-4.353	0.00	0.704	0.691	0.073	53.499	0.000**
Number of contact agency	9658.200	1286.953	7.505	0.000					
Cost of mulberry leaf	0.354	0.107	3.319	0.002					

Notes: *** statistical significant relation at .001

Part 6 Constraints in Commercial Sericultural Production

This part will discuss constraints in sericulture production, marketing, accounting management, human resources management and also agencies supporting as shown in Table 73.

Constraints in commercial sericultural production

1. Sericulture production constraints

Regarding constraints in sericulture production, it divided into 4 major categories including mulberry cultivation, silkworm rearing, silk yarn reeling and silk fabric weave aspects.

In terms of mulberry cultivation aspect, most constraint was disease, accounting for 56.25 %. This is because root rot disease is a serious disease that always destroyed mulberry trees in the study areas.

The rests were lack of water resource in mulberry planting, insufficiency of mulberry planting equipment, insufficiency of mulberry area, lack of knowledge in mulberry cultivation, insufficiency of good mulberry variety and lack of labor in mulberry cultivation, respectively.

In terms of silkworm rearing aspect, most constraint was silkworm disease, accounting for 68.75%. The common found diseases in study area were Grasserie and Mycoses. These diseases damaged silkworm and reduced cocoon yield. The duration of silkworm rearing was short, so it is hard to prevent these diseases.

The rests were limited knowledge in chemical use to prevent silkworm disease, insufficiency of mulberry leaves for silkworm feeding, insufficiency of silkworm rearing equipment, lack of standard silkworm rearing room, insufficiency of good silkworm eggs, lack of labor in silkworm rearing, lack of knowledge in bed

cleaning, lack of knowledge in enlarging silkworm rearing area and lack of knowledge in practice while silkworm are molting, respectively.

In terms of silk yarn reeling aspect, most constraint was lack of high productivity of silk yarn apparatus, accounting for 33.33%. The rests were low silk yarn quality, insufficiency of silk yarn reeling equipment, lack of knowledge in silk yarn reeling, lack of labor in silk yarn reeling, and complicating in silk yarn culling, respectively.

The study revealed that most farmers had constraint in silk yarn reeling aspect less than 50% because they had more experience and gained new knowledge and new technology in silk yarn production from concerned agencies.

In terms of silk fabric weaving aspect, most constraint was high cost of silk fabric production, accounting for 58.33 %. These constraints were because raw materials were expensive, especially the warp yarn that farmer bought from reeling factories. The rest were limited capital, limited knowledge in silk fabric design, high weaving wage, limited knowledge in silk yarn dyeing, limited knowledge in silk fabric weaving, lack of weaving materials and equipment and lack of weaving labor, respectively.

2. Sericulture marketing constraints

Most constraint in sericulture marketing was limited marketing channels, accounting for 52.08 %. The rest were limited marketing information, decreases in price, instability of marketing channels, limited knowledge in market advertising, limited knowledge in packaging, price reduction by middleman and lack of negotiation power, respectively.

The study revealed that most farmers received silk production information rather than marketing. Moreover, only group leader and group committee received

marketing information from the government officers. This is because they had the responsibility for group market distribution.

3. Accounting management constraints

In terms of accounting management constraints, the majority of respondent had 2 constraints included lack of sericulture production return analysis, accounting for 58.33 % and lack of knowledge in sericulture production accounting management, accounting for 56.25 %, respectively.

The finding revealed that most farmers did not have time to record accounting. In addition, they were lack of knowledge in return analysis and difficulty in keeping records.

4. Human resource management constraints

In terms of human resource management constraints, the respondents had various constraints included group member disregards the profit from group activities, group members ignored benefit or dividends from sericulture activities group members were not involved in election for group committee, group members were not actively involved in group activities, group members did not join in group products sale, group members did not participate in sericulture knowledge improving activity, limitation of financial to support members, and some members did not share group business expenditure, respectively.

The finding revealed that most farmers had constraints in human resources management less than 50%. This is because sericulture groups provided good management and gave welfare to their members. In addition, most farmers have regular access to share knowledge in sericulture production among members.

5. Agencies supporting constraints

In terms of agencies supporting constraints, few of respondents had constraints in lack of marketing support, accounting for 20.83 %. The rests were lack of new sericulture information from concerned agencies, lack of input supporting, lack of a good coordination with officers, no direct responsible concern agencies and officers did not having enough time for consultation, respectively.

The study found that most farmers had constraints less than 50%. It is because farmers often received the assistant and encouragement from concerned agencies. In addition, officers always visited farmers in villages that it is more convenient for the farmers.

Table 73 Constraints in commercial sericultural production

Constraints	Having		Have not		Total	
	No.	%	No.	%	No.	%
Production						
Mulberry cultivation						
Mulberry disease	27	56.25	21	43.75	48	100.00
Lack of water resource in mulberry planting	16	33.33	32	66.67	48	100.00
Insufficiency of mulberry planting equipment	10	20.83	38	79.17	48	100.00
Lack of knowledge in mulberry cultivation	10	20.83	38	79.17	48	100.00
Insufficiency of good mulberry variety	9	18.75	39	81.25	48	100.00
Lack of labor in mulberry planting	4	8.333	44	91.67	48	100.00
Silkworm rearing						
Disease and pest	33	68.75	15	31.25	48	100.00
Limited knowledge in disinfection	19	39.58	29	60.42	48	100.00
Insufficiency of mulberry leaves for silkworm feeding	13	27.08	35	72.92	48	100.00
Insufficiency of silkworm rearing equipment	8	16.67	40	83.33	48	100.00
Silkworm rearing under the set standard	7	14.58	41	85.42	48	100.00
Insufficiency good silkworm egg	6	12.50	42	87.50	48	100.00

Table 73 (Continue)

Constraints	Having		Have not		Total	
	No.	%	No.	%	No.	%
Lack of labor in silkworm rearing	3	6.25	45	93.75	48	100.00
Lack of knowledge in bed cleaning	2	4.17	46	95.83	48	100.00
Lack of knowledge in enlarging silkworm rearing area	1	2.08	47	97.92	48	100.00
Lack of knowledge in practice while silkworm are molting/un molting	1	2.08	47	97.92	48	100.00
Silk Yarn reeling						
Lack of high silk yarn apparatus productivity	16	33.33	32	66.67	48	100.00
Low quality of silk yarn	9	18.75	39	81.25	48	100.00
Insufficiency of silk yarn reeling equipment	8	16.67	40	83.33	48	100.00
Lack of knowledge in silk yarn reeling	7	14.58	41	85.42	48	100.00
Lack of labor in silk yarn reeling	5	10.42	43	89.58	48	100.00
Complicating in silk yarn culling	2	4.17	46	95.83	48	100.00
Complicating in cocoon culling	0	0.00	48	100.00	48	100.00
Silk fabric weaving						
High cost of silk fabric production	28	58.33	20	41.67	48	100.00
Limited capital	24	50.00	24	50.00	48	100.00
Limited knowledge in silk fabric design	21	43.75	27	56.25	48	100.00
High weaving labor wage	11	22.92	37	77.08	48	100.00
Limited knowledge in silk yarn dyeing	9	18.75	39	81.25	48	100.00
Limited knowledge in silk fabric weaving	9	18.75	39	81.25	48	100.00
Lack of weaving materials and equipment	8	16.67	40	83.33	48	100.00
Lack of weaving labor	5	10.42	43	89.58	48	100.00
Marketing management						
Limited marketing channels	25	52.08	23	47.92	48	100.00
Limited marketing information	23	47.92	25	52.08	48	100.00
Decreases in price	19	39.58	29	60.42	48	100.00
Instability of marketing channels	18	37.50	30	62.50	48	100.00
Limited knowledge in market advertising	17	35.42	31	64.58	48	100.00
Limited knowledge in packaging	15	31.25	33	68.75	48	100.00

Table 73 (Continue)

Constraints	Having		Have not		Total	
	No.	%	No.	%	No.	%
Price reduction by middleman	11	22.92	37	77.08	48	100.00
Lack of negotiating power	11	22.92	37	77.08	48	100.00
Accounting management						
Lack of sericulture production return analysis	28	58.33	20	41.67	48	100.00
Lack knowledge in sericulture production accounting	27	56.25	21	43.75	48	100.00
Limited knowledge and experience in capital supporting	22	45.83	26	54.17	48	100.00
Limited knowledge and experience in financial planning	21	43.75	27	56.25	48	100.00
Non deposit saving	18	37.50	30	62.50	48	100.00
Human resource management						
Group members disregards the profit from group activities.	3	6.25	45	93.75	48	100.00
Group members ignored benefit or dividends from sericulture activities.	3	6.25	45	93.75	48	100.00
Group members were not involved in election for group committee	2	4.17	46	95.83	48	100.00
Group members were not actively involved in group activities.	1	2.08	47	97.92	48	100.00
Group members did not join in group products sale.	1	2.08	47	97.92	48	100.00
Group members group did not participate in sericulture knowledge improving activity	1	2.08	47	97.92	48	100.00
Limitation of financial to support members	1	2.08	47	97.92	48	100.00
Some members did not share group business expenditure.	1	2.08	47	97.92	48	100.00
Concern agency supporting						
Limited cooperation for marketing activities	10	20.83	38	79.17	48	100.00
Limited new sericulture information	6	12.50	42	87.50	48	100.00

Table 73 (Continue)

Constraints	Having		Have not		Total	
	No.	%	No.	%	No.	%
Limited sericulture input support	6	12.50	42	87.50	48	100.00
A few coordination among concern agencies	4	8.33	44	91.67	48	100.00
No direct responsible concern agencies	4	8.33	44	91.67	44	91.7.00
Insufficiency of agency officers	3	6.25	45	93.75	45	93.8.00

Source: Survey (2011)

CHAPTER V

CONCLUSION AND RECOMMENDATIONS

Conclusions

Objective of the investigation

This research focused on analyzing the productivity in commercial sericultural production. The objectives were 1) to describe basic personal and socio-economic background of sericulture farmers 2) to describe the existing conditions in commercial sericultural production 3) to determine the cost and income of sericultural production and assess the knowledge, attitude, and practice in commercial sericultural production towards technical efficiency 4) to find out an appropriate model in commercial sericultural production and 5) to determine constraints and recommendations in order to improve commercial sericultural production.

Research methodology

Population was sericulture farmer in Huafai village, Por Dang subdistrict, Chonnabot district, Khon Kaen province. The studied samples were 48 sericulture farmers selected through multistage sampling technique and determined by Arkin (1974). The data were collected in year 2011 from farmer. The question was defining farmer's personal background, sericulture production, knowledge, attitude and practice in commercial sericultural production, and also constraints and recommendation. An in-depth interview was obtained to collect data from stakeholders.

Testing the reliability of knowledge and practices in commercial sericultural production were obtained through the KR-20 with the reliability of 0.86. The reliability of attitude on commercial sericultural production was by Conbrach's alpha coefficient at 0.89.

In terms of data analysis, both descriptive and inferential statistics were determined. Frequencies, percentage, arithmetic means, and standard deviation were employed to describe socio – economic background, sericulture production, knowledge, practice and attitude in commercial sericultural production, cost and return and also constraints and recommendations. In addition, Cobb – Douglas production function was employed to determine production function. Multiple linear regression was employed to obtain the farm income function. Furthermore, Pearson product moment correlation coefficient was employed to determine factors affecting farmer's knowledge, practice and attitude in commercial sericultural production.

Findings of the study

1. Personal background of sericulture farmers

All of respondents were female. The average age was 55.96 years old. The majority of them graduated primary school (75.00 %). The average number of household member was 4.50 persons.

2. Socio – economic background

The majority of respondents had a labor force between 6- 10 persons per household (56.25 %). The average number of land tenure was 21.90 rai per household. Most major occupation was sericulture production (60.42 %). The rest were rice cultivation (31.25 %), filed crop (6.25 %) and trader (2.08 %). Minor occupation was rice cultivation (56.25 %). The rest were sericulture (37.50 %) and field crop (6.25 %).

The average farm income was 76,113 baht. The average non farm income was 12,092 baht. The average total income was 88,486.90 baht. The average income from sericulture was 37,311 baht. The average of loans was 91,906.25 baht per year. Most credit source was Agriculture and Cooperatives. Most main reason for credit spending was farm production (66.67 %).

The majority of respondents were member of sericulture production group (93.75 %). The average of sericulture group belonging was 13.89 years. Most of them participated in group activities between 11-20 times per year (50.00 %).

3. Commercial sericultural production

The majority of respondents had experience in sericulture between 1-20 years (29.17 %). The average experience in sericulture was 32.60 years. The majority of them received personal media information from group leader (95.83 %). Most of them received mass media information from village broad casting (70.83 %). The majority of them also received interactive media by government agencies training (54.16 %).

Most number of agencies supporting in sericulture production between 1 – 2 agencies (75.00 %). Most of supporting agency was Queen Sirikit Department of sericulture (95.83 %).

The majority of respondents attended training in silk yarn dyeing (91.1%). Most of them attended farm visit in silk yarn dyeing (72.92 %). All of them also gained silkworm eggs from government agencies.

All of respondents had their own areas mulberry cultivation. Most of them had mulberry cultivation areas between 0.5-1 rai per household. The average mulberry cultivation area was 0.76 rai. Most of them cultivated “BURIRAM” (97.92 %). The rest cultivated “NOI” (2.08 %). The majority of mulberry cultivation depended on rain (56.25 %). The rest depend on ground water (18.75 %) ponds (12.50 %) and artificial water supply (12.50 %).

Most respondent did not applied local wisdom in mulberry cultivation (97.92 %). A few of them applied local wisdom in diseases prevention (2.08 %). The majority of respondent applied technology in mulberry cultivation (56.25 %). Most

of them applied recommended technology was watering (61.77 %). The rests were weed control (35.29 %) and mulberry planting (2.94%), respectively.

The average silkworm rearing was 7.10 cycles. The majority of respondent reared silkworm throughout the year by breaking for rearing room preparation (64.58 %). The rest were rearing silkworm after rice harvesting (18.75 %) and rearing silkworm all year-round without a break (16.67 %), respectively.

The majority of respondents had low cost silkworm rearing rooms that located inside a house (58.33 %). The rests had low cost rearing rooms separated from the house (31.25 %) and standard rearing rooms (10.42 %), respectively. Most respondents did not keep silkworm rearing record (83.33%). The most record was molting and after molting stage.

The majority of respondents reared “DOKBUA” variety (50.00 %). All of respondents had reason of silkworm rearing to produce silk yarn and fabric weaving. Most of them selected “DOKBUA” variety for commercial production (68.75 %). The rest was “DOKKUN” (31.25 %).

The majority of respondents reared 1 silkworm egg sheet per cycles. The majority of respondents had sufficient mulberry leaf to feed silkworm (68.75 %). The most common silkworm disease was Grasserie. (77.08 %). The most silkworm pest was Tachinid fly.

Most respondents applied local wisdom in sericulture production (62.50 %). Most of them applied local wisdom in disease prevention (83.33 %). The rest were newly hatched larva rearing (16.67 %) silkworm selecting (6.67 %) and collecting mature worms for mounting (3.33 %), respectively. The majority of respondents applied recommended technology in silkworm rearing (77.08 %). Most of them applied technology in newly hatched larva rearing. The rest were prevention of silkworm disease and bed cleaning, respectively.

The average cocoon yield was 17.09 kg. Most of them culled cocoon before reeling (91.67 %). All of them used developed hand reeling apparatus. The majority of respondents produced silk yarn 1.1-2 kg. per cycle (58.33 %). Most of them produced 2nd grade of silk yarn (97.92 %). The majority of them produced silk yarn for sale and weaving (91.67 %).

The majority of respondents did not applied local wisdom in silk yarn reeling (72.92 %). A few of them applied local wisdom in re-reeling technique (27.08 %). All respondents applied recommendation technology in silk yarn reeling.

The majority of respondents produced “MUDMEE” (91.67 %). The rest were plain fabric (39.58 %), shawl (20.83 %), “PHAKHOWMA” (18.75 %) and “SARONG” (18.75 %). The average weaving silk fabric was 57.39 meters.

The majority of respondents applied local wisdom in silk fabric weaving (72.92 %). Most of them applied recommended technology (66.75 %). Most technology applied was dying.

The majority of respondents did not sell cocoon (79.16 %). Most of them sold silk yarn to sericulture group (81.25 %). The rest were middlemen (20.83 %) and local market (20.83 %). The majority of respondent also sold silk fabric to sericulture group (81.25 %). The rest were middlemen (12.50 %), local market (4.17 %) and the province (4.17 %), respectively.

4. Farmers’ practice towards silk production standard

In terms of farmers’ practice towards silk yarn production standard, the majority of respondent practiced more than 50% on identifying date–month–year of production (93.75 %). The rest were identifying type, size and diameter of skein (91.67 %), identifying the term of Thai silk yarn and silkworm variety or silkworm race (87.50 %), acceptable tolerance for the first level grade quality do not deviate more than 10% of from the criteria set for first level grade quality (83.33 %), acceptable

tolerance for the second level grade quality do not deviate more than 10% from the criteria set for second level grade quality (83.33 %), deviation criterion for the size aspect not more than 10% of that specified on the label (83.33 %), identifying name of producer and location (81.25 %), identifying number of skeins and net weight of the package (79.17 %), acceptable tolerance for the diameter of silk skein is not more than 3% of that specified on the label (75.00 %) and visible part of the Thai silk yarn represents all Thai silk yarn as labeled (66.67 %), respectively.

In terms of farmers' practice towards silk fabric production standard, all of respondents used authentic silk yarn for silk fabric weaving. Most of them practiced more than 50% on producing silk fabric without stains and damage including splitting yarn, hole, and uniform in color characteristic of silk throughout the length (97.92 %). The rest were packed and wrapped silk fabric with clean and adequately durable material to protect the product from any damage (95.83 %) producing silk fabric resistant to light was not less than 5 level blue scales (70.83 %), weaving heavy weight silk with a weight with approximately 121-160 g. per square meter (66.67 %), producing silk fabric with a length not less than the value indicated in the label (66.67%) , producing fabric width as indicated in the label with deviation $\pm 3\%$ (60.42%) , producing silk fabric with a number of yarns per 25.4 mm as indicated in the label with deviation $\pm 2\%$ (54.17%) and producing silk fabric with a weight per area unit is as indicated in the label with deviation $\pm 2\%$ (52.08 %), respectively.

5. Knowledge, attitude and practice on commercial sericultural production

The majority of the respondents' knowledge was at the moderate level. The highest corrected answer was in concerning with harvesting mulberry leafs for young silkworm (79.17 %). The lowest corrected answer was chemical used to sprinkle over newly hatched silkworm (20.83 %). The results revealed that they had high ability to understand the concept of commercial sericultural production. When looking into the sub category, the highest corrected answer on silkworm rearing management was harvesting mulberry leafs for young silkworm (79.17 %). The highest corrected answer

on mounting management was the time for cleaning montage (72.92 %). The highest corrected answer on silkworm disease management was method for unhealthy or infected silkworm eliminating (79.17 %). The highest corrected answer on production of silk product was appropriate amount of cocoon to be boiled to ensure good quality of silk yarn (60.42 %). The highest corrected answer on marketing management was method for making silk product well known in the market (62.50 %). The highest corrected answer on accounting management was accounting management after sale (70.83 %). The highest corrected answer on human resource management was method for group working to produce good quality product (72.92 %).

The majority of respondent had extremely positive attitude (58.33 %) at average score of 4.29. Most respondents had extremely positive attitudes towards commercial sericultural production on human resource management with average score of 4.68. The rest were marketing management, financial management and mounting management with average score of 4.42, 4.31 and 4.23, respectively. It revealed that most respondents had positive attitude towards all items in commercial sericultural production. It indicated that they believe that good practice towards commercial sericultural production can improve good product quality meet market requirement.

The majority of respondent had practiced scores in moderate level (68.75 %). The results revealed that they had good practice in commercial sericultural production. The most corrected practice was harvesting young mulberry leaf from the 2^{sd} – 3rd leaf from the top for feeding young and feed leaf to young silkworms by chopping mulberry leaves into the appropriate size for silkworms (79.17 %). The lowest corrected practice was sprinkling “PEBSOL” on newly hatched silkworm every time (6.25 %). When looking into the sub category, the most corrected practice on silkworm rearing management was feeding mulberry leaf to young silkworm by chopping mulberry leaf into the appropriate size for silkworm (79.17 %). The most corrected practice on mounting management was collecting silk cocoon softly from mountage to prevent pupa body breakage or death (72.92 %). The most corrected practice on silkworm disease and pest management was eliminate unhealthy and infected silkworm by using 3% formalin (79.17 %). The most corrected practice on production of silk products was

using 80-100 cocoon/time in every boiling pot for drawing the silk from the cocoon in order to get good quality silk yarn (60.42 %). The most corrected practice on marketing management was advertising silk product through various media channels (64.58 %) The most corrected practice on accounting management was providing capital in advance for sericulture production (68.75 %). The most corrected practice on human resource management participation in group benefits (75.00 %), respectively.

When comparison between knowledge and practice in commercial silk production of corrected knowledge and practice more than 50%, they are divided into 3 aspects. First, farmers actually had corrected both in knowledge and practiced. Second, farmers actually had corrected knowledge but they did not practice. The last, farmers had less knowledge and they did not practice it.

6. Factors affecting farmers' perception

Regarding factors affecting farmers' perception, there were 3 factors included number of sericulture information perception, number of contact agency and frequency of group participation had positive significant with farmers' knowledge, practice and attitude in commercial sericultural production. On the other hand, sericulture production experiences had negative statistically significant with attitude in commercial sericultural production.

7. Cost and return in sericulture production

Total cost of mulberry cultivation was 7,595.06 baht. Variable cost was 5,664.29 baht. Most variable cost was labor cost (44.78 %). Fix cost was 1,930.77 baht. Most fixed cost was land cost (23.68 %). Cash cost was 1,347.99 baht. Most cash cost fertilizer. Non cash was 6,247.81 baht. Most non cash was labor cost. Break-even yield was 2,531.69 kg. Break-even price was 2.08 baht.

Total cost of silk rearing was 2,984.52 baht. Variable cost was 2,963.86 baht. Most variable cost was labor cost (56.95 %). Fix cost was 20.66 baht. Fix cost was depreciation cost (0.69 %). Cash cost was 348.49 baht. Most cash cost was others cost.

Non cash cost was 2,615.35 baht. Most non cash was labor cost. Break-even yield was 29.85 kg. Break-even price was 170.54 baht.

Total cost of silk yarn production was 18,515.59 baht per year. Variable cost was 18,347.09 baht. Most variable was cost cocoon cost (79.54 %). Fixed cost was 168.50 baht. Fixed cost was depreciation cost. Cash cost was 1,005.17 baht. Most cash cost was labor cost. Break-even yield was 15.43 kg. Break-even price was 1,259.56 baht.

Total cost of plain silk fabric per year was 6,307.05 baht. Variable cost was 6,270.60 baht (99.42 %). Most variable cost was silk yarn cost. Fixed cost was 36.45 baht (0.58 %). Fixed cost was depreciation cost. Cash cost was 1,597.45 baht. Most cash cost was silk yarn cost. Non cash cost was 4,709.60 baht. Most non cash cost was silk yarn cost. Break- even yield was 20.54 meters and break-even price was 230.18 baht.

Total cost of “MUDMEE” silk fabric production per year was 9,334.81 baht. Variable cost was 8,436.72 baht. Most variable cost was silk yarn cost (65.14 %). Fixed cost was 898.09 baht (9.62 %). Fixed cost was depreciation cost. Cash cost was 2,300.56 baht. Most cash cost was silk yarn cost. Non cash cost was 7,034.25 baht. Most non cash cost was silk yarn cost. Break-even yield was 13.65 meters. Break-even price was 286.34 baht.

Total cost of “PHAKAOMA” production per year was 4,467.05 baht. Variable cost was 3,343.05 baht (74.84 %). Most variable cost was silk yarn (60.44 %) Fixed cost was 1,124.0 baht (25.16 %). Fixed cost was depreciation cost. Cash cost was 111.0 baht. Most cash cost was material cost. Non cash cost was 3,232.05 baht. Most non cash cost was silk yarn cost. Break-even yield was 16.75 meters. Break-even price was 186.13 baht.

Total cost of “SARONG” production per year was 7,082.00 baht. Variable cost was 5,831.19 baht (82.34 %). Most variable cost was silk yarn (66.93 %) Fixed cost

was 1,251.00 baht (17.66 %). Fixed cost was depreciation cost. Cash cost was 1,056.00 baht. Most cash cost was silk yarn cost. Non cash cost was 6,026.19 baht. Most non cash cost was silk yarn cost. Break-even yield was 12.50 meters. Break-even price was 380.76 baht.

Total cost of shawls production per year was 5,049.00 baht. Variable cost was 4,221.77 baht (83.60 %). Most variable cost was silk yarn (67.44 %) Fixed cost was 828.00 baht (16.40 %). Fixed cost was depreciation cost. Cash cost was 1,040.00 baht. Most cash cost was silk yarn cost. Non cash cost was 4,009.77 baht. Most non cash cost was silk yarn cost. Break-even yield was 18.70 meters. Break-even price was 200.39 baht.

8. Factor determine yield

The result from Cobb – Douglas production function had confirmed that number of silkworm egg (SILK) and mulberry leaf (MULB) had positive statistically significant with yield as explained in the equation below.

$$Y = 1.2510(\text{SILK}_i)^{0.403} (\text{MULB}_i)^{0.400}$$

It can be point out that further increase 1.0% unit of silkworm egg, the cocoon yield is expected to increase by 0.403% and further increase 1.0% of mulberry leaf, the cocoon yield is expected to increase by 0.400%.

9. Factor determine net earning

The investigations had confirmed that number of contact agency (X_{18}), the opportunity cost of capital (X_8) and cost of silk fabric weaving material (X_7) were positive statistically significant with variation of net earnings. Therefore, the most appropriated model of farm income by net earning function of commercial sericultural production in study area can be explained as follow:

$$\text{Net earnings} = -8340.854 + 10001.242(X_{18}) + 0.446(X_8) + 32.436(X_7)$$

Therefore, the appropriate prototype model of net earnings for farmer in study area can be determine and promoted by selecting farmers who have more number of contact agency, more opportunity cost of capital and more cost of silk fabric weaving material.

10. Factor determine net profit

The investigations had confirmed that number of agency contact(X_8) and cost of mulberry leaf (X_2) were positive statistically significant relationship to the variation of net profit. Therefore, the most appropriated model of farm income by net profit function of commercial sericultural production in study area can be explained as follow:

$$\text{Net profit} = -11448.053 + 9658.200(X_{18}) + 12203.408(X_2)$$

Therefore, the appropriate prototype model of net profit for farmer in study area can be determine and promoted by selecting farmers who have more number of contact agency, and more cost of mulberry leaf.

11. Constraints in commercial sericultural production

In terms of production constraints, there were 4 constraints that more than 50 % of respondents defined. Most constraint was silkworm disease, (68.75 %). The rest were high production cost (58.33%), and mulberry disease (56.25 %), respectively.

In terms of marketing constraints, there were 2 constraints that more than 50 % of respondents defined. Most constraint was limited marketing channels (58.33%). The rest was limited marketing information (52.08 %).

In terms of accounting management, there were 2 constraints that more than 50% of respondents defined. The most constraint was lack of sericulture production

return analysis (58.33 %). The rest were lack knowledge in sericulture production accounting (56.25 %).

In term of human resource management, most respondent had constraints less than 50% in all items.

Recommendations

According to the investigation from this study, the recommendations that should be promoted to concern agencies divided into four aspects including economic assessment aspect, technical assessment aspect, policy oriented aspect and also implementation oriented.

Economic assessment aspect

Regarding the economic assessment, the appropriate recommendations are as follow:

1. Mulberry cultivation

In terms of mulberry cultivation, the findings revealed that main cost in mulberry cultivation is labor cost. In order to get a better income, the farmers should focus on reducing labor cost by using skilled labor and appropriate technology on fertilizer application, weed control, watering and harvesting to save time and cost.

2. Silkworm rearing

For the silkworm rearing, the investigation pointed out that the most important factor affecting silkworm rearing cost is labor cost. Actually it is non cash cost, then we should recommend the farmer to use skilled labor on silkworm rearing

such as silkworm feeding, enlarging silkworm rearing area, collecting mature worms for mounting and cocoon harvesting in order to reduce labor cost.

Moreover, from the finding can also point out that the important factor affecting cocoon yield are number of silkworm egg used and number of mulberry leaf used. In order to get high cocoon yield, farmers should focus on number of silkworm egg used and number of mulberry leaf used.

3. Silk yarn reeling

Regarding silkworm reeling cost, from the investigation indicated that the main cost is cocoon cost actually, non cash. In order to reducing cocoon cost, farmers should use the high yield variety of silkworm such as “DOKBUA” that recommended by QSDS.

4. Silk fabric weaving

In terms of silk fabric weaving, form the finding revealed that the main cost in silk fabric weaving is silk yarn cost. Actually, silk yarn price depends on marketing price. Since the silk yarn is high price, this leads to the silk fabric weaving cost to be high. Thus, farmers must concentrate on high quality of silk fabric under standard such as The Royal Peacock logo under QSDS.

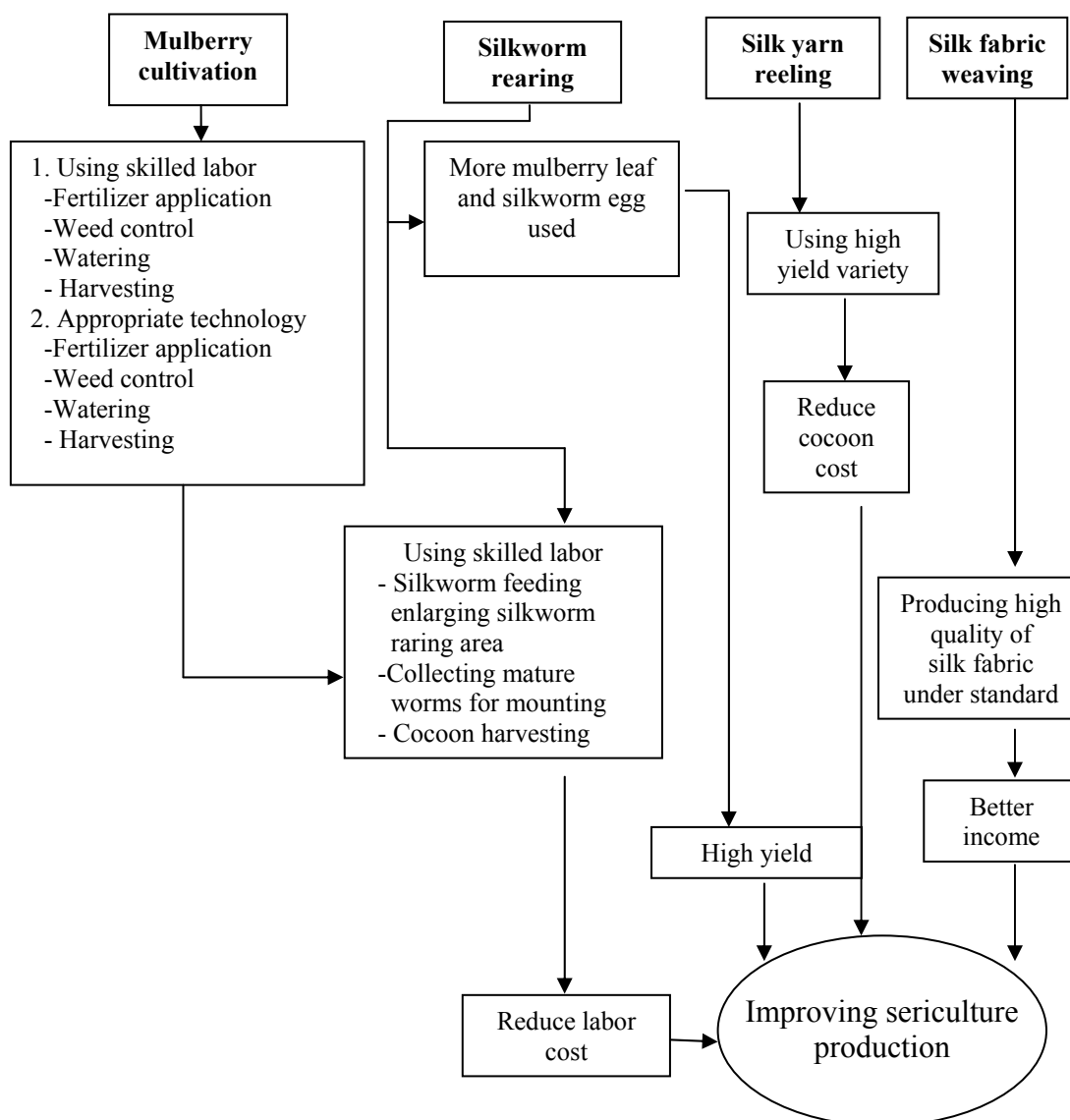


Figure 16 Model from economic assessment aspect

Source: Survey (2011)

Technical assessment aspect

Regarding the technical assessment, in order to support commercial sericultural production the appropriate recommendations are as follow:

1. Mulberry cultivation

Form the investigation, it pointed out that the most important constraint in the study area is mulberry disease in particular root rot disease. From DOAE recommendation, farmers can control the disease by use *Trichoderma* spp. and also test soil pH before and during planting. Implementing mulberry disease prevention, training course should be provided continuously for farmers to gain new knowledge in disease prevention.

2. Silkworm rearing

From the findings, it pointed out that the most constraint is silkworm disease in particular Grasserie disease and *Aspergillus* spp. In order to prevent the disease, farmers should control by burning infected silkworm and sterilize whole rearing room and equipment by 3% solution of formalin

3. Silk yarn reeling

The investigation pointed out that on silk yarn reeling process, farmers had a problem on the lack of high potential in silk yarn reeling apparatus. Thus, the concerned agencies should support a new technology in silk yarn processing such as electric silk yarn reeling apparatus.

In addition, the findings found that farmers did not practice correctly on packaging of silk yarn toward silk yarn standard. Thus, concerned agencies should provide packaging information to farmers continuously to awareness them regarding how important of packaging in order to control silk yarn quality.

4. Silk fabric weaving

In terms of silk fabric waving, the main constraint is high cost of silk fabric production. The concerned agencies should focus on technology and local wisdom application in silk fabric weaving including silk yarn preparation, silk yarn dyeing, and weaving process in order to reduce cost. For example using electric silk preparation equipment, power loom and making weaving equipment by themselves.

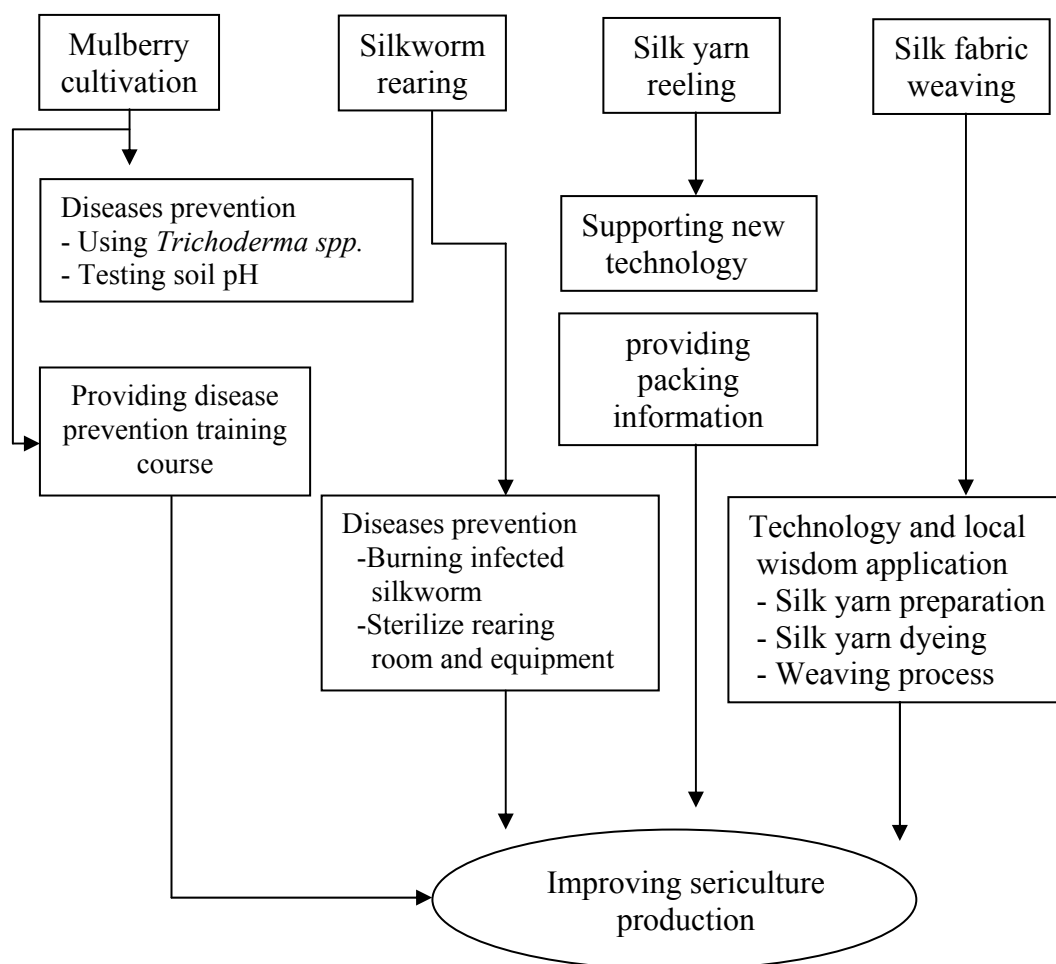


Figure 17 Model from technical assessment aspect

Source: Survey (2011)

Policy orientation

Based on the findings in study area, recommendation for commercial sericultural production policy level are as follows:

1. Production aspects

1.1 In order to support commercial sericultural production, the government should support concerned agencies to research and development in mulberry and silkworm diseases prevention, in particular Grasserie disease and root rot. It is because these diseases are serious problems in the study areas. In addition, research and development on appropriate production pattern to reduce cost and also more various silk products and design under marketing requirement are necessary.

1.2 For recommended technology application in commercial sericultural production in order to save time in production and get a better quality yield, concerned agencies policy should focus on the continuously application in silk yarns reeling, rearing of newly hatched larva, silk yarn dyeing, silkworm disease prevention, mulberry watering, silk yarn re-reeling, weed control, silk yarn preparation, mulberry planting, bed cleaning, and also silk yarn drying, respectively.

1.3 In terms of local wisdom application, in order to reduce cost and get the better quality of silk product, the concerned policy should continuously promote on silk fabric weaving, silkworm diseases and pest prevention, silk yarn re-reeling, rearing newly hatched larva, silkworm variety selection, mulberry diseases prevention and collecting of mature worm for mounting, respectively.

2. Marketing aspects

2.1 Concerned agencies should continuously support to research and development in consumer demands including U.S.A, EU, and Japan because these are the main market of Thai silk products. The main research items should focus on their

requirement in design, color, and fabric type in order to get various silk marketing channels.

2.2 To setting marketing information in the community is also the most important supporting in order to help farmers to produce the appropriate products that meet the demand.

2.3 To empower more sericulture group networks among local and nearby provinces for exchanging marketing information and silk products should be promoted

3. Human resource development

The strategic policy towards human resource development should focus on farmers capability building enhancement in particular for the new generation such as setting the youth group in village and school. Various means promotion includes providing sericulture production course in school and internship by let the young generation have the opportunity to learning by doing are also should be urgent concerns.

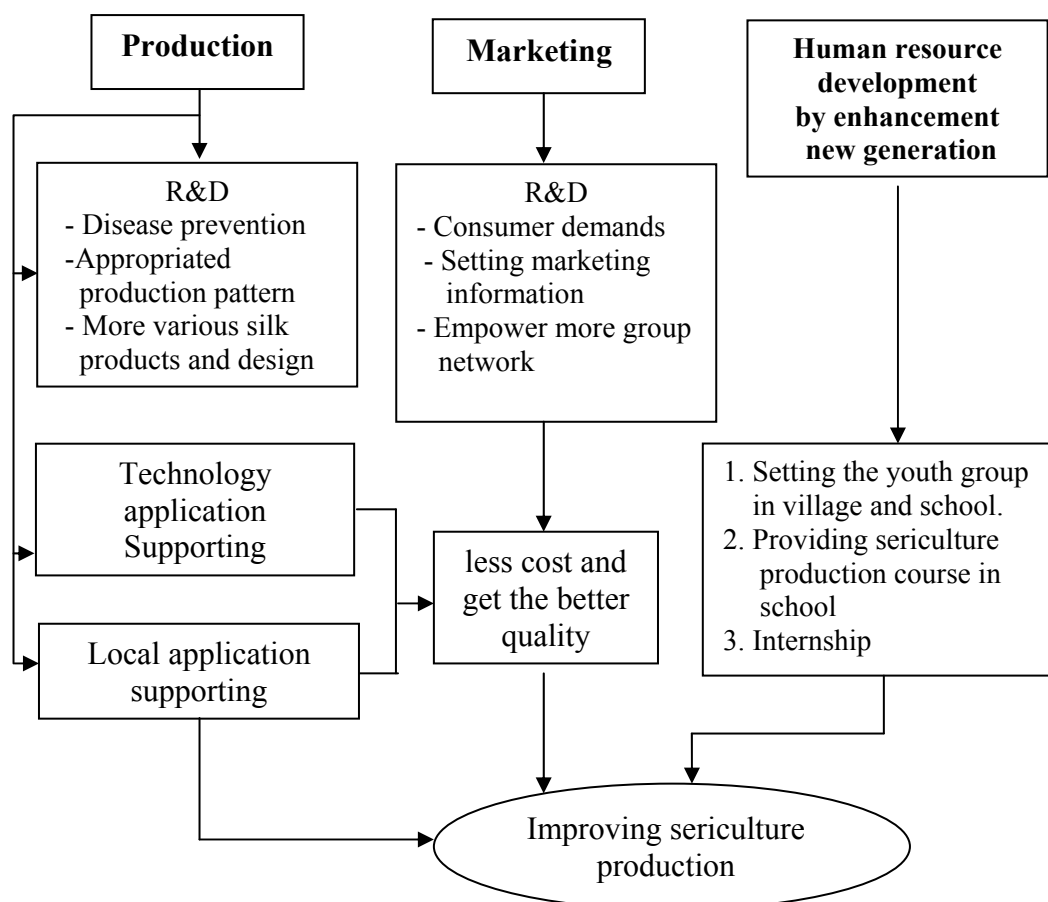


Figure 18 Policy orientation model

Source: Survey (2011)

Implementation oriented

1. Intervention program supporting

The urgent need to improve commercial sericultural production towards intervention programs that should be promoted continuously by concern agencies are 1) using substance to reduce humidity when the silkworm is molting 2) suitable time to harvest cocoon 3) using chemical to sprinkle over newly hatched silkworm 4) using chemical to spray in the room and equipment for rearing silkworm before rearing silk worm 5) preventing ant from damaging silkworm 6) method for producing silk product that meet market requirement 7) method for setting price according to target group and

also 8) method for setting price according to silk quality, respectively. It is because from the investigation, it found that the majority of respondent had less knowledge and didn't practice in this topic.

2. Empower group member capability

According to the finding, it found that the more participation of farmer in group activity can help them get more knowledge and correct practice. Then to empower group member capability through leading farmers, the members can have more opportunity to get high yield and better quality products, this because the group activities to encourage them for more participation it can increase their sericulture productivity.

3. Enhancing a capability of farmer

In order to enhance a capability of farmer, the concern agencies should focus on technology contribution through farmer leader because from the investigation it found that almost of respondent always use the information for their better practice from group leader.

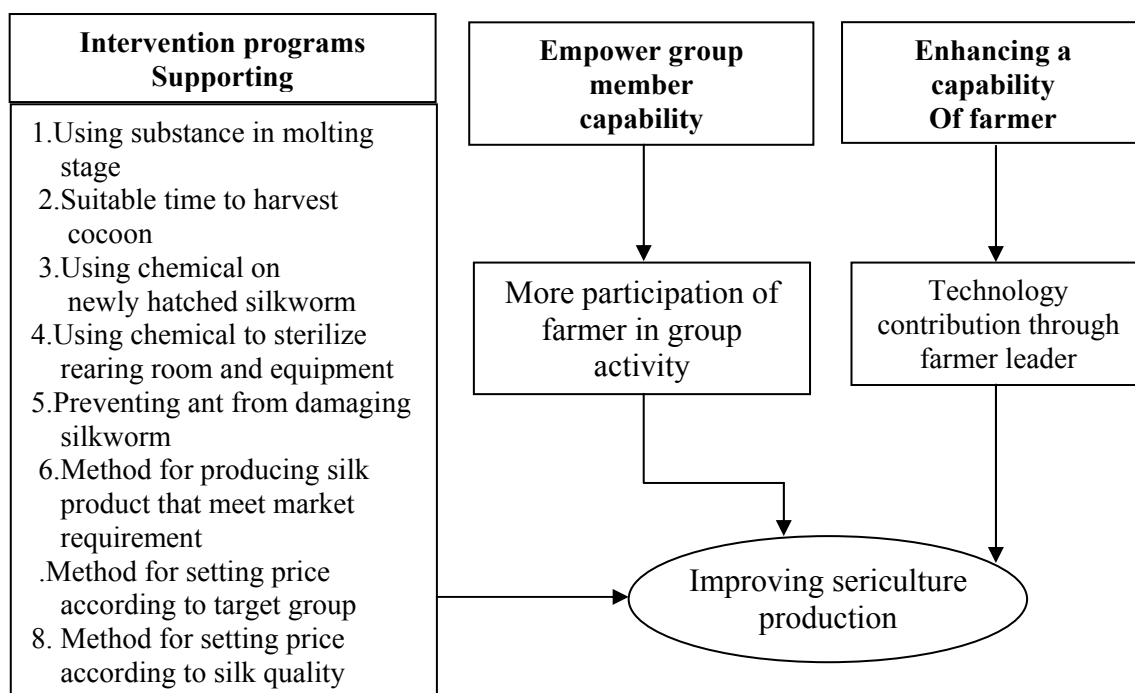


Figure 19 Implementation oriented model

Source: Survey (2011)

4. Innovation on commercial sericultural production

From the findings, it can point out that the innovation should be promoted though intervention program to less cost and get better quality of production can divide into four aspects as follow:

4.1 Mulberry cultivation, farmers should plant mulberry by putting the cutting in a hold and covered by rice husks under shady trees, then watering for 5-7 days until the knots appear ready for planting. In this way, it can increase the growth rate of the mulberry. They also should use steel plowing to save time in weed control.

4.2 Silkworm rearing, farmers should spray lime or baby powder on silkworm after molting stage to reduce humidity.

4.3 Silkworm reeling, farmers should use developed silk yarn apparatus in silk yarn reeling process. They also use clothes dryers to dry silk yarn in order to save time. Soaking silk yarn in water after reeling to prevent silk yarn drying is also required.

4.4 Silk fabric weaving, farmers should apply electric warping board in silk yarn preparation. They also use olive oil or vinegar in dyeing technique to fix color. Using rice cleaning water or hair conditioner for silk yarn combing to make silk yarn soft and easily for weaving are also required.

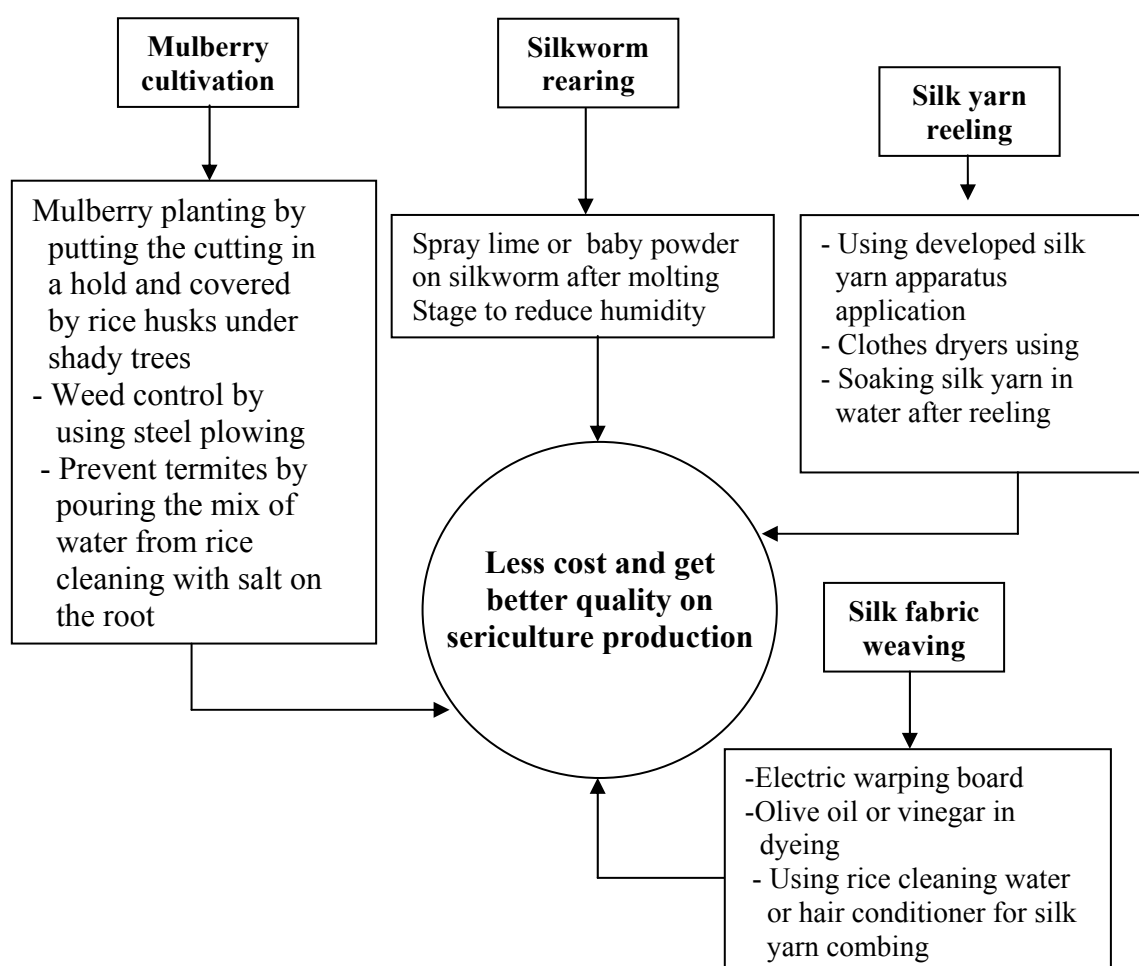


Figure 20 Innovation on commercial sericultural production model

Source: Survey (2011)

4.5 For the prototype outreach program in the future, the characteristics of farmers that should be concerned to recruit them for the success of the project or further prototype model include number of sericulture information perception, frequency of group participation, number of extension contact, sericulture production experience, cost of mulberry leaf, opportunity cost of capital and cost of silk fabric weaving material.

Further research suggestions

From this investigation the suggestion for further study are as proposed below:

1. Study on mulberry and silkworm disease control and prevention in particular root rot disease and Gaserries disease through farmer participation.
2. Study on appropriate technology to reduce cost in particularly labor cost.
3. Study on value added in silk products such as new design focus on new target group and also new product.
4. Study on marketing demand including domestic and international market demand.
5. Study on duplication of commercial sericultural production to another area.

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APPENDIXAS

Appendix A
Survey Items

No.

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SURVEY ITEMS

Economic and Technical Assessment on Commercial sericultural Production in Khon Kaen Province, Northeastern Thailand

Farmer's name.....

House No.....Village No...Hua Fai village, Pro Dang Sup-district, Chonnabut District
, Khon Kaen Province

Telephone number.....Date of interview/...../.....

Recommendation : Please mark **X** for your responses and fill out the following questions.

Part 1. Background characteristics of farmers

1. Sex () Female

2. Ageyears (Over 6 months above is ranged 1 year old)

3. Education

() No education

() Less than compulsory

() Compulsory education () Grade 4 () Grade 6 () Grade 7 () Grade 8

() More than compulsory.....

() Others (specify).....

4.Number of household members

No. of resident	Sex		age	education	Household status				Occupation 1/
	Male	female			Husband	wife	child	Other	
1									
2									
3									
4									
5									
6									
7									
8									

Note^{1/} 1. Rice farming

2. Field crop.....

3. Fruit crop.....

4. Vegetable.....

5. Livestock.....

6. Fishery.....

7. Silkworm rearing

8. Silk fabric weaving

9. Government officer

10. Trader

11. Wage labor

12. Student

13. Others

5. Household labor in agriculture

Status	Sex		Age	Type of labor ^{1/}		Agricultural activity ^{2/}
	male	Female		Full time	Part time	
() Husband						
() Wife						
() Child						
() Child						
()						
()						

Note ^{1/} 1. Rice farming 2. Field crop.....3. Fruit crop.....4. Vegetable.....
 5. Livestock 6. Fishery.....7. Mulberry planting
 8. Silkworm rearing 9. Silk yarn reeling 10. Weaving 11. Others.....

^{2/} 1. Land preparation 2. Mulberry planting 3. Watering
 4. Fertilizer applying 5. Weeding 6. Pruning
 7. Mulberry leaves harvesting 8. Silkworm rearing room cleaning
 9. Silkworm feeding 10. Bed cleaning 11. Enlargement rearing area
 12. Collecting mature worms for mounting 13. Cocoon harvesting
 14. Cocoon culling 15. Silk yarn reeling 16. Bleaching and dyeing
 17. Weaving 18. Others.....

6. Labor

Type of labor	Time wage	No. (person)	Wage rate (Baht/ person)	Activity specify ^{1/}	Sericulture activity ^{2/}
1.Fulltime	<input type="radio"/> Daily				
	<input type="radio"/> Monthly				
	<input type="radio"/> Yearly				
	<input type="radio"/> Others.....				
2. Part time	<input type="radio"/> Daily				
	<input type="radio"/> Others....				

Total of full time laborperson Total of part time..... person

Note ^{1/} 1. Rice farming 2. File crop..... 3. Fruit crop.....
 4. Vegetable.....5. Livestock 6. Fishery.....
 7. Mulberry planting 8. Silkworm rearing 9. Silk yarn reeling
 10. Weaving 11. Others.....

^{2/} 1. Land preparation 2. Mulberry planting 3. Watering
 4. Fertilizer applying 5. Weeding 6. Pruning
 7. Mulberry harvesting 8. Silkworm rearing room cleaning
 9. Silkworm feeding 10. Bed cleaning 11. Enlargement rearing room
 12. Collecting mature worms for mounting 13. Cocoon harvesting
 14. Cocoon culling 15. Silk yarn reeling 16. Bleaching and dyeing
 17. Weaving 18. Others.....

7. Land tenure and use in 2010

Land use	Area (Rai)	Land tenure status		
		Owner	rent	Others.....
1. Rice farming				
2. Field crop.....				
3. Fruit crop.....				
4. Vegetable.....				
5. Livestock.....				
6. Fishery.....				
7. Mulberry planting				
8. Others.....				
9. Others.....				
Total				

8. Households occupation

8.1 Major occupation (Only one occupation that farmer generate high income)

.....

8.2 Minor occupation (Please specify in order).

1).....

2).....

3).....

4).....

9. Household income in 2010

9.1 Farm income

Source of income	Yield (Units/year)	Price/unit (Baht)	Total income (Baht/year)
1. Rice farming			
2. field crop farming			
3. Fruit crop.....			
4. Vegetable planting.....			
5. Livestock.....			
6. Fisheries			
7. Mulberry cultivation			
8. Silkworm rearing			
9. Silk yarn production			
10 silk weaving			
11.....			
12.....			
13.....			

Total farm income.....Baht/year

Sericulture income.....Baht/year

9.2 Non farm income

Source of income	Income (Baht/month)	Months/year	Total (Baht/year)
1. Salary			
2. Wage worker			
3. Trader			
4. Other.....			
5.....			

Total non farm income..... Baht/year

9.3 Total income (Farm income + non farm income).....Baht/year

10. Loan facilities in 2010

Source of loan	Amount of loan	Loan purpose ^{1/}
1. The Bank for Agriculture and Agriculture Cooperative		
2. Agriculture Cooperative		
3. Government Saving bank		
4. Government housing Bank		
5. Commercial bank		
6. Village fund		
7. Middleman		
8. cousin/ neighbor		
9. Others.....		
Total		

Note ^{1/} 1. Farm production

2. Non farm enterprise

3. Households living

4. Others.....

11. Group membership

() Never associated to any group, because.....

() Being associated

Group name	Member status			Reason in attend Group (Answer more than 1)	Time of Membership
	president	Committee	Member		
1. The Bang for Agriculture and Agriculture Cooperative					
2. Agriculture Cooperative					
3. Village fund					
4. House wife group					
5. Sericulture group					
6. Farmer group					
7. SMCE. Group					
8. Saving group					
9.....					
10.....					

- Note/ 1. Buy lower price of input 2. Sale product at a high price
3. Gaining knowledge in agricultural production 4. Access soft loan
5. Got a good welfare form group 6. Others.....
12. Did you participate in your sericulture group last year?
() Participated.....Time/year. Participation in activities.....
() Did not participation because.....

13. What channel of sericulture media were you percept in 2010?

Type of media	Non perception	Times/ week	Times/ month	Times / year
1. Personal media				
1.1 Neighbor				
1.2 Cousin				
1.3 Group leader				
1.4 Local leader				
1.5 Government officer				
1.6 Private officer				
1.7 Others.....				
2. Mass media				
2.1 Radio				
2.2 Television				
2.3 Newspapers				
2.4 Village broadcast				
2.5 Internet				
2.6 Others.....				
3. Interactive media				
3.1 government agency training attending				
3.2 Private agency training attending				
3.3 Field visit with government agency				
3.4 Field visit with Private agency				
3.5 Demonstration with government agency				
Demonstration with government agency				
3.7 Others.....				

14. What kind of sericulture supporting did you receive from concerned agencies in 2010?

Agency supporting	Receive		Agency name ^{1/}
	Never	Received (Times)	
1. Training			
1.1 Sericulture production			
1.2 Silk yarn production			
1.3 Bleaching and dying silk yarn			
1.4 Silk fabric design			
1.5 Silk fabric weaving			
1.6 Silk marketing			
1.7 Others.....			
2. Field visit			
2.1 Sericulture production			
2.2 Silk yarn production			
2.3 Bleaching and dying silk yarn			
2.4 Silk fabric design			
2.5 Silk fabric weaving			
2.6 Silk marketing			
2. Investment and input supporting			
3.1 Investment			
3.2 Mulberry cutting			
3.3 silkworm egg			
3.4 Disinfectant			
3.5 Silk worm rearing room			
3.6 Rearing room cleaning chemical			
3.7 Reeling apparatus			
3.8. weaving material			
3.9 Others.....			

- Note ^{1/}
1. The Queen Sirikit Department of Sericulture
 2. Department of Agricultural Extension
 3. Community Development Department
 4. Department of Industrial Promotion
 5. The Local Administration Organization
 6. Private Agency
 7. Others.....

Chapter 2. Mulberry cultivation condition

15. How long have you planted mulberryyears

16. Mulberry cultivation

Filed No.	Land tenure			Mulberry Variety ^{1/}	Mulberry area (Rai)	Source of mulberry variety ^{2/}	Reason for Mulberry variety selecting ^{3/}
	Owner	rant	Other				
1.							
2.							
3.							
4.							
5.							

- Note ^{1/}
- | | | |
|---------------|---------------|-------------------------|
| 1. Buriram 51 | 2. Buriram 60 | 3. Nakhonratchasrima 60 |
| 4. Sisaket 33 | 5. Kun-Pi | 6. Pi |
| 7. Soi | 8. Noi | 9. Others..... |

- ^{2/}
- | | | |
|-----------------------------|-------------------|---------------|
| 1. The Queen Sirikit Center | 2. Private agency | 3. Neighbor |
| 4. Sericulture group | 5. Owner | 6. Other..... |

- ^{3/}
- | | | |
|-------------------------|---------------------|------------------|
| 1. Inherited | 2. Agency promotion | 3. High nutrient |
| 4. Large and thick leaf | 5. Others..... | |

17. What water resource did you use in mulberry cultivation?

- Rain water
- Irrigation
- Pond
- Underground water
- Others.....

18. Did you have sufficient mulberry leaf to feed silkworm

- Sufficient
- Insufficient

19. In the event that the mulberry leaves were insufficient, what did you do?

- Borrow from neighbor.
- Buy.....kg. from neighbor which cost..... Baht/kg
- Buy.....kg. from other village which costBaht/kg
- Buy.....kg. from government agency which cost ... Baht/kg
- .Others.....

20. Mulberry cultivation cost in 2010

20.1. Land cost

No.	Amount of land used	Cost (Baht/year)
1.	Land owner amount.....Rai	
2.	Rental amount.....Rai	
3.	Others amount.....Rai	
4.	Land tax	
Total cost		

20.2 Material cost

Item		Cost (Baht/unit)	Buy		Their own/get for free	
			Quantity	Cost	Quantity	Cost
1. Mulberry variety						
1.1 Cutting	pc					
2. Fertilizer						
2.1 Organic fertilizer	kg					
2.2 Chemical fertilizer	kg					
Formula.....						
2.3.....						
3. Others						
3.1.....						
3.2.....						
4. Soil conditioner						
4.1 Dolomite	kg					
4.2 Lime	kg					
4.3 Others.....						
5. Water, gasoline, and electricity cost						
5.1 Water						
5.2 Gasoline						
5.3 Electricity						
6. Others cost.....						

20.4 Machine and equipment cost

Items	Quantity	(Baht/ unit)	Source		Usage Life (Year)	Used (Year)	Maintenance cost (Baht/year)	Total cost (Baht)
			Buy	Owner/free				
1. Knife								
2. Hoe								
3. Spade								
4. Bucket								
5. Four wheel tractor								
6. Two wheel tractor								
7. Irrigation pump								
8.....								
9.....								

20.5 Long term investment

Items	Quantity (units)	Cost (Baht)	Spending
1. Pond			
2. Underground water			
3.....			
4.....			

21. Local wisdom and technology in mulberry cultivation

Activities	Local wisdom	Source of local wisdom	Technology	Source of technology
1. Mulberry variety				
2. Mulberry planting				
3. Applying				
4. Watering				
5. Weeding				
6. Pruning				
7. Disease preservation				
8. Harvesting				
9. Others.....				

Chapter 3. Silkworm rearing condition in 2010

22. How many cycles of silkworm rearing did you do per year ?.....cycles/ year

Time cycle of silkworm rearing from.....to.....

23. What pattern of silkworm rearing did you practice?

() Stop and start throughout the year.....

() Continuous rearing throughout the year because.....

() Seasonal rearing such as rearing after rice harvesting

24. What kind of silkworm rearing room did you belong to ?

() Standard type (excluded from the house) because

() Cost saving type (excluded from the house) because.....

() Cost saving type (Inside the house, under the house) because.....

25. Did you record silkworm rearing information?

Items	Record	Did not record because.....
1.Silkworm planning		
2.Rearing times		
3.Temperature and humidity		
4.Mulberry leaf weigh		
5.Silkworm disease		
6. Silkworm molting times/ after molting (day/Times)		
7. Chemical using and amount of used		
8. Silkworm Moughting time		
9. Cocoon yield		
10. Silkworm rearing problems		

26. Input of commercial sericultural production in 2010

26.1 Silkworm variety

Variety	Amount of silkworm egg	Source of variety ^{1/}	Reason of silkworm variety selecting ^{2/}	Proposed for silkworm rearing			Which is commercial silkworm variety
				Cocoon sale	Silk yarn sale	weaving	
1. NANGNOI SRESAKET							
2. NANGLAI							
3. NANG LUANG							
4. SUMRONG							
5. SUMRONG × NANGNOI SRESAKET							
6. DOKBUA							
7.SAKON NAKHON 1							
8. UDON THANI							
9. PAKCHONG 21							
10. DOKKUN							
11.....							
12.....							
13.....							

Note ^{1/} 1. The Queen Sirikit Center 2. Private agency 3. Neighbor

4. Sericulture group

5. Owner

6. Other.....

^{2/} 1. Inherited

2. Agency promotion

3. High yield

4. Resistant to whether

26.2 Amount of mulberry leaves to silkworm feeding

Silkworm age	Number of day for silkworm feeding	Mulberry leaves weight			
		Weight (kg/day)	Total weight of leaves	Buy (kg)	Cost (Baht/kg)
1					
2					
3					
4					
5					
Total					

26.3 What was the material cost in silkworm rearing?

Items	Quantity	Cost (Baht/ Unit)	Buy		Owner/ free	
			Quantity	Cost (Baht)	Quantity	Cost (Baht)
1. Silkworm egg						
2. Chemical in silkworm rearing						
2.1 Lime						
2.2 Chlorine						
2.3 Formaldehyde						
2.4 Pepsol						
2.5 Soap						
2.6 Powdered detergent						
2.7 Ant control						
2.8 fly control						

Items	Quantity	Cost (Baht / Unit)	Buy		Owner/ free	
			Quantity	Cost (Baht)	Quantity	Cost (Baht)
2.9.....						
2.10.....						
3. Other materials						
3.1 Newspapers						
3.2.....						
4. Other costs						
4.1 Water						
4.2 Gasoline						
4.3 Electricity						
5. Others.....						

Activities	Household labor			Hire			Wage (Baht)	Total labor cost (Baht)
	Person	Day	Hr./ day	Person	Day	Hr./ day		
5.2 Enlargement area and bed cleaning								
6. 5th Instar								
Silkworm wakeup.....day								
Sleep.....day								
feeding.....meal/day								
6.1 Mulberry chopping and feeding								
6.2 Enlargement area and bed cleaning								

26.6. What was your long term investment?

Items	Number (unit)	Cost (Baht)	Cost of repairs (Baht)	
			Fix hire	Fix by self
1.silkworm rearing room				
1.1 Standard type size				
1.2 Cost saving type size.....				
2.Silkworm rearing shelf make from.....size.....				
3. Others.....				

27. What kind of silkworm disease and pest occurred in last cycle?

27.1 silkworm disease

Disease	No Disease	Silkworm age (Instar)					Disease spread				Disease prevention ^{1/}
		1	2	3	4	5	1-25	26-50	51-75	76-100	
1. Grassery											
2. Flacherie											
3. Aspergilus											
4. Pebrine											
5. Muscardine											
6Other.....											

Note ^{1/}

1. Fumigation silkworm rearing room with 3% of chlorine
2. Spraying lime at the silkworm rearing room then wait until it dries and fumigate with 3% of formaldehyde
3. Making a good ventilate silkworm rearing room
4. Using the silkworm egg from the reliable sources
5. Separating infected silkworm and eliminate by using formalin 3 %

27.2 Silkworm pest

Pest	No pest	Silkworm age (Instar)					Disease spread				Disease prevention ^{1/}
		1	2	3	4	5	1-25	26-50	51-75	76-100	
1. Fly											
2. Ant											
3. Lizard											
4. Gecko											
5. Rat											
6. Other.....											

- Note ^{1/}
1. Silkworm rearing room should be a wire or mosquito plastic net and make sure of no hole
 2. Eliminating silkworm pest immediately when found in the rearing room
 3. Exercise extreme care when bring the basket of mulberry leaf into the silkworm rearing room
 4. Build the ditch around the silkworm rearing room
 5. Make sure there's water at the end of each silkworm shelf's legs
 6. Rub at the end of each silkworm shelf's legs with oil
 7. Make the dark room for fly trapping

28. Local wisdom and technology in silkworm rearing

Activities	Local wisdom	Source of local wisdom	Technology	Source of technology
1. Silk variety				
2. Silkworm rearing room and equipment preparation				
3. Feeding				
4. Enlargement area				
5. Bed cleaning				
6. Practice while silkworms are sleeping and awake				
7. Collecting mature worms for mounting				
8. Cocoon harvesting				
9. Prevention and elimination disease and pest				
10. Others.....				

29. Amounts of cocoon yield in 2010.....kg

30. Did you practice culling cocoon before reeling?

() No, because.....

() Yes, how did you do.....

31. What kind of reeling apparatus did you use?

() Hand reeling apparatus because.....

() Developed hand reeling apparatus.....

() Others.....

32. Silk yarn production in 2010

No. of silk yarn production per year	Amount of cocoon (Kg)	Silk yarn types			Silk yarn yield (Kg.)	Silk yarn using 1/
		1 st silk	2 nd silk	3 rd silk		
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
Total						

Note^{1/} 1. weaving 2. Sale 3. Weaving and sale 4. Others.....

33. Silk yarn reeling cost in 2010

33.1 Equipments cost

Items	Quantity	Cost (Baht/unit)	Source		Usage Life	Used (year)	Maintenance (baht/year)	Total cost (baht)
			Buy	Owner/ free				
1.Reeling apparatus								
()1.1 Hand reeling apparatus								
() 1.2 Developing hand reeling apparatus								
() 1.3.....								
2. Cocoon boiling Pot								
3.Small reel								
4. Spinning wheel								
5. Basket								
6. Silk yarn hanger								
7. Stove								
8. Others.....								
9.								
10.....								

33.2 Labor cost in silk yarn reeling

Items	Household labor			Hired labor			Wage (Baht)	Total labor cost (Baht)
	person	Day	Hr./day	person	Day	Hr./day		
1. Cocoons culling								
2. Silk yarn reeling								
3. Re-reeling								
4. Others.....								
5.....								

34. Local wisdom and technology in silk yarn reeling

Activities	Local wisdom	Source of local wisdom	Technology	Source of technology
1. Cocoons culling				
2. Silk yarn reeling				
3. Re-reeling				
4. Others.....				
5.....				
6.....				
7.....				

35. What kind of silk fabric did you produce in 2010 (answer more than 1)

- Plain fabric “MUDMEE” “SARONG”
 “PHAKAOMA” Dying fabric Others.....

Reason of weaving.....

36. What kind of loom did you use for weaving?

Power loom because.....

Hand loom because.....

Others.....

37. Silk fabric quantity in 2010

Fabric type	Silk yarn quantity/ loom		Loom/year	Meter /loom
	Warp (kg)	Weft (kg)		
1. Plain fabric				
2. " MUDMEE"				
3. " SARONG"				
4. " PHAKAOMA"				
5. Dying fabric				
6. Others.....				
7.				
8.				
9.				
10.				

38. Silk fabric weaving cost in 2010

38.1 Silk yarn cost

Fabric type	Warp (kg)		Weft (kg)		Cost (Baht/kg)
	Owner	Buy	Owner	Buy	
1. Plain fabric					
2. “MUDMEE”					
3. “SARONG”					
4. “PHAKAOMA”					
5. Dying fabric					
6. Others.....					
7.					
8.....					
9.....					
10.....					

38.3 Material costfabric/ loom

Items	Warp			weft			Total cost
	unit	Quantity	Cost (Baht)	unit	Quantity	Cost (Baht)	
1. dye color 1.1.....							
2. Bleaching agents 2.1.....							
2.2.....							
3. Plastic rope							
5. Tapioca flour							
6. Olive oil							
7. Shampoo							
8. Others.....							
9.....							
10.....							

38.4 Equipment cost in silk fabric weaving

Items	Quantity	Cost (Baht)	Usage Life	Used (year)	Maintenance (baht/year)	Total cost (baht)
1. Bleaching pot						
2. Dying pot						
3. Basin						
4. Stove ()..... ().....						
5. Hanger						
6. Dying ring						
7. Small reel						
8. Spinning wheel						
9. Reed () steel () wood						
10. Heddle						
11. Shuttle						
12. Loom						
13. Spool stool						
14. Combs						
15. knife						
16. Scissors						
17. Others.....						
18. Others.....						

39. Local wisdom and technology in silk fabric weaving

Activities	Local wisdom	Source of local wisdom	Technology	Source of technology
1. Bleaching				
2. Warp yarn preparation				
3. Weft yarn preparation				
4. Design				
5. weaving				
6. Others.....				
7. Others.....				
8. Others.....				

Chapter 4 Silk marketing condition

40. Marketing channels

40.1 Cocoons

Marketing channel	Quantity (kg)	Cost (Baht/ kg)	Transportation cost	Price setup by ^{1/}	Reason for sale ^{2/}
() Sericulture group					
() Middleman					
() Local market					
() Neighbor					
() reeling factory					
()					
()					

Note^{1/}

1. Farmer

2. Seller

3. Group member

4. According to market price

5. Others.....

^{2/}

1. High price

2. Familiarity

3. Near production place

4. Others.....

40.2 Silk yarn

Marketing channel	Quantity (kg)	Cost (Baht/ kg)	Transportation cost	Price setup by ^{1/}	Reason for sale ^{2/}
<input type="checkbox"/> Sericulture group					
<input type="checkbox"/> Middleman					
<input type="checkbox"/> Local market					
<input type="checkbox"/> Neighbor					
<input type="checkbox"/> weaving factory					
<input type="checkbox"/>					
<input type="checkbox"/>					

Note^{1/}

1. Farmer

2. Buyer

3. Group member

4. According to market price

5. Others.....

^{2/}

1. High price

2. Familiarity

3. Near production place

4. Others.....

40.3 Silk fabric

Marketing channel	Plain fabric		“ MUDMEE”		“SARONG”		“PHAKAOMA”			Transportation cost	Price setup by1/	Reason for sale 2/
	Quantity (m.)	Cost (Baht/m)	Quantity (m.)	Cost (Baht/m)	Quantity (m.)	Cost (Baht/m)	Quantity (m.)	Cost (Baht/m)	Quantity (m.)	Cost (Baht/m)	Quantity (m.)	Cost (Baht/m)			
() Sericulture group															
() Middleman															
() Local market															
() Bangkok market															
() International market															
() Other.....															
() Other.....															

Note^{1/} 1. Farmer 2. Seller 3. Group member 4. According to market price 5. Others.....

^{2/} 1. High price 2. Familiarity 3. Near production place 4. Others.....

41. Farmer's practice to meet silk products standard

41.1 Do you product silk yarn towards silk yarn standard?

Items	Practices		
	Always	Sometimes	Never
1. Silk yarn quality The silk yarn is even in structure, size and color, round, clean and free from adulterated materials.			
2. Packaging			
2.1 The silk yarn skein is orderly packed in a package			
2.2 Each package is even in quality and size			
2.3 Each package contains 1 or 2 kg of Thai silk yarn			
2.4 Packaging materials are of good quality, which shall well protect the products from humidity, insect contamination and tolerate transportation.			
2.5 They are free from odor and adulterated materials, which may affect the yarn quality.			
2.6 The visible part of the Thai silk yarn must represent all Thai silk yarn as labeled.			
3. Acceptable tolerance The Thai silk yarn contained in each package is subjected to an acceptable level of tolerance as follows;			
3.1 Acceptable tolerance for the diameter of silk skein is not more than 3% of that specified on the label.			

Items	Practices		
	Always	Sometimes	Never
3.2 Premium Grade Not more than 5% of deviation from the criteria set for Premium Grade quality, but meet those of First level grade			
3.3 First Level Grade Not more than 10% of deviation from the criteria set for First Level Grade quality, but meet those of Second level grade.			
3.4 Second Level Grade Not more than 10% of deviation from the criteria set for Second Level Grade quality.			
3.5 Deviation criterion for the size aspect not more than 10% of that specified on the label.			
4. Label and markings Each unit of the Thai silk yarn package supposedly contain number, alphabet, mark, and statement, clearly visible without any counterfeit that details the following:			
4.1 The term Thai silk yarn and silkworm variety or silkworm race			
4.2 Type, size and diameter of skein			
4.3 Number of skeins and net weight of the package			
4.4 Date–month–year of production			
4.5 Name of producer / group and location			

41.2 Do you product silk fabric towards silk fabric standard?

Items	Practices		
	Always	Sometime	Never
1. Types			
1.1 Light weight silk: weigh not more than 90 grams per square meter			
1.2 Medium weight silk: weigh from 91 -120 grams per square meter			
1.3 Heavy weight silk: weigh from 121 – 160 grams per square meter			
1.4 Extra heavy weight silk: weigh more than 160 grams per square meter			
2. Size			
2.1 The width is as indicated in the label with deviation $\pm 3\%$			
2.2 The length is not less than the value indicated in the label			
3. Number of yarn			
3.1 Number of yarn per 25.4 mm is as indicated in the label with deviation $\pm 2\%$			
4. Weight			
4.1 Weight per area unit is as indicated in the label with deviation $\pm 2\%$			
5. Required Characteristics			
5.1 All kinds of the silk fabric are neat in appearance, free from stains and damage including splitting yarn, hole, and uniform in color characteristic of silk through out the length.			
5.2 The silk is authentic			

Items	Practices		
	Always	Sometime	Never
5.3 The resistant to light (xenon arc light) is not less than 5 level blue scale.			
6. Packaging			
6.1 The silk fabric is tidily and securely packed and wrapped with clean and adequately durable material to protect the product form any damage.			
7. Marking and Label			
Each silk fabric bale shall bear at least number, letter, or mark indicating clearly and legibly the following information.			
7.1 Product name			
7.2 Type of fabric by type of weaving			
7.3 Width and length in meters			
7.4 Dye type (natural or chemical dye)			
7.5 Number of yarns in each row			
7.6 Weight in grams per square meters			
7.7 Recommended care and maintenance			
7.8 The name of the manufacturer or factory, address or registered trademark			

Chapter 5 Farmers' knowledge, practice and attitude on commercial sericultural production

42.1 Farmers' knowledge and practice on commercial sericultural production

Preparation before silkworm rearing

1. What is chemical do you use for injecting or fumigating silkworm raising room and equipment before rearing?

- a. Formalin 3%
- b. Hyter
- c. DDT
- d. Termite control

Do you spray or fumigate the silkworm rearing room and equipment with formalin 3% every time before silkworm rearing?

- () Always because.....
- () Never because.....

Silkworm feeding

2. How do you collect mulberry leaf to feed young silkworms?

- a. Collecting from bottom
- b. Collecting from every part of the tree
- c. Collecting the 2nd – 3rd leaf from the top
- d. Collecting nice leaves from every part of stem

Do you collect the young mulberry leaves from the 2^{sd} – 3rd leaf from the top for feeding young silkworms every time?

- () Always because.....
- () Never because.....

3 How do you feed mulberry leaf to young silkworms?

- a. Feed whole leaves
- b. Feed whole branch
- c. Mix chopped mulberry leaves and whole ones
- d. Chop mulberry leaves in appropriate size to feed silkworms

Do you feed to young silkworms by chopping mulberry leaves into the appropriate size for silkworms?

- () Always because.....
- () Never because.....

Silkworm rearing management

4. What substance do you spray on newly hatched silkworms to prevention disease?

- a. Alum
- b. Pepzole
- c. Burnt chaff
- d. Powder

Do you sprinkle "PEBSOL" on newly hatched silkworms every time?

- () Always because.....
- () Never because.....

5. How often do you enlarge the silkworm rearing area?

- a. Depend on farmers
- b. Every other day
- c. Once a week
- d. Every day before feeding

Do you enlarge the silkworm rearing area every time before feeding?

- () Always because.....
- () Never because.....

6. What is suitable time for silkworm bed cleaning?

- a. During sleeping time
- b. Before feeding
- c. After feeding
- d. Depend on farmers

Do you clean silkworm excrement every time before feeding?

- () Always because.....
- () Never because.....

7. During the molting time of silkworms, what should you do?

- a. Close doors and windows of raising room
- b. Feed more mulberry leaves
- c. Nothing
- d. Cull un-molting silkworm form molting silkworm form molting silkworm

During molting time of silkworms, do you separate non-molting silkworm form molting silkworm every time?

- () Always because.....
- () Never because.....

8. During the after molting time of silkworms, what do you do?

- a. Stop feeding
- b. Place paper on silkworm raising utensils
- c. Sprinkling “PEBSOL” on silkworms once before they come out of their molting state
- d. Depend on farmer

During after molting time of silkworms, do you sprinkle “PEBSOL” on silkworms once before they come out of their molting state every time?

- () Always because.....
- () Never because.....

9. What is substance do you use to reduce humidity while silkworms are molting?

- a. Lime or rice husks
- b. Powder
- c. Straw
- d. Paper

Do you use lime or rice husks to reduce humidity while silkworms are molting?

- () Always because.....
- () Never because.....

Mounting management

10. What is suitable time to clean mountage?

- a. No cleaning required
- b. Before keeping cocoon into mountage and after bringing cocoon out of mountage
- c. After bringing cocoon out of mountage
- d. Clean only once with silkworm raising equipment

Do you clean mountage before putting cocoon into mountage and after bringing cocoon out of mountage?

- () Always because.....
- () Never because.....

11. What is suitable environment for mounting?

- a. Good ventilation
- b. High humidity
- c. Low light
- d. High temperature

Do you select a well ventilated place for mounting every time?

- () Always because.....
- () Never because.....

Cocoon harvesting

12. What is the best time to harvest cocoons?

- a. 1-2 days
- b. 4-5 days
- c. 2 weeks
- d. More than 2 weeks

Do you harvest cocoon 4-5 days after silkworm mounting?

- () Always because.....
- () Never because.....

13. What is the right process to harvest cocoons from mountage?

- a. Shake plate strongly until pupa fall
- b. Pull firmly to easily collect cocoons
- c. Press silkworms hard to see whether pupa die or not
- d. Collect cocoons softly from mountage to prevent pupa's body breaking or death

In cocoon harvesting, do you collect cocoons softly from mountage to prevent pupa body breakage or death?

- () Always because.....
- () Never because.....

14. What is the good cocoon?

- a. Small
- b. Unusual body
- c. Different colors
- d. Tight cocoon, not twinned, not thin, clean both inside and outside, no defects

Do you cull firm cocoons with tight cocoon, not twinned, not thin, clean both inside and outside, and no defects.

- () Always because.....
- () Never because.....

Prevention silk worm disease and pest

15. What do you do to eliminate unhealthy or infected silkworms?

- a. Continue rearing
- b. Eliminate some diseased ones
- c. Separate diseased ones to other plates
- d. Eliminate unhealthy and infected silkworms by using formalin 3%

Do you eliminate unhealthy and infected silkworms by using Formalin 3% every time?

- () Always because.....
- () Never because.....

16. How do you prevent ants from damaging silkworms?

- a. No prevention required
- b. Apply anti-ant chalk on the silkworm rearing shelf base
- c. Apply DDT daily
- d. Dig a ditch around silk worm rearing room

Do you dig a ditch around the silkworm rearing room to prevent ant intrusion?

- () Always because.....
- () Never because.....

Silk yarn reeling

17. How do you maintain reeling equipment?

- a. Clean both before and after use
- b. No cleaning required
- c. Clean once a week
- d. Clean 2 times a week

Do you clean reeling equipment before and after use?

- Always because.....
- Never because.....

18. What kind of water is used for boiling cocoons?

- a. Brackish water
- b. Clean water
- c. Tap water
- d. Any kind of water

Do you use clean water for boiling cocoons every time?

- Always because.....
- Never because.....

19. What is the appropriate amount of cocoon to be boiled to ensure good quality of silk yarn?

- a. 20-30 cocoons
- b. 40-50 cocoons
- c. 60-70 cocoons
- d. 80-100 cocoons

Do you use 80-100 cocoons/time in every boiling pot for drawing the silk from the cocoons in order to acquire good quality silk yarn?

- Always because.....
- Never because.....

Silk fabric weaving

20. What kind of substance do you use to fix color in dyeing method?

- a. Sunlight Soap
- b. vinegar
- c. alum
- d. limewater

Do you use vinegar to fix color in dyeing method?

- () Always because.....
- () Never because.....

Marketing management

21. What is the best way to make your product meet marketing requirements?

- a. Produce products according to the farmer's requirement
- b. Produce products according to the market's requirement
- c. Produce products according to the particular group's opinion
- d. Produce products according to the farmer's budget

Do you produce silk product according to market requirement?

- () Always because.....
- () Never because.....

22. In order to produce a product that meet the market requirement, how do you select your raw materials?

- a. Use only raw materials that are easy to find
- b. Depend on farmers
- c. Use a good quality raw materials
- d. Use raw materials that are available locally
- e. Do you use a good quality raw material in silk production every time?
 - () Always because.....
 - () Never because.....

23. How do you make sure that your product meet the standard quality and is able to be sold for a high price?

- a. Determine silk product quality before selling
- b. Follow what has already been sold in the market
- c. Follow the old tradition
- d. Do nothing

Do you determine silk product quality before selling?

- () Always because.....
- () Never because.....

24. What group should be taken into consideration first before setting the price of the silk?

- a. sellers
- b. farmers
- c. target customers
- d. members

Do you set prices according to target groups?

- () Always because.....
- () Never because.....

25. How do you set the price of the silk?

- a. Set it according to the market price
- b. Depends on sellers
- c. Depends on farmer
- d. Depends on the silk product quality

Do you set prices according to silk quality, design and color?

- () Always because.....
- () Never because.....

26. How do you make your silk products become known in the market?

- a. advertise silk products through various media channels
- b. Discount price so that the price is actually lower than the cost of production
- c. Increase the price to be equal to the price of imported goods
- d. Find a store location that is close to the source of production

Do you advertise silk products through various media channels?

- () Always because.....
- () Never because.....

27. How do you make your products become accepted in the market?

- a. Produce silk product according to the farmer's ability
 - b. Produce silk product towards quality certification
 - c. Produce silk product according to the middleman's requirement
 - d. Produce silk product according to the farmer's requirement
 - e. Do you produce silk product towards quality certification every time?
- () Always because.....
- () Never because.....

Accounting management

28. How do you produce silk product that are the most effective in terms of accounting?

- a. Plan expenditures in silk production
- b. Loan money to produce silk
- c. Use the installment system when the product is sold
- d. Customers have to pay before production starts

Do you plan expenditures in silk production?

- () Always because.....
- () Never because.....

29. Which one of these is the most crucial thing in order to plan the production of silk?

- a. Land
- b. Labor
- c. Capital
- d. Water sources

Do you provide capital in advance for silk production?

- () Always because.....
- () Never because.....

30. How do you calculate the cost of silk's production?

- a. No calculation; use money in regular basis like usual
- b. Make accounting records
- c. By memory
- d. Already save a part of income for the production of silk

Do you provide accounting record in silk production?

- () Always because.....
- () Never because.....

31. Which one of these has an influence on your decision to become a silk producer?

- a. The characteristics of that local area
- b. The weather
- c. The price of raw materials that are used in the silk production
- d. Silk production return

Do you analyze return in silk production?

- () Always because.....
- () Never because.....

32. How do you manage your money after selling silk products?

- a. Pay off debt
- b. Use it on a daily basis
- c. Earn as capital in further production
- d. Save it for children's education

Do you earn as capital in further production?

- () Always because.....
- () Never because.....

Human resource management

33. How do you strengthen your group and create unity between the members?

- a. Sometimes attend the activities
- b. Always attend the activities
- c. Rarely attend any activities
- d. Never attend any activities

Do you participate in group activity?

- () Always because.....
- () Never because.....

34. In order for group members to produce products that meet the standard quality, what should group members do?

- a. Participate in all group learning process
- b. Give raw materials for group members
- c. Give funds to the group members
- d. Find market for group members

Do you participate in all groups learning process?

- Always because.....
- Never because.....

35. In order to motivate group members, what can be done?

- a. Provide group benefit to members
- b. Find raw materials for members
- c. Give funds to the members
- d. Find market for members

Do you participate in group benefit?

- Always because.....
- Never because.....

42.2 Farmers' knowledge and practice on commercial sericultural production

How do you have opinion in the following questions?

Items	Attitude levels				
	Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
Production management <u>Preparation before silkworm rearing</u> 1. Spraying or fumigating silk worm rooms and equipment with formalin 3% every time before rearing silk worms					
<u>Silkworm feeding</u> 2. Harvesting young mulberry leaf from the 2 nd – 3 rd leaf from the top for rearing silkworm every time					
3. Feeding mulberry leaf to young silk worms by chopping mulberry leaf into proper sizes for silkworm					
<u>Silkworm rearing management</u> 4. Sprinkling “PEBSOL” on newly hatched silk worms every time					
5. Enlargement of silkworm rearing areas every day before feeding					

Items	Attitude levels				
	Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
6. Bed cleaning every time before feeding					
7. Culling non-molting silkworm from molting silkworm every time during molting silkworm					
8. Sprinkling "PEBSOL" on silkworms once before they come out of their molting state every time					
9. Using lime or rice husks to reduce humidity while silkworms are molting					
<u>Mounting management</u>					
10. Cleaning the mountage every time before putting cocoon into mountage and after bring cocoons out of mountage					
11. Selecting a well ventilated place for mounting every time					
12. Harvesting cocoon 4-5 days after silkworm mounting					
13. Collecting silk cocoons softly from mountage to prevent pupa body breakage or death					
14. Culling firm cocoons with tight cocoon, no twin or thin cocoons that are not clean inside and outside, and no defects					

Items	Attitude levels				
	Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
<u>Prevention silkworm disease and pest</u>					
15. eliminate unhealthy and infected silkworms by using formalin 3% every time					
16. Preventing ants from damaging silk worms by digging a ditch around silkworm rearing room					
17. Cleaning reeling equipment before and after use					
18. Using clear water for boiling cocoons every time					
19. Using 80-100 silk worms/time in every boiling pot for drawing the silk from the cocoons in order to acquire good quality silk yarn					
20. Using vinegar to fix color in dyeing method					
<u>Marketing management</u>					
21. Producing silk products according to market requirement					
22. using good quality raw materials in silk production every time					

Items	Attitude levels				
	Strongly agree	Agree	Uncertain	Disagree	Strongly disagree
23. determine silk product quality before selling					
24. setting prices according to target groups					
25. Setting prices according to silk quality, design and color					
26. Advertising silk products through various media channels					
27. produce silk product towards quality certification every time					
<u>Accounting management</u>					
28.Planning expenditure sericulture production					
29. Provide capital in advance for sericulture production					
30. Provide accounting record in sericulture production					
31. analyzing return in sericulture production					
32. Earning as capital in further production					
<u>Human resource management</u>					
33. participating in group activity					
34. participating in all group learning process					
35.praticipation in group benefit					

Chapter 6. Constraints and recommendations on commercial sericultural production

43. Did you have problems in commercial sericultural production? If so, how did you deal with the problems?

Constraints	No problem	Have problem		Recommendation
		Un solving	solving specific	
Production				
<u>1. Mulberry cultivation</u>				
1.1 Insufficiency of mulberry area				
1.2 Insufficiency of good mulberry variety				
1.3 Lack of water resource in mulberry planting				
1.4 Insufficiency of mulberry planting equipment				
1.5 Lack of labor in mulberry planting				
1.6 Lack of knowledge in mulberry cultivation				
1.7 Mulberry disease and pest				
<u>2. Silkworm rearing</u>				
2.1 silkworm rearing under the set standard				
2.2 Insufficiency good silkworm egg				
2.3 Insufficiency of silkworm rearing equipment				

Constraints	No problem	Have problem		Recommendation
		Un solving	solving specific	
2.4 Lack of labor in silkworm rearing				
2.5 insufficiency of mulberry leaves for silkworm feeding				
2.6 Limited knowledge in disinfection				
2.7 Lack of knowledge in bed cleaning				
2.8 Lack of knowledge in Enlarging silkworm rearing area				
2.9 Lack of knowledge in practice while silkworm are sleeping/wake up				
2.10 Lack of knowledge in mounting method				
2.11 Disease and pest				
<u>3. Silk yarn reeling</u>				
3.1 Complicating in cocoon culling				
3.2 Insufficiency of silk yarn reeling equipment				
3.3 Lack of high silk yarn apparatus productivity				
3.4 Lack of labor in silk yarn reeling				
3.5 Lack of knowledge in silk yarn reeling				

Constraints	No problem	Have problem		Recommendation
		Un solving	solving specific	
3.6 Complicating in silk yarn culling				
3.7 Low quality of silk yarn				
4. Silk fabric weaving				
4.1 Lack of weaving materials				
4.2 high cost of materials				
4.3 Insufficiency in weaving equipment				
4.4 Lack of weaving labor				
4.5 high weaving wage				
4.6 Limited knowledge in silk yarn dyeing				
4.7 Limited knowledge in silk fabric design				
4.8 Limited knowledge in silk fabric weaving				
5 Limited capital				
6. High cost of production				
Others.....				
Marketing				
1. Instability of marketing channels				
2. Decreases in price				
3. Limited marketing channels				
4. Price reduction by middleman				
5. lack of negotiating power				
6. Limited knowledge in packaging				
7. Limited knowledge in marketing advertising				
8.Limited marketing information				
Other.s.....				

Constraints	No problem	Have problem		Recommendation
		Un solving	solving Specific	
Accounting				
1. Limited knowledge and experience in financial planning				
2. Limited knowledge and experience in capital supporting				
3. Limited knowledge in sericulture production accounting				
4. No sericulture production return analysis				
5. No saving profits from sale as reserve capital				
Others.....				
Human resource management				
5. Group members ignored benefit or dividends from sericulture activities.				
6. The group was not financially competent enough to provide the members welfare				
7. Group members did not share group business expenditure.				
8. Others.....				

44. Do you have any problems in commercial sericultural support by concern agencies? If so, how did you deal with them?

Constraints	No problem	Have problem		Recommendation
		Un solving	solving Specific.....	
1. Limited new sericulture information				
2. Rare coordination among related agencies				
3. Limited sericulture input support				
4. Limited cooperation for marketing activities				
5. No direct related agencies responsible				
6. insufficiency of agency officers				

45. Did you have any recommendations for the improvement of silk's production?

Recommendation	Farmer's need		Reasons
	Need	No need	
Production			
<u>1. Related agencies should continues provide trainings to transfer technical knowledge especially in the following issues.</u>			
1.1 Mulberry variety selecting			
1.2 Mulberry cultivation			
1.3 Prevention in mulberry disease			
1.4 Silkworm variety selection			
1.5 Silkworm rearing technique			
1.6 Prevention in silkworm disease			
1.7 Silk yarn reeling technique for good silk yarn quality			
1.8 dying technique for high quality			
1.9 Natural dying technique			
1.10 Silk fabric design			
1.11 Silk processing technique			
Others.....			
<u>2. Related agencies should support farmers study visits</u>			
2.1 visit sericulture network group with certified standardization.			
2.2 visit silk producers with export ability			
Others			

Recommendation	Farmer's need		Reasons
	Need	No need	
Marketing			
1. Related agencies should increase silk marketing channels			
2. Run campaign to promote use of silk products			
3. Establish silk information center			
Others			
Financial			
1. <u>Related agencies should continues providing trainings to transfer technical knowledge especially in the following issuers.</u>			
1.1 Make revenues – expenses accounting			
1.2 cost and return analysis in silk production			
Others.....			
Human resource			
1. Training and farm visit to improve the farmer knowledge			
2. Promote group participation for group members			
3. Share profit and dividend to group members			
4. Provide welfares for group members			
Supports from the related agencies			
1.....			
2.....			

Appendix B
Example of Mulberry Cultivation Cost Calculation

Example of Mulberry Cultivation Cost Calculation

Total cost in mulberry cultivation cost consists of total variable cost and total fixed cost

$$\text{Total cost} = \text{Variable cost} + \text{Fixed cost}$$

1. Variable cost

Variable cost = Fertilizer cost + soil conditioner cost+ labor cost (fertilizing, watering, weeding, and pruning)

1.1 Fertilizer cost

$$\text{Fertilizer cost} = \text{organic fertilizer} + \text{Chemical fertilizer}$$

$$= 1,627.92 + 253.20$$

$$= 1,881.12 \text{ baht/rai}$$

1.2 Soil conditioner cost

$$\text{Soil conditioner cost} = \text{Lime}$$

$$= 50.20 \text{ baht/rai}$$

1.3 Labor cost consists of fertilizer application, weeding, watering and pruning cost

$$\text{Labor cost} = \text{Number of working hour} \times \text{wage rate /day}$$

Man day = Number of working man per day × number of working hour/
day/one person × number of day) ÷ 8

1.3.1 Labor cost of fertilizer application

$$\text{Man day} = (2 \times 4.558 \times 3) \div 8$$

$$= 3.419$$

$$\text{Labor cost} = 3.4 \times 150$$

$$= 512.92 \text{ baht/ rai}$$

1.3.2 Labor cost of weeding

$$\text{Man day} = (2 \times 8 \times 7) \div 8$$

$$= 14$$

$$\text{Labor cost} = 14 \times 150$$

$$= 2,100 \text{ baht/ rai}$$

1.3.3 Labor cost of watering

$$\text{Man day} = (1 \times 0.501 \times 24) \div 8$$

$$= 1.503$$

$$\text{Labor cost} = 1.5 \times 150$$

$$= 225.55 \text{ baht/ rai}$$

1.3.4 Labor cost of pruning

$$\text{Man day} = (2 \times 3 \times 5) \div 8$$

$$= 3.75$$

$$\text{Labor cost} = 1.6 \times 150$$

$$= 562.5 \text{ baht/rai}$$

$$\text{Labor cost} = \text{Fertilizer application} + \text{Weeding} + \text{Watering} + \text{Pruning}$$

$$= 512.92 + 2,100 + 225.55 + 562.5$$

$$\text{Opportunity cost of capital} = (\text{Total variable non cash cost} \times \text{Saving interest rate})$$

$$= 5,472.74 \times 0.035$$

$$= 191.55$$

$$\text{Others cost} = \text{Water} + \text{Petrol} + \text{Diesel}$$

$$= 100.45 + 40$$

$$= 140.45 \text{ baht per rai}$$

$$\text{Total Variable cost} = 1881.12 + 50.20 + 3400.97 + 191.55 + 140.45 \text{ baht/rai}$$

$$= 5,664.29 \text{ baht/rai}$$

2. Fixed cost

$$\text{Fixed cost} = \text{Land cost} + \text{Depreciation cost}$$

$$2.1 \text{ Land cost} = \text{land tax} + \text{land rent}$$

$$= 28.15 + 1170.42 \quad \text{baht/rai}$$

$$= 1,798.57 \quad \text{baht/rai}$$

$$2.2 \text{ Depreciation cost} = 132.20 \quad \text{baht/rai}$$

$$\text{Total Fixed cost} = 1,798.5 + 132.20 \quad \text{baht/rai}$$

$$= 1,930.77 \quad \text{baht/rai}$$

3. Total cost

$$\text{Total cost} = \text{Variable cost} + \text{Fixed cost}$$

$$= 5,664.29 + 1,930.77 \quad \text{baht/rai}$$

$$= 7,595.06 \quad \text{baht/rai}$$

4. Cost per kg

$$\text{Cost per kg} = \text{Total cost} \div \text{Total yield}$$

$$= 7,575.80 \div 3,645$$

$$= 2.08 \quad \text{baht/kg}$$

5. Price

$$\text{Price} = 3.00 \text{ baht/kg}$$

6. Gross income

$$\text{Gross income} = \text{Yield (kg)} \times \text{Price (baht/rai)}$$

$$= 3645.00 \times 3.00 \text{ baht/rai}$$

$$= 10,935.00 \text{ baht/rai}$$

7. Net earnings

$$\text{Net earnings} = \text{Gross income} - \text{Variable cost (cash cost)}$$

$$= 10,935.00 - 1,347.99 \text{ baht/rai}$$

$$= 9,587.01 \text{ Baht/rai}$$

8. Net profit

$$\text{Net profit} = \text{Gross income} - \text{Total cost}$$

$$= 10,935.00 - 7,595.06 \text{ baht/rai}$$

$$= 3,339.20 \text{ baht/rai}$$

9. Break-even yield

$$\text{Break-even yield} = \text{Total cost} \div \text{Price}$$

$$= 7,595.06 \div 3 \text{ kg/rai}$$

$$= 2,531.68 \quad \text{kg/rai}$$

10. Break- even price = Total cost ÷ Yield (kg)

$$= 7,595.06 \div 3,645.00 \quad \text{baht/kg}$$

$$= 2.08 \quad \text{baht/kg}$$

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